State of New York—Department of Agriculture.

FIFTEENTH ANNUAL REPORT

OF THE

BOARD OF CONTROL

OF THE

NEW YORK
Agricultural Experiment Station,

(GENEVA, ONTARIO COUNTY.)

For the Year 1896,

With Reports of Director and Other Officers.

TRANSMITTED TO THE LEGISLATURE MARCH 15. 1897.

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1897.

STATE OF NEW YORK.

No. 88.

IN ASSEMBLY

March 15, 1897.

FIFTEENTH ANNUAL REPORT

OF THE

Board of Control of the New York Agricultural Experiment Station.

STATE OF NEW YORK:

DEPARTMENT OF AGRICULTURE,
ALBANY, March 15, 1897.

To the Assembly of the State of New York:

I have the honor to transmit herewith the Fifteenth Annual Report of the Director and Board of Managers of the New York Agricultural Experiment Station at Geneva, N. Y., in pursuance of the provisions of the Agricultural Law, Chapter 338 of the Laws of 1893.

I am, respectfully yours,

CHARLES A. WIETING,

Commissioner of Agriculture.

1896.

ORGANIZATION OF THE STATION.

BOARD OF CONTROL.

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STATION STAFF.

W. H. JORDAN, Sc. D.	Director.
L. L. VAN SLYKE, Ph. D.	Chemist.
WM. P. WHEELER	First Assistant.
S. A. BEACH, M. S.	Horticulturist.
VICTOR H. LOWE, B. S.	Entomologist.
*F. A. SIRRINE, M. S.	Entomologist.
*F. C. STEWART, M. S.	Mycologist.
WENDELL PADDOCK, B. S.	Assistant Horticulturist.
C. G. JENTER, Ph. C.	Assistant Chemist.
A. L. KNISELY, M. S.	Assistant Chemist.
J. A. LE CLERC, B. S.	Assistant Chemist.
†A. D. COOK, Ph. C.	Assistant Chemist.
†W. H. ANDREWS, B. S.	Assistant Chemist.
C. P. CLOSE, B. S.	Assistant Horticulturist.
GEO. W. CHURCHILL	Agriculturist and Sup't of Labor.
FRANK E. NEWTON	Clerk and Stenographer.

Address all correspondence, not to individual members of the staff, but to the NEW YORK AGRICULTURAL EXPERIMENT STATION, GENEVA, N. Y.

The Bulletins published by the Station will be sent free to any farmer applying for them.

* Connected with Second Judicial Department Branch Station.
† Connected with Fertilizer Control.

TABLE OF CONTENTS.

Fifteenth Annual Report

OF THE

Board of Control of the New York State Agricultural Experiment Station.

TREASURER'S REPORT.

GENEVA, N. Y., *October* 1, 1896.

To the Board of Control of the New York Agricultural Experiment Station:

As Treasurer of the Board of Control, I respectfully submit the following report for the fiscal year ending September 30, 1896.

Maintenance Account.

Receipts.

1895.			
Oct.	1.	To balance on hand	$2,579 89
		To balance transferred from account produce sold	884 77
		Account amount received from produce sold	1,460 37
		Account amount received from Comptroller	5,000 00
			$54,925 03

Expenditures.

1895.			
Oct.	1.	By farm	$390 16
		By farm implements and tools	541 46
		By freight, cartage and express	408 40
		By fuel	918 71
		By furniture	459 14
		By labor	13,887 31
		By library	634 89
		By live stock	658 25
		By manure and fertilizer	646 56
		By insurance	50 00
		By permanent improvement	790 09
		By printing	3,155 75
		By repairs	2,619 44
		By salaries	12,121 19
		By telephone and telegraph	152 02
		By stationery	94 95
		By sundries	1,714 05
		By supplies	4,698 16
		By water	358 75
		By travel	508 61
		By Board of Control	1,002 82
		By gas	502 57
1896.			
Oct.	1.	Balance on hand	8,611 75
			$54,925 03

EXPENSE OF BULLETINS AND ENFORCING PROVISIONS OF CHAPTER 437 OF THE LAWS OF 1890.

Receipts.

1895.			
Oct.	1.	To balance on hand	$1,905 36
		To amount received from Comptroller	10,000 00
			$11,905 36

Expenditures.

1895.			
Oct.	1.	By chemicals	$275 57
		By chemical apparatus	204 99
		By express	7 05
		By gas	346 52
		By miscellaneous expenses	191 02
		By printing	4,144 17
		By salaries	4,302 50
		By expense of securing samples	1,396 77
		By water	114 00
1896.			
Oct.	1.	By balance on hand	922 77
			$11,905 36

SECOND JUDICIAL DEPARTMENT, CHAPTER 675 OF THE LAWS OF 1894.

Receipts.

1895.			
Oct.	1.	To balance on hand	$45 88
		To amount received from Comptroller	6,817 80
			$6,863 68

Expenditures.

By advertising and printing	$1,010 92
By apparatus and supplies	404 32
By cartage, express and freight	42 44
By compensation	3,388 95
By fares	349 07
By fuel	37 50
By hotel	112 46
By labor	320 93
By library	65 46
By livery	16 06
By notary fees	16 08
By postage and stationery	16 23

1895.			
Oct.	1.	By rents	$505 25
		By telegrams and mesages	5 99
		By miscellaneous	234 91
		By farmer's meetings	291 24
1896.			
Oct.	1.	By balance on hand	45 88
			$6,863 68

POSTAGE ACCOUNT, SPECIAL APPROPRIATION.

1895.			
Oct.	1.	To balance on hand	$262 00

Expenditures.

By postage	$262 00

SPECIAL APPROPRIATION FOR NEW BUILDING.

Receipts.

To amount received from Comptroller	$7,500 00

Expenditures.

By construction	$6,632 00
By equipment	868 00
	$7,500 00

SPECIAL APPROPRIATION FOR FRUIT HOUSE.

Receipts.

To amount received from Comptroller	$1,000 00

Expenditures.

By construction	$1,000 00

All expenditures are supported by vouchers, approved by the Auditing Committee of the Board of Control, and have been furnished the Comptroller of the State of New York.

United States Appropriation under Act of Congress Approved March 2, 1887.

Dr.

1895.		
July	1. To balance on hand..................	$12 82
	To receipts from Treasurer of United States, as per appropriation for fiscal year ending June 30, 1896, as per act of Congress, approved March 2, 1887..	1,487 18
		$1,500 00

Cr.

By scientific apparatus................	$491 76
By salaries..........................	1,000 00
By contingent........................	8 24
	$1,500 00

William O. Hanlon,
Treasurer.

PLATE I.

THE DIRECTOR'S HOME AND OFFICE.

DIRECTOR'S REPORT.*

To the Honorable Board of Control of the New York Agricultural Experiment Station:

Gentlemen.—I have the honor to present the report of the New York Agricultural Experiment Station for 1896. It is not necessary for me to remind you that I assumed the duties of Director on July 1, 1896, and that during the first half of the year Dr. L. L. Van Slyke, as Acting Director, ably and faithfully administered the affairs of the Station. A sense of obligation impels me to acknowledge my indebtedness to him for the aid he gave me in taking up my new work, and I am equally grateful for the consideration shown to me by all members of the Station staff. I am confident that this pleasant beginning is a forecast of such coöperation and sympathy as are essential among a body of men who are intimately associated in a common effort.

The Status of the Station.

It seems entirely proper that when an institution passes over to the immediate charge of a new executive head, there should be presented to the governing board a definite and comprehensive statement of its condition. This is desirable as furnishing the necessary starting point from which to proceed to whatever changes or enlargements that may seem advisable.

I take the liberty, therefore, of laying before you a review of the condition of this Station as I found it on July 1.

Location and general surroundings.—It is a matter for congratulation that the Station is well located, both agriculturally and socially. It is in the midst of one of the most fertile and prosperous farming regions of the State which has an almost worldwide reputation for its production of nursery stock and fruit.

* Published also as Bulletin No. 115.

It occupies a desirable situation, commanding an outlook over a section of country which in its beauty and evidences of prosperity is seldom, if ever, excelled. The Station grounds in their arrangement and appearance give pleasing evidence of the painstaking care and good taste which have brought them into an unusually attractive condition.

Moreover, the Station has a desirable social environment. The village of Geneva is one of the oldest in the State, and has long been the home of a cultivated people who have received the Station as an institution in which they have a peculiar and abiding interest. This is fortunate, because the prosperity and efficiency of any work which calls together a body of educated men is greatly enhanced by a loyal local support and agreeable social relations.

The officers of the Station are also in immediate contact with a class of agriculturists of more than average ability. It is noteworthy that wherever the production of fruit is a leading industry, there will be found the farmers who are progressive and in sympathy with an intelligent study of methods. This is especially true of that portion of New York from which has been shipped millions of dollars worth of nursery stock to all parts of the United States, and which is one of the finest fruit-growing regions in the world.

The financial basis of the Station.—The Station is at present maintained by three separate funds known as the "General Fund," the fund for "Expense of Bulletins and Enforcing the Provisions of the Fertilizer Law," and the "Appropriation for Horticultural Investigations, etc., in the Second Judicial Department."

The first fund serves to maintain the work of experiment and investigations carried on at the Station, the second pays for printing bulletins and the expense of sampling and analyzing fertilizers, and the third supports the work of the Branch Station located at Jamaica, Long Island.

The Station staff.—The scientific staff proper now includes fifteen persons besides the Director. Of these, seven belong to the chemical department, three are engaged in horticultural work, two are entomologists, one is giving attention to poultry culture and other matters pertaining to animal industry, one is studying plant diseases, and one has the immediate charge of the farm and is superintendent of labor. Two of the staff are detailed for work at the Branch Station in the Second Judicial Department, which is located at Jamaica, Long Island. The preponderance of chemists over those in any other single line of work is explained by the fact that the Station is now analyzing six or seven hundred samples of fertilizers annually. It should be remarked that there is scarcely any line of investigation in which the Station engages where the aid of the chemist is not required.

Clerical and labor force.—Three persons are at the present employed as clerical assistants to the scientific staff, and the janitors, dairyman, poultryman, forcing house assistant, gardeners, herdsmen, teamsters, mailing assistant, and watchman number about sixteen more. Besides these permanent employees, day laborers are hired during the summer as they are needed. The lines of work carried on are so varied and the details are so elaborate that a large labor force is a necessity. This is especially the case where so extensive a fruit plant is to be managed in an experimental way.

The library.—One of the most essential aids to scientific research is a fairly complete record of what has previously been accomplished. Few persons can afford the private ownership of a scientific library sufficiently extensive to meet the needs of the investigator, but it is nevertheless important that he shall have access to the data which other workers have collected.

For these reasons it is highly desirable that the library of the Station shall be made much more complete in the literature of investigation. Although it has recently received valuable additions, it is still deficient in material and is without proper classification and arrangement. Outside of recent purchases, the larger part of the books contained in the library is of comparatively little value as a record of recent scientific research in those lines related to agriculture.

The Station farm.—This farm is located in one of the finest fruit districts of the State of New York, and is largely made up of soil that not only sustains the successful growth of a great variety of good fruit, but is well adapted to general farming. It includes about 130 acres, only a small area of which is unfit for the purposes of tillage. A few acres are occupied by the buildings and grounds, and about thirty acres are taken up by fruit, the remainder being devoted to a variety of experiments in forage and grain production. Nearly all the farm has at one time been underdrained and is, on the whole, in very good condition for the purposes for which it is intended.

The Station buildings.—Exclusive of the forcing-houses and some minor structures, the Station building equipment consists of a Director's house, which also contains offices, a chemical laboratory, five residence houses, three barns, and a cold-storage house, eleven in all. The forcing-houses include something less than 4,000 square feet of glass.

Many of these buildings are comparatively new and all are being kept in good repair. I wish to emphatically call attention to the fact that only one of these buildings is adapted to work of a strictly scientific character. With the exception of the chemical laboratory, no one of them can be utilized to domicile any of the scientific departments of the Station. Desirable space in which to conduct botanical, bacteriological, horticultural, and entomological studies is largely wanting. Nevertheless, the Station is forced by demands made upon it to carry on investigations in all these lines, although at present under great disadvantages.

It is noteworthy, moreover, that no dairy building is included in the list given above. To be sure, the Station possesses a small one of very inferior quality, but it is convenient only for making a limited amount of butter and has no facilities for cheese work. This is an unfortunate condition for the Station to be in when supposed to efficiently aid the immense dairy interests of the state of New York—one which should be promptly remedied.

PLATE II.

VIEW OF BUILDINGS AND GROUNDS.

The present cattle barn is comparatively new and is built in a substantial manner. In accordance with a custom prevalent in the state of New York, the cows are tied in the basement. In this case, at least, the arrangement is open to criticism. The basement walls are of stone, the lighting is unsatisfactory, and the space occupied by the animals cannot be regarded as ideal in its hygienic conditions. In view of this fact and of the proposal to enter into dairy investigation on a scale that shall admit of study of commercial problems, which will perhaps require a larger herd of animals, it would be wise and may be necessary either to attach a wing to the barn which shall be well lighted and ventilated, in which the more valuable permanent herd can be kept, using the main building as a storage for food and other necessary purposes, or to enlarge the basement windows to increase the light and to sheath the walls to diminish the dampness.

In naming the building equipment no mention was made of the poultry houses, although the Station is in possession of three small ones of the ordinary kind. They are entirely inadequate, either in extent or construction, for certain lines of experimental work in modern methods of poultry culture. As the poultry interest is large, and as it is comparatively neglected by experiment stations, it appears that the Station could develop no more promising line of investigation. If this is done it will be necessary to provide a modern outfit.

The farm is also lacking that most essential of all minor buildings, a convenient tool shed. At present the farm and garden machinery is scattered through several buildings in a very inconvenient way, and is occupying space in the barns that is needed for the proper storage of experimental crops and foods. This causes dirt and disorder in places where they are extremely undesirable. A separate tool shed, conveniently planned and located, is certainly needed.

Apparatus and other equipment for scientific work.—The chemical laboratories appear to be well supplied with apparatus, as indeed, they must be in view of the very large number of analyses which are required. After certain minor changes and additions of apparatus are made, these laboratories may be regarded as among the most convenient and efficient of any in the country. As much could not properly be claimed for the scientific equipment for biological investigation as it existed on July first. This should be of the best. Microscopes, section cutters and other pieces of apparatus of the most approved forms necessary to botanical and entomological research should be available. It is a waste of means to associate good men and poor apparatus. As will be seen later, this condition of things is being gradually remedied.

Fruit plant.—In one direction the Station is exceptionally well provided with the means of observation and experiment. Reference is made to the collection of fruits that are now being grown on the Station grounds. This now includes 3,088 varieties, and constitutes a notable opportunity for horticultural study. As the value of what is known as "variety testing" is called in question by many, special reference is made further on to this department of Station work.

Dairy animals.—It is very well known that the Station is in possession of cows from several breeds which for some years have been used in what is known as the breed test. It cannot be claimed that these animals are in all respects satisfactory as good specimens of the breeds which they represent, although they include some individuals of excellent quality. It is probable that as a breed test alone, it would not be profitable to continue longer the collection of data such as has been recorded during the past four or five years. Any additional figures will be essentially a repetition of those we now have. But as we need a herd of cows to use in an experimental way, it will be possible to keep up a breed classification of the records with but little expense, and it is certainly desirable to complete, if possible, the life-history of some of the animals.

THE DISTRIBUTION OF INFORMATION BY THE STATION.

The bulletins.—These are published by means of a special state appropriation made for that purpose. The present edition of each bulletin is 27,000. This covers the mailing list and leaves a supply of copies with which to meet subsequent requests and to fill incomplete sets for the officers of other stations.

A newspaper summary, written concisely and in a popular style, is now prepared for each bulletin. This is mailed to all state papers and to some others, and is copied wholly or in part by nearly all the papers which publish agricultural matter. The outcome of this must be to call widespread attention to the work which the Station is doing.

It seems desirable that one other step should be taken towards rendering more available and popular the information contained in the Station publications. Everyone who has had experience realizes the great difficulty and even impossibility of writing an account of an investigation that shall give reasonably full data and at the same time be sufficiently simple and clear to be understood by the great mass of unprofessional readers. It is to be feared that the present somewhat extended bulletins, requiring as they do close attention to discover the lessons which they teach, sometimes discourage rather than encourage those who are beginning to seek for aid. At the present time the full bulletins are issued to the entire mailing list of 25,000 names. It is not improbable that the larger part of these fails to accomplish much in the way of imparting information, and the expense of printing them is too great to allow their waste.

It is necessary, though, both to write the extended bulletin and to convey its lessons to the agricultural public, and the plan which it is proposed to follow in the future is to print a sufficiently large edition of each complete bulletin to cover the experiment station and professional exchange list and to meet the requests that will come from the higher class of readers, and then to send to the large mailing list a popular and practical resumé of the bulletin, written, if possible, in a manner that shall prove attractive and helpful. This plan will be less expensive than the present one, and can scarcely fail to augment the value and influence of the Station.

The Annual Report.—This is printed by the state printers, and sometimes is not issued for nearly a year after the copy is put in their hands. Only a few copies of the Report for 1895 have so far been received. It is possible that the delay is unavoidable, but it is none the less unfortunate. If the Station was not given the means and authority for promptly publishing its results in the form of bulletins, the conclusions would be stale and often useless when finally in the hands of the public. It would be a great improvement if the Annual Report could be printed on a better grade of paper and be given such a mechanical finish as would place it in appearance on a par with the reports of many other stations. The general appearance of any volume has much to do with its popularity and value. It is obvious that the state of New York can afford as well as any other to give to this report a high order of typographical excellence.

The preparation of the Station publications.—One of the most important duties pertaining to the successful management of an experiment station is the editing of its publications, especially where the report is so large and the bulletins so numerous as is the case at this Station.

It is evident that the work should be done by one person in order to insure uniformity, and the maintenance of our publications up to a desirable standard of arrangement, illustration and typographical quality will require much time and effort. Reference has been made to a desirable change in the manner of publishing bulletins, and someone must be charged with the duty of writing the proposed popular summaries.

The purpose to enlarge and organize the library has also been mentioned. These several duties will surely require the full time of one person, who must give to them a high order of special ability. No present member of the Station staff can be taken from his present duties for this work, and it is gratifying to know that steps have been taken to add a new officer to the Station force who shall give his entire time to the preparation of Station literature and the building up of a library.

Station correspondence.—It is estimated that annually the Station officers respond by letter to not less than five thousand requests from New York farmers for information touching agricultural practices. These inquiries relate chiefly to fertilizers, crops, foods, dairy products, fruits, and injurious insects and fungi. It is impossible to determine accurately the benefits of this correspondence, but in some instances they are known not to be insignificant. It is certainly proper that the Station should serve as a bureau of information on a great variety of scientific and practical subjects, and if it was more fully consulted the farmers of the state would make fewer mistakes and suffer less seriously from conditions that might be avoided.

The mailing list.—There are now approximately 25,000 names on the Station mailing list, chiefly of New York farmers whose mail is received at nearly 2,300 postoffices. During the year the postmasters of these offices were asked to correct the lists of names of those to whom the Station was sending its publications, and in that way several hundred errors were discovered. The mailing list has for some time been increasing rapidly and is now receiving generous additions. It could be enlarged to enormous proportions by indiscriminately adding names which might be obtained in various ways, but it is believed to be wise to limit the additions to those persons who are sufficiently interested to make a request for the publications.

The Future Work and Development of the Station.

The New York Experiment Station was established nearly fifteen years ago and has, during its existence, gradually enlarged its activities and influence. Notwithstanding the extent of its work at the present time, it should not be imagined that there is no further profitable development possible. Such development is not only possible, but appears to be demanded by the conditions and problems which face New York farmers. In urging that the state enlarge the scope and increase the efficiency of the Experiment Station, it is proper to review the considerations which appear to justify this policy. Two questions are pertinent in this connection:

(1) Is it reasonable to regard the experiment station as a permanent and necessary adjunct of modern agriculture?

(2) In what directions should this Station be most active in order to best serve the interests of New York farmers?

The permanence of experiment stations.—These stations give great promise of permanence, because they are in entire harmony with the whole trend of modern life. They are a necessary outgrowth of the scientific activity of the age. They are an avenue through which science is bringing to agriculture the same beneficent results that it has secured to other industries. It would be remarkable if, in the midst of the great world-movement towards the application of exact knowledge to practical affairs, the industry which is fundamental to all others should fail to receive due recognition, and as science is more and more fully modifying and controlling man's activities, we may expect that agricultural experiment stations will remain as permanent and increasingly necessary institutions.

Again, the growth of experiment stations in number and importance during the past twenty-five years gives promise of permanence. The first one was established in this country as late as 1875, and now there are fifty-five. For the support of these our government expends nearly a million of dollars annually, an appropriation which appears to be made without objection by any member of Congress, and which is popular throughout the country.

One of the most important bureaus of the United States Department of Agriculture exists for the sole purpose of promoting the work and efficiency of the stations. It is not too much to claim that these institutions are firmly intrenched in our governmental departments, and what is more important, in the good will of the people in whose interests they were established.

The influence which these stations now exert is indicative of vitality and strength. They are consulted on all sides concerning the more difficult problems of agriculture, and their investigations form the basis of the most reliable and important current agricultural literature. They are largely concerned in the official inspection of fertilizers and foods, and have, to a great extent, become a court of final appeal in all agricultural contentions that lie outside ordinary experience.

These stations should continue because of the unsolved problems which confront the agriculturist. Just enough has been learned to show clearly the vast gain that must come from further investigation. To stop where we are would be to lose richer rewards than have yet been gained. For these reasons we must conclude that the experiment stations have come to stay—that they are a fixed and essential factor in modern agriculture. This being the case, it will be readily conceded that this Station is entitled to such support as will enable it to render the best possible service to the people of the state.

In what manner and along what lines can this service be most surely rendered?

The general character of the investigations.—If we base the reply to this question upon experience, the answer must be that the farmer will be best served even from a business point of view by a rigid inquiry into the facts and principles which underlie his practice. The knowledge which, in its application to agriculture, has been in the past fruitful of the best results, is that which has come from investigations in the field of pure science, and this will undoubtedly be true in the future. Tests of theories and illustrative experiments in matters pertaining to the business of farming are useful and even necessary, but all safe and permanent advance must proceed primarily from a study of fundamentals. Judged in the light of these statements then, the real function of the experiment station is to conduct severe scientific inquiry in those lines related to the practice of agriculture, and, therefore, the controlling policy of this Station should be to strengthen and develop its facilities for making such research exhaustive and conclusive.

The particular field of investigation.—The most profitable field for this research should be determined by the relative importance of the various agricultural industries in the state. It is certain that at the present time, and there are no indications of a change of conditions, dairying and horticulture occupy a commanding position in New York agriculture. Both are greatly aided by our proximity to the largest home markets in this country. The former can scarcely become less important because of the great increase in the consumption of dairy products, especially of raw milk, and the latter must always be fostered in this state in view of the unexcelled natural advantages for the production of small and large fruits. Everything points, therefore, to the conclusion that the experiment stations of this state should give prominent consideration to whatever will promote these two lines of practice.

Dairy investigations.—The problems which confront the dairy interest pertain on the one hand to the feeding of dairy stock, and on the other to the manipulation of milk in the manufacture of butter and cheese. The Station is already in a fairly satisfactory position to study the questions involved in the production of forage crops and in the compounding of rations, but as has previously been intimated, it possesses no equipment for investigating certain facts fundamental to dairy processes. Dairy bacteriology now appears to be furnishing the needed explanations of many phenomena that are observed in cheese and butter making, and here is a very promising field of inquiry. The two additions, therefore, which the Station needs for entering upon this line of research are a dairy bacteriologist and a building adapted to the dairy work on a commercial scale.

Horticultural and allied investigations.—The practical side of horticulture is already well developed at the Station, and is being pushed by a corps of able, earnest workers whose chief drawback is that they are sadly in need of proper office and laboratory conveniences. Just now four men are at work in one office, which also serves as their only laboratory.

Much more attention should be given, moreover, to a study of plant diseases. If the grower of vegetables or fruit could more successfully combat his fungoid enemies, his success would be more uniform. Old plant diseases are imperfectly understood and new ones are constantly appearing, the life-history of which should be learned. The success which now attends spraying warrants the assertion that the control of the fungoid diseases of vegetables and fruits may be greatly extended. Should a vegetable pathologist be appointed to take this line of research at the Station, he must have laboratory facilities and should be given the use of a forcing-house as a plant hospital.

Economic entomology is an important and necessary adjunct of all lines of agricultural practice and cannot be ignored in our attempt to aid the gardener and fruit grower. Two entomologists are now doing as good work for the Station as the facilities at command will permit. An insectary should be provided, however, this being indispensable to an all-year study of insects and their depredations. It will be necessary, moreover to furnish and equip rooms for the Entomologist at the Station, as he is now allowed the use of only a part of one room in the chemical building.

Museum.—Much material now comes into the possesion of the Station which should be permanently preserved. Conveniently arranged working collections of plants and insects are indispensable. At present the Station is without any space in which to locate such collections. This should be provided at once, and it should be such as to reasonably insure against loss of the materials by fire.

The various recommendations relative to the Station staff, equipment and work are briefly summarized.

Additions to Station staff.

1. A Dairy Bacteriologist.*
2. A Botanist and Mycologist.*
3. A Station Editor and Librarian.

New buildings needed.

1. Biological and dairy building containing offices and laboratories for the horticulturist, botanist and mycologist, and entomologist, and a first-class equipment for the investigation of practical dairy problems.
2. A plant disease forcing-house.
3. An insectary.
4. Additions to the poultry plant, including an incubator cellar, breeding pens and brooder houses.

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* Possibly one department under a single head.

5. A new wing to the cattle barn or changes in the basement of this barn.

6. A tool shed.

Additions to the equipment of scientific apparatus.

Microscopes, section cutter, calorimeter, reference collections, insect cases, etc.

Library.—A material increase in the literature of investigation.

The most important of these recommendations have already been favorably considered by your Board, and steps are now being taken to carry them into execution. These needed additions cannot wisely be made at once, but should be the subject of definite arrangements during the coming year. Every possible effort should be put forth to begin the erection of the biological and dairy building in the early spring, so that in a year from now it may be available for use.

THE WORK IN WHICH THE STATION IS NOW ENGAGED.

Subjects now under investigation.—The following is a list of the subjects which to a greater or less extent have been under investigation by the Station during the past year. It is obvious that some of these receive attention only at such intervals as season, growth and other conditions may determine, and in certain cases it may be a long time before the results reached will justify the publication of conclusions.

Plant nutrition.

Fertilizer requirements of fruit and vegetables.

Composition of fruits as affected by feeding the plant.

Foraging power of different species of plants for phosphoric acid.

Soda as a substitute for potash.

Value of indirect fertilizers.

Crop production.

Fertilizer tests with potatoes.

Growth of sugar beets.

Study of varieties of potatoes.

Influence of seed upon the potato crop.

Profitable amount of commercial fertilizers on wheat.

Comparative yield of various forage crops.

Horticultural experiments, etc.

Testing spraying machines.
Fertilizing apple trees.
Effect of girdling grapes.
Self-fertility of varieties of grapes.
Value of various stocks for plum orchards.
Survey of hardiness of varieties of fruits in New York.
Successful conditions for forcing radishes.
Forcing lettuce, fertilizers, soils and watering.
Forcing tomatoes, selection of seed, training.
Study of varieties of fruits.

Diseases of plants, etc.

Treating leaf spot on plum trees.
Treating leaf spot on cherry trees.
Prevention of raspberry anthracnose.
Peach yellows.
Spraying for prevention of carnation rust.
Application of sulphur for prevention of carnation stem-rot.
Methods of spraying potatoes.
Prevention of cucumber blight.
Life-history of certain potato diseases.
Prevention of onion smut.

Entomological work.

Efficiency of poisoned bait for cut worms.
Prevention of pear midge.
Destruction of San José scale.
Spraying Brussels sprouts.
Destruction of cut-worm moth eggs.
Life-history of seed-stalk weevil.
Use of dendrolene.
Use of green arsenite.
Study of the pistol-case bearer.
Study of the cotton-wood leaf beetle.
Causes of root galls.
Habits of apple fruit worm.

Value of trap lanterns.

Cause of "pimply" potatoes.

Animal production.

Feeding experiment with pigs.

Comparison of rations compounded from unlike sources.

Sources of milk fat.

Study of cheese-factory milk.

Study of dairy breeds.

Poultry culture.

Value of selection in breeding poultry.

Feeding experiment with chicks.

Feeding experiment with laying hens.

Source of lime to growing chicks.

Relative value of vegetable and animal foods.

Chemical work.

Analysis of fertilizers.

Analysis connected with various investigations.

The foregoing seems to be a large number of subjects to have under investigation at one time, and perhaps it is too large and should be diminished, though the strong tendency is to increase it. New problems are constantly being urged upon the Station by its constituency, and it is much more easy to give favorable attention to such requests than to put them one side. Besides, the officers of the Station do not feel quite sure that they will escape vigorous criticism if they confine their investigations to a few subjects and study them exhaustively, although undoubtedly this is the right course to follow. We have now too many half answered questions, and greater ultimate good would result if the study of a less number of the most important problems could be continued to a definite solution. Past experience justifies this policy, and the time will come when public sentiment will more fully sustain its adoption by American stations.

Variety tests.—Probably no American station is so largely engaged in a study of varieties, chiefly fruits, as is this one, and consequently its officers are specially interested in the adverse criticisms which occasionally appear concerning what is known as variety testing. The two common arguments against this work being undertaken by experiment stations are these: (1) It is a low grade of work which may be successfully done by men of less ability and training than station experts are supposed to possess. (2) Variety tests have little value except in the immediate locality where they are conducted.

It is impossible to ignore the force of these arguments when applied to mere variety testing as often conducted. Certainly much that experiment stations have done in the past in an indiscriminate and brief comparison of varieties has been of very doubtful value, which was temporary at the best. Doubtless this criticism will, to some extent, apply to the horticultural work of this Station.

This raises a practical and important question, viz.: What policy shall be pursued in the horticultural activities of this Station? It has over 3,000 varieties of fruit under cultivation and observation, a collection which attracts the widespread attention of New York fruit-growers, and which receives frequent visits from the horticulturists of other experiment stations. Shall this collection be maintained and still further developed, or shall it be reduced in variety and extent to the dimensions which are merely necessary for certain lines of experiment and investigation, such as fertilizing, spraying, etc.? There are several reasons which appear to fully justify the maintenance of this part of the Station equipment on its present scale.

(1) Under the conditions existing in Western New York even the variety testing has undoubted value, and it would be done nowhere else. The conditions at the Station are very similar to those prevailing over a large area of a fine fruit country, and any observations of varieties made here are of great interest not only to a large number of fruit-growers, but to nurserymen who are producing an immense annual output of nursery stock. This study of varieties has discovered old ones under new names and has greatly benefited nurserymen, as well as fruit-growers, by determining the value of new fruits before they have been placed upon the market.

(2) This large collection, really a living museum of species and varieties, offers what a distinguished horticulturist is reported to have called "a magnificent opportunity" for a botanical study of fruits and vegetables horticulturally important. The study of types and the breeding of varieties to a definite purpose requires just such conditions as these.

(3) Problems connected with plant diseases and with injurious insects, because of the varying susceptibility of different varieties to these pests, are most successfully investigated in connection with such a collection of large and small fruits as the Station possesses.

IMPORTANT RESULTS IN 1896.

In order to make clear to those interested in the extensive and important relations of the work of this Station to the agriculture of the State, a brief resumé is herewith given of the important data and conclusions which are to be found in the publications for the year, or which will be presented in bulletins about to be issued.

CHEMICAL DEPARTMENT. *Inspection of commercial fertilizers.*—The new fertilizer law of 1896 requires all fertilizer manufacturers doing business in the State to file at the Station a statement of their place of business and the name and guaranteed composition of all brands they are to offer for sale in the state during the year. The Station Director is authorized to make analyses of samples selected from such of these brands as are found in the market, in order to determine whether they correspond to the guaranteed composition.

During the year 126 manufacturers have complied with the law and have registered 1,126 brands. The Station has selected at different points and analyzed 760 samples representing 577 brands. In the main the goods have been as good as guaranteed, averaging better. In comparatively few brands has the percentages of valuable ingredients fallen below the advertised standard to an important extent. The deficiencies in available phosphoric acid have been more frequent than in the case of nitrogen or potash.

It is evidently very generally the purpose of the manufacturers to keep their goods up to the registered standard. In some instances the deficiencies in composition constitute a violation of the law, but it is not the purpose of the Director to advise legal action by the Attorney-General until it is clearly shown that the manufacturers concerned are purposely and persistently trying to sell fertilizers that are poorer than represented. The conditions involved, as, for instance, the sampling from a small portion of a large output of goods, are such that the application of a penalty for a single deficiency in one ingredient might be very unjust. The rights of both the farmers and the manufacturers will be respected, but there will be no hesitancy in giving prompt attention to an evident attempt at fraud. It should be remembered that the figures published in our bulletins constitute more of a menace to the manufacturer who is inclined to dishonesty than does the fear of legal action.

It was found necessary to call special attention to a fertilizer sold in the state under the name of "Natural Plant Food." This mixture was being sold at a price greatly above the cost of entirely similar materials, and the claims made for it were so stated as to seriously mislead farmers. The complaints made by farmers who used this fertilizer on hoed crops are justified by the facts discovered. The guarantee was so worded, however, that no ground exists for legal action.

Dairy investigations.—The data secured by Dr. Van Slyke from a study of the composition and yield of milk during a whole season from fifty herds of cows contain lessons of great importance to the dairyman.

(1) Aside from furnishing certain useful facts relative to the changes in the composition of milk, the investigation shows that the yield of cheese in June was about forty per cent larger than in August, a result largely due to the insufficient food supply during the latter month. A careful comparison with a herd that was liberally fed with soiling crops shows that this decrease was mostly unnecessary and certainly unprofitable.

(2) Further evidence is obtained in proof of the claim that the cheese values of different milks are very closely proportional to

the percentages of butter fat which they contain, and that the purchase of milk of varying quality at a uniform price is a most unbusinesslike operation, unjust alike to producer and buyer.

Use of fertilizers on potatoes.—Experiments conducted on Long Island for the purpose of comparing the relative profits from using 1,000 lbs. and 2,000 lbs. of commercial fertilizer per acre on potatoes showed: (1) that the smaller quantity was the more profitable, and (2) that in a single application of 2,000 lbs. of fertilizer per acre twenty-five per cent more nitrogen, nearly five times as much phosphoric acid and not far from sixty-five per cent more potash were added to the soil than were removed in two crops. This indicates that Long Island potato growers may be incurring serious losses by applying too much of an improperly compounded fertilizer.

HORTICULTURAL INVESTIGATIONS.—During 1896 the horticultural investigations at this Station have been conducted largely along the following lines:

Testing fruits.—This necessitates the keeping of permanent records of the very large number of varieties which are now included in the Station collections. In many cases photographs, drawings and herbarium specimens are preserved. The accompanying report includes the results of comparative tests of apples, strawberries, raspberries, blackberries, gooseberries and grapes, together with descriptions of different varieties of these fruits.

The origination of new fruits for the purpose of securing improved sorts.—Station seedlings of apple, pear, cherry, plum, grape, currant, gooseberry, blackberry, dewberry, raspberry and strawberry, 1,111 varieties in all, are being tested. With but few exceptions these are crosses, hybrids or pure bred seedlings, the parents of which, both male and female, have been selected for a definite purpose; in other words, they are the result of systematic plant breeding.

The treatment of plant diseases. (*a*) *Plum leaf spot.*—Gratifying results have followed the investigations as to the best time for making the applications and as to the fewest number of treatments with the Bordeaux mixture by which plum leaf spot in bearing orchards may be practically controlled. The experiments have been in progress for two years, during which period 693 trees in all have been under treatment. They have been conducted on a scale sufficiently extensive to insure reliable results, and a definite course of treatment based on this work is now confidently recommended. In the course of these experiments a marked increase in the yield of the sprayed trees has been recorded. One of the varieties which was treated, the Italian Prune, yielded forty-five per cent more marketable fruit where sprayed than where not sprayed. The fruit also ripened later on the sprayed trees, which, in this case, resulted in securing better market prices.

(*b*) *Cherry leaf spot.*—Experiments with cherry leaf spot similar to those conducted with plum leaf spot have not given sufficiently marked results to permit of recommending a line of treatment for this disease in bearing orchards. During a considerable portion of the time when the treatment should be given, the use of Bordeaux mixture is objectionable because it sticks to the fruit till it is ripe and so injures its market value.

(*c*) *Apple scab.*—Some of our prominent fruit-growers have advocated the idea that liberal applications of wood ashes to apple orchards increases the healthfulness of the foliage and enables the leaves and fruit to better resist the attack of the scab fungus. One of the Station orchards has for four years been devoted to an investigation of this question.

A comparison of different kind of spraying apparatus.—The improvements in the apparatus designed for spraying orchards, vineyards and field crops have been progressing very rapidly in recent years. Two years ago a report on the various kinds of spraying devices was issued by this Station. Since that time Mr. Paddock has given special attention to this subject and has prepared for this report an account of recent modifications of spraying apparatus.

A report of the winter injury which was sustained in 1895-6 by the varieties of fruit which are grown in this state.—Not since the

Station was established has the temperature been so low here as it was in February, 1896, when at one time the mercury registered 21 degrees below zero. All fruit buds of peaches, apricots and sweet cherries were killed; plums, except natives, suffered almost as severely, and sour cherries and pears were damaged to a considerable extent. It was thought that since the winter was unusually destructive to fruit buds throughout the state, and in many cases to the trees as well, this condition afforded an unusually good opportunity for learning the relative hardiness of different varieties of fruit. An effort was made to secure a correspondent in every town in the State to report on the condition of fruit and the amount of winter injury. The names of nearly 700 correspondents were furnished to the Station, and about two-thirds of them responded to the inquiries which were sent to them. From the mass of data which was thus secured, the report on this subject, which is given in the following pages, has been compiled.

A series of experiments in thinning fruit has been undertaken to study the influence which the practice of thinning fruit, continued systematically for a series of years, may have on the vigor and productiveness of the tree and the size, color and quality of the fruit. By the account of progress of the experiments with apples which is given in this report it is seen that the trees which were thinned in 1896 gave fruit of a higher color and a larger per cent of No. 1 grade than did the trees which were not thinned. The total amount of fruit per tree borne by the former was so much superior in appearance that it is estimated it would usually bring fifteen per cent more in price.

Plant Disease Investigations. *Spraying potatoes.*—The experiments of 1895 reported in Bulletin No. 101 on spraying potatoes with Bordeaux mixture showed three definite results:

(*a*) The early blight was largely prevented, and the late blight did not appear at all on the potatoes. The unsprayed vines were badly diseased.

(*b*) Spraying five times increased the yield of merchantable tubers sixty-two bushels per acre.

(*c*) The injuries caused by the cucumber flea-beetle were much diminished by the spraying.

In 1896 neither of the two common potato blights appeared, but nevertheless the spraying was accompanied with excellent results.

Cucumber blight.—The pickle industry of Long Island is an important one and it has lately been threatened with destruction by downy mildew. Many cucumber growers are reported to have about decided to give up the business on this account.

An experiment made by Mr. Stewart has pointed out a successful and practical remedy for this disease, an account of which will appear in a future bulletin.

Spraying for carnation rust.—At the present time a large amount of money is received by forcing house men from the growth of carnations. One obstacle to this industry is the ravages of the rust, and much attention is being given by the Station to this matter.

The results so far reached indicate that spraying with a solution either of copper sulphate or potassium sulphide, preferably the former, may at least partially control the disease. In one experiment fifty-eight per cent of the plants of a very susceptible variety were kept free from rust, the unsprayed plants being all affected.

ENTOMOLOGICAL INVESTIGATIONS. *Cause of pimply potatoes.*—A condition of the potato tubers which is termed "pimply" has been noticed in southeastern New York and other places, the cause of which has heretofore been unknown.

An investigation instituted by the Station has brought to light the fact that this injury is caused by larvæ of the cucumber flea-beetle feeding upon the tuber.

As the flea-beetle is discouraged from feeding upon the vines by the use of Bordeaux mixture, spraying with the liquid is recommended as a preventive of "pimply" potatoes.

Prevention of insect ravages.—The reports of the entomologist advise, on the basis of careful experiments, that the injuries due to certain insects can be wholly or in part prevented by the several methods mentioned below.

(*a*) Attacks of Colorado potato beetle and flea-beetle are avoided by spraying with Bordeaux mixture.

(*b*) The squash borer can be controlled by cultural methods.

(*c*) The onion thrips can be kept away by planting set onions on the margin of the field, to be sprayed frequently with kerosene emulsion.

(*d*) The red spider is largely kept from raspberries by raking and burning the leaves in the fall and spraying with kerosene emulsion in the spring.

(*e*) The application of kainit in June diminishes the damage done by the pear midge.

Cultivation of the orchards is equally beneficial.

(*f*) The cabbage-looper was killed in the open field by the use of poisoned resin-lime mixture.

(*g*) The use of a mixture of dry bran or middlings and Paris green was found to be a cheap and efficient means of preventing the destruction of onions by cut worms.

This is an important result in view of the extent of onion culture in Orange County, as it is estimated that during the past year forty-six per cent of the crop was ruined by this pest.

(*h*) The experiments of the past season indicate that spraying with green arsenite and lime can be successfully used against the apple fruit worm, pistol-case bearer, cotton-wood leaf beetle, apple flea-beetle and the potato beetle.

Outbreak of the army worm.—The Station was able to render prompt and extensive assistance in controlling the outbreak of the army worm in this state during the past season.

Tests of insecticides.—A thorough test of dendrolene showed that it is dangerous to the trees, and that as a preventive of the canker worm it is unsatisfactory.

Collections of insects.—Good progress has been made in increasing the reference collections. The Station now has about 5,000 specimens, representing 2,395 species of insects, chiefly those that are injurious.

CROP PRODUCTION. *Alfalfa.*—A record is being kept on the Station farm of certain forage crops. The most noteworthy of these is alfalfa. During three years a field of several acres of this legume has yielded an average of approximately 17.5 tons of green fodder per acre. This has been equivalent to about 8,400 pounds of dry matter per acre, or 5,000 pounds of digestible material. During the past season the older alfalfa fields produced four cuttings of a most excellent green food which was greatly relished by the cows. This is by far the most successful soiling forage crop which is grown by the Station, and our experience with it will soon be made the subject of a bulletin.

Silage corn.—In maintaining a herd of twenty-five animals without pasturage, the Station places great dependence upon the corn crops. From eight to ten acres of corn are grown annually, nearly all of which is put into the silo. It is allowed to mature until the kernels begin to glaze, and in this condition produces silage of uniformly good quality, which serves as a supply of succulent food during the entire winter season. The milk from cows which eat as much as fifty pounds of the material daily is excellent in quality and flavor. The experience of several years on the Station farm and on many successful dairy farms justify the assertion that the silo has passed beyond the experimental period. It is an economical adjunct of animal husbandry and its use is consistent with the manufacture of dairy products of the highest quality.

During the year the Station has isued a bulletin entitled, "Silage and Silos," written by Mr. Wheeler, which is an admirable resumé of such facts as are valuable to those who wish to consider the subject.

ANIMAL PRODUCTION. *Tests of dairy breeds.*—During two years a large amount of unpublished data has accumulated from this test, which is now being arranged and digested for publication.

Feeding experiments with swine.—Tests have been made of the comparative growth of crossbred pigs, including Tamworth-Yorkshire, Yorkshire-Tamworth, Tamworth-Duroc, Tamworth-Poland China, and Ohio Improved Chester-Poland China. Considered in connection with trials of former years the main result is favorable to the Tamworth crosses.

Poultry feeding experiments.—A test of the relative value of whole and ground grains as food for laying hens, continued during two years, showed a marked advantage for the ground grains in feeding Leghorns and the reverse in feeding Cochins.

EXPERIMENTS CARRIED ON OUTSIDE OF THE STATION PREMISES.

The larger part of the data herein presented was secured in the laboratories and on the farm connected with the Station. It is sometimes necessary, however, in order to find the conditions required for particular experiments, to secure the privilege of using land, trees, or other facilities owned by private parties. In 1896 several interesting and profitable tests of varieties, spraying, thinning fruit and girdling grape vines, have been carried on in the orchards and vineyards of private fruit growers. The following are the gentlemen who have kindly and faithfully assisted the Station in this work.

W. D. Barns & Son, Middle Hope. Test of varieties.

S. A. Hosmer, Clifton. Spraying for raspberry anthracnose.

T. C. Maxwell & Brothers, Geneva. Spraying for plum leaf spot.

E. Smith & Sons, Highland. Girdling grapes.

Frank Smith, North Hector. Thinning plums.

L. Rice, Manchester. Spraying for raspberry anthracnose.

Walter E. Taber, Poughkeepsie. Girdling grapes.

T. B. Wilson, Hall's Corners. Thinning apples.

SPECIAL WORK IN THE SECOND JUDICIAL DEPARTMENT.

The appropriation for three years which has been made for the maintenance of investigations in the Second Judicial Department is a recognition of the special conditions that prevail in the territory adjacent to the great markets of New York and Brooklyn. In the expenditure of this fund the Station evidently has endeavored to give due consideration to the agricultural practices of most importance in southeastern New York. A branch Station has been established at Jamaica, from which as a center, experiments and investigations have been conducted with reference to relieving the most pressing difficulties encountered, especially by market gardeners and forcing-house men. While the control of the work remains with the Station at Geneva, the

PLATE III.

FARMERS' PICNIC AT THE STATION, 1896.

men at Jamaica have been more or less thrown upon their own resources, and much credit is due to them for the efficient and practical manner in which they have performed the duties that were assigned to them.

In 1896 five bulletins were printed by this fund. Some important results have been reached. Leaving out of consideration much other valuable information gained, it is safe to assert that if the facts demonstrated by Messrs. Stewart and Sirrine relative to spraying potatoes and cucumbers and the control of the cut worm that attacks onions would be heeded by the farmers of Long Island and Orange County alone, the benefits would annually pay the entire expense of the Experiment Station several times over. For account of these results reference is made to the previous summary and to the detailed report herewith presented.

This appropriation provides for instruction as well as investigation, and in 1896 eight farmers' institutes were held in the Second Department at Southold, Riverhead, Southampton, Jamaica, Northville, Newburgh and Goshen. Twelve more are already planned for 1897.

The Relation of New York Farmers to their Experiment Station.

It is gratifying to note how generally the agriculturists of this state are in cordial sympathy with the work of their Experiment Station. This is very encouraging to the officers of the Station. They recognize that the coöperation of the farmers is essential to the success of their efforts. There must be on the one hand the search for truth, and on the other the disposition to learn and practice it. Effort is demanded no less on the part of the farmers than from those who are attempting to serve their interests. Bulletins must be written in order that they may be read, but they must be read,—yes, studied, before they effect any good.

We suggest therefore, that while the Station officers are being held to faithful and vigorous work, farmers shall consult their own interests by giving careful consideration to whatever facts the Station lays before them, either to approve and utilize or to form the basis of criticism and inquiry.

BULLETINS PUBLISHED IN 1896.

Sixteen bulletins have been published during the past year, containing 317 pages.

No. 98. Plum leaf spot. Cherry leaf spot. Fruit rot. By S. A. Beach.

*No. 99. The spinach leaf maggot or miner. By F. A. Sirrine.

*No. 100. Combating carnation rust. By F. C. Stewart.

*No. 101. Potato diseases on Long Island in the season of 1895. By F. C. Stewart.

No. 102. Silage and silos. By W. P. Wheeler.

No. 103. Provisions of the new fertilizer law of New York. By L. L. Van Slyke.

No. 104. Notes on the recent invasion of the army worm. By V. H. Lowe.

No. 105. Effects of drouth upon milk production. By L. L. Van Slyke.

No. 106. Feeding experiments with laying hens. The relative efficiency of whole and ground grains. By W. P. Wheeler.

No. 107. Report of analyses of commercial fertilizers for the spring of 1896.

No. 108. The real value of "natural plant food." By L. L. Van Slyke.

No. 109. Strawberries. By Wendell Paddock.

No. 110. Milk-fat and cheese yield. By L. L. Van Slyke.

No. 111. Variety tests with blackberries, dewberries and raspberries. By Wendell Paddock.

*No. 112. Economy in using fertilizers for raising potatoes. By L. L. Van Slyke.

*No. 113. The cucumber flea beetle as the cause of "pimply" potatoes. By F. C. Stewart.

Five of these bulletins (*) were isued under the authority of the laws of 1895 and 1896, which provided for special work in the Second Judicial Department.

W. H. JORDAN,
Director.

New York Agricultural Experiment Station,
Geneva, N. Y., Dec. 31, 1896.

PLATE IV.

THE CHEMICAL LABORATORY.

REPORT

OF THE

CHEMICAL DEPARTMENT.

L. L. VAN SLYKE, Ph. D., Chemist.

Assistant Chemists.

C. G. JENTER, Ph. C.

A. L. KNISELY, M. S.

J. A. LE CLERC, B. S.

A. D. COOK,* Ph. C.

W. H. ANDREWS,* B. S.

E. C. WORDEN,* Ph. C.

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* Connected with Fertilizer Control.

Table of Contents.

REPORT OF THE CHEMIST.

L. L. VAN SLYKE.

I. EFFECTS OF DROUTH UPON MILK PRODUCTION.*

SUMMARY.

During the season of 1895 analysis was made of the milk of each of fifty herds of cows, whose milk was taken to a cheese-factory. The object was to study the variations which milk undergoes as the result of climatic conditions. The averages of all the results obtained are presented.

(1) Cheese-producing constituents of milk include fat and casein.

(2) Variation of fat in milk. It was found that the amount of fat in 100 pounds of milk was about the same in June as in May, and then increased during the rest of the season.

(3) Variation of casein in milk. The casein was less in June than in May, and still less in July, after which there was a more or less rapid increase from month to month.

(4) Variation in relation of casein to fat. During June, July and August there was less casein for each pound of fat in milk than during each month preceding. After August the proportion of casein relative to fat increased.

(5) Variation in cheese produced. In June and July less cheese was made from 100 pounds of milk than in each preceding month; and after July the amount increased from month to month.

(6) Variation in relation of fat to cheese yield. The amount of cheese made for one pound of fat was less in June than in May, and continued to decrease during July and August, after which there was an increase.

* Published without detailed data as Bulletin No. 105.

TABLE SHOWING VARIATION OF FAT, CASEIN, CHEESE, ETC.

MONTH.	Pounds of fat in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of casein for one pound of fat for milk.	Pounds of cheese made from 100 pounds of milk.	Pounds of cheese made for one pound of fat in milk.
May	3.58	2.40	0.67	9.94	2.78
June	3.59	2.33	0.65	9.77	2.72
July	3.71	2.20	0.59	9.58	2.58
August	4.04	2.26	0.56	10.10	2.50
September	3.97	2.47	0.62	10.54	2.65
October	4.20	2.69	0.64	11.35	2.70

(7) Cause and bearing of variations in yield and composition of milk. The decreased yield and cheese-producing power of the milk in July and August were mainly due to insufficient nutrition, caused by the drying up of the pastures. Had the cows been properly supplied with abundance of nutritious, succulent food, it is estimated that the yield of milk and cheese would have been increased to the extent of five dollars a cow on an average.

(8) Provision against effects of drouth. In this State drouth generally prevails at some time during the summer. Provision should be made to supplement dried pastures. For this purpose corn silage, alfalfa and oat and pea fodder are recommended.

INTRODUCTION.

For several years we have carried on a systematic analysis of cheese-factory milk for the purpose of studying its composition and the various influences which affect its composition. These analyses have been continued for a period of time covering essentially the cheese-factory season, generally from April or early May until November. One object which we have had in mind in this work has been to study the variations which milk undergoes during the season as the result of climatic conditions. It is now our purpose to consider in what manner and to what extent climatic conditions affect the composition of milk and how these changes of composition are related to cheese production. We purpose also to consider how we may overcome undesirable changes produced in the composition of milk by unfavorable conditions of weather, particularly such as drouth.

Previous to the season of 1895 we analyzed samples representing the entire mixed milk. During the season of 1895, we not only continued this work, but we also made analyses of the milk of each of fifty separate herds during the entire season. We obtained the samples through the coöperation of Messrs. G. and F. H. Merry, of Verona, to whom we have been similarly obligated in our former work.

In studying the results of our season's work, we shall consider:—

(1) Cheese-producing constituents of milk.

(2) Variations in amount of fat in milk.

(3) Variations in amount of casein in milk.

(4) Variations in relation of casein to fat in milk.

(5) Variations in amount of cheese produced.

(6) Variations in relation of fat to cheese-yield.

(7) Variations in aggregate yield of milk-fat, casein, and cheese.

(8) Cause and bearing of variations in yield and composition of milk.

(9) Provisions against effects of drouth.

1. The Cheese-Producing Constituents of Milk.

Of the several compounds contained in milk, only two are prominent as cheese-producing materials; or, stated in another way, the cheese-producing power of milk is almost entirely measured by two of its solid constituents, so far as the composition of milk is concerned. These two constituents are *fat* and *casein*. The other constituents of the milk, such as albumen, sugar, etc., pass into the whey and are lost, so far as regards ordinary cheese production.

The query may suggest itself,—"Is not water an important constituent of both milk and cheese?" While water is a prominent constituent of both milk and cheese, the amount of water retained in cheese is quite independent of the amount of water in the milk from which the cheese is made. The amount of water retained in cheese depends upon the conditions of manufacture, and the cheese-maker has it in his power to retain more or less water in cheese, regardless of the composition of the milk used, so long as the milk is normal. In studying variations found in the cheese-producing constituents of milk, we need, therefore, to consider only the fat and casein.

The fat which forms so large a proportion of natural butter comes from the fat in milk, and it is this same milk-fat that forms the fat of cheese.

Casein, in an impure form, is familiar to every one under the name of curdled milk. When milk sours, a white, solid substance or curd forms, and this substance is called casein, though, strictly, it is a compound of casein and something else. In using the term casein we do not include albumen and albumose, as is commonly, though erroneously, done, but refer only to the compound that is coagulated by rennet and retained in cheese.

2. VARIATIONS IN AMOUNT OF FAT IN MILK.

We shall give the detailed results secured with the fifty different herds, whose milk was examined during the season, and shall then give a general summary, showing the average variations of the milk of all the herds from month to month during the season.

TABLE SHOWING PERCENTAGE OF FAT IN MILK OF DIFFERENT HERDS DURING SEASON.

NUMBER OF HERD.	May.	June.	July.	August.	September.	October.	Average for season.
1	3.57	3.50	3.90	4.00	4.15	4.20	3.88
2	3.88	3.83	3.95	4.28	4.37	4.62	4.16
3	3.92	3.93	3.80	4.08	3.97	4.47	4.01
4	3.57	3.48	3.48	3.80	3.68	4.08	3.68
5	3.27	3.10	3.35	3.68	3.78	4.15	3.55
6	3.20	3.48	3.40	3.70	3.53	3.95	3.55
7	3.73	3.70	3.90	4.10	4.10	3.90	3.90
8	3.70	4.23	3.98	4.35	4.08	4.32	4.08
9	3.43	3.35	3.40	3.58	3.60	3.80	3.53
10	3.28	3.35	3.33	3.50	3.33	3.80	3.43
11	3.97	3.85	4.00	4.78	4.67	4.25	4.27
12	3.30	3.28	3.60	3.70	3.65	4.30	3.64
13	3.47	3.30	3.70	3.73	3.55	4.05	3.63
14	3.98	3.60	3.83	3.85	3.73	4.12	3.88
15	3.63	3.60	3.80	3.90	3.83	4.32	3.86
16	3.45	3.43	3.58	3.80	3.70	3.90	3.63
17	3.78	4.00	4.05	4.30	4.25	4.52	4.15
18	3.57	3.40	3.83	4.23	4.33	4.77	4.04
19	3.42	3.43	3.68	3.88	3.80	4.03	3.71
20	3.48	3.50	3.65	4.00	3.50	4.28	3.76
21	3.55	3.53	3.70	4.00	4.00	4.47	3.90
22	3.33	3.53	3.70	4.00	4.20	4.12	3.78
23	3.58	3.50	4.05	4.37	4.00	4.15	3.92
24	3.15	3.37	3.43	3.90	3.80	4.03	3.61
25	3.70	3.63	3.95	4.50	4.15	4.30	4.03
26	3.38	3.43	3.50	3.85	4.10	4.07	3.72
27	3.32	3.53	3.75	4.20	4.10	4.20	3.87
28	3.50	3.40	3.88	4.28	3.93	4.12	3.87
29	3.83	4.00	3.66	4.05	3.95	4.18	3.93
30	3.43	3.70	3.73	4.33	3.55	4.17	3.84
31	3.58	3.40	3.40	3.60	3.83	3.75	3.59
32	3.80	3.63	4.00	4.20	4.20	4.23	4.02
33	3.65	3.18	3.40	3.85	3.83	4.25	3.69
34	4.00	3.90	3.97	4.33	4.43	5.03	4.31
35	3.78	3.95	3.75	4.90	4.60	4.45	4.22
36	3.73	3.55	3.75	3.95	3.98	4.35	3.87
37	3.78	3.50	3.82	4.05	4.10	4.55	4.00
38	3.25	3.15	3.35	3.67	3.61	3.81	3.47
39	3.90	3.95	4.07	4.58	4.83	5.00	4.37
40	3.60	4.08	4.10	4.18	4.05	4.28	4.06
41	3.20	3.70	3.85	3.80	4.00	4.22	3.84
42	3.30	3.35	3.25	3.90	3.85	4.30	3.63
43	3.20	3.18	3.00	3.50	3.20	3.60	3.28
44	4.00	3.30	3.83	4.12	3.53	4.03	3.80
45	4.35	4.15	3.98	3.70	4.78	4.63	4.24
46	3.30	3.40	3.47	3.73	3.70	3.87	3.58
47	3.10	3.60	3.08	3.63	3.90	4.03	3.56
48	3.95	4.20	4.30	4.20	3.90	4.20	4.14
49	3.40	3.50	3.55	3.93	4.00	4.23	3.79
50	3.80	4.00	4.10	4.60	4.52	4.78	4.35

The results embodied in the preceding table can be summarized as follows:

TABLE SHOWING POUNDS OF FAT IN 100 POUNDS OF MILK.

May	3.58 pounds.
June	3.59 pounds.
July	3.71 pounds.
August	4.04 pounds.
September	3.97 pounds.
October	4.20 pounds.

Averaging the amount of fat contained in the milk of all the different herds, we see that the fat in 100 pounds of milk was about the same in May and June, that the amount increased during July and August, fell slightly in September and then increased in October.

Giving a more detailed summary, we find—

(1) In June 24 herds produced more fat in 100 pounds of milk than in May, the amount of increase varying from 0.01 to 0.53 pound; while 26 herds produced less fat than in May by amounts varying from 0.02 to 0.70 pounds. *The general average was a slight increase of fat amounting to 0.01 pound of fat for 100 pounds of milk.*

(2) In July 38 herds produced more fat in 100 pounds of milk than in June, the amount of increase varying from 0.02 to 0.55 pound; while 10 herds produced less fat than in June by amounts varying from 0.02 to 0.52 pound. Two herds showed neither decrease nor increase. *The general average of all results was an increase amounting to 0.12 pound of fat for 100 pounds of milk.*

(3) In August 45 herds produced more fat in 100 pounds of milk than in July, the amount of increase varying from 0.03 to 0.78 pound; while only 3 herds produced less fat than in July by amounts varying from 0.05 to 0.28 pounds. *The general average was an increase of 0.33 pound of fat for 100 pounds of milk.*

(4) In September 16 herds produced more fat in 100 pounds of milk than in August, the amount of increase varying from 0.02 to 0.30 pound; while 28 herds produced less fat than in August by amounts varying from 0.02 to 0.78 pound. Three herds showed

neither increase nor decrease. *The general average was a decrease of 0.07 pound of fat for 100 pounds of milk.*

(5) In October 33 herds produced more fat in 100 pounds of milk than in September, the amount of increase varying from 0.03 to 0.78 pounds; while 7 herds produced less fat than in September by amounts varying from 0.03 to 0.62 pounds. *The general average was an increase of 0.23 pound of fat for 100 pounds of milk.*

3. VARIATIONS IN AMOUNT OF CASEIN IN MILK.

TABLE SHOWING PERCENTAGE OF CASEIN IN MILK OF DIFFERENT HERDS DURING SEASON.

NUMBER OF HERD.	May.	June.	July.	August.	September.	October.	Average for season.
1	2.25	2.41	2.17	2.29	2.58	2.85	2.42
2	2.43	2.44	2.15	2.29	2.68	2.92	2.50
3	2.44	2.45	2.18	2.23	2.61	2.87	2.47
4	2.40	2.33	2.12	2.25	2.68	2.85	2.45
5	2.30	2.30	2.03	2.16	2.54	2.61	2.34
6	2.12	2.05	2.00	2.10	2.33	2.42	2.17
7	2.40	2.33	2.16	2.22	2.48	2.70	2.41
8	2.38	2.28	2.34	2.40	2.58	2.81	2.47
9	2.35	2.24	1.94	2.06	2.30	2.45	2.25
10	2.17	2.06	1.98	2.14	2.35	2.54	2.23
11	2.44	2.24	2.20	2.37	2.53	2.60	2.38
12	2.34	2.32	2.20	2.15	2.27	2.76	2.37
13	2.68	2.18	2.02	2.19	2.37	2.66	2.31
14	2.47	2.38	2.26	2.27	2.55	2.70	2.46
15	2.33	2.32	2.27	2.20	2.32	2.63	2.37
16	2.40	2.34	2.36	2.37	2.54	2.75	2.45
17	2.33	2.30	2.32	2.21	2.53	2.67	2.41
18	2.33	2.43	2.36	2.39	2.71	2.91	2.54
19	2.18	2.38	2.09	2.18	2.39	2.48	2.29
20	2.29	2.38	2.23	2.36	2.60	2.70	2.44
21	2.25	2.21	2.11	2.17	2.44	2.73	2.34
22	2.30	2.27	2.16	2.16	2.30	2.75	2.35
23	2.27	2.36	2.24	2.26	2.44	2.81	2.42
24	2.35	2.31	2.11	2.16	2.34	2.68	2.33
25	2.33	2.36	2.21	2.44	2.49	2.72	2.44
26	2.21	2.19	2.21	2.22	2.24	2.43	2.26
27	2.30	2.32	2.27	2 28	2.30	2.70	2.39
28	2.38	2.39	2.22	2.16	2.55	2.81	2.43
29	2.46	2.47	2.27	2.25	2.46	2.68	2.42
30	2.34	2.34	2.15	2.30	2.44	2.69	2.38
31	2.28	2.25	2.11	2.08	2.14	2.47	2.20
32	2.55	2.44	2.37	2.49	2.61	2.77	2.54
33	2.63	2.39	2.24	2.31	2.64	2.68	2.48
34	2.30	2.30	2.23	2.23	2.40	2.69	2.37
35	2.48	2.38	2.31	2.43	2.56	2.71	2.48
36	2.45	2.41	2.28	2.20	2.39	2.61	2.38
37	2.56	2.39	2.34	2.38	2.61	2.83	2.53
38	2.43	2.34	2.37	2.29	2.50	2.72	2.44
39	2.49	2.45	2.50	2.52	2.61	2.84	2.57
40	2.41	2.24	2.29	2.33	2.69	2 93	2.47
41	2.44	2.34	2.32	2.35	2.44	2.66	2.44
42	2.54	2.25	2.11	2.16	2.41	2.80	2.35
43	2.23	2.19	2.00	2.11	2.12	2.56	2.19
44	2.44	2.13	2.00	2.07	2.30	2.68	2.24
45	2.41	2.38	2.20	2.40	2.58	2.88	2.51
46	2.38	2.34	2.21	2.24	2.45	2.67	2.38
47	2.43	2.31	2.19	2.21	2.47	2.69	2.37
48	2.75	2.47	2.32	2.31	2.61	2.96	2.50
49	2.59	2.45	2.31	2.30	2.63	2.87	2.49
50	2.74	2.53	2.42	2.33	2.56	2.77	2.54

The data embodied in the preceding table are summarized as follows:

TABLE SHOWING POUNDS OF CASEIN IN 100 POUNDS OF MILK.

May	2.40 pounds.
June	2.33 pounds.
July	2.20 pounds.
August	2.26 pounds.
September	2.47 pounds.
October	2.69 pounds.

Taking a general average of all the results, we see that the amount of casein contained in 100 pounds of milk was less in June than in May, and still less in July, after which there was a more or less rapid increase from month to month.

The following summary gives greater details:

(1) In June 11 herds produced more casein in 100 pounds of milk than in May, the amount of increase varying from 0.01 to 0.20 pound; while 36 herds produced less casein than in May by amounts varying from 0.01 to 0.50 pound. Three herds showed neither increase nor decrease. *The general average of all results shows a decrease of 0.07 pound of casein for 100 pounds of milk.*

(2) In July 7 herds produced more casein in 100 pounds of milk than in June, the amount of increase varying from 0.02 to 0.06 pounds; while 43 herds produced less casein than in June by amounts varying from 0.04 to 0.34 pound. *The general average was a decrease of 0.13 pound of casein for 100 pounds of milk.*

(3) In August 36 herds produced more casein in 100 pounds of milk than in July by amounts varying from 0.01 to 0.23 pound; while 10 herds produced less casein than in July by amounts varying from 0.01 to 0.11 pound. Two herds showed neither increase nor decrease. *The general average was an increase of 0.06 pound of casein for 100 pounds of milk.*

(4) In September every herd without exception produced more casein in 100 pounds of milk than in August, the amount of increase varying from 0.01 to 0.43 pound, and *averaging 0.21 pound of casein for 100 pounds of milk.*

(5) In October every herd produced more casein than in September by amounts varying from 0.04 to 0.49 pound, *the general*

average increase amounting to 0.22 pound of casein for 100 pounds of milk.

4. Variations in Relation of Casein to Fat in Milk.

We have already seen in what manner fat and casein, the cheese-producing constituents of milk, varied during the different months of the season of 1895. It will be interesting to consider these two compounds together. We will present the data so as to show the number of pounds of casein for each pound of fat contained in milk. It should be kept in mind that when the proportion of casein to fat increases, the yield of cheese for each pound of fat also increases.

There is another point concerning the relation of fat and casein in milk in respect to the bearing which this relation has upon the methods of manufacture. In the months of July and August, cheese-makers often complained of the behavior of the cheese made at this time, without understanding the cause of their difficulty. The cheese leaked fat badly and did not stand up well, although behaving properly when first made. This behavior is due to a decrease of casein and increase of fat, so that the milk and cheese contained an excess of fat. Cheese-makers, at such times, are really dealing with milk which is not normal factory milk, but which is like normal factory milk to which some cream has been added.

TABLE SHOWING RELATION OF FAT TO CASEIN IN MILK OF DIFFERENT HERDS DURING SEASON.

Pounds of casein for one pound of fat in milk.

NUMBER OF HERD.	May.	June.	July.	August.	September.	October.	Average for season.
1	0.63	0.69	0.56	0.57	0.62	0.68	0.63
2	0.63	0.64	0.55	0.53	0.61	0.63	0.60
3	0.63	0.63	0.58	0.56	0.66	0.65	0.62
4	0.67	0.67	0.61	0.59	0.73	0.70	0.67
5	0.70	0.74	0.61	0.59	0.67	0.63	0.66
6	0.66	0.59	0.59	0.57	0.66	0.61	0.61
7	0.65	0.63	0.56	0.54	0.61	0.69	0.62
8	0.64	0.54	0.59	0.55	0.63	0.65	0.61
9	0.68	0.67	0.57	0.58	0.64	0.65	0.64
10	0.66	0.62	0.60	0.61	0.70	0.67	0.65
11	0.62	0.58	0.55	0.50	0 54	0.61	0.56
12	0.71	0.71	0.61	0.58	0.62	0.64	0.65
13	0.77	0.66	0.55	0.59	0.67	0.66	0.63
14	0.62	0.66	0.59	0.59	0.68	0.65	0.64
15	0.65	0.65	0.60	0.57	0.61	0.61	0.61
16	0.69	0.68	0.66	0.63	0.68	0.70	0.67
17	0.62	0.58	0.57	0.51	0.60	0.59	0.58
18	0.65	0.71	0.62	0.57	0.65	0.61	0.63
19	0.64	0.69	0.57	0.56	0.63	0.62	0.62
20	0.66	0.68	0.61	0.59	0.74	0.64	0.65
21	0.64	0.63	0.57	0.54	0.61	0.61	0.60
22	0.69	0.67	0.59	0.54	0.55	0.67	0.63
23	0.64	0.67	0.55	0.52	0.61	0.67	0.62
24	0.75	0.68	0.62	0.56	0.62	0.67	0.64
25	0.63	0.65	0.56	0.54	0.60	0.64	0.61
26	0.65	0.64	0.63	0.58	0.55	0.60	0.61
27	0.69	0.67	0.61	0.54	0.56	0.64	0.62
28	0.68	0.70	0.58	0.51	0.65	0.68	0.63
29	0.64	0.62	0.62	0.56	0.62	0.64	0.62
30	0.68	0.64	0.58	0.53	0.68	0.65	0.62
31	0.64	0.66	0.62	0.58	0.56	0.66	0.61
32	0.67	0.67	0.59	0.59	0.62	0.65	0.64
33	0.71	0.75	0.66	0.60	0.69	0.63	0.67
34	0.58	0 59	0.56	0.52	0.54	0.53	0.55
35	0.66	0.60	0.62	0.50	0.56	0.61	0.59
36	0.66	0.68	0.61	0.56	0.60	0.60	0.61
37	0.67	0.68	0.61	0.59	0.64	0.63	0.64
38	0.75	0.74	0.70	0.62	0.69	0.71	0.70
39	0.64	0.62	0.61	0.55	0.54	0.57	0.59
40	0.67	0.55	0.56	0 56	0.67	0.69	0.61
41	0.76	0.64	0.60	0.62	0.61	0.63	0.64
42	0.77	0.67	0.65	0.56	0.63	0.65	0.64
43	0.71	0.69	0.67	0.60	0.66	0.71	0.66
44	0.61	0.65	0.52	0.50	0.65	0.67	0.59
45	0.56	0.58	0.55	0.65	0.54	0.62	0.59
46	0.71	0.69	0.64	0.60	0.66	0.69	0.67
47	0.76	0.64	0.71	0.61	0.64	0.67	0.66
48	0.69	0.59	0.54	0.55	0.67	0.70	0.60
49	0.76	0.70	0.65	0.59	0.66	0.68	0.66
50	0.71	0.64	0.59	0.51	0.57	0.58	0.59

The details of the preceding table are summarized below:

TABLE SHOWING POUNDS OF CASEIN FOR ONE POUND OF FAT IN MILK.

MONTH.	Pounds of fat in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of casein for one pound of fat in milk.
May	3.58	2.40	0.67
June	3.59	2.33	0.65
July	3.71	2.20	0.59
August	4.04	2.26	0.56
September	3.97	2.47	0 62
October	4.20	2.69	0.64

Summarizing the data from which the foregoing table is derived, we give the following details:

(1) In June 16 herds produced more casein in proportion to fat than in May by amounts varying from 0.01 to 0.06 pound of casein for each pound of fat; while 30 herds produced less casein in proportion to fat by amounts varying from 0.01 to 0.13 pound for each pound of fat. Four herds remained the same as in May. *The general average was a decrease of 0.02 pound of casein for each pound of fat.*

(2) In July 4 herds produced more casein in proportion to fat than in June by amounts varying from 0.01 to 0.07 pound; while 42 herds produced less casein in proportion to fat by amounts varying from 0.01 to 0.13 pound for each pound of milk-fat. Four herds remained the same as in June. *The general average resulted in a decrease of 0.06 pound of casein for each pound of fat.*

(3) In August 7 herds produced more casein in proportion to fat than in July by amounts varying from 0.01 to 0.10 pound of casein for each pound of fat; while 38 herds produced less casein by amounts varying from 0.01 to 0.12 pound of casein for each pound of fat. Three herds remained the same as in July. *The general average amounted to a decrease of 0.03 pound of casein for each pound of fat.*

(4) In September 43 herds produced more casein in proportion to fat than in August by amounts varying from 0.01 to 0.15 pound of casein for each pound of fat; while 5 herds produced less

casein by amounts ranging from 0.01 to 0.11 pound of casein for each pound of fat. *In general, there was an average increase of 0.06 pound of casein for each pound of fat.*

(5) In October 22 herds produced more casein in proportion to fat than in September by amounts varying from 0.01 to 0.11 pound of casein for each pound of fat; while 14 herds produced less casein by amounts varying within similar limits. Four herds did not change. *In general, there was an average increase of 0.02 pound of casein for each pound of fat.*

5. VARIATIONS IN AMOUNT OF CHEESE PRODUCED.

Fat and casein have each a fairly definite value in determining cheese yield. From extended investigation we have found that we can very closely approximate the true yield of green cheese from 100 pounds of milk by multiplying the percentage of milk-fat by 1.1 and the percentage of casein by 2.5 and adding the two products. Yields of cheese obtained in this manner are dependent directly and entirely upon the amount of fat and casein in the milk, and are, therefore, independent of variations in uncontrolled conditions of manufacture. The yields of cheese given below have been obtained in this manner and for purposes of comparison are much more uniform and satisfactory than could possibly have been secured by actually making cheese in each individual case.

TABLE SHOWING POUNDS OF CHEESE MADE FROM ONE HUNDRED POUNDS OF MILK.

NUMBER OF HERD.	May.	June.	July.	August.	September.	October.	Average for season.
1	9.55	9.88	9.72	10.13	11.02	11.75	10.32
2	10.34	10.31	9.75	10.43	11.51	12.38	10.83
3	10.41	10.45	9.63	10.06	10.89	12.09	10.59
4	9.93	9.65	8.86	9.81	10.75	11.61	10.16
5	9.35	9.16	8.76	9.10	10.51	11.09	9.76
6	8.82	8.95	8.74	9.32	9.71	10.40	9.33
7	10.10	9.90	9.69	10.06	10.71	11.04	10.32
8	10.02	10.35	10.23	10.79	10.94	11.78	10.66
9	9.65	9.29	8.59	9.09	9.71	10.31	9.52
10	9.03	8.84	8.61	9.20	9.54	10.53	9.37
11	10.47	9.84	9.90	11.18	11.46	11.18	10.65
12	9.48	9.40	9.46	9.45	9.69	11.63	9.95
13	10.52	9.08	9.12	9.58	9.83	11.11	9.79
14	10.55	9.94	10.11	9.91	10.48	11.28	10.42
15	9.82	9.76	9.86	9.79	10.01	11.33	10.17
16	9.82	9.62	9.84	10.11	10.42	11.17	10.12
17	9.61	10.15	10.26	10.26	11.00	11.65	10.59
18	9.75	9.82	10.30	10.65	11.54	12.52	10.80
19	9.88	9.72	9.27	9.72	10.18	10.63	9.81
20	9.55	9.80	9.59	10.30	10.35	11.46	10.24
21	9.53	9.41	10.58	9.83	10.50	11.74	10.14
22	9.41	9.42	9.06	9.80	10.37	11.41	10.03
23	9.61	9.75	10.06	10.46	10.50	11.59	10.36
24	9.34	9.48	9.05	9.69	10.03	11.13	9.22
25	9.90	9.97	9.87	11.05	10.79	11.53	10.53
26	9.24	9.27	9.38	9.74	10.11	10.55	9.75
27	9.40	9.68	9.80	10.32	10.26	11.37	10.26
28	9.80	9.72	9.82	10.11	10.70	11.56	10.33
29	10.36	10.58	10.20	10.08	10.50	11.30	10.37
30	9.62	9.92	9.48	10.51	10.00	11 31	10.17
31	9.64	9.37	9.02	9.16	9.53	10.33	9.45
32	10.56	10.09	10.25	10.85	11.15	11.58	10.77
33	10.59	9.47	9.34	10.01	10.81	11.38	10.28
34	10.15	10.04	9.94	10.31	10.87	12.26	10.69
35	10.36	10.30	9.90	11.50	11.59	11.67	10.84
36	10.23	9.93	9.83	9.85	10.38	11.31	10.21
37	10.56	9.85	10.05	10.41	11.04	12.08	10.73
38	9.65	9.08	9.61	9.76	10.22	11.00	9.92
39	10.52	10.47	10.73	11.34	11.84	12.60	11.23
40	9.93	10.09	10.24	10.42	11.18	12.03	10.64
41	9.62	9.92	10.04	10.06	10.50	11.30	10.32
42	9.98	9.31	8.85	9.69	10.26	11.73	9.96
43	9.10	8.97	8.30	8.88	8.82	10.36	9.12
44	10.50	8.96	9.21	9.71	9.63	11.13	9.78
45	10.81	10.52	9.88	10.01	11.71	12.29	10.94
46	9.58	9.59	9.34	9.70	10.20	10.93	9.89
47	9.50	9.74	8.86	9.52	10.47	11.15	9.90
48	11.22	10.80	10.53	10.40	10.82	12.02	10.80
49	10.22	9.98	9.68	10.07	10.98	11.83	10.39
50	11.03	10.78	10.56	10.90	11.37	12.18	11.14

Below we present the data of the preceding table in summarized form.

TABLE SHOWING POUNDS OF CHEESE MADE FROM 100 POUNDS OF MILK.

May	9.94 pounds.
June	9.77 pounds.
July	9.58 pounds.
August	10.10 pounds.
September	10.54 pounds.
October	11.35 pounds.

We see, in general, that the cheese yield decreased in June and July and then increased from month to month during the rest of the season. In regard to the details concerning different herds, we can make the following statements:

(1) In June 19 herds produced more cheese from 100 pounds of milk than in May by amounts varying from 0.01 to 0.54 pound; while 31 herds produced less by amounts varying from 0.33 to 1.12 pounds for 100 pounds of milk. *In general, the herds produced, on an average, 0.17 pound less of cheese for 100 pounds of milk.*

(2) In July 20 herds produced more cheese from 100 pounds of milk than in June by amounts varying from 0.04 to 1.17 pounds; while 30 herds produced less by amounts varying from 0.03 to 1.12 pounds for 100 pounds of milk. *On an average, less cheese was produced from 100 pounds of milk by 0.19 pound.*

(3) In August 39 herds produced more cheese from 100 pounds of milk than in July by amounts varying from 0.02 to 1.60 pounds; while 8 herds produced less by amounts varying from 0.01 to 0.65 pound for 100 pounds of milk. *In general, more cheese was produced from 100 pounds of milk by an average of 0.52 pound.*

(4) In September 42 herds produced more cheese from 100 pounds of milk than in August by amounts varying from 0.04 to 1.64 pounds; while 5 herds produced less by amounts varying from 0.06 to 0.51 pound for 100 pounds of milk. *There was a general average increased yield of 0.44 pound of cheese for 100 pounds of milk.*

(5) In October 39 herds produced more cheese than in September from 100 pounds of milk by amounts varying from 0.08 to 1.94 pounds; while only one herd produced less. *There was a general average increased yield of cheese amounting to 0.81 pound for 100 pounds of milk.*

It will be interesting to notice more in detail to what changes in the composition of milk the variations in the yield of cheese were due from month to month. In the subjoined table, we indicate by plus and minus signs the amount of increase or decrease of fat, casein and cheese for 100 pounds of milk for each month compared with the preceding month.

TABLE SHOWING MONTHLY INCREASE AND DECREASE OF FAT, CASEIN AND CHEESE FOR 100 POUNDS OF MILK.

	Pounds of fat for 100 pounds of milk.	Pounds of casein for 100 pounds of milk.	Pounds of cheese for 100 pounds of milk.
From May to June	+0.01	−0.07	−0.17
From June to July	+0.12	−0.13	−0.19
From July to August	+0.33	+0.06	+0.52
From August to September	−0.07	+0.21	+0.44
From September to October	+0.23	+0.22	+0.81

In June we see that there was a slight increase of fat but a much larger decrease of casein so that the general result was a decrease in yield of cheese. The same was true in July. In August the fat increased largely and the casein slightly. In September, while the fat decreased somewhat, the casein increased enough to counterbalance the loss of fat and add to the yield of cheese 0.44 pound for 100 pounds of milk. In October both fat and casein increased and the relative cheese yield increased correspondingly.

6. Variations in Relation of Fat to Cheese Yield.

When the relative proportions of fat and casein in milk remain uniform, the amount of cheese produced for each pound of fat in milk remains the same. When the casein increases relative to the fat, then the amount of cheese produced for each pound of fat increases. When the casein decreases relative to the fat, then the amount of cheese produced for each pound of fat decreases. In the table below, we give the amounts of fat and casein in the milk, the yield of cheese and the amount of cheese produced for each pound of milk-fat.

TABLE SHOWING POUNDS OF CHEESE MADE FOR ONE POUND OF FAT IN MILK.

NUMBER OF HERD.	May.	June.	July	August.	September.	October.
1	2.70	2.82	2.50	2.53	2.66	2.80
2	2.67	2.69	2.50	2.44	2.63	2.68
3	2.65	2.66	2.54	2.47	2.74	2.71
4	2.80	2.77	2.55	2.60	2.92	2.84
5	2.86	2.96	2.62	2.47	2.79	2.67
6	2.76	2.57	2.57	2.52	2.75	2.64
7	2.71	2.68	2.50	2.43	2.61	2.83
8	2.71	2.45	2.57	2.48	2.68	2.73
9	2.81	2.77	2.53	2.54	2.70	2.71
10	2.75	2.64	2.60	2.63	2.86	2.77
11	2.64	2.56	2.48	2.34	2.45	2.63
12	2.87	2.87	2.63	2.56	2.66	2.70
13	3.03	2.75	2.47	2.57	2.78	2.74
14	2.65	2.74	2.64	2.59	2.81	2.74
15	2.70	2.71	2.60	2.51	2.62	2.62
16	2.85	2.80	2.75	2.66	2.82	2.86
17	2.54	2.54	2.53	2.38	2.60	2.58
18	2.73	2.90	2.70	2.52	2.67	2.63
19	2.88	2.83	2.52	2.51	2.68	2.64
20	2.74	2.80	2.63	2.58	2.96	2.68
21	2.70	2.67	2.86	2.46	2.63	2.66
22	2.83	2.77	2.50	2.45	2.47	2.77
23	2.69	2.79	2.48	2.40	2.63	2.79
24	2.96	2.81	2.64	2.50	2.64	2.76
25	2.69	2.70	2.50	2.46	2.60	2.68
26	2.73	2.70	2.69	2.53	2.46	2.60
27	2.83	2.74	2.62	2.46	2.50	2.71
28	2.80	2.86	2.53	2.36	2.72	2.80
29	2.71	2.65	2.79	2.49	2.67	2.70
30	2.80	2.70	2.54	2.43	2.82	2.71
31	2.69	2.76	2.65	2.54	2.50	2.75
32	2.78	2.79	2.56	2.60	2.66	2.74
33	2.80	2.99	2.75	2.60	2.83	2.70
34	2.54	2.57	2.51	2.38	2.45	2.44
35	2.74	2.61	2.64	2 35	2.52	2.62
36	2.74	2.80	2.62	2.50	2.61	2.60
37	2.80	2.81	2.63	2.57	2.70	2.66
38	2.97	2.93	2.87	2.66	2.83	2.88
39	2.70	2.64	2.63	2.48	2.45	2.52
40	2.76	2 47	2.50	2.50	2.76	2.81
41	3.00	2.70	2.61	2.65	2.63	2.68
42	3.02	2.78	2.72	2.50	2.65	2.73
43	2.84	2.82	2.77	2.54	2.76	2.88
44	2.63	2.72	2.41	2.36	2.73	2.76
45	2.50	2.53	2.50	2.72	2.45	2.66
46	2.90	2.82	2.75	2.60	2.76	2.83
47	3.06	2.70	2.87	2.62	2.69	2.77
48	2.84	2.57	2.45	2.50	2.77	2.86
49	3.00	2.85	2.73	2.56	2.75	2.80
50	2.90	2.70	2.58	2.40	2.52	2.55

TABLE SHOWING RELATION OF FAT IN MILK TO YIELD OF CHEESE.

MONTH.	Pounds of fat in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of cheese made from 100 pounds of milk.	Pounds of casein for one pound of fat in milk.	Pounds of cheese made for one pound of fat in milk.
May	3.58	2.40	9.94	0.67	2.78
June	3.59	2.33	9.77	0.65	2.72
July	3.71	2.20	9.58	0.59	2.58
August	4 04	2.26	10.10	0.56	2.50
September	3.97	2.47	10.54	0.62	2.65
October	4.20	2.69	11.35	0.64	2.70

In making a comparison of results for different months, we observe the following facts:

(1) In June 19 herds produced more cheese for milk-fat than in May by amounts varying from 0.01 to 0.19 pound; while 29 herds produced less cheese for milk-fat by amounts varying from 0.02 to 0.36 pound. Two herds gave uniform results for both months. *In general, the amount of cheese produced for each pound of fat in milk averaged 0.06 pound less in June than in May.* This is explained by the fact that the casein decreased, while the fat slightly increased.

(2) In July 6 herds produced more cheese in proportion to milk-fat than in June by amounts varying from 0.03 to 0.19 pound; while 43 herds produced less cheese for milk-fat by amounts varying from 0.01 to 0.34 pound. One herd remained unchanged. *In general, the average yield of cheese, relative to fat in milk, decreased 0.14 pound in July as compared with June.* This result is explained by simultaneous increase of fat and decrease of casein in milk.

(3) In August 8 herds produced more cheese relative to milk-fat than in July by amounts varying from 0.01 to 0.2 pound; while 39 herds showed a decrease in amount of cheese produced for each pound of fat in milk. One herd remained the same during the two months. *In general, there was a decreased average yield of 0.08 pound of cheese for each pound of fat in milk.* This was owing to the fact that the amount of fat in milk increased relative to the amount of casein.

(4) In September, as compared with August, 42 herds increased the amount of cheese produced for each pound of milk-fat by amounts varying from 0.02 to 0.39 pound; while 5 herds showed a decrease by amounts varying from 0.02 to 0.27 pound. *In general, the average amount of cheese produced for each pound of milk-fat was increased by 0.15 pound in September as compared with August.* This increase was due to increase of casein in milk relative to fat.

(5) In October 24 herds produced more cheese for milk-fat than in September by amounts varying from 0.01 to 0.03 pound; while 15 herds produced less within similar limits and one herd remained unchanged. *In general, the average yield of cheese was increased by 0.05 pound for each pound of milk-fat.* This result was owing to an increase of casein in milk relative to milk-fat.

7. VARIATIONS IN TOTAL MONTHLY YIELDS OF MILK, FAT, CASEIN AND CHEESE.

In the table below we give the amounts of milk produced month by month and also the total yield, in pounds, of fat, casein and cheese.

TABLE SHOWING YIELDS OF MILK, FAT, CASEIN AND CHEESE.

MONTH.	Pounds of milk.	Pounds of fat.	Pounds of casein.	Pounds of cheese.
May	327,638	11,729.5	7,863.3	32,560·7
June	368,672	13,235.3	8,590.0	36,034.0
July	293,004	10,870.5	6,446.0	28,072.7
August	230,690	9,320.0	5,213.5	23,285.8
September	242,360	9,621.7	5,986.3	25,549.6
October	218,243	9,166.2	5,870.7	24,759.7

(1) In yield of milk there was an aggregate increase from May to June of 41,034 pounds; from June to July, an aggregate decrease of 75,668 pounds; from July to August, a further decrease of 62,314 pounds; from August to September, an increase of 11,670 pounds; and from September to October, a decrease of 24,117 pounds.

(2) In regard to the comparative monthly yields of fat, there was an increase of 1,505.8 pounds from May to June; a decrease of 2,364.8 pounds from June to July; a further decrease of 1,550.5 pounds from July to August; an increase of 301.7 pounds from August to September; and a decrease of 455.5 pounds from September to October.

(3) As regards the yields of casein, compared month by month, there was an increase of 726.7 pounds from May to June; a decrease of 2,144 pounds from June to July; a further decrease of 1,232.5 pounds from July to August; an increase of 772.8 pounds from August to September; and a decrease of 115.6 pounds from September to October.

(4) Comparing month by month the yields of cheese, there was an increase of 3,473.3 pounds from May to June; a decrease of 7,961.3 pounds from June to July; a further decrease of 4,786.9 pounds from July to August; an increase of 2,263.8 pounds from August to September; and a decrease of 789.9 pounds from September to October.

Tabulating these data we have a

Table Showing Comparative Monthly Increase and Decrease of Yields.

	Pounds of milk.	Pounds of fat	Pounds of casein.	Pounds of cheese.
May to June	+41,034	+1,505.8	+726.7	+3,473.3
June to July	—75,668	—2,364.8	—2,144.0	—7,961.3
July to August	—62,314	—1,550.5	—1,232.5	—4,786.9
August to September	+11,670	+301.7	+772.8	+2,263.8
September to October	—24,117	—455.5	—115.6	—789.9

8. Cause and Bearing of Variations in Yield and Composition of Milk.

Summarizing the results which we have been studying we have observed that —

(1) There was an increase of milk and cheese from May to June and then a variable decrease during the following months, except that in September there was an increase over August.

(2) Expressing the decrease of cheese yield noticed in July and August in the form of dollars and cents, there was a falling off amounting to about $600 from June to July or an average of $20 a day and a further decrease in August amounting to nearly $400.

(3) Expressed in the form of yield of butter, there was a decrease of 2,760 pounds in July as compared with June and a further decrease of 1,810 pounds in August.

Having observed the facts, we are confronted with several questions, which inevitably suggest themselves, such as,—

"To what causes were the observed variations due?"

"Were they entirely normal?"

"Could such variations be modified so that the losses observed could be lessened?"

If we look to one or more of several causes to explain the variations observed in the composition and yield of milk, we shall be impressed with the belief that in this case the chief cause of the changes noticed was the lack of nutritious food; and this deficient food supply was caused by the influence of severe drought upon the pastures. It must be kept in mind that those who produce milk for cheese-making depend exclusively during the larger part of the season upon the pastures as the source of food supply, very rarely supplementing this by grain rations or green fodder. In the summer of 1895, the Mohawk Valley, where Mr. Merry's factory is located, experienced one of the most severe and prolonged drouths known in years. Commencing in July, rains were very infrequent and insufficient until some time in September. In July and August when the drouth was most severe, we observe the greatest changes both in composition and in yield of milk. In September there was an increase in yield of milk and a change in composition in the direction of more normal milk. This was in part due to improved pastures, as a result of rains, and also in part due to the fact that farmers were quite generally feeding green corn fodder.

Of course, we may ask if the changes in composition and yield of milk were not due to advance of lactation and to the discomforts of hot weather and annoyance by flies. Fortunately we have a means of comparison in our Station herd. These cows are kept in the quiet of the stables most of the time and are protected as much as practicable from conditions which cause disturbance in any way. They are supplied all the time with an abundance of succulent and nutritious food. If we examine the milk produced by these cows during the summer of 1895, we find that there was marked uniformity in composition, taking the relation of fat and casein as our basis of comparison. Taking the relation of fat to casein in May as 100, and comparing this with the following months, we have the following:—

	Factory herds.	Station herd.
May	100	100
June	97	100
July	88	100
August	84	100

Thus we see that while the relation of fat to casein in the milk of the Station herd was very uniform, there was a continuous marked change in the milk of the factory herds. Stated in another way, the cheese-producing efficiency of the milk was not affected by the season in case of the Station herd, while in case of the factory herds, there was marked change in the direction of loss.

The changes in the milk of the factory herds cannot be accounted for on the ground of advancing lactation. In the absence of other disturbing conditions, it appears that the relation of fat and casein in milk is fairly uniform with a general tendency for the casein to increase in relation to the fat, especially toward the end of the period of lactation. In the factory herds the reverse is seen during the summer months.

In regard to the yield of milk and its variations from month to month, we know that lactation exercises a fairly definite influence. Again, we will make comparison of our Station herd with the factory herds. It is not far from truth to say that the month of May represents on an average the first month of lactation of factory cows — at least this is sufficiently close for the purpose of comparison. We have averaged the yield of milk by lactation months from our Station herd covering a period of five years. Now, taking the yield of the first month of lactation as 100, we give below the comparative yield, on this basis, for the first six months of lactation. It has been necessary to make some correction in case of the factory herds, as the yield in September and October was to some slight extent affected by the discontinuance of some herds.

MONTH OF LACTATION.	Factory herd. Comparative yield of milk.	Station herd. Comparative yield of milk.
First	100	100
Second	112.5	116.3
Third	89.4	110 8
Fourth	72.0	105.2
Fifth	76.5	97.4
Sixth	73.2	93.7

Assuming that the data furnished by the Station herd represent averages near the truth, we see that in the second month of lactation there was a marked increase of milk yield and this was followed by a fairly uniform decrease from month to month. In the case of the factory herds, we observe an increase of milk yield in the second month of lactation and then a decrease, irregular and rapid. In the fifth month (September) there was an increase of yield due to improved pastures, supplemented by green corn fodder. In the factory herds the marked decrease of milk yield, compared with what we may call the normal conditions, as seen in our Station herd, can be explained satisfactorily only on the ground of an insufficient supply of nutritious food, due to dry pastures.

We have reason to believe, therefore, that the observed changes in composition and yield of milk during July and August in case of the factory herds were due to abnormal conditions unfavorable to the production of milk, and the main cause of the effects observed was the lack of nutritious food.

We have previously noticed and called attention to this same subject. Dr. Babcock also presents data in the 12th annual report of the Wisconsin Station showing the effect of insufficient food upon the composition of milk.

If the factory cows had been supplied with an abundance of nutritious, succulent food, the season's yield of milk would have been greater, the percentage of decrease after May being much less; and, in addition, the cheese-producing efficiency would have been greater than it was. If the percentage decrease in yield of milk had been the same in the case of the factory cows as in the case of our Station herd, the yield of milk would have been materially greater than it was, and we can calculate what this increased yield should have been, if the condition of the factory cows had been entirely normal. We can also calculate how much more cheese would have been produced under normal conditions. Below we present data showing the amounts of milk and cheese actually produced and then the amounts which would have been produced if the milk had undergone in yield and composition only such changes as come normally with the advance of lactation.

MONTH.	Actual yield of milk.	Normal yield of milk.	Increased yield of milk under normal conditions.	Actual yield of cheese.	Normal yield of cheese.	Increased yield of cheese under normal conditions.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
May	327,638	327,638	....	32,561	32,561	....
June	368,672	381,044	12,372	36,034	36,466	432
July	293,004	363,023	70,019	28,073	36,375	8,302
August	230,690	344,675	113,985	23,286	36,984	13,698
September	242,360	319,119	76,759	25,550	34,880	9,330
October	218,243	306,917	88,754	24,760	35,060	10,300
Total	1,680,607	2,042,496	361,889	170,264	212,326	42,062

If the yield of milk had not fallen off more rapidly than in the case of properly fed cows, the factory cows would have produced during the season about 360,000 pounds more milk than they did, and this would be equivalent to about 42,000 pounds of cheese, which at normal prices would be worth over three thousand dollars, or about five dollars a cow. Can we prevent this loss or any part of it in an economical way? The obvious conclusion is that farmers must provide against dry spells by raising some satisfactory crop to feed during the summer.

9. Provision Against Effects of Drouth.

From observations covering a period of several years, it appears that drouth, more or less severe, at some time during the summer season is the rule and not the exception. Even in fairly favorable seasons the abundance of pasture grass is liable to decrease after July and its nutritious quality also deteriorates. The most practicable method of keeping good the food supply during dry times is to plan regularly to supplement the pasture with some nutritious, succulent food. This additional supply may be obtained by holding corn silage or by growing crops to be fed green. Often a small grain ration may be added to advantage. Succulent food, however, must be liberally supplied in order to keep up the flow of milk. There is a variety of crops which may be grown for the purpose of supplementing pastures. In actual practice, we have depended chiefly upon two crops for green food in summer, alfalfa and oats mixed with peas.

Corn silage has the advantage of being at hand in case the dry time comes early in the season, when it might be difficult to get spring crops growing early enough. With this food one is quite independent of the conditions of season. One can easily secure ten tons of green food from one acre, while yields often run as high as eighteen and twenty tons. For a full discussion of the value of silage as a food for dairy cows and for information in regard to making ensilage and building silos, see Bulletins 97 and 102.

Alfalfa has the advantage of producing three or four cuttings in one season, yielding per acre seventeen tons or more of green fodder, containing four tons or more of dry matter. The first crop is generally cut in May, the second in June or July; and the number and time of subsequent cuttings depend upon the character of the season. If the first crop is not fed green, it can be made into hay. We feed from 30 to 40 pounds a day to each animal. We reproduce here some remarks concerning the cultivation of alfalfa, which Mr. W. P. Wheeler prepared and published in Bulletin 80.

"For those who are unacquainted with alfalfa a few general facts concerning the plant may be briefly mentioned here to advantage. Alfalfa (*Medicago sativa*), sometimes called lucerne, although not generally grown in this part of the country, has been cultivated for a long time. It was cultivated by the Egyptians, Greeks and Romans, and in later centuries by the nations of the warmer parts of Europe. It was early introduced into South America and brought from there to Mexico and California.

"Alfalfa being a leguminous plant like the clovers and able to gather nitrogen that is not available to most plants, will, when the crop is fed on the farm, enrich the soil in this necessary element, and leave a field in improved condition when finally plowed under. The long tap root with its numerous branches reaches deep in the sub-soil (roots often reach to a depth of ten or twelve feet — are said sometimes to extend over twenty feet) and is often able to obtain plant food and water for the lack of which surface-feeding plants may be suffering. The plant is a perennial and when once well established will yield paying crops for an indefinite number of years if the field is not overrun with grass or plantain.

"Alfalfa grows well on widely varying kinds of top soil, but the sub-soil must be open and porous. It does best on a warm and friable soil with a loose or gravelly sub-soil. A dense clay or hardpan sub-soil is most unfavorable. Although a rich soil is of course the best and gives the largest crops, alfalfa sometimes does exceedingly well on poor gravelly soils. The plant consumes much water but will not survive long in a saturated or flooded soil, and too much water in the soil during winter is fatal. If water stands for any considerable time within a few feet of the surface the crop will be injured. Alfalfa, in the West, seldom if ever winter kills on ground with a deep and porous sub-soil.

"The seed should not be sown unless the soil has received careful and thorough preparation, for it is of the utmost importance to secure a dense and uniform stand, especially if hay is to be made. If crops of seed only are desired a more scattering stand of plants may give good results. The seed should be sown in the spring, after danger of severe frost is past, and when the ground would be considered in the best possible condition for planting garden seeds. The treatment of the soil for the preceding season should have been such as to have most effectually subdued all weeds, and caused the sprouting and destruction of any seeds in the ground. *The seed should not be sown with grain, but alone;* although a good catch is sometimes reported when sown with oats—only about half the usual quantity of grain being used. If sown with grain the young plants are likely to be killed by the sun after the grain is cut. It is best to sow not less than thirty pounds of seed per acre—especially when sown broadcast. When sown with the drill twenty pounds often give good results. In short, to guard against the decidedly unsatisfactory result of a poor stand, plenty of seed should be used on carefully prepared ground.

" Pure seed is essential. Only plump, bright, good seed should be sown, for shrunken seed may produce weak and worthless plants. The seed resembles that of red clover but is larger. Too many small seeds would indicate the possible admixture of white clover, etc. The presence of the seed of narrow-leaf-plantain or rib-grass is of vital importance to guard against. This is a long brownish seed something like a diminutive date seed and is easily detected without the aid of a glass by anyone familiar with it.

" In order to check the growth of weeds a mowing machine can be run over the field of young alfalfa with the cutting bar raised so as to avoid cutting near the crowns of the young plants. If the clipping is not too heavy it can, with advantage, be left on the field, and will serve as a mulch during the dry weather. On rich soil sometimes two crops can be secured the first year, but on poor soil or in a dry season no crop can be expected the first year. Alfalfa should be cut every time it begins to blossom, whether the growth is short or tall, unless a seed crop is desired. The second crop of the season is better for seed than the first, possibly on account of the greater number of insects that assist in fertilizing the blossoms.

"Alfalfa is of exceptional value as a soiling crop, but it will also make excellent hay, palatable and very nutritious. Much care and time are necessary to make good hay, and experience and good judgment are required. If handled much when very dry all the leaves are likely to fall off, and if not thoroughly cured it is likely to mold and mildew. The hay will not shed water well and any stacks should be well covered.

"If you have a suitable field, try a small patch of alfalfa,— not too much at first."

Oats and peas. Six tons or more of green oat and pea fodder, containing two tons of dry matter, can be grown on an acre. This crop should be sown early and at two or three intervals not too wide apart. The amount of seed sown should be from one and one-half to two bushels of each kind. It is fed while the oats are in the milk stage of growth.

Of necessity, additional labor and expense are involved in making provisions against the effects of drouth. The question naturally suggests itself as to whether the added expense will be recompensed by the increased yield of milk and milk-solids. While it is difficult to determine for different conditions the cost of producing any of the foods mentioned, we estimate that under average circumstances the amount of supplementary food required for one season would not exceed two dollars for each animal. This would leave a net increased yield of three dollars a cow on the basis of the data which have been presented.

While the effects of drouth upon milk production have been studied more particularly from the standpoint of cheese production, it can readily be seen that the conclusions reached are fully applicable to milk production for any other purpose. If it were possible, by carrying out the suggestions given, to increase the annual yield of milk and its products so as to increase the profit only one dollar a cow, the aggregate increase to the dairymen of this State would be one and one-half million dollars a year. From the data presented, such an increase is not only possible, but almost certain during our average seasons.

II. MILK-FAT AND CHEESE YIELD.*

Summary.

During the season of 1895 analysis was made of the milk of each of fifty herds of cows, whose milk was taken to a cheese factory. The immediate object was to learn the existing relation between milk-fat and casein, or milk-fat and cheese yield, with individual herds of cows; the further purpose being to ascertain whether milk-fat forms the fairest basis of paying for milk for cheese-making.

The data, thus obtained, when studied month by month and also for the entire season, lead to the following conclusions:

(1) When fat in milk increases, the casein and cheese yield also increase in general, though in special cases the casein and cheese yield may increase while the fat remains unchanged, or the fat increase while the casein remains unchanged or even decreases. Different milks containing the same per cent of fat may show considerable range in the per cent of casein. However, the general tendency is for both fat and casein to increase at the same time.

(2) Although casein and cheese yield generally increase when the milk-fat increases, the casein more often increases less rapidly in proportion than the fat. The general averages obtained from the season's results as between milk containing 3 and 4 per cent of fat can be indicated as follows:

Per cent. of fat in milk.	Per cent. of casein in milk.	Pounds of casein for one pound of fat in milk.	Pounds of cheese made from 100 pounds of milk.	Pounds of cheese made for 1 pound of fat in milk.
3	2.10	0.70	8.55	2.85
4	2.40	0.60	10.40	2.60

*Published without detailed data as Bulletin No. 110.

The amount of casein for one pound of milk-fat decreases about one-tenth of a pound, from 0.70 to 0.60 pound, when the fat in milk increases one pound.

(3) As a rule, when milk-fat increases, the amount of cheese made for each pound of milk-fat decreases. In milk containing 3 per cent of fat, 2.85 pounds of cheese are made for each pound of milk-fat; while in milk containing 4 per cent of fat, 2.60 pounds of cheese are made for each pound of fat.

(4) Why is the cheese-yield greater for a pound of fat in poor milk than in richer milk? What makes the cheese-yield for a pound of fat 2.85 pounds, or 0.25 pound more in 3 per cent fat milk than in 4 per cent fat milk (yielding 2.60 pounds of cheese for each pound of milk-fat)? The increased yield of 0.25 pound comes from casein and water.

(5) Cheese made from milk poor in fat is not like, in composition, cheese made from milk rich in fat. The former contains more casein and water in 100 pounds. This increased cheese-yield relative to fat, in case of poor milk, due to casein and water has a market value of only 2 cents a pound.

(6) Milk rich in fat can be made to yield cheese of the same composition as milk poorer in fat in one of two ways: (1) By adding skim-milk to the richer milk, or (2) removing fat from it. Then the cheese-yield for a pound of fat becomes the same.

(7) The difference in the cheese-yield of milk-fat in the case of poor milk over richer milk is a skim-milk difference and the extra yield of cheese for fat from poor milk is the poorest kind of skim-milk cheese.

(8) Payment for milk according to amount of cheese-yield gives unfair advantage to poor milk, since cheese made from rich milk is worth more, pound for pound, than cheese made from poorer milk.

(9) Milk should in no case be paid for at cheese-factories by weight of milk alone, since different milks differ greatly in their cheese-making powers.

(10) A critical comparison of all methods of paying for milk, suggested or in use, leads to the conclusion that milk-fat affords the fairest practicable basis to use in paying for milk for cheese-making.

INTRODUCTION.

Until five years ago there was little evidence at hand to show whether there was any uniform relation between the amount of fat in milk and the yield of cheese made from milk. Up to this time it was almost universally held that, while fat in milk might have some definite relation to butter yield, there could be no similar relation between milk-fat and cheese, because casein played so important a part in cheese-yield. As a result of work done at this Station, it has been established beyond question that there is, within certain limits, a fairly definite and uniform relation between milk-fat and cheese-yield, especially when we deal with large quantities of milk. Up to 1895, our work dealt largely with mixed factory milk, without extended study of detailed variations that might exist in the milk of different herds of cows. During the summer of 1895, we made a detailed study of the milk of each of fifty different herds of cows, whose milk was used in cheese-making at the factory of G. & F. H. Merry, of Verona, to whose co-operation we are indebted for securing for us the samples of milk examined.

The specific object of our investigation was to study the relation of fat to casein and to cheese-yield in the milk of different herds, in order to ascertain whether this relation was uniform, or whether it varied and, if it varied, whether regularly or irregularly.

In order to insure a clear understanding of what our investigation involves and of what its bearing is upon the dairy industry in relation to cheese-making, we will present briefly some of the fundamental considerations relating to the question which forms the subject of this bulletin.

Formerly milk was universally paid for at cheese-factories according to weight alone, on the supposition that all kinds of normal milk were of equal value for cheese production. Investigation showed that the cheese-producing power of milk varied greatly, because the amount of cheese-making constituents in milk was very different in different milks. It was found that, of the several compounds contained in milk, only two are prominent as cheese-producing materials, or, stated differently, the cheese-producing power of milk is almost entirely measured by two of its solid constituents, so far as the composition of the milk is concerned. These two cheese-producing constituents are *fat* and *casein*. The other constituents of the milk, such as albumen, sugar, etc., pass into the whey for the most part and are lost. These two cheese-making constituents of milk vary much in different milks. If the amount of cheese made from milk depends upon the amount of fat and casein in milk, why would it not be well to use the fat and casein together as a basis in paying for milk? One serious objection lies in the fact that we have no simple method for determining the amount of casein in milk which is practicable in the hands of anyone but a trained chemist. Milk-fat, on the other hand, can be readily determined; but does it alone furnish a satisfactory guide as to the amount of cheese that can be made from milk? It was held that milk-fat cannot be an accurate guide in regard to cheese-yield, because when fat increases in milk, the casein does not increase in anything like the same proportion, or, expressed in another way, milk poor in fat contains more casein for a pound of fat than does milk richer in fat, and will, therefore, make more cheese for each pound of fat than will richer milk. The difference existing was asserted in a broad way, but not in detail, and no evidence was offered. Our former work showed conclusively that, while fat and casein did not preserve an absolutely uniform relation, the relation varied within such limits as not to affect seriously the value of the method of paying for milk on the basis of its fat-content, especially when we take into consideration the influence of fat and casein on the quality of cheese produced, and also the relative market values of fat and casein.

In this report we propose to consider more in detail than ever before just to what extent the relation of fat and casein in milk varies in the milk of different herds of factory cows.

We secured separate samples of milk from each of 50 herds every alternate week continuously for six months, obtaining in all 632 samples.

Our previous work has established fairly beyond question that the fat and casein in milk tend to preserve a quite uniform relation from month to month as the period of lactation advances, provided abnormal conditions are absent, such as insufficient nutrition. We shall now study the relation of fat and casein in the milk of different herds, taking each month by itself, and also the season as a whole, thus eliminating any influence that might come from advance of lactation.

We present tabulated summaries of our detailed results. The tables contain the following data:

(1) The percentage of fat in milk arranged in groups, each differing from the preceding and following by one-tenth of one per cent.

(2) The average percentage of casein corresponding to each group.

(3) The amount of casein for each pound of milk-fat in each group.

(4) The amount of cheese made from 100 pounds of milk in each group.

(5) The amount of cheese made for each pound of milk-fat in each group.

The number of herds embraced in each group is also stated. A separate table is presented for each month of the season from May to October inclusive, and also a table giving the herd averages for the entire season.

In studying these results, it is well to keep in mind that the yield of cheese, relative to milk-fat, varies directly with the amount of casein relative to milk-fat. When the relative proportions of fat and casein in milk remain uniform, the amount of cheese produced for each pound of fat in milk remains the same. When the casein in milk increases relative to the fat, then the amount of cheese produced for each pound of fat increases. When the casein in milk decreases relative to the fat, then the amount of cheese produced for each pound of fat decreases.

TABLE GIVING FULL DATA FOR THE MONTH OF MAY.

NUMBER OF HERD.	Pounds of fat in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of casein for one pound of fat in milk.	Pounds of cheese made from 100 pounds of milk.	Pounds of cheese made for one pound of fat in milk.
47	3.10	2.43	0.78	9.50	3.06
24	3.15	2.35	0.75	9.34	2.96
6	3.20	2.12	0.66	8.82	2.76
41	3.20	2.44	0.76	9.62	3.00
43	3.20	2.23	0.70	9.10	2.84
38	3.25	2.43	0.75	9.65	2.97
5	3.27	2.30	0.70	9.35	2.86
10	3.28	2.17	0.66	9.03	2.75
46	3.30	2.38	0.72	9.58	2.90
12	3.30	2.34	0.71	9.48	2.87
42	3.30	2.54	0.77	9.98	3.02
27	3.32	2.30	0.69	9.40	2.83
22	3.33	2.30	0.69	9.41	2.83
26	3.38	2.21	0.65	9.24	2.73
49	3.40	2.59	0.76	10.22	3.00
19	3.42	2.18	0.63	9.21	2.70
9	3.43	2.35	0.69	9.65	2.82
30	3.43	2.34	0.68	9.62	2.80
16	3.45	2.40	0.70	9.82	2.85
13	3.47	2.68	0.77	10.52	3.03
20	3.48	2.29	0.66	9.55	2.74
28	3.50	2.38	0.68	9.80	2.80
21	3.55	2.25	0.63	9.53	2.70
4	3.57	2.40	0.67	9.93	2.78
18	3.57	2.33	0.65	9.75	2.73
1	3.57	2.25	0.63	9.55	2.70
31	3.58	2.28	0.63	9.64	2.69
23	3.58	2.27	0.63	9.61	2.69
40	3.60	2.41	0.67	9.93	2.77
15	3.63	2.33	0.64	9.82	2.70
33	3.65	2.63	0.72	10.59	2.90
8	3.70	2.38	0.64	10.02	2.71
25	3.70	2.33	0.63	9.90	2.69
36	3.73	2.45	0.66	10.23	2.74
7	3.73	2.40	0.64	10.10	2.70
37	3.78	2.56	0.67	10.56	2.80
17	3.78	2.33	0.62	9.61	2.64
35	3.78	2.48	0.66	10.36	2.74
50	3.80	2.74	0.72	11.03	2.90
32	3.80	2.55	0.67	10.56	2.78
29	3.83	2.46	0.64	10.36	2.71
2	3.88	2.43	0.63	10.34	2.67
39	3.90	2.49	0.64	10.52	2.70
3	3.92	2.44	0.62	10.41	2.65
48	3.95	2.75	0.70	11.22	2.84
11	3.97	2.44	0.62	10.47	2.64
14	3.98	2.47	0.62	10.55	2.65
44	4.00	2.44	0.61	10.50	2.62
34	4.00	2.30	0.58	10.15	2.54
45	4.35	2.41	0.55	10.81	2.50

TABLE SHOWING THE RELATION OF FAT IN MILK TO CASEIN AND TO YIELD OF CHEESE DURING MAY.

NUMBER OF HERDS.	Pounds of fat in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of casein for one pound of fat in milk.	Pounds of cheese made from 100 pounds of milk.	Pounds of cheese made for one pound of fat in milk.
0	3 to 3.1	....	....	....	....
2	3.1 to 3.2	2.39	0.76	9.41	3.01
6	3.2 to 3.3	2.28	0.71	9.26	2.86
6	3.3 to 3.4	2.35	0.71	9.53	2.86
7	3.4 to 3.5	2.40	0.70	9.79	2.84
7	3.5 to 3.6	2.31	0.65	9.69	2.72
3	3.6 to 3.7	2.46	0.68	10.14	2.80
7	3.7 to 3.8	2.42	0.65	10.17	2.72
4	3.8 to 3.9	2.55	0.67	10.60	2.76
5	3.9 to 4	2.52	0.64	10.64	2.70
2	4 to 4.1	2.37	0.59	10.33	2.58
0	4.1 to 4.2	....	....	....	....
0	4.2 to 4.3	....	....	....	....
1	4.3 to 4.4	2.41	0.55	10.81	2.50

An examination of the preceding table enables us to make the following statements:

(1) In the milk of the 50 herds of cows the fat varied from 3.1 to 4.4 per cent while the amount of casein for a pound of fat in milk varied from 0.76 to 0.55 pound. If we take the variation of fat as one per cent, say from 3 to 4 or 3.1 to 4.1 per cent, etc., the decrease of casein relative to fat amounted to about 0.16 pound.

(2) Excluding 5 extreme herds and using the results obtained from 45 herds, the decrease of casein for a pound of fat amounted to 0.07 pound.

(3) Taking all the results, the relative average decrease of casein was 0.016 pound for each tenth of a pound of fat in milk.

(4) Between the limits of 3.2 and 4 per cent of fat, which include 45 herds, the relative average decrease was only 0.007 pound of casein for each tenth of a pound of fat.

(5) Expressed in yield of cheese relative to milk-fat, there was in the extreme cases a decrease of 0.50 pound of cheese for one pound of fat in milk; or, excluding 5 extreme herds, there was a decrease of 0.16 pound of cheese for a pound of milk-fat.

(6) Between the limits of 3.2 and 4 per cent of fat in milk, the amount of cheese made for one pound of fat in milk varied between the limits of 2.86 and 2.70 pounds, equivalent to an average decrease of 0.016 pound of cheese for one-tenth of a pound of milk-fat.

TABLE GIVING FULL DATA FOR THE MONTH OF JUNE.

NUMBER OF HERD.	Pounds of fat in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of casein for one pound of fat in milk.	Pounds of cheese made from 100 pounds of milk.	Pounds of cheese made for one pound of fat in milk.
5	3.10	2.30	0.74	9.16	2.94
38	3.15	2.34	0.74	9.24	2.93
43	3.18	2.19	0.69	8.97	2.82
33	3.18	2.39	0.75	9.47	2.98
12	3.28	2.32	0.71	9.40	2.87
13	3.30	2.18	0.66	9.08	2.75
44	3.30	2.13	0.65	8.96	2.72
10	3.35	2.06	0.62	8.84	2.64
9	3.35	2.24	0.67	9.29	2.77
42	3.35	2.25	0.67	9.31	2.78
24	3.37	2.31	0.68	9.48	2.81
18	3.40	2.43	0.71	9.82	2.88
46	3.40	2.34	0.69	9.59	2.82
31	3.40	2.25	0.66	9.37	2.76
22	3.40	2.27	0.67	9.42	2.77
28	3.40	2.39	0.70	9.72	2.86
16	3.43	2.36	0.68	9.62	2.80
19	3.43	2.38	0.69	9.72	2.83
26	3.43	2.19	0.64	9.27	2.70
6	3.48	2.05	0.59	8.95	2.57
4	3.48	2.33	0.67	9.65	2.77
49	3.50	2.45	0.70	9.98	2.85
20	3.50	2.38	0.68	9.80	2.80
1	3.50	2.41	0.69	9.88	2.82
23	3.50	2.36	9.67	9.75	2.78
37	3.50	2.39	0.68	9.85	2.81
27	3.53	2.32	0.66	9.68	2.74
21	3.53	2.21	0.63	9.41	2.67
36	3.55	2.41	0.68	9.93	2.80
47	3.60	2.31	0.64	9.74	2.70
15	3.60	2.32	0.64	9.76	2.71
14	3.63	2.38	0.66	9.94	2.74
32	3.63	2.44	0.67	10.09	2.79
25	3.70	2.36	0.64	9.97	2.70
30	3.70	2.34	0.63	9.92	2.68
41	3.70	2.34	0.63	9.92	2.68
7	3.70	2.33	0.63	9.90	2.68
2	3.83	2.44	0.64	10.31	2.69
11	3.85	2.24	0.58	9.84	2.56
34	3.90	2.30	0.59	10.04	2.57
3	3.93	2.45	0.62	10.45	2.66
35	3.95	2.38	0.60	10.30	2.61
39	3.95	2.45	0.62	10.47	2.64
29	4.00	2.47	0.62	10.58	2.65
17	4.00	2.30	0.58	10.15	2.54
50	4.00	2.53	0.64	10.78	2.70
40	4.08	2.24	0.55	10.09	2.48
45	4.15	2.38	0.58	10.52	2.53
48	4.20	2.47	0.59	10.80	2.57
8	4.23	2.28	0.54	10.35	2.45

We summarize the preceding table as follows:

TABLE SHOWING RELATION OF FAT IN MILK TO CASEIN AND TO YIELD OF CHEESE DURING JUNE.

NUMBER OF HERDS.	Pounds of fat in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of casein for one pound of fat in milk.	Pounds of cheese made from 100 pounds of milk.	Pounds of cheese made for one pound of fat in milk.
4	3 1 to 3.2	2.30	0.73	9 21	2.92
1	3.2 to 3.3	2.32	0.71	9.40	2.87
6	3.3 to 3.4	2.20	0.66	9.17	2.75
10	3.4 to 3.5	2.30	0.67	9.52	2.78
8	3.5 to 3.6	2.37	0.67	9.79	2.78
4	3.6 to 3.7	2.36	0.65	9.88	2.73
4	3.7 to 3.8	2.34	0.63	9.92	2.68
2	3.8 to 3.9	2.34	0.61	10.07	2.62
4	3.9 to 4	2.40	0.61	10.32	2.62
4	4 to 4.1	2.39	0.60	10.40	2.59
1	4.1 to 4.2	2.38	0.58	10.52	2.53
2	4.2 to 4.3	2.38	0.57	10.59	2.51

In connection with the preceding table, containing data for the month of June, attention is called to the following facts:

(1) The fat in milk varied from 3.1 to 4.3 per cent, while the amount of casein present in milk for each pound of fat varied from 0.73 to 0.57 pound; or, taking the variation of fat in milk as one per cent, from 3.1 to 4.1 per cent, etc., the decrease of casein relative to fat amounted to about 0.15 pound.

(2) Excluding 5 extreme herds and using the results obtained from 45 herds, there was a decrease of 0.10 pound of casein for a pound of fat in milk.

(3) Taking all the results, the relative decrease of casein was 0.013 pound for each tenth of a pound of milk-fat.

(4) Between the limits of 3.3 and 4 per cent of fat, the relative decrease was only 0.006 pound of casein for each tenth of a pound of fat.

(5) Expressed in yield of cheese relative to milk-fat, there was in the extreme cases a decrease of 0.41 pound of cheese for one pound of fat in milk.

(6) Between the limits of 3.3 and 4 per cent of fat in milk, the amount of cheese made for one pound of fat in milk varied between the limits 2.75 and 2.62 pounds, equivalent to an average decrease of 0.013 pound of cheese for one-tenth of a pound of milk-fat.

TABLE GIVING FULL DATA FOR THE MONTH OF JULY.

NUMBER OF HERD.	Pounds of fat in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of casein for one pound of fat in milk.	Pounds of cheese made from 100 pounds of milk.	Pounds of cheese made for one pound of fat in milk.
43	3.00	2.00	0.67	8.30	2.77
47	3.08	2.19	0.71	8.86	2.87
42	3.25	2.11	0.65	8.85	2.72
10	3.33	1.98	0.60	8.61	2.60
38	3.35	2.37	0.70	9.61	2.87
5	3.35	2.03	0.61	8.76	2.62
9	3.40	1.94	0.57	8.59	2.53
6	3.40	2.00	0.59	8.74	2.57
31	3.40	2.11	0.62	9.02	2.65
33	3.40	2.24	0.66	9.34	2.75
24	3.43	2.11	0.62	9.05	2.64
46	3.47	2.21	0.63	9.34	2.70
4	3.48	2.12	0.61	8.86	2.62
26	3.50	2.21	0.63	9.38	2.69
49	3.55	2.31	0.65	9.68	2.73
16	3.58	2.36	0.66	9.84	2.75
12	3.60	2.20	0.61	9.46	2.63
20	3.65	2.23	0.61	9.59	2.63
22	3.65	2.16	0.59	9.06	2.60
29	3.66	2.27	0.62	9.70	2.65
19	3.68	2.09	0.57	9.27	2.52
13	3.70	2.02	0.55	9.12	2.47
21	3.70	2.11	0.58	9.35	2.52
30	3.73	2.15	0.58	9.48	2.54
27	3.75	2.27	0.61	9.80	2.62
36	3.75	2.28	0.61	9.83	2.62
35	3.75	2 31	0.62	9.90	2.64
15	3.80	2.27	0.60	9.86	2.60
3	3.80	2.18	0.58	9.63	2.54
37	3.82	2.34	0.61	10.05	2.63
44	3.83	2.00	0.52	9.21	2.41
14	3.83	2.26	0.59	9.86	2.58
18	3.83	2.36	0.62	10.11	2.64
41	3.85	2.32	0.60	10.04	2.61
28	3.88	2.22	0.58	9.82	2.53
1	3.90	2.17	0.56	9.72	2.50
7	3.90	2.16	0.56	9.69	2.50
25	3.95	2.21	0.56	9.87	2.50
2	3.95	2.15	0.55	9.75	2.47
34	3.97	2.23	0.56	9.94	2.51
8	3.98	2.34	0.59	10.23	2.57
45	3.98	2.20	0.55	9.88	2.48
32	4.00	2.37	0.59	10.25	2.56
11	4.00	2.20	0.55	9.90	2.48
23	4.05	2.24	0.55	10.06	2.48
17	4.05	2.32	0.57	10.26	2.53
39	4.07	2.50	0.61	10.73	2.63
40	4.10	2.29	0.56	10.24	2.50
50	4.10	2.42	0.59	10.56	2.58
48	4.30	2.32	0.54	10.53	2.45

The foregoing table may be summarized as follows:

TABLE SHOWING RELATION OF FAT IN MILK TO CASEIN AND TO YIELD OF CHEESE DURING JULY.

NUMBER OF HERDS.	Pounds of fat in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of casein for one pound of fat in milk.	Pounds of cheese made from 100 pounds of milk.	Pounds of cheese made for one pound of fat in milk.
2	3 to 3.1	2.10	0.69	8.58	2.83
0	3.1 to 3.2	....	....	....	....
1	3.2 to 3.3	2.11	0.65	8.85	2.72
3	3.3 to 3.4	2.13	0.64	9.00	2.70
7	3.4 to 3.5	2.10	0.61	9.01	2.63
3	3.5 to 3.6	2.29	0.65	9.63	2.72
5	3.6 to 3.7	2.19	0.60	9.49	2.60
6	3.7 to 3.8	2.19	0.59	9.58	2.57
8	3.8 to 3.9	2.24	0.59	9.82	2.56
7	3.9 to 4	2.21	0.56	9.87	2.50
5	4 to 4.1	2.33	0.57	10.26	2.53
2	4.1 to 4.2	2.36	0.58	10.40	2.54
0	4.2 to 4.3	....	....	....	....
1	4.3 to 4.4	2.32	0.54	10.53	2.45

From a study of the data for July we can summarize our results as follows:

(1) The fat in milk varied from 3 to 4.4 per cent, while the amount of casein in milk for each pound of fat varied from 0.69 to 0.54 pound; or, taking the range of milk fat as one per cent as from 3 to 4 or 3.4 to 4.4 per cent, etc., the decrease of casein relative to fat amounted to about 0.11 pound.

(2) Excluding 3 extreme herds and using the results obtained from 47 herds, there was a decrease of 0.09 pound of casein for a pound of fat in milk.

(3) Taking all the results, the average relative decrease of casein was 0.011 pound for each tenth of a pound of fat in milk.

(4) Between the limits of 3.2 and 4.2 per cent of fat in milk, the relative average decrease was only 0.007 pound of casein for each tenth of a pound of fat.

(5) Expressed in yield of cheese relative to fat in milk, there was in the extreme cases a decrease of 0.38 pound of cheese for one pound of fat in milk.

(6) Between the limits of 3.2 and 4.2 per cent of fat in milk, the amount of cheese made for one pound of fat in milk varied between the limits 2.72 and 2.50 pounds, which is equivalent to an average decrease of 0.022 pound of cheese for one-tenth of a pound of milk-fat.

TABLE GIVING FULL DATA FOR THE MONTH OF AUGUST.

NUMBER OF HERD.	Pounds of fat in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of fat for one pound of casein in milk.	Pounds of cheese made from 100 pounds of milk.	Pounds of cheese made for one pound of fat in milk.
43	3.50	2.11	0.60	9.13	2.61
10	3.50	2.14	0.61	9.20	2.63
9	3.58	2.06	0.58	9.09	2.54
31	3.60	2.08	0.58	9.16	2.54
47	3.63	2.21	0.61	9.52	2.62
38	3.67	2.29	0.62	9.76	2.66
5	3.68	2.16	0.59	9.45	2.57
6	3.70	2.10	0 57	9.32	2.52
12	3.70	2.15	0.58	9.45	2.56
45	3.70	2.40	0.65	10.07	2.72
46	3.73	2.24	0.60	9.70	2.60
13	3.73	2.19	0 59	9.58	2.57
16	3.80	2.37	0.62	10.11	2.66
4	3.80	2.25	0.59	9.81	2.58
41	3.80	2.35	0.62	10.06	2.65
33	3.85	2.31	0.60	10.01	2 60
26	3.85	2.22	0.58	9.79	2.55
14	3.85	2.27	0.59	9.91	2.57
19	3.88	2.18	0.56	9.72	2.51
24	3.90	2.16	0.56	9.69	2.50
42	3.90	2.16	0.56	9.69	2.50
15	3.90	2.20	0.56	9.79	2.51
49	3 93	2.30	0.59	10.07	2.56
36	3.95	2.20	0.56	9.85	2.50
20	4.00	2.36	0.59	10.30	2.58
22	4.00	2.16	0.54	9.80	2.45
1	4.00	2.29	0.57	10.13	2.53
21	4.00	2.17	0.54	9.83	2.46
29	4.05	2.25	0.56	10.08	2.50
37	4.05	2.38	0.59	10.41	2.57
3	4.08	2.23	0.55	10.06	2.47
7	4.10	2.22	0.54	10.06	2.46
44	4.12	2.07	0.50	9.71	2.36
40	4.18	2.33	0.56	10.42	2.50
27	4.20	2.28	0.54	10.32	2.46
32	4.20	2.49	0.59	10.85	2.58
48	4.20	2.31	0.55	10.40	2.47
18	4.23	2.39	0.57	10.65	2.52
28	4.28	2.16	0.50	10.11	2.36
2	4.28	2.29	0.53	10.43	2.44
17	4.30	2.21	0.51	10.26	2.38
30	4.33	2.30	0.53	10.51	2.43
34	4.33	2.23	0.51	10.31	2.38
8	4.35	2.40	0.55	10.79	2.48
23	4.37	2.26	0.52	10.46	2.40
25	4.50	2.44	0.54	11.05	2.46
39	4.58	2.52	0.55	11.34	2.48
50	4.60	2.33	0.51	10.90	2.37
11	4.78	2.37	0.50	11.18	2.35
35	4.90	2.43	0.50	11.50	2.35

We summarize below the preceding table:

TABLE SHOWING RELATION OF FAT IN MILK TO CASEIN AND TO YIELD OF CHEESE DURING AUGUST.

NUMBER OF HERDS.	Pounds of fat in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of casein for one pound of fat in milk.	Pounds of cheese made from 100 pounds of milk.	Pounds of cheese made for one pound of fat in milk.
0	3 to 3.5	....	....	....	....
3	3.5 to 3.6	2.10	0.60	9.13	2.59
4	3.6 to 3.7	2.18	0.60	9.46	2.59
5	3.7 to 3.8	2.22	0.60	9.63	2.59
7	3.8 to 3.9	2.28	0.60	9.92	2.59
5	3.9 to 4	2.21	0.56	9.83	2.50
7	4 to 4.1	2.26	0.56	10.09	2.50
3	4.1 to 4.2	2.21	0.53	10.07	2.44
6	4.2 to 4.3	2.32	0.55	10.46	2.47
5	4.3 to 4.4	2.28	0.53	10.47	2.42
0	4.4 to 4.5	....	....	....	....
2	4.5 to 4.6	2.48	0.55	11.20	2.47
1	4.6 to 4.7	2.33	0.51	10.90	2.37
1	4.7 to 4.8	2.37	0.50	11.18	2.35
0	4.8 to 4.9	....	....	....	....
1	4.9 to 5	2.43	0.50	11.50	2.35

The results secured in August can be summarized from the preceding table as follows:

(1) The fat in milk varied from 3.5 to 5 per cent, while the amount of casein in milk for each pound of fat ranged from 0.60 to 0.50 pound; or, taking the variation of milk-fat as one per cent, as 3.6 to 4.6, 3.7 to 4.7 per cent, etc., the decrease of casein relative to fat amounted to about 0.07 pound.

(2) Excluding three extreme herds and using the results secured with 47 herds, there was a decrease of 0.07 pound of casein for a pound of fat in milk.

(3) Taking all the results, the average relative decrease of casein was 0.007 pound for each tenth of a pound of fat in milk.

(4) Between the limits of 3.5 and 4.2 per cent of fat in milk, the relative average decrease was only 0.007 pound of casein for each tenth of a pound of fat.

(5) Expressed in yield of cheese relative to fat in milk, there was in extreme cases a decrease of 0.24 pound of cheese for one pound of fat in milk.

(6) Between the limits of 3.5 and 4.5 per cent of fat in milk, the amount of cheese made for one pound of fat in milk varied between the limits of 2.59 and 2.47 pound, which is equivalent to an average decrease of 0.012 pound of cheese for one-tenth of a pound of milk-fat.

Table Giving Full Data for the Month of September.

Number of herd.	Pounds of fat in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of casein for one pound of fat in milk.	Pounds of cheese made from 100 pounds of milk.	Pounds of cheese made for one pound of fat in milk.
43	3.20	2.12	0.66	8.82	2.76
10	3.33	2.35	0.70	9.54	2.86
20	3.50	2.60	0.74	10.35	2.96
6	3.53	2.33	0.66	9.71	2.75
44	3.53	2.30	0.65	9.63	2.73
13	3.55	2.37	0.67	9.83	2.78
30	3.55	2.44	0.68	10.00	2.82
9	3.60	2.30	0.64	9.71	2.70
38	3.61	2.50	0.69	10.22	2.83
12	3.65	2.27	0.62	9.69	2.66
4	3.68	2.68	0.73	10.75	2.92
46	3.70	2.45	0.66	10.20	2.76
16	3.70	2.54	0.68	10.42	2.82
14	3.73	2.55	0.68	10.48	2.81
5	3.78	2.54	0 67	10.51	2.79
24	3.80	2.34	0.62	10.03	2.64
19	3.80	2.39	0.63	10.18	2.68
31	3.83	2.14	0.56	9.53	2.50
33	3.83	2.64	0.69	10.81	2.83
15	3.83	2.32	0.61	10.01	2.62
42	3.85	2.41	0.63	10.26	2.67
47	3.90	2.47	0.64	10.47	2.69
48	3.90	2.61	0.67	10.82	2.77
28	3.93	2.55	0.65	10.70	2.72
29	3.95	2.46	0.62	10.50	2.66
3	3.97	2.61	0.66	10.89	2.74
36	3.98	2.39	0.60	10.38	2.61
49	4.00	2.63	0.66	10.98	2.75
41	4.00	2.44	0.61	10.50	2.63
21	4.00	2.44	0.61	10.50	2.63
23	4.00	2.44	0.61	10.50	2.63
40	4.05	2.69	0.67	11.18	2.76
8	4.08	2.58	0.63	10.94	2.68
26	4.10	2.24	0.55	10.11	2.47
27	4.10	2.30	0.56	10.26	2.50
7	4.10	2.48	0.61	10.71	2.61
37	4.10	2.61	0.64	11.04	2.70
1	4.15	2.58	0.62	11.02	2.66
25	4.15	2.49	0.60	10.79	2.60
22	4.20	2.30	0.55	10.37	2.47
32	4.20	2.61	0.62	11.15	2.66
17	4.25	2.53	0.60	11.00	2.60
18	4.33	2.71	0.63	11.54	2.67
2	4.37	2.68	0.61	11.51	2.63
34	4.43	2.40	0.54	10.87	2.45
35	4.60	2.56	0.56	11.46	2.50
11	4.67	2.53	0.54	11.46	2.45
45	4.78	2.58	0.54	11.71	2.45
50	4.78	2.56	0.54	11.66	2.45
39	4.83	2.61	0.54	11.84	2.45

Below we give a summary of the details contained in the preceding table.

TABLE SHOWING RELATION OF FAT IN MILK TO CASEIN AND TO YIELD OF CHEESE DURING SEPTEMBER.

NUMBER OF HERDS.	Pounds of fat in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of casein for one pound of fat in milk.	Pounds of cheese made from 100 pounds of milk.	Pounds of cheese made for one pound of fat in milk.
0	3 to 3.2	....	....	....	....
1	3.2 to 3.3	2.12	0.66	8.83	2.76
1	3.3 to 3.4	2.35	0.70	9.54	2.86
0	3.4 to 3.5	....	....	....	....
5	3.5 to 3.6	2.41	0.68	9.91	2.80
4	3.6 to 3.7	2.44	0.67	10 10	2.78
4	3.7 to 3.8	2.52	0.68	10.40	2.80
6	3.8 to 3.9	2.37	0.62	10.14	2.65
6	3.9 to 4	2.52	0.64	10 63	2.70
6	4. to 4.1	2.54	0.63	10.77	2.68
6	4.1 to 4.2	2.45	0.60	10.66	2.60
3	4.2 to 4.3	2.48	0.59	10.84	2.58
0	4.3 to 4.4	2.70	0.62	11.53	2.65
2	4.4 to 4.5	2.40	0.54	10.87	2.45
2	4.5 to 4.6	....	....	....	....
1	4.6 to 4.7	2.55	0.55	11.46	2.47
2	4.7 to 4.8	2.57	0.54	11.71	2.45
1	4.8 to 4.9	2.61	0.54	11.84	2.45

A study of the results for September, contained in the preceding table, can be summarized as follows:

(1) The fat in milk varied from 3.2 to 4.9 per cent, while the amount of casein in milk for each pound of fat varied from 0.70 to 0.54 pound; or, taking the variation of fat in milk as one per cent, as 3.2 to 4.2, 3.3 to 4.3 per cent, etc., the decrease of casein relative to fat amounted to about 0.10 pound.

(2) Excluding 5 extreme herds and using the results given by the remaining 45 herds, there was a decrease of 0.13 pound of casein for a pound of fat in milk.

(3) Taking all the results, the average relative decrease of casein was 0.01 pound for each tenth of a pound of fat in milk.

(4) Between the limits of 3.4 and 4.4 per cent of fat in milk, the relative average decrease was only 0.009 pound of casein for each tenth of a pound of fat.

(5) Expressed in yield of cheese, relative to fat in milk, there was in extreme cases a decrease of 0.41 pound of cheese for one pound of fat in milk.

(6) Between the limits of 3.2 and 4.2 per cent of fat in milk, the amount of cheese made for one pound of fat in milk varied between the limits of 2.86 and 2.58 pounds, which is equivalent to an average decrease of 0.028 pound of cheese for one-tenth of a pound of milk-fat.

TABLE GIVING FULL DATA FOR THE MONTH OF OCTOBER.

NUMBER OF HERD.	Pounds of fat in 200 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of casein for one pound of fat in milk.	Pounds of cheese made from 100 pounds of milk.	Pounds of cheese made for one pound of fat in milk.
43	3.60	2.56	0.71	10.36	2.88
31	3.75	2.47	0.66	10.33	2.75
9	3.80	2.45	0.65	10.31	2.71
10	3.80	2.54	0.67	10.53	2.77
38	3.81	2.72	0.71	11.00	2.88
46	3.87	2.67	0.69	10.93	2.83
16	3.90	2.75	0.70	11.17	2.86
7	3.90	2.70	0.69	11.04	2.83
6	3.95	2.42	0.61	10.40	2.64
24	4.03	2.68	0.67	11.13	2.76
19	4.03	2.48	0.62	10.63	2.64
44	4.03	2.68	0.67	11.13	2.76
47	4.03	2.69	0.67	11.15	2.77
13	4.05	2.66	0.66	11.11	2.74
26	4.07	2.43	0.60	10.55	2.60
4	4.08	2.85	0.70	11.61	2.84
22	4.12	2.75	0.67	11.41	2.77
28	4.12	2.81	0.68	11.56	2.80
14	4.12	2.70	0.65	11.28	2.74
5	4.15	2.61	0.63	11.09	2.67
23	4.15	2.81	0.67	11.59	2.79
30	4.17	2.69	0.65	11.31	2.71
29	4.18	2.68	0.64	11.30	2.70
27	4.20	2.70	0.64	11.37	2.71
1	4.20	2.85	0.68	11.75	2.80
48	4.20	2.96	0.70	12.02	2.86
41	4.22	2.66	0.63	11.30	2.68
32	4.23	2.77	0.65	11.58	2.74
49	4.23	2.87	0.68	11.83	2.80
33	4.25	2.68	0.63	11.38	2.70
11	4.25	2.60	0.61	11.18	2.63
20	4.28	2.70	0.64	11.46	2.68
40	4.28	2.93	0.69	12.03	2.81
12	4.30	2.76	0.64	11.63	2.70
42	4.30	2.80	0.65	11.73	2.73
25	4.30	2.72	0.64	11.53	2.68
8	4.32	2.81	0.65	11.78	2.73
15	4.32	2.63	0.61	11.33	2.62
36	4.35	2.61	0.60	11.31	2.60
35	4.45	2.71	0.61	11.67	2.62
21	4.47	2.73	0.61	11.74	2.63
3	4.47	2.87	0.65	12.09	2.71
17	4.52	2.67	0.59	11.65	2.58
37	4.55	2.83	0.62	12.08	2.66
2	4.62	2.92	0.63	12.38	2.68
45	4.63	2.88	0.62	12.29	2.66
18	4.77	2.91	0.61	12.52	2.63
50	4.78	2.77	0.58	12.18	2.55
39	5.00	2.84	0.57	12.60	2.52
34	5.03	2.69	0.53	12.26	2.44

Summarizing the data presented in the preceding table, we have the following:

Table Showing Relation of Fat in Milk to Casein and to Yield of Cheese During October.

NUMBER OF HERDS.	Pounds of fat in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of casein for one pound of fat in milk.	Pounds of cheese made from 100 pounds of milk.	Pounds of cheese made for one pound of fat in milk.
0	3 to 3.6	....	....	....	....
1	3.6 to 3.7	2.56	0.71	10.36	2.88
1	3.7 to 3.8	2.45	0.66	10.33	2.75
4	3.8 to 3.9	2.60	0.68	10.70	2.80
3	3.9 to 4	2.62	0.67	10.87	2.77
7	4 to 4.1	2.64	0.65	11.05	2.73
7	4.1 to 4.2	2.72	0.66	11.36	2.75
10	4.2 to 4.3	2.77	0.66	11.59	2.74
6	4.3 to 4.4	2.72	0.63	11.55	2.68
3	4.4 to 4.5	2.77	0.62	11.84	2.64
2	4.5 to 4.6	2.75	0.60	11.87	2.61
2	4.6 to 4.7	2.90	0.63	12.34	2.67
2	4.7 to 4.8	2.84	0.59	12.35	2.59
0	4.8 to 4.9	....	....	....	....
0	4.9 to 5	....	....	....	....
2	5 to 5.1	2.77	0.55	12.44	2.48

The results obtained in October and presented in the preceding table can be summarized as follows:

(1) The fat in milk varied from 3.6 to 5 per cent, while the amount of casein in milk for each pound of fat varied from 0.71 to 0.55 pound; or, taking the range of fat in milk within limits of one per cent, as 3.6 to 4.6, 3.7 to 4.7 per cent, etc., the decrease of casein relative to fat amounted to about 0.08 pound.

(2) Excluding 3 extreme herds and using the results given by the remaining 47 herds, there was a decrease of 0.09 pound of casein for a pound of fat in milk.

(3) Taking all the results, the average relative decrease of casein was 0.01 pound for each tenth of a pound of fat in milk.

(4) Between the limits of 3.7 and 4.8 per cent of fat in milk, the relative average decrease was only 0.009 pound of casein for each tenth of a pound of fat.

(5) Expressed in yield of cheese relative to milk-fat, there was in extreme cases a decrease of 0.40 pound of cheese for one pound of fat in milk.

(6) Between the limits of 3.7 and 4.8 per cent of fat in milk, the amount of cheese made for one pound of fat in milk varied between the limits of 2.80 and 2.59 pounds, which is equivalent to an average decrease of 0.021 pound of cheese for one-tenth of a pound of fat in milk.

Table Giving Averages for the Entire Season.

Number of herd.	Pounds of fat in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of casein for one pound of fat in milk.	Pounds of cheese made from 100 pounds of milk.	Pounds of cheese made for one pound of fat in milk.
43	3.31	2.19	0.66	9.12	2.76
10	3.45	2.23	0.65	9.37	2.72
38	3.47	2.44	0.70	9.92	2.86
9	3.54	2.25	0.64	9.52	2.70
5	3.55	2.34	0.66	9.76	2.75
6	3.55	2.17	0.61	9.33	2.63
46	3.58	2.38	0.66	9.89	2.76
31	3.59	2.20	0.61	9.45	2.63
47	3.61	2.37	0.66	9.90	2.74
16	3.63	2.45	0.68	10.12	2.80
24	3.63	2.33	0.64	9.82	2.70
13	3.65	2.31	0.63	9.79	2.68
12	3.66	2.37	0.65	9.95	2.72
4	3.67	2.45	0.67	10.16	2.77
33	3.71	2.48	0.67	10.28	2.77
42	3.71	2.35	0.64	9.96	2.70
19	3.71	2.29	0.62	9 81	2.65
26	3.73	2.26	0.61	9.75	2.62
20	3.76	2.44	0.65	10.24	2.72
22	3.78	2.35	0.62	10.03	2.66
49	3.79	2.49	0.66	10.39	2.75
44	3.80	2.24	0.59	9.78	2.58
30	3.84	2.38	0.62	10.17	2.65
41	3.84	2.44	0.64	10.32	2.69
15	3.86	2.37	0.61	10.17	2.64
27	3.87	2.39	0.62	10.26	2.65
28	3.87	2.43	0.63	10.33	2.67
36	3.87	2.38	0.61	10.21	2.64
1	3.88	2.42	0.63	10.32	2.66
14	3.88	2.46	0.64	10.42	2.70
7	3.90	2.41	0.62	10.32	2.65
21	3.90	2.34	0.60	10.14	2.60
23	3.92	2.42	0.62	10.36	2.64
29	3.93	2.42	0.62	10.37	2.64
37	4.00	2.53	0.63	10.73	2.68
3	4.01	2.47	0.62	10.59	2.64
32	4.02	2.54	0.63	10.77	2.68
25	4 03	2.44	0.60	10.53	2.61
18	4.04	2.54	0.63	10.80	2.67
40	4.06	2.47	0.61	10.64	2.62
8	4.08	2.47	0.61	10.66	2.61
48	4.14	2.50	0.60	10.80	2.60
17	4.15	2.41	0.58	10.59	2.55
2	4.16	2.50	0.60	10.83	2.60
35	4.22	2.48	0.59	10.84	2.57
45	4.24	2.51	0.59	10.94	2.58
11	4.27	2.38	0.56	10.65	2.50
34	4.31	2.37	0.55	10.69	2.48
50	4.35	2.54	0.59	11.14	2.56
39	4.37	2.57	0.59	11.23	2.57

TABLE SHOWING AVERAGE RELATION OF FAT IN MILK TO CASEIN AND TO YIELD OF CHEESE DURING THE SEASON OF 1895 FROM MAY TO OCTOBER.

NUMBER OF HERDS.	Pounds of fat in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of casein for one pound of fat in milk.	Pounds of cheese made from 100 pounds of milk.	Pounds of cheese made for one pound of fat in milk.
0	3 to 3.3	....	....	....	....
1	3.3 to 3.4	2.19	0.66	9.12	2.76
2	3 4 to 3.5	2.34	0 68	9.67	2.80
5	3.5 to 3.6	2.27	0.64	9.59	2.70
6	3.6 to 3.7	2.38	0.65	9.95	2.73
7	3.7 to 3.8	2.38	0.64	10.06	2.70
9	3.8 to 3.9	2.39	0.62	10.22	2.65
4	3.9 to 4	2.40	0.61	10.30	2.63
7	4 to 4.1	2.50	0.62	10.68	2.65
3	4.1 to 4.2	2.47	0.60	10.74	2.60
3	4.2 to 4.3	2.46	0 58	10.81	2.55
3	4.3 to 4.4	2.50	0.58	11.02	2.55

In the preceding table we have tabulated general averages for the entire season. We obtained season averages for each herd and then summarized the averages in this tabulated form. Attention is called to the following facts:

(1) The fat in milk varied from 3.3 to 4.4 per cent, and the amount of casein present in milk for each pound of fat varied from 0.68 to 0.58 pound, a decrease of 0.10 pound between the herds highest and lowest in fat.

(2) Excluding three herds, there was a decrease of 0.07 pounds of casein for a pound of fat in milk; or, using the results secured with 41 of the 50 herds, the decrease was reduced to 0.05 pound of casein.

(3) Including all the results, the average relative decrease of casein was a little less than 0.01 pound for each tenth of a pound of fat in milk.

(4) Between the limits of 3.3 and 4.2 per cent of fat in milk, the relative average decrease was only 0.008 pound of casein for each tenth of a pound of fat.

(5) Expressed in yield of cheese relative to milk-fat, there was in the extreme cases a decrease of 0.25 pound of cheese for one pound of fat in milk.

(6) Between the limits of 3.3 and 4.2 per cent of fat in milk, the amount of cheese made for one pound of fat in milk varied between the limits of 2.80 and 2.60 pounds, which is equivalent to an average decrease of 0.02 pound of cheese for one-tenth of a pound of fat in milk.

1. Milk-Fat as a Basis for Measuring Cheese Production.

We have seen that, while milk-fat is not an absolutely strict measure of the cheese-producing value of milk, it is in reality a fair and practicable guide in enabling us to learn the relative values of different milks for cheese production. It is probably true more often than not that milk containing three per cent of fat will make somewhat more cheese for a pound of fat than will milk containing four or more per cent of fat. The practical phase of the question which at once presents itself is this: Is the difference in the cheese-producing value of milk poor in fat and milk richer in fat so great as to destroy the value of milk-fat as a basis for measuring cheese production? How great a difference can be expected to exist usually? The data secured with 50 separate herds of cows during one factory season enable us to ascertain very closely what average variations exist in the cheese-producing power of milk-fat contained in milks of different composition.

We find, taking the average of our whole season's work, that, when two milks differ in fat by one per cent, the one containing the smaller amount of fat contains one-tenth more of a pound of casein for a pound of fat than does the richer milk. To illustrate, milk containing 3 per cent of fat usually can be expected to contain 2.10 per cent. of casein or 0.70 pounds of casein for one pound of fat; while milk containing 4 per cent of fat will rarely, under normal conditions, contain less than 2.40 per cent of casein or 0.60 pounds of casein for one pound of fat. We shall, in our further discussion, use for convenience the limits 3 and 4 per cent of milk-fat. It is important to bring out clearly what makes the difference in relative cheese yield between milk poor in fat and milk rich in fat.

2. DIFFERENCE IN CHEESE-PRODUCING POWER OF MILK-FAT IN DIFFERENT MILKS.

From 100 pounds of milk containing 3 per cent of fat, we have a yield of 8.55 pounds of cheese; from 100 pounds of milk containing 4 per cent of fat, we have a yield of 10.4 pounds of cheese. The increased yield of cheese from 100 pounds of milk is due to the added amount of fat and casein contained in the richer milk. In the milk containing 3 per cent of fat, there are made 2.85 pounds of cheese for each pound of milk-fat; in the milk containing 4 per cent of fat, there are made 2.60 pounds of cheese for each pound of milk fat. The difference between 2.85 and 2.60 equals 0.25 pounds. Now, what makes this extra yield of 0.25 pounds of cheese for each pound of fat in the case of the milk containing 3 per cent of fat? Is it due to fat? It cannot be, as the figures are based on one pound of fat in both cases. It must then be due to the fact that the milk poorer in fat contains more casein for a pound of fat than does the milk richer in fat. *This increased yield of 0.25 pounds of cheese for a pound of milk-fat comes from casein and the water which it absorbs.* Take out this casein and water and the yield for a pound of fat would be the same in rich and poor milk.

3. MARKET VALUE OF CASEIN AND WATER IN CHEESE.

In the table below we have indicated the amount of fat, casein and cheese obtained from 100 pounds of milk ranging from 3 to 4 per cent of fat and varying by one-tenth of one per cent of fat. In column 4 is given the amount of cheese made for each pound of fat in milk.

In column 5 we give the amount of cheese which would be made from 100 pounds of milk, if each milk contained for each pound of milk-fat the same amount of casein as is contained in the milk containing 4 per cent of milk-fat. In other words, these figures represent cheese having the same identical composition as cheese made from the milk containing 4 per cent of fat. We have simply removed the excess of casein in the poorer milks.

In column 6 is given the amount of casein removed from each milk in order to make the relation of fat and casein uniform with the fat and casein in the richest milk. In column 7 is given the amount of water which this removed casein would absorb in being made into cheese. By adding the figures in columns 6 and 7, we get the total amount of cheese yield due to casein contained in column 6. The sum of the figures contained in columns 5, 6 and 7 is equal to the figures contained in column 3. We assume that the cheese given in column 5 sells for 8½ cents a pound; the money derived from this sale is given in column 8. We assume that the mixture of casein and water which is practically separator-skim-milk cheese, sells for 2 cents a pound. The money derived from this sale is given in column 9. In column 10 is given the total sum derived from adding the figures in columns 8 and 9. In column 11 we give the value of each pound of milk-fat as found for each milk from the values given in column 10.

TABLE SHOWING RESULTS OF CALCULATING CHEESE TO UNIFORM COMPOSITION AND ALLOWING MARKET VALUES FOR CONSTITUENTS.

Pounds of fat in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of cheese made from 100 pounds of milk.	Pounds of cheese made for one pound of fat in milk.	Pounds of cheese made from 100 pounds of milk after removing excess of casein.	DECREASED YIELD OF CHEESE DUE TO REMOVAL OF		Value of cheese in column 5 at 8½ cents a pound.	Value of casein and water in columns 6 and 7 at 2 cents a pound.	Total value of cheese, casein and water in columns 8 and 9.	Value of one pound of milk-fat.
					Casein.	Water.				
1	2	3	4	5	6	7	8	9	10	11
					Pounds.	Pounds.	Cents.	Cents.	Cents.	Cents.
3.	2.10	8.55	2.85	7.80	0.30	0.45	66.30	1.50	67.8	22.60
3.1	2.14	8.76	2.82	8.06	0.28	0.42	68.50	1.40	69.9	22.55
3.2	2.18	8.97	2.80	8.32	0.26	0.39	70.70	1.30	72.0	22.50
3.3	2.21	9.16	2.78	8.58	0.23	0.35	72.93	1.16	74.1	22.45
3.4	2.24	9.34	2.75	8.84	0.20	0.30	75.14	1.00	76.1	22.40
3.5	2.27	9.53	2.72	9.10	0.17	0.26	77.35	0.86	78.2	22.35
3.6	2.30	9.71	2.70	9.36	0.14	0.21	79.56	0.70	80.3	22.30
3.7	2.33	9.90	2.68	9.62	0.11	0.17	81.77	0.56	82.3	22.25
3.8	2.36	10.08	2.65	9.88	0.08	0.12	83.98	0.40	84.4	22.20
3.9	2.38	10.24	2.62	10.14	0.04	0.06	86.19	0.20	86.4	22.15
4.	2.40	10.40	2.60	10.40	0	0	88.20	0	88.2	22.10

In the foregoing table we have reduced all the cheese to the same composition or proportion of fat and casein by removing from the figures contained in column 3 such amounts of casein and water as would make all the cheese obtained from the different milks have the same composition. *The sole difference in composition between cheese made from milks poor and rich in fat is the increased proportion of casein and water contained in the cheese made from the poorer milk.* In market value this increased casein and water is much inferior to cheese. In allowing an increased value for each pound of fat in poor milk, we cannot in justice give more than is called for by the market value of those constituents which the cheese from poorer milk contains in larger proportions, relative to fat. In other words, it is unjust to allow 8½ cents for extra casein and water which cheese from poor milk contains, as compared with cheese from richer milk. The market value of casein and water, as represented by separator skim-milk cheese, is rarely over 2 cents a pound; and it is therefore not just to pay for casein and water the same as we pay for whole-milk cheese.

From column 11 we see that, on the basis used, each pound of fat in the poorest milk (3 per cent of fat) brings one-half cent more than does each pound of fat in the richest milk (4 per cent of fat). To make a greater difference than this is simply to cheat the producer of richer milk in behalf of the producer of poorer milk.

4. The Effect of Adding Skim-milk to Different Milks to Make Cheese of Uniform Composition.

There is another and, perhaps, clearer way of presenting the differences to which attention has been called above. We can easily make the cheese-producing value of milk-fat in milk containing 4 per cent of fat identical with that of milk-fat in milk containing 3 per cent of fat. How this can be done, we readily see, when we consider that the cheese-making power of fat in poor milk is greater than that in richer milk solely because it contains more casein in proportion to the fat. From our season's general average, we find that in milk containing 3 per cent of fat, there is 2.10 per cent of casein, while in milk containing 4 per cent of fat there is 2.40 per cent of casein. Now, if the richer milk contained as much casein for its fat as does the poorer milk, the milk containing 4 per cent of fat would contain 2.80 per cent of casein instead of 2.40 per cent. Now, is there any practicable way by means of which we can add casein to the richer milk, so that it will contain 2.80 pounds of casein for 4 pounds of fat? We need only to add a certain amount of separator-skim-milk according to the amount of casein contained. In the table below we have indicated in column 4 how much casein it is necessary to add to 100 pounds of each milk in order to make the cheese-producing power of each pound of milk-fat the same in all milks. In column 5 we state the number of pounds of separator-skim-milk, containing 2.25 per cent of casein, that should be added to 100 pounds of milk to furnish the increased amount of casein given in column 4. The yield of cheese from 100 pounds of these casein-fortified milks is given in column 7; and in column 8, the increased yield of cheese due to the casein added. Allowing 8½ cents a pound for the cheese and deducting the cost of the skim-milk added, at the rate of 12 cents for 100 pounds, we obtain in column 11 the money values received from the cheese produced. In column 12 the value is given for each pound of milk-fat.

In the case of each milk, after receiving the added casein in the form of skim-milk, there are 0.70 pound of casein for each pound of milk-fat, and 2.85 pounds of cheese are made for each pound of fat.

TABLE SHOWING RESULTS OF ADDING SKIM-MILK TO DIFFERENT MILKS IN ORDER TO MAKE CHEESE OF UNIFORM COMPOSITION.

Pounds of fat in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of casein required to make proportion of fat and casein uniform.	Pounds of casein to be added to 100 pounds of milk to make fat and casein uniform.	Pounds of skim-milk to add to 100 pounds of milk to furnish required casein.	Cost of skim-milk added.	Cheese-yield from milk to which skim-milk is added.	Increased cheese-yield caused by adding skim-milk.	Value of increased cheese-yield at 8½ cents a pound.	Profit derived from adding skim-milk to 100 pounds of whole milk.	Value of total cheese-yield, less cost of skim-milk.	Value of one pound of milk-fat.
1	2	3	4	5	6	7	8	9	10	11	12
					Cents.	Pounds.	Pounds.	Cents.	Cents.	Cents.	Cents.
3	2.10	2.10	0	0	0	8.55	0	0	0	72.68	24.23
3.1	2.14	2.17	0.03	1.3	0.16	8.84	0.08	0.68	0.52	74.98	24 20
3.2	2.18	2.24	0.06	2.5	0.30	9.12	0.15	1.28	0.98	77.23	24.13
3.3	2.21	2.31	0.10	4.2	0.50	9.41	0.25	2.13	1.63	79.49	24.10
3.4	2.24	2.38	0.14	6.0	0.72	9.69	0.35	2.98	2.26	81.65	24.02
3.5	2.27	2.45	0.18	7.5	0.90	9.98	0.45	3.83	2.93	83.93	23.97
3.6	2.30	2.52	0.22	9.2	1.10	10.26	0.55	4.68	3.58	86.12	23.92
3.7	2.33	2.59	0.26	10.8	1.30	10.55	0.65	5.53	4.23	88.38	23.89
3.8	2.36	2.66	0.30	12.5	1.50	10.83	0.75	6.38	4.88	90.56	23.83
3.9	2.38	2.73	0.35	14.6	1.75	11.12	0.88	7.48	5.73	92.77	23.80
4	2.40	2.80	0.40	16.7	2	11.40	1.00	8.50	6.50	94.90	23.73

The facts which are embodied in the foregoing table indicate the same difference of actual money value between the richest and poorest milks that we observed before. The value of one pound of milk-fat is one-half of one cent more in the poorest than in the richest milk.

5. THE EFFECT OF REMOVING FAT FROM DIFFERENT MILKS TO MAKE CHEESE OF UNIFORM COMPOSITION.

There is still another way in which these milks can have the cheese-making power of their fat made uniform. As milk grows richer in fat, there is more fat in proportion to casein. Instead of adding casein to make up the deficiency, we can remove fat and thus make the relation of fat and casein uniform. By separating a certain amount of milk and returning the skim-milk to the unseparated portion, we can easily remove the excess of fat relative to casein in any rich milk. The milk thus treated will make cheese of exactly the same composition as the poorer milk and the fat removed can be made into butter. In the following table, we give in column 2 the amounts of fat remaining in the milks, after enough fat has been removed to make the amount of casein equal 0.70 pound for each pound of milk-fat. In column 3 we state the amounts of fat to be removed and in column 4 the approximate amount of milk to be separated in 100 pounds in order to remove the fat desired. We state also the amounts of butter made from the fat removed, and the value of such butter at 18 cents a pound. In column 7 we give the amounts of cheese made from the milks after the desired amounts of fat have been removed. In column 8 is stated the value of the cheese at 8½ cents a pound and in column 9 the total value of cheese and butter. In column 10 we give the value of each pound of milk-fat, corresponding to the values given in column 9.

Table Showing Results of Removing Fat from Different Milks in Order to Make Cheese of Uniform Composition.

Pounds of fat in 100 pounds of milk.	Fat left in milk after removing fat to make relation of fat and casein uniform.	Pounds of fat removed from 100 pounds of milk.	Pounds of milk to be separated to remove fat.	Pounds of butter made from fat removed from 100 pounds of milk.	Value of butter in column 5 at 18 cents a pound.	Pounds of cheese made from milk after removing fat.	Value of cheese in column 7 at 8½ cents a pound.	Value of cheese and butter made from 100 pounds of milk.	Value of one pound of milk-fat.
1	2	3	4	5	6	7	8	9	10
					Cents.		Cents.	Cents.	Cents.
3	0	0	0	0	0	8.55	72.68	72.68	24.23
3.1	3.06	0.04	1.3	0.05	0.90	8.72	74.12	75.02	24.20
3.2	3.11	0.09	3	0.10	1.80	8.87	75.40	77.20	24.12
3.3	3.16	0.14	7.2	0.16	2.88	9.00	76.50	79.38	24.06
3.4	3.20	0.20	6	0.23	4.14	9.12	77.52	81.66	24.02
3.5	3.24	0.26	7.4	0.30	5.40	9.24	78.54	83.94	23.98
3.6	3.29	0.31	8.6	0.36	6.48	9.37	79.65	86.13	23.93
3.7	3.33	0.37	10	0.43	7.74	9.49	80 67	88.41	23.89
3.8	3.37	0.43	11.3	0.50	9	9.61	81.68	90.68	23.86
3.9	3.40	0.50	13	0.58	10.44	9.69	82.36	92.80	23.80
4	3.43	0.57	14.3	0.66	11.88	9.77	83.05	94.93	23.73

An examination of the figures in column 10 leads to the same result reached in the previous conclusions, viz.: that the actual value of one pound of milk-fat in milk containing 3 per cent of fat does not exceed the value of one pound of milk-fat in milk containing 4 per cent of fat by more than one-half of one cent.

6. Milk-Fat as a Basis of Paying for Milk for Cheese-making.

Dairymen who produce milk for cheese-making hold one of three opinions in regard to the use of milk-fat as a basis to use in paying for milk. Some strongly object to its use on the ground that all normal milks have an equal value for cheese production; but this objection is founded on the densest ignorance of the composition of milk and its relation to cheese production. Others fully accept the use of the milk-fat basis as representing what is fair and desirable. Others accept the use of the milk-fat basis in a modified form, claiming that fat in poorer milk corresponds relatively to more cheese than does fat in richer milk and that the actual cheese production should, as nearly as possible, serve as the basis of payment, on the ground that the constituents in 100 pounds of cheese made from poor milk have just as great a market value as do the constituents in 100 pounds of cheese made from richer milk.

Let us now briefly make some comparisons between different methods of paying for milk for cheese-making, in order to test the question of fairness, expressed in money value. For the sake of simplicity we will compare the milks of two men, when there is a difference of one per cent of milk-fat, for example, 3 and 4 per cent. We will assume that the cheese produced nets ten cents a pound. We will make our comparison on the basis of 100 pounds of milk, allowing that the cheese yield from 100 pounds of milk containing 3 per cent of fat is 8.55 pounds, and from milk containing 4 per cent of fat, 10.40 pounds.

As a standard of comparison, we will use the values which are found by taking the market value of the fat and solids-not-fat separately. To explain more fully, when cheese sells at ten cents a pound, this makes each pound of fat in the cheese worth about 25.9 cents and each pound of solids-not-fat (casein, ash, etc.) worth about 3.9 cents. Applying these values to the cheese made from the two milks under consideration, or *determining the value of the cheese according to its composition*, we find that the cheese made from 100 pounds of milk containing 3 per cent of fat has a market value of 82.1 cents, while the cheese made from 100 pounds of milk containing 4 per cent of fat has a market value of 107.4 cents. This may be called the exact or standard method of ascertaining the value of milk for cheese-making. This method recognizes the real value of all the constituents of the milk which are concerned in cheese-making. This method does the greatest possible justice to all kinds of milk, and, therefore, we will use the results given by this method as a basis for comparison with other methods.

The methods to be compared are the following:

(1) Standard method based on yield and composition of cheese.

(2) Method based on weight of milk.

(3) Method based on weight of cheese produced.

(4) Modified method based on milk-fat.

(5) Method based on milk-fat.

(1) *Comparison of Standard Method and Weight-of-Milk Method.*— When milk is paid for by weight alone, each patron receives the same amount of money for 100 pounds of milk, without any regard whatever for the composition of the milk or the amount of cheese it will make. The amount of cheese made from 100 pounds of each kind of milk specified above is the sum of 8.55 pounds and 10.40 pounds, or a total of 18.95 pounds, which at 10 cents a pound, brings 189.5 cents. This is divided equally between the two patrons, because each furnishes the same amount of milk. Hence each receives 94.75 cents for the cheese made from his milk.

PATRONS.	Pounds of fat in 100 pounds of milk.	Pounds of cheese made from 100 pounds of milk.	STANDARD METHOD. Amount of money received when divided according to yield and composition of cheese.	WEIGHT-OF-MILK METHOD. Amount of money received when divided according to weight of milk furnished.
			Cents.	Cents.
A	3	8.55	82.1	94.75
B	4	10.40	107.4	94.75

When payment is made by the weight-of-milk method, A receives the same amount of money for 8.55 pounds of cheese that B receives for 10.40 pounds; A receives over 11 cents for each pound of the cheese made from his milk, while B receives only 9.1 cents a pound for the cheese made from his milk. A receives 31.6 cents for each pound of his milk-fat, while B receives only 23.7 cents for each pound of his. A receives for 100 pounds of milk 12.65 cents which belongs entirely to B, because this extra money comes solely from the additional amount of more valuable cheese produced by the milk of B. One method makes no difference in the value of the milk furnished, while there actually exists a difference of 25.3 cents for 100 pounds of milk in favor of B. Estimated for a season, the difference between the dividends of A and B should not be less than $7.50 for each cow. That gross injustice is inevitably done, when milk is paid for by the weight-of-milk method, must become too obvious to require further discusion.

(2) *Comparison of Standard Method and the Yield-of-Cheese Method.*—The proposition that yield-of-cheese furnishes the only just basis upon which to pay for milk is very plausible; but it is seen not to be fair when we consider the difference existing in the composition of the cheese produced from milks containing different amounts of fat. We have only to consider that all the difference that may exist in favor of poorer milk is entirely eliminated by adding skim-milk to, or removing fat from, the richer milk, so far as relates to the composition of the cheese produced or the relation of milk-fat to cheese yield. The difference in the relation of milk-fat to cheese yield in favor of poor milk as compared with richer milk is simply a *skim-milk difference and therefore a skim-milk-cheese difference.* This difference, as it affects paying for milk, is indicated in the following table:

PATRONS.	Pounds of fat in 100 pounds of milk	Pounds of cheese made from 100 pounds of milk.	STANDARD METHOD. Amount of money received when divided according to yield and composition of cheese.	YIELD-OF-CHEESE METHOD. Amount of money received when divided according to yield of cheese.
			Cents.	Cents.
A	3	8.55	82.1	85.5
B	4	10.40	107.4	104.0

When payment is made by the yield-of-cheese method, A receives for 100 pounds of milk 3.4 cents more, and B, 3.4 cents less, than each should when the payment is made in the most equitable manner. While there is a much closer approximation to fairness, we see that there is still a marked advantage in favor of the poorer milk; since A's milk-fat brings him 28.5 cents a pound and B's milk-fat brings him only 26 cents a pound, whereas there should, at most, be an average difference of not more than one-half cent. Estimated for a season, B receives for each cow about two dollars less than he should receive, and A receives that much more, when each is paid according to the amount of cheese made from milk, without reference to the composition of the cheese made.

(3) *Comparison of Standard Method and the Modified Milk-fat Method.*—A method of paying for milk at cheese factories has been proposed and used to a very limited extent in Canada, which is intended to take into consideration the casein of milk as well as the fat. The effort is made to accomplish this by adding two to the per cent of milk. For example, in the case of A and B, whose milk contain 3 and 4 per cent of fat, we add two to each and the figures become 5 and 6. If the total cheese sells for 189.5 cents, then A will receive five-elevenths of this or 86.1 cents, while B will receive six-elevenths or 103.4 cents. The addition of this fixed number is supposed to make allowance for the casein in the different milks. In the tabulated statement below, we give the results of this method of dividing the money received from cheese, compared with the results of dividing according to the yield and composition of cheese.

PATRONS.	Pounds of fat in 100 pounds of milk.	Pounds of cheese made from 100 pounds of milk.	STANDARD METHOD.	MODIFIED MILK-FAT METHOD.
			Amount of money received when divided according to yield and composition of cheese.	Amount of money received when divided according to modified milk-fat method
			Cents.	Cents.
A	3	8.55	82.1	86.1
B	4	10.40	107.4	103.4

When payment for milk is made by the modified milk-fat method, A receives for 100 pounds of milk 4 cents more, and B, 4 cents less, than each should, when the payment is made in the fairest manner. A's milk-fat will yield him 28.7 cents a pound and B's will bring him only 25.85 cents a pound. This is a marked advantage in favor of the poorer milk, nearly six times as great a difference as there should justly be. Estimated for a season, B receives for each cow $2.40 less than he should receive, and A receives that much more, when paid according to the modified milk-fat method as described above, without reference to the composition of the cheese made.

The fairness of this modified milk-fat method is based upon two erroneous assumptions. First, it assumes that cheese made from poor milk has the same composition and its constituents the same market value as cheese made from richer milk. Second, it assumes that by adding two we make proper allowance for the casein in all milks, or, in other words, that A's milk contains as much casein as B's. It ignores the general rule that casein increases when the fat increases, even though the increase may not be proportional to the increase of fat. It allows payment for all the casein in poor milk, but only for a part of the casein in richer milk. The advantage is in favor of poor milk, and is as before a skim-milk advantage.

If any fixed factor is to be added, the figure which will give results in closest agreement with the yield and composition of cheese is 0.3. To illustrate, in case of A and B, adding 0.3 to 3 and 4, we have 3.3 and 4.3. Dividing 189.5 cents between these in proportion we have

A's receipts, 82.28 cents (Standard method = 82.1 cents).

B's receipts, 107.22 cents (Standard method = 107.4 cents).

(4) *Comparison of Standard Method and Milk-fat Method.*— In the milk-fat method the receipts from cheese are divided in proportion to the amount of fat furnished. A and B furnish respectively 3 and 4 pounds of milk-fat. The receipts from cheese are 189.5 cents, of which A receives three-sevenths, 81.2 cents, and B four-sevenths, 108.3 cents.

PATRONS.	Pounds of fat in 100 pounds of milk.	Pounds of cheese made from 100 pounds of milk.	STANDARD METHOD. Amount of money received when divided according to yield and composition of cheese.	MILK-FAT METHOD. Amount of money received when divided according to amount of milk-fat furnished.
			Cents.	Cents.
A	3	8.55	82.1	81.2
B	4	10.40	107.4	108.3

When payment for milk is made according to the amount of milk-fat furnished, A receives nine-tenths of one cent less, and

B receives nine-tenths of one cent more, than each does, when the payment is made in the fairest manner. A pound of milk-fat brings each 27.07 cents. Estimated for a season, A receives for each cow 54 cents less, and B 54 cents more, than each would receive, if paid according to the standard method.

Now that we have compared each of the different methods with what we have called a standard method, it will be well to bring all the methods together for a general comparison.

Amount of Money Received for 100 Pounds of Milk by Difeerent Methods of Division.

Patron.	Pounds of fat in 100 pounds of milk.	Pounds of cheese made from 100 pounds of milk.	Standard Method.	Milk-Fat Method.	Yield of Cheese Method.	Modified Milk-Fat Method.	Weight-of-Milk Method.
			On basis of yield and composition of cheese.	On basis of amount of milk-fat furnished.	On basis of weight of cheese produced.	On basis of milk-fat with 2 added for casein.	On basis of amount of milk furnished.
			Cents.	Cents.	Cents.	Cents.	Cents.
A.......	3	8.55	82.1	81.2	85.5	86.1	94.75
B.......	4	10.40	107.4	108.3	104.0	103.4	94.75

We indicate below the amount received for each pound of fat in milk by A and B according to the different methods of division.

Amount of Money Received for One Pound of Milk-Fat by Different Methods of Division.

Patrons.	Standard method.	Milk-fat method.	Yield-of-cheese method.	Modified milk-fat method.	Weight-of-milk method.
	Cents.	Cents.	Cents.	Cents.	Cents.
A..............	27.37	27.07	28.50	28.70	31.58
B..............	26.85	27.07	26.00	25.85	23.69

In the tabulated statement below we give the amount of money each patron receives above or below the amount each would receive, when division is made by the standard method.

PATRON.	Milk-Fat Method.		Yield-of-Cheese Method.		Modified Milk-Fat Method.		Weight-of-Milk Method.	
	Above.	Below.	Above.	Below.	Above.	Below.	Above.	Below.
A	......	0.09	3.4	......	4	......	12.65	......
B	0.09	......	......	3.4	......	4	......	12.65

From the last table preceding it will be noticed that of the different methods every one except the milk-fat method gives to the poorer milk more than belongs to it, while the milk-fat method alone gives to the richer milk more than strictly belongs to it. But while the extra amount given to the richer milk by the milk-fat method is only nine-tenths of one cent for 100 pounds of milk, the extra amount given to the poorer milk is in no case less than 3.4 cents for 100 pounds of milk and varies from this to 12.65 cents. It will thus be seen that the milk-fat method comes nearer to doing absolute justice than any other method in use.

By way of review, it is desirable to emphasize statements of certain important facts.

(1) Milk varies greatly in its composition. In paying for milk for cheese-making, absolute fairness can be realized in every individual case only by a careful direct determination of both fat and casein. But this is not practicable.

(2) Cheese made from milk rich in fat is greater in yield, and its constituents, pound for pound of cheese, possess a higher value than cheese made from milk poorer in fat.

(3) When a pound of fat in poor milk is equivalent to more cheese than is a pound of fat in richer milk, the difference can be wholly removed by adding skim-milk to, or removing fat from, the richer milk. The difference in composition between cheese made from poor and rich milk is a skim-milk difference and a skim-milk cheese difference.

(4) Of all practicable methods suggested, the use of milk-fat as a basis in paying for milk for cheese-making gives the nearest approach to absolute fairness.

(5) All proposed modifications of the milk-fat method are in the interest of the producer of poor milk as against the interest of the producer of richer milk.

7. Reasons for Discarding the Weight-of-Milk Method.

(1) *Because it is based upon the false assumption, that all kinds of milk have the same cheese-producing value.* It fails to recognize the fundamental fact that milks differ in regard to the amount of cheese they can produce.

(2) *Because the method, being founded upon a false basis, is unjust and is, therefore, not business-like.* By this system, money which belongs solely to the producer of the better milk is taken from his pocket and transferred to that of his neighbor, who produces poorer milk.

(3) *Because the old system discourages the production of better milk and is a positive barrier to improvement.* When milk is paid for by weight alone, then more money can be gained by increasing the amount of milk produced, without regard to its composition. It is a well-known fact that under this system the composition of milk has deteriorated in the last generation, and, so long as a premium was offered for increasing the amount of milk produced, there was no inducement to pay any attention to the composition of the milk, if only it met the legal requirements.

(4) *Because the old system encourages the addition of water, removal of cream and all similar forms of dishonesty.* When quantity and not quality is paid for, some will be found who will try dishonestly to take advantage of the system; and this can hardly be surprising, when the system itself is founded upon an untruth, and is itself dishonest.

8. Reasons for Using the Milk-Fat Basis in Paying for Milk at Cheese Factories.

(1) *Because the amount of fat in milk offers the most accurate, practicable and just basis we have for determining the cheese-producing value of milk.*

(2) *Because this method recognizes the fundamental truth that different milks possess different values for cheese-making.*

(3) *Because this method, being based upon the truth, is just to all and is, therefore, in the highest sense business-like.* It guarantees pay for what is in the milk that makes cheese.

(4) *Because the adoption of this method will result in an improvement in the character of the milk production.* Why? Because it offers an inducement to each dairyman to improve the composition of his milk. It puts more money into the pocket of the man who produces the better milk. This improvement will be realized as a result of more careful selection of dairy animals, more attention to breeding, more intelligent and economical feeding, more humane treatment of dairy animals and better care of milk.

(5) *Because all temptation to adulterate milk by watering or skimming is removed,* since a man receives pay for just what he furnishes that is of most value for cheese production.

(6) *Because the adoption of this system lies at the very foundation of the future improvement of the dairy industry.* Nothing will so quickly open the eyes of dairymen and show them the need of improvement in milk production as the application of this system to their herds and individual animals.

(6) *Because improvement in the character of dairy animals and in the consequent yield and composition of milk means economy of production and increased profit.* Our investigation with different breeds of dairy animals has emphasized the fact that a pound of fat in rich milk is produced at a lower cost than in poorer milk. It would not be difficult to show that it would be easily possible within a few years to increase the yield of our annual cheese-product by an amount equal in value to one million dollars, with fewer animals and at an actually less cost than at present.

III. ECONOMY IN USING FERTILIZERS FOR RAISING POTATOES.*

SUMMARY.

In 1895 fertilizers were applied at the rate of 1,000 and 2,000 pounds an acre in raising potatoes. A second crop of potatoes was raised on the same ground in 1896 without using fertilizers in order to ascertain to what extent the fertilizers applied in 1895 would benefit the crop of 1896.

The application of 1,000 pounds of fertilizer increased the crop of marketable potatoes 48.4 bushels an acre in 1895 and 39.6 bushels in 1896, the total increase for the two years being 88 bushels. The use of 2,000 pounds of fertilizer increased the yield over the foregoing to the extent of 4.4 bushels in 1895 and 14.1 bushels in 1896, the total increase for the two years being 18.5 bushels.

The application of 1,000 pounds of fertilizer increased the proportion of marketable potatoes 6.8 per cent in 1895 and 9 per cent in 1896; while the use of an additional half ton of fertilizer increased the percentage of marketable potatoes over the foregoing to the extent of 1.3 per cent in 1895 and 2.6 per cent in 1896.

The use of 1,000 pounds of fertilizer an acre produced an increased yield of marketable potatoes, which, at 50 cents a bushel, made a net gain of $27.58 in income during the two years. The use of 2,000 pounds of fertilizer yielded in net increase of income during the two years $7.12 less than did the application of 1,000 pounds.

In using 1,000 pounds of fertilizer there were added to an acre of soil, on an average, 36.4 pounds of nitrogen, 76.9 pounds of available phosphoric acid, and 90.6 pounds of potash; and twice these amounts in using 2,000 pounds of fertilizer. Adding to these the amount of plant-food already known to be present in the soil and then deducting the quantities removed by the two crops grown, we find that excessive amounts of nitrogen, potash

* Published also as Bulletin No. 112.

and, particularly, phosphoric acid, were left unused when 2,000 pounds of fertilizer were applied.

Phosphoric acid is probably applied often in uselessly large quantities in raising potatoes, as compared with potash and nitrogen.

The use of over 1,000 pounds of fertilizer an acre under the conditions tried was attended with loss, as compared with the results obtained in using 1,000 pounds of fertilizer.

INTRODUCTION.

In 1895 several different commercial fertilizers were used in an experiment which had for its object a comparison of these fertilizers for use in raising potatoes, and especially a comparison of results obtained by using different amounts of fertilizer. The results were given in detail in Bulletin 93. It was found that the application of 2,000 pounds of fertilizer gave in no case as economical results as did the use of 1,000 pounds.

It was further designed to raise potatoes on this same field in 1896, without use of additional fertilizers, in order to ascertain to what extent the fertilizing materials remaining unused in the soil could be utilized during the second season. The soil is peculiarly adapted to leaching, consisting of light loam, two or three feet deep, underlaid by sand and gravel and extending down indefinitely.

The field is located at Northville, L. I. The details of the work were in the hands of Mr. H. L. Hallock, under the supervision of Messrs. Stewart and Sirrine, of Jamaica, as representatives of the Station. The same methods were used in growing the crop as the preceding year.

We will now consider in order the following points:

(1) Yield of potatoes.

(2) Proportion of marketable potatoes.

(3) Relation of yield to cost of fertilizer used.

(4) Relation of plant-food applied to that removed by crop.

The table below gives the detailed results secured from each plot with reference to yield and proportion of marketable potatoes during the two years of the experiment.

TABLE SHOWING YIELD OF POTATOES DURING TWO YEARS.

NUMBER OF PLOT.	Pounds of fertilizer used per acre.	YIELD OF POTATOES PER ACRE.		PER CENT OF MARKETABLE POTATOES.		PER CENT OF CULLS.	
		In 1895.	In 1896.	In 1895.	In 1896.	In 1895.	In 1896.
		Bushels.	Bushels.				
1	None.	150.6	113.6	83.8	75.2	16.2	24.8
2	1000	197.3	148.2	88.4	81.8	11 6	18.2
3	1500	188.4	172.7	91.0	83.4	9.0	16.6
4	2000	216.3	167.0	91.6	85.2	8.4	14.8
5	1000	207.5	154.1	91.0	82.8	9.0	17.2
6	1500	197.1	174.9	91.6	85.6	8.4	14.4
7	2000	199.8	149.1	92.3	86.3	7.7	13.7
8	1000	180.0	177.8	88.9	83.4	11.1	16.6
9	2000	183.3	170.3	92.6	86.3	7.4	13.7
10	1000	193.4	160.4	89.2	83.0	10.8	17.0
11	2000	219.2	174.6	92.6	86.2	7.4	13.8
12	1000	204.0	156.8	92.0	85.7	8.0	14.3
13	2000	169.4	170.7	92.3	88.0	7.7	12.0
14	1000	194.5	146.0	91.5	85.6	8.5	14.4
15	2000	187.5	154.7	90.5	85.4	9.5	14.6
16	1000	189.8	140.9	90.6	83.1	9.4	16.9
17	2000	196.3	154.5	92.0	86.1	8.0	13.9
18	1000	193.7	129.0	90.5	83.0	9.5	17.0
19	2000	191.4	150.9	91.7	85.9	8.3	14.1
20	1000	156.9	140.1	89.5	85.8	10.5	14.2
21	2000	158.4	159.9	91.9	89.6	8.1	10.4
22	1000	200.5	140.0	91.5	87.1	8.5	12.9
23	2000	233.1	167.0	92.0	88.6	8.0	11.4
24	1000	201.8	139.4	93.0	85.0	7.0	15.0
25	2000	187.9	144.0	91.5	87.5	8.5	12.5

1. YIELD OF POTATOES.

That portion of the foregoing table relating to yield of crop can be summarized in the following manner, taking the average of those plots receiving 1,000 pounds of fertilizer and the average of those receiving 2,000 pounds.

TABLE SHOWING YIELD OF POTATOES FOR TWO YEARS.

Pounds of fertilizer applied per acre.	BUSHELS OF POTATOES PRODUCED PER ACRE IN 1895.			BUSHELS OF POTATOES PRODUCED PER ACRE IN 1896.			BUSHELS OF POTATOES PRODUCED PER ACRE IN TWO YEARS.		
	Total.	Marketable.	Culls.	Total.	Marketable.	Culls.	Total.	Marketable.	Culls.
0	150.6	126 2	24.4	113.6	85.4	28.2	264.2	211.6	52.6
1000	192.7	174.6	18.1	148.4	125.0	23.4	341.1	299.6	41.5
2000	194.8	179.0	15.8	160.2	139.1	21.1	355.0	318.1	36.9

From this summarized tabular statement, it can be seen that:

(1) In general terms, the unfertilized land produced the smallest crop; the land receiving 1,000 pounds of fertilizer produced a considerably larger crop; and the land receiving 2,000 pounds of fertilizer produced a little larger crop than the one receiving 1,000 pounds.

(2) The use of 1,000 pounds of fertilizer increased the whole crop 42.1 bushels per acre in 1895 and 34.8 bushels in 1896, the total increase for the two years being 76.9 bushels.

(3) The use of 2,000 pounds of fertilizer increased the yield over the crop receiving 1,000 pounds of fertilizer to the extent of 2.1 bushels per acre in 1895 and 11.8 bushels in 1896, the total increase for the two years being 14 bushels for the additional application in 1895 of 1,000 pounds of fertilizer.

In order to study the effect of the application of fertilizers upon the proportion of marketable potatoes produced, we summarize the detailed results given above in the following tabulated statement:

2. Proportion of Marketable Potatoes.

Table Showing Proportion of Marketable Potatoes Produced.

Pounds of fertilizer applied per acre in 1895.	Per cent of marketable potatoes produced in 1895.	Per cent of marketable potatoes produced in 1896.	Average per cent of marketable potatoes produced in two years.	Average per cent of culls produced in two years.
0	83.8	75.2	79.5	20.5
1000	90.6	84.2	87.4	12.6
2000	91.9	86.8	89.4	10.6

This tabulated summary indicates that,—

(1) In general, the proportion of marketable potatoes increased with the amount of fertilizer used.

(2) The use of 1,000 pounds of fertilizer increased the proportion of marketable potatoes 6.8 per cent in 1895 and 9 per cent in 1896, the average increase for the two years being about 8 per cent.

(3) The use of an additional half ton of fertilizer (or 2,000 pounds an acre) increased the percentage of marketable potatoes

slightly over the crop produced by the use of 1,000 pounds of fertilizer, the increase being 1.3 per cent in 1895 and 2.6 per cent in 1896, the average increase for the two years being about 2 per cent.

3. Relation of Yield to Cost of Fertilizer Used.

We have seen above that the application of fertilizers produced an increased crop having a larger proportion of marketable potatoes. Considered from the standpoint of economy, it is essential that we know how much the increased production cost and whether it was made at a profit or loss. We present only a summarized form of our results covering the two years of work.

Table Showing Fertilizer Cost of Potato Crop.

Pounds of fertilizer applied per acre.	Average cost of fertilizer.	Increased number of bushels of marketable potatoes resulting from use of fertilizer during two years.	Cost of each bushel of marketable potatoes resulting from use of fertilizers.	Bushels of marketable potatoes produced in two years.	Value of marketable portion of crop at 50 cents a bushel.	Net gain from use of fertilizer.
			Cents.			
0	0	0	0	211.6	$105.80	....
1000	$16.37	88	18.6	299.6	149.75	$27.58
2000	32.74	106.4	30.8	318.1	159.00	20.46

The foregoing tabulated results enable us to make the following statements:

(1) During the two years the use of 2,000 pounds of fertilizer an acre increased the yield of potatoes 18½ bushels over the yield produced by the use of 1,000 pounds of fertilizer.

(2) This increase of 18½ bushels cost $16.37 or 88½ cents a bushel and was produced at a marked loss.

(3) The use of 1,000 pounds of fertilizer an acre increased the crop during two years by about 88 bushels of marketable potatoes over the unfertilized portions.

(4) Deducting the cost of 1,000 pounds of fertilizer, we find that there was a net gain of $27.58 an acre for the two years.

(5) The use of 2,000 pounds of fertilizer an acre, as compared with the use of no fertilizer, gave a net gain, during the two years, of $20.46 an acre.

4. Relation of Plant-Food Supplied to That Removed by the Two Crops.

In the table below we have indicated the amounts of nitrogen, phosphoric acid, and potash applied to each plot and have also calculated the amounts removed by the crop during each of the two years. The amounts of plant-food removed by the crops from plot No. 1, which received no fertilizer, can be regarded as representing the quantity of plant-food in the soil available, under the conditions present, for the potato crop. In discussing the results presented we shall consider each form of plant-food by itself, summarizing the detailed results.

Table Showing Amounts of Plant-Food Supplied and Used During two Years.

Number of Plot.	Pounds of nitrogen applied per acre	Pounds of Nitrogen used per Acre.		Pounds of available phosphoric acid applied per acre.	Pounds of Phosphoric Acid used per Acre.		Pounds of potash applied per acre.	Pounds of Potash used per Acre.	
		In 1895.	In 1896.		In 1895.	In 1896.		In 1895.	In 1896.
1	0	24.8	18.7	0	15	11.4	0	46.7	35.2
2	40	32.6	24.5	83.7	19.7	14.8	105.4	61.2	45.9
3	60	31.1	28.5	125.5	18.8	17.3	158	58.4	53.5
4	80	35.7	27.6	167.4	21.6	16.7	210.8	67	51.8
5	40	34.2	25.4	83.7	20.7	15.4	105.4	64.3	47.8
6	60	32.5	28.9	125.5	19.7	17.5	158	61.1	54.2
7	80	33	24.6	167.4	20	14.9	210.8	62	46.2
8	45	29.7	29.3	62.1	18	17.8	115.5	55.8	55.1
9	90	30.2	28.1	124.2	18.3	17	231	56.8	52.8
10	35.5	31.9	26.5	77.5	19.3	16	75	60	49.7
11	71	36.2	28.8	155	21.9	17.5	150	68	54.1
12	39.5	33.7	25.9	79.2	20.4	15.7	107.5	63.2	48.6
13	79	28	28.2	158.4	16.9	17.1	215	52.5	52.9
14	38.7	32.1	24.1	80.6	19.5	14.6	110	60.3	45.2
15	77.4	30.9	25.5	161.2	18.8	15.5	220	58.1	48
16	33.1	31.3	23.2	58.5	19	14.1	81.2	58.8	43.7
17	66.2	32.4	25.5	117	19.6	15.5	162.4	60.9	47.9
18	36.7	32	21.3	79.2	19.4	12.9	96.7	60	40
19	73.4	31.6	24.9	158.4	19.1	15.1	193.4	59.4	46.8
20	26.1	25.9	23.1	97.8	15.7	14	71.2	49.6	43.4
21	52.2	26.1	26.4	195.6	15.8	16	142.4	49.1	49.6
22	32.9	33.1	23.1	83.5	20	14	61.5	62.2	43.4
23	65.8	38.5	27.6	167	23.3	16.7	123	72.3	51.8
24	32.7	33.3	23	60.4	20.2	13.9	67.1	62.6	43.1
25	65.4	31	23.8	120.8	18.8	14.4	134.2	58.2	44.6

Amounts of Nitrogen Applied and Removed.

Pounds of fertilizer applied per acre in 1895.		Pounds of nitrogen supplied per acre in fertilizer.	Pounds of nitrogen removed by crop in 1895.	Pounds of nitrogen removed by crop in 1896.	Total number of pounds of nitrogen removed by crops in two years.
None.		None.	24.8	18.7	43.5
1,000	Least	26.1	25.9	21.3	....
1,000	Greatest	45.0	34.2	29.3	....
1,000	Average	36.4	31.8	24.5	56.3
2,000	Least	52.2	26	23.8	....
2,000	Greatest	90.0	38.5	28.8	....
2,000	Average	72.8	32.1	26.5	58.6

The results which this summarized table present are of exceeding interest, and we call attention to the following points:

(1) On the plot where no fertilizer was applied, the crop removed from one acre of soil 24.8 pounds of nitrogen the first year and 18.7 pounds the second year, making a total of 43.5 pounds for the two years. This practically represents the amount of nitrogen in the soil available for the potato crop at the time under the conditions prevailing.

(2) On the various plots where we applied 1,000 pounds of fertilizer in 1895, we supplied from 26.1 to 45 pounds of nitrogen, the average being 36.4 pounds. In 1895 the crop used from 25.9 to 34.2 pounds of nitrogen, the average being 31.8 pounds. In 1896 the crop used from 21.3 to 29.3 pounds, the average being 24.5 pounds. The total amount of nitrogen removed by these two succesive crops amounted to 56.3 pounds an acre.

(3) On the various plots where we applied per acre 2,000 pounds of fertilizer in 1895, we supplied from 52.2 to 90 pounds of nitrogen, the average being 72.8 pounds. In 1895 the crop used from 26 to 38.5 pounds of nitrogen, the average being 32.1 pounds; and in 1896 the crop used from 23.8 to 28. 8 pounds, the average being 26.5 pounds. The total amount of nitrogen removed by these two successive crops amounted to 58.6 pounds an acre.

(4) In the two years the application of 36.4 pounds of nitrogen in 1,000 pounds of fertilizer caused a sufficiently increased crop to remove about 13 more pounds of nitrogen than did the crop from the unfertilized soil. More nitrogen was removed during the two years than was added in the fertilizer by about 20 pounds.

(5) The application of 72.8 pounds of nitrogen, contained in 2,000 pounds of fertilizer, caused during the two years an increase of crop sufficient to use only 2.3 pounds more of nitrogen than in the case where half the amount was applied. Less nitrogen was removed than applied by about 14 pounds, leaving about 58 pounds of nitrogen unused, including the soil-nitrogen.

(6) If we add the available nitrogen contained in the soil to that supplied in the fertilizer, and then indicate the amounts used each year, we can prepare the following interesting table.

Pounds of fertilizer applied per acre.	Pounds of nitrogen for use of crop at beginning of first year.	Pounds of nitrogen used by first year's crop.	Pounds of nitrogen left for second crop.	Pounds of nitrogen used by second year's crop.	Pounds of nitrogen remaining unused after second year.
0	43.5	24.8	18.7	18.7	0
1,000	79.9	31.8	48.1	24.5	23.6
2,000	116.3	32.1	83.5	26.5	57.0

It is more than probable that the unfertilized soil would still contain some available nitrogen and would not be completely exhausted, but how much remains we could only tell by further investigation. The amount of nitrogen supplied in 1,000 pounds of fertilizer is not greatly in excess of the crop's needs for two years; but, it is safe to say, more economical results would have been obtained by applying one-half of the amount during each of two years than the whole amount during the first year, particularly on soil which is so apt to lose nitrogen by leaching. Much more, then, would the foregoing statement apply to the case where we used 2,000 pounds of fertilizer and supplied three times as much as the first crop used. At the end of two years it is almost certain that very little of the applied nitrogen remained within reach of the plant and most of the remaining 57 pounds had been carried far down into the subsoil.

AMOUNT OF PHOSPHORIC ACID APPLIED AND REMOVED.

Pounds of fertilizer applied per acre in 1895.		Pounds of available phosphoric acid applied per acre in fertilizer.	Pounds of phosphoric acid removed by crop in 1895.	Pounds of phosphoric acid removed by crop in 1896.	Total number of pounds of phosphoric acid removed by crops in two years.
None	....	None	15.0	11.4	26.4
1,000	Least........	58.5	15.7	12.9	....
1,000	Greatest.....	97.8	20.7	17.8	....
1,000	Average.....	76.9	19.2	14.8	34.
2,000	Least........	117	15.8	14.4	....
2,000	Greatest.....	195.6	23.3	17.5	....
2,000	Average.....	160.2	19.5	16.0	35.5

Summarizing this table, we can make the following statements:

(1) When no fertilizer was applied, the crop removed from the soil 15 pounds of phosphoric acid the first year and 11.4 pounds the second year, or a total of 26.4 pounds for the two years. Under the conditions present, this total represents the amount of phosphoric acid available for the potato crops at the time and under the prevailing conditions:

(2) When an application was made in 1895 of 1,000 pounds of fertilizer, an average amount of 76.9 pounds of available phosphoric acid was supplied per acre. In 1895 the crop used 19.2 pounds of phosphoric acid and in 1896 14.8 pounds, making a total of 34 pounds an acre for the two years.

(3) When an application was made in 1895 of 2,000 pounds of fertilizer, an average amount of 160.2 pounds of available phosphoric acid was supplied per acre. The first year the crop removed 19.5 pounds an acre, and the second year 16 pounds; and, during the two years, 35.5 pounds.

(4) When 76.9 pounds of available phosphoric acid were added to the soil, the crop used only 34 pounds, or less than half the amount added, and only 7.6 pounds more than the amount used by the crop grown on unfertilized soil.

(5) When the amount of phosphoric acid applied was increased to 160 pounds an acre the crop used only 35.5 pounds, less than

one fourth the amount applied, and only 9 pounds more than was removed when no phosphoric acid was added.

(6) We will assume that at the beginning of the two years the soil contained not less than 26.4 pounds of available phosphoric acid. Adding this to the applied amounts we can prepare the following tabulated statement:

Pounds of fertilizer applied per acre.	Pounds of phosphoric acid for use of crop at beginning of first year's crop.	Pounds of phosphoric acid used by first year's crop.	Pounds of phosphoric acid left for second year's crop.	Pounds of phosphoric acid used by second crop.	Pounds of phosphoric acid remaining unused after second year.
0	26.4	15	11.4	11.4	0
1,000	103.3	19.2	84.1	14.8	69.3
2,000	186.6	19.5	167.1	16.0	151.1

While the data do not probably express the complete truth regarding the amount of available phosphoric acid in the unfertilized soil, it is the fertilized soil to which our attention here is called. When we applied 1,000 pounds of fertilizer, we had in the soil nearly six times as much as the first crop used. At the beginning of the second year there was remaining about six times as much as the second crop actually used, and at the end of two years twice as much phosphoric acid still remained unused as had been used by two crops. When an application was made of 2,000 pounds of fertilizer an acre, there was present for the use of the crop about ten times as much as was used by the first crop. There was left for the second crop ten times as much as it used, and after the removal of two crops there remained over four times as much phosphoric acid as had been used by two whole crops. The amount of phosphoric acid furnished by the average potato-fertilizer found in the market would, from these considerations, be regarded as containing phosphoric acid in excessive amounts as compared with the actual needs of the crop.

Amounts of Potash Applied and Removed.

Pounds of fertilizer applied per acre in 1895.		Pounds of potash applied per acre in fertilizer.	Pounds of potash removed by crop in 1895.	Pounds of potash removed by crop in 1896.	Total number of pounds of potash removed by crops in two years.
None	....	None	46 7	35.2	81.9
1,000	Least..........	61.5	48.6	40	....
1,000	Greatest.......	110.0	64.3	55.1	....
1,000	Average.......	90.6	59.7	45.1	104.8
2,000	Least..........	123	49.1	44.6	....
2,000	Greatest.......	220	72 3	54.1	....
2,000	Average........	181.2	60 4	49.7	110.1

Attention is called to the following points in connection with the table above:

(1) When no fertilizer was applied, the crop removed from one acre of soil 46.7 pounds of potash the first year and 35.2 pounds the second year, or a total of 81.9 pounds for the two years. We are justified in saying that this amount represents the minimum amount of potash available for the potato crops at the time grown and under the conditions existing.

(2) When an application was made in 1895 of 1,000 pounds of fertilizer, an average amount of 90.6 pounds of potash was supplied per acre. In 1895 the crop used 59.7 pounds of potash and in 1896, 45.1 pounds, making a total of 104.8 pounds an acre for the two years. The two crops removed about 15 pounds more than was applied.

(3) When an application was made in 1895 of 2,000 pounds of fertilizer, an average amount of 181.2 pounds of potash was supplied per acre. The first year's crop removed 60.4 pounds of potash, the second crop, 49.7 pounds, and the two crops, 110.1 pounds. The amount of potash applied exceeded that used in two years by over 70 pounds.

(4) When we added to the soil 90.6 pounds of potash, the two crops used 23 pounds more potash than when none was applied.

(5) When the amount of potash applied was increased to 181.2 pounds an acre, the two crops used only 5 pounds more than when half that amount was applied.

(6) During the two years the crops on the unfertilized soil used 81.9 pounds of potash, and we will call this the amount available at the beginning of the two years. Adding this amount to the applied amounts, and indicating how much was removed and left each year, we can prepare the following tabulated statement:

Pounds of fertilizer applied per acre.	Pounds of potash for use of crop at beginning of first year.	Pounds of potash used by first year's crop.	Pounds of potash left for second year's crop.	Pounds of potash used by second crop.	Pounds of potash remaining unused after second year.
0	81.9	46.7	35.2	35.2	0
1,000	172.5	59.7	112.8	45.1	67.7
2,000	263.1	60.4	202.7	49.7	153.0

When we applied 1,000 pounds of fertilizer, we had in the soil about three times as much potash as the first crop used. At the beginning of the second year, there was more than twice as much as the second crop actually used, and at the end of two years enough still remained unused to meet the demands of another good crop. When we applied 2,000 pounds of fertilizer an acre, there was present for the use of the crop about four-and-one-half times as much as was used by the crop the first season. There was left for the second crop about four times as much as it used; and after the removal of the second crop there remained about three times as much as would be required to meet the demands of another crop. We notice that the excessive application of potash was not so great as that of phosphoric acid, but still, in the application of 2,000 pounds of an average potato fertilizer, there is apt to be applied very much more potash than the single crop can possibly use.

When we consider that some farmers on Long Island are in the habit of applying a ton of commercial fertilizer per acre every year in growing potatoes and frequently on the same field for some years succession, we see that one of two results must inevitably follow: First, there will be an accumulation of plant-food, rendering further fertilization unnecesasry for a period; or, second, the unused portions of plant-food will be more or less largely lost by leaching. From the general experience gathered it would appear that the latter result most often occurs.

IV. THE REAL VALUE OF "NATURAL PLANT FOOD."*

SUMMARY.

Within the past year the sale of a material called "Natural Plant Food" has been vigorously pushed among the farmers of this State. Extravagant and misleading claims have been made for its value as a plant-food.

The guaranteed analysis implies, and a specific claim is made, that the material is "all available to plants in the soil." Chemical analysis at this Station shows that the materials are mostly in unavailable forms as plant-food. An average of three samples shows the following composition:

Total phosphoric acid	22.21 per cent.
Insoluble phosphoric acid	20.81 per cent.
Available phosphoric acid	1.40 per cent.
Potash soluble in water	0.13 per cent.

"Natural Plant Food" is really a mixture of some rock phosphate (probably Florida soft phosphate) with glauconite, a mineral containing potash in an insoluble form, commonly known as "green sand marl."

The selling price of "Natural Plant Food" varies usually from $25 to $28 a ton; its real agricultural value as plant-food is probably below $10 a ton at a liberal estimate.

INTRODUCTION.

For some months past numerous inquiries have been addressed to this Station asking for information in regard to a fertilizing material, the sale of which was being vigorously pushed. The following extract from one of these letters is an indication of the contents of many others: "We are in trouble over this fertilizer and would like to know just what it is. It is sold to the

* Published also as Bulletin No. 108.

people through here to be genuine fish and bone, and it is a complete sell on us all. We paid $26 to $28 a ton for it, and my crop was just as good where nothing was used." The parties selling this material have been so aggressive, so many misleading statements have been made by them to purchasers, and so many farmers appear to have been imposed upon through the misrepresentations made, that the circumstances appear to demand at this time authoritative statement from us, in order that the farmers may be fully informed in regard to this material and be placed upon their guard against further misrepresentations.

1. "NATURAL PLANT FOOD."

The material referred to is sold under the name of "Natural Plant Food" by the Natural Plant Food Company, 35 B St., Washington, D. C. The advertising circulars which are sent out are filled with extravagant claims and testimonials in praise of the wonderful fertilizing value of this material. The following statement affords an illustration of the claims made: "Natural Plant Food. This is the best fertilizer on the market. There have been many official tests made with it and it always came out ahead of all competitors, having produced the largest crops of all. Being a natural fertilizer, it is equally good on all crops."

2. MISLEADING CHARACTER OF GUARANTEE-ANALYSIS.

The guaranteed analysis of this "Natural Plant Food" is thoroughly and ingeniously misleading. The following is a copy of one of the forms in which the guaranteed composition is expressed:

Phosphoric Acid. Total (P_2O_5)	21.60 to 29.49	per cent
Eq. to Bone Phos. of Lime	47.20 to 64.38	"
Potash (K_2O) (From Glauconite)	1.00 to 2.00	"
Eq. to common Sulphate of Potash	2.00 to 4.00	"
Silicic Acid (SiO_2)	5.26 to 8.10	"
Carbonic Acid (CO_2)	2.07 to 3.00	"
Lime (CaO)	29.16 to 32.00	"
Magnesia (MgO) and Soda (Na_2O)	3.21 to 8.05	"
Aluminic (Al_2O_3) and Ferric (Fe_2O_3) Oxides	5.14 to 10.26	"

ALL AVAILABLE TO PLANTS IN THE SOIL.

The above are the Lowest and the Average Analyses."

This guaranteed analysis is misleading in the following particulars:

(1) It guarantees to be present constituents which have no market value as fertilizers, such as silicic acid, carbonic acid, etc., leading the average farmer to believe that these constituents are as valuable as potash and phosphoric acid.

(2) It states that the total phosphoric acid is *equal to* 47.20 to 64.38 per cent of *bone phosphate of lime.* This statement is made for the specific purpose of representing to farmers that the phosphoric acid is as good as the phosphoric acid contained in bone.

(3) It states that the potash present is from glauconite, the latter in very small type, and adds that it is "equal to common sulphate of potash." Potash in glauconite is very slowly available, while in sulphate of potash it is readily and completely available.

(4) Beneath the guarantee statement appears in capital letters, " all available to plants in the soil." How misleading this assertion is, we can show by the results of our analysis, coupled with experimental work done elsewhere.

3. Analyses of "Natural Plant Food" at this Station.

Our collecting agents secured in May and June three samples, one each in Fayetteville, Gouverneur and Saratoga Springs.

The results of analysis are as follows:

SAMPLE.	Pounds of Phosphoric Acid in 100 Pounds of N. P. F.			Pounds of potash soluble in water in 100 pounds of N. P. F.
	Available	Insoluble.	Total.	
Number 1	2.22	23.87	26.09	0.11
Number 2	0.93	19.60	20.53	0.12
Number 3	1.06	18.96	20.02	0.17
Average	1.40	20 81	22.21	0.13

While the claim is made that "Natural Plant Food" is "all available to plants in the soil," we see that chemical analysis shows that of the phosphoric acid only one to one and one-half per cent is available, and of the potash only a trace.

4. Real Character of "Natural Plant Food."

Before considering further points in regard to "Natural Plant Food," we will indicate more clearly what the material is. It is undoubtedly a mixture of soft rock phosphate and the mineral glauconite. This rock phosphate is more commonly known as Florida soft phosphate. So far as experiments have been made, the soft phosphates are entirely inferior to acid phosphates and probably not in any way superior to the form of finely ground phosphate known as floats.

Glauconite, the mineral which furnishes the potash in "Natural Plant Food," contains potash and iron in the insoluble form of silicate. This is more familiar under the name of "green sand marl" of New Jersey. Potash in this form is about as effective on crops as potash in granite, so far as we have evidence.

It is claimed that "Natural Plant Food" has remarkable power as a seed germinator. This claim is made in the following language, which bears a remarkable resemblance to the phraseology so familiar to us in patent-medicine circulars:

"Every intelligent farmer knows that fertilizer is the best which can soonest start the seed to growing and cause the largest number of seeds to sprout and grow, out of the whole number planted. This, the Natural Plant Food has done in every case. The Natural Plant Food makes more seed grow, out of the whole number planted, than any other fertilizer on earth. It makes these seeds come up much earlier and faster, grow more vigorously, withstand a drouth much longer and finally produce a much better crop than any other grade of fertilizer yet known, as has been fully demonstrated and proven beyond all manner of doubt by tens of thousands of witnesses to its marvelous germinating and forcing powers. This all goes to show that a *Natural* fertilizer is of vastly more benefit to the soil than an artificial imitation; for, after all, a Chemical or Artificial fertilizer is simply an attempt in an artificial manner to supply the crops with a chemical mixture which is simply an imitation of a first-class Natural fertilizer; surely the Almighty is a better chemist than the human race has yet produced and better knows the need of all growing things."

The Ohio Experiment Station made a test of this matter and they conclude that "the claim made for a soft phosphate as a quick germinator is rather rash, and that, as a matter of fact, it is inferior to the green-house soil without a fertilizer."

The Commissioner of Agriculture of Georgia recently called the attention of the farmers of his State to the sale of soft phosphate under the name "Natural Plant Food," and the following extract is taken from his statement:

"There is a material now being sold in Georgia which is attracting considerable attention on account of the extensive advertising which has been given it and the broad claims which have been made. This material is the soft phosphate of Florida. These phosphates contain only two or three per cent of available phosphoric acid, and in no way represent the acid phosphates of the market, which contain from thirteen to fourteen per cent of available phosphoric acid. This material has not been tried sufficiently to demonstrate whether it is in any way superior to ordinary floats.

"These phosphates contain from fifteen per cent to twenty-seven per cent of total phosphoric acid. They usually, however, run about twenty per cent. This, its promoters claim, can all be secured by the plant the first season. The evidence thus far has not been of a conclusive nature. The claim certainly appears an unwarranted one, as positive proof is wanting. Acid phosphates of the market usually contain from fourteen to eighteen per cent of total phosphoric acid, of which from thirteen to sixteen per cent is available, and the soft phosphates only about twenty per cent of total phosphoric acid, with about two and one-half per cent available. The law of Georgia recognizes, as commercial plant food, available phosphoric acid, and does not so recognize insoluble phosphoric acid. If the farmers of the State desire to try the soft phosphates on their lands the department of agriculture wishes them to do so with their eyes wide open, and on this account has forbidden the sale of this material under a name which indiactes that it is of the same character as (acid) phosphates, which it most certainly is not. It more closely approaches in character a finely ground phosphate rock. We have permitted the sale of these soft phosphates under their correct name as 'soft phosphate' just as we would any crude fertilizing material. There has been a special effort made by several parties to secure permission to sell this material, mixed with potash and ammonia, as a complete fertilizer. The sale of such a mixture has always been forbidden, if it contained less than ten per cent of plant food, as clearly a violation of the State laws. Any material which will furnish plant food to our farmers cheaply will be welcome to us, but many cannot afford to use such unproven materials and will not use them if they are aware of their unproven character; hence we have ruled and insisted that soft phosphates must be sold as 'soft phosphates' and not masqueraded as something else."

5. Selling Price and Actual Value of "Natural Plant Food."

One other point to which attention should be called is the price at which "Natural Plant Food" is sold. The lowest price reported to us has been $17, and this was when a farmer bought direct from the company. When sold through dealers, the price has been from $25 to $28 a ton. The commercial value of these goods, as based on their composition, would not exceed $10 a ton, and it is probable that their agricultural value is even below this.

It is not probably within the power of this Station to prevent the sale of "Natural Plant Food" in this State through the courts; and the only method of preventing continued imposition upon our farmers is to make the foregoing statement.

Whenever farmers are offered fertilizers of which they have no knowledge, they should secure information from this Station before purchasing such materials.

V. PROVISIONS OF THE NEW FERTILIZER LAW OF NEW YORK.*

SUMMARY.

I. History of Fertilizer Legislation. In 1878 the first law was passed to regulate the sale of fertilizers, but no provisions were made for its execution. Another law was passed in 1890 and amended in 1894, but was so full of technical defects as to defeat all attempts at making prosecutions for violations. The present law became operative May 28, 1896.

II. Application of New Law. The present fertilizer law applies to "any commercial fertilizer or any material to be used as a fertilizer, the selling price of which exceeds ten dollars per ton," when such goods are sold, offered or exposed for sale in this State.

III. Statement Required on Packages. The new fertilizer law requires that there shall be printed on or affixed to each package of fertilizer, in a conspicuous place on the outside of the package, a plainly printed statement certifying,

1. The net weight;
2. The name, brand or trade-mark;
3. The name and address of the manufacturer;
4. The chemical composition expressed as follows:
    - (a) Per cent of nitrogen.
    - (b) Per cent of available phosphoric acid, or, in case of undissolved bone, total phosphoric acid.
    - (c) Per cent of potash soluble in distilled water.

IV. Filing of Statements. Before any fertilizer can be legally sold, offered or exposed for sale in this State, the manufacturer or agent must file with the New York Agricultural Experiment Station at Geneva a statement like that provided for on packages, and also an additional statement in January of every year.

* Printed also as Bulletin No. 103.

V. When fertilizers contain leather or similar inert products, the fact must be explicitly and conspicuously stated on each package.

VI. Statement of Work Accomplished. Since July, 1890, there have been collected and analyzed by this Station over 2,700 samples of commercial fertilizers, manufactured by over 120 different firms. During this time eleven million pages of printed matter have been distributed among farmers in the form of bulletins.

INTRODUCTION.

In 1878 the first attempt was made by legislative enactment to afford protection against fraud to purchasers of commercial fertilizers. The law proved a failure, because no provisions were made for its execution. After occasional agitation of the subject for ten years, a systematic effort was made to secure a new law which should be a practical measure. Work done at this Station brought to light the existence of serious frauds and aroused a new and strong interest in the matter. Finally, in 1890 a law was passed, the execution of which was placed in charge of the Agricultural Experiment Station at Geneva. Efforts to enforce the provisions of this statute revealed exceeding looseness in its language and other serious defects. The general principles embraced in the act were satisfactory to both consumers and manufacturers, but, in its practical working, it was found difficult to carry through prosecutions against offending parties. The first prosecution begun under the enactment of 1890 was successful in the lower court, but, on appeal to the supreme court, the decision of the lower court was reversed on account of certain technical defects in the statute. An effort was made to remedy these defects by amendments which became operative May 9, 1894. Again proceedings were instituted against violators of the law, but only to show that the statute was practically useless so far as it caused offenders to be punished by legal process. So serious were the defects of the enactment of 1890 that it was decided to secure the passage of a new law. A new law was prepared by a committee appointed by the

Board of Control of this Station coöperating with the acting director who had had practical charge of the execution of the old law. In framing the new act, advantage was taken of the experience gained in trying to enforce the old statute.

After receiving the most careful attention in every phase of its preparation, the new law was introduced in the Assembly on February 27, 1896, by Hon. M. V. B. Ives and was in due time passed both branches of the Legislature. It received the signature of Governor Morton and thus became a law on May 28.

In order that manufacturers and consumers of fertilizers may fully understand the provisions of the new fertilizer law at the earliest practicable moment, we give below a copy of the law with such explanations of special points as may make its provisions understood beyond reasonable doubt.

THE NEW FERTILIZER LAW OF NEW YORK.

CHAP. 955.

Approved by the Governor May 28, 1896. Passed, three-fifths being present.

AN ACT

For the protection and education of farmers and manufacturers in the purchase and sale of fertilizers.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

SECTION 1. Every person who shall sell, offer or expose for sale in this state any commercial fertilizer or any material to be used as a fertilizer, the selling price of which exceeds ten dollars per ton, shall stamp on or affix to each package of such fertilizer, in a conspicuous place on the outside thereof, a plainly printed statement which shall certify as follows:

(1) The number of net pounds of fertilizer in the package sold or offered for sale;

(2) The name, brand or trade-mark under which the fertilizer is sold;

(3) The name and address of the manufacturer of the fertilizer;

(4) The chemical composition of the fertilizer expressed in the following terms:

(a) Per centum of nitrogen;

(b) Per centum of available phosphoric acid, or, in case of undissolved bone, the per centum of total phosphoric acid;

(c) Per centum of potash soluble in distilled water.

If any such fertilizer be sold, offered or exposed for sale in bulk, such printed statement shall accompany every lot and parcel so sold, offered or exposed for sale.

Section 2. It shall be a violation of the provisions of this act if the statement required by section one of this act shall be false in regard to the number of net pounds of fertilizer in the package sold, offered or exposed for sale, or in the name, brand or trade-mark under which the fertilizer is sold, or in the name and address of the manufacturer of the fertilizer. It shall also be a violation of the provisions of this act if any commercial fertilizer or material to be used as a fertilizer shall contain a smaller percentage of nitrogen, phosphoric acid or potash than is certified in said statement to be contained therein, when such deficiency shall be greater than one-third of one per centum of nitrogen, or one-half of one per centum of available phosphoric acid (or one per centum of total phosphoric acid in the case of undissolved bone), or one-half of one per centum of potash soluble in distilled water.

Section 3. Before any commercial fertilizer or any material to be used as a fertilizer is sold, offered or exposed for sale in this state, the manufacturer, importer or person who causes the same to be sold, offered or exposed for sale shall file with the New York Agricultural Experiment Station at Geneva, a certified copy of the statement prescribed in section one of this act; and, in addition, such statement shall be filed thereafter annually during the month of January.

Section 4. No person shall sell, offer or expose for sale in this state leather or its products or other inert nitrogenous material in any form, as a fertilizer or as an ingredient of any fertilizer, unless an explicit printed statement of the fact shall be conspicuously affixed to every package of such fertilizer, and shall accompany every parcel or lot of the same.

Section 5. Every person violating any of the provisions of this act shall forfeit and pay to the people of the state of New York the sum of one hundred dollars for every such violation.

Section 6. Every certificate, duly signed and acknowledged, of a chemist or other expert employed by the director of the New York Agricultural Experiment Station at Geneva relating to the analysis of any commercial fertilizer or material to be used as a fertilizer, shall be presumptive evidence of the facts therein stated.

Section 7. The doing of anything prohibited by this act shall be evidence of the violation of the provisions of this act relating to the thing so prohibited and the omission to do anything directed to be done shall be evidence of a violation of the provisions of this act relative to the things so directed to be done.

Section 8. The director of the New York Agricultural Experiment Station at Geneva is charged with the enforcement of the provisions of this act, and for this purpose, may employ agents, chemists and experts, and whenever he shall know or have reason to believe that any penalty has been incurred by any person for the violation of any of the provisions of this act, or that any sum has been forfeited by reason of any such violation, he shall report the said violation with a statement of the facts to the attorney-general, who, pursuant to the provisions of chapter eight hundred and twenty-one of the laws of eighteen hundred and ninety-five, may cause an action or proceeding to be brought in the name of the people for the recovery of the same.

Section 9. Chapter four hundred and thirty-seven of the laws of eighteen hundred and ninety and chapter six hundred and one of the laws of eighteen hundred and ninety-four are hereby repealed.

Section 10. This act shall take effect immediately.

While the provisions of the law are clearly and simply stated, we wish to make some added statements to anticipate inquiries which are likely to arise. These additional statements we will make under the following heads:

(1) To what goods the law applies.

(2) What must be stated on each package of fertilizer.

(3) Filing of statements.

(4) Requirements regarding inert nitrogenous materials.

(5) What constitutes violation of the law.

(6) What persons are regarded as responsible parties.

1. TO WHAT GOODS THE LAW APPLIES.

In the terms of the statute, its provisions apply to "any commercial fertilizer or any material to be used as a fertilizer, the selling price of which exceeds ten dollars per ton," when such goods are sold, offered or exposed for sale in this State.

Originally the term "commercial fertilizer" applied to mixtures of fertilizing materials sold under trade names, containing nitrogen, phosphoric acid and potash. The term now has a broader application and includes materials commonly used for fertilizing purposes, whether mixed or unmixed, containing either nitrogen, phosphoric acid or potash, or any combination of these three elements of plant-food.

The law also applies specifically to "any material to be used as a fertilizer." If there were any doubt in regard to the term "commercial fertilizer" covering any forms of unmixed fertilizing materials, such materials would be comprehended under "any material to be used as a fertilizer."

A question may arise as to the interpretation of the phrase, "to be used as a fertilizer." The meaning of the word fertilizer in its broadest signification may be defined as any substance which, by its addition to the soil, is intended to produce a better growth of plants. But the design of those who framed the law was to use the word fertilizer in its more restricted sense, confining it to the materials and artificial mixtures put on the market under specific names, containing either nitrogen, phosphoric acid or potash or any combination of these.

The law therefore applies to all mixtures containing nitrogen, phosphoric acid or potash or any combination of these, and also to all unmixed materials containing any of these elements of plant-food, when they sell for more than ten dollars per ton. So-called "specials" are also included under the law. Such materials as nitrate of soda, sulphate of ammonia, potash salts, dried blood, tankage, acid phosphate, rock phosphate, bones, etc., etc., all come under the provisions of this law, as prices stand at present.

The law does not apply to cases in which farmers go outside of New York State and purchase fertilizers for their own personal use. They assume their own risks in such cases.

2. What Must Be Stated on Each Package of Fertilizer.

The law requires that four things shall be stated on each package of fertilizer coming under the meaning of its provisions:

(1) The net weight;

(2) The name, brand or trade-mark;

(3) The name and address of the manufacturer;

(4) The chemical composition.

The law provides that the above statement shall be stamped on or affixed to *each package* of fertilizer, *in a conspicuous place on the outside* of the package and that the statement shall be *plainly printed.*

(1) The Net Weight.

The law does not specify any particular weight which shall be contained in packages of fertilizers. The manufacturer may make his packages of any size that pleases him, but he must guarantee to each purchaser for each package that the weight contained in the guarantee statement is contained in the packages. All goods sold, offered or exposed for sale must come up to the guarantee in weight, whether such goods have been away from the factory one month or several years. Every purchaser has a legal right to demand the full guaranteed weight of every individual package. This requirement holds good for all separate packages, whether the weight is a fraction of one pound or any other quantity. There has been a common practice of selling fertilizers for house plants in small packages without giving weight or analysis. This practice is a clear violation of the law.

(2) THE NAME, BRAND OR TRADE-MARK.

The law assumes that every fertilizer coming under its provisions shall have some kind of a distinctive name or mark, and that such name or mark shall appear plainly printed in connection with each package of fertilizer.

(3) THE NAME AND ADDRESS OF THE MANUFACTURER.

The law plainly provides that with each package of fertilizer "the name and address of the manufacturer of the fertilizer" shall be given. Under the former fertilizer law, there were numerous instances of omission, no name or address of manufacturers being given. It is not sufficient to use the expression "manufactured for." Some doubt has arisen in regard to the interpretation of the word "manufacturer." The intention of the framers of the law was that the word did not necessarily apply to the party who did the mechanical work of mixing and sacking the goods. A party who makes his formulas and brands and hires some one else to prepare the materials is properly the manufacturer. The main object of this provision of the law is to require the name of some party to appear who shall be held responsible as manufacturer. Agents and dealers will be held responsible for handling goods, whose packages are not properly marked in this respect, when such goods are manufactured outside of the State.

(4) THE CHEMICAL COMPOSITION.

The law requires that the chemical composition or guarantee-statement of analysis of a fertilizer shall be expressed in the following terms:

(a) Per cent of nitrogen;

(b) Per cent of available phosphoric acid, or, in case of undissolved bone, the per cent of total phosphoric acid;

c) Per cent of potash soluble in distilled water.

(*a*) *Nitrogen.*—The law requires in a guarantee-statement of chemical composition that the per cent of nitrogen *as nitrogen* shall be stated. The law does not forbid stating the equivalent of nitrogen in the form of ammonia *in addition*, but the per cent of nitrogen as nitrogen must be given in any and every case. The indiscriminate and exclusive us of the term "ammonia" in guaranteeing nitrogen is misleading and is no longer permitted.

(*b*) *Phosphoric Acid.*—The law requires the per cent of available phosphoric acid to be stated, and, in case of undissolved bone, the per cent of total phosphoric acid. There is nothing in the law to prevent the statement of reverted, soluble, insoluble and total phosphoric acid *in addition to* the available form; but the per cent of available phosphoric acid must always be stated when present, except in case of undissolved bone.

The present law differs from the former law in that the former required the separate statement of both soluble and available phosphoric acid and made no provision for undissolved bone. The former law, however, did not require manufacturers to maintain their guarantee in respect to soluble phosphoric acid. It was deemed wise to have the legal requirements consistent and drop the soluble phosphoric acid from the guarantee, since this is so readily liable to change on standing. The farmer is sufficiently protected in requiring manufacturers to observe the guarantee with reference only to the available form of phosphoric acid.

In respect to bone, it is well known that the usual chemical methods used in determining available phosphoric acid do not give reliable results when applied to undissolved bone. The former law was not enforced in respect to untreated bone because it was not properly applicable, though technically no exception was made. The present law recognizes a condition which actually exists and makes provision to cover a case which the former law did not reach.

(*c*) *Potash.*—In a statement of chemical composition, the per cent of potash (K^2O) *soluble in distilled water* must be given.

Potash which is not thus soluble cannot legally be included in the statement.

There is no provision which would prevent one expressing the equivalent of potash in the form of sulphate or muriate of potash *in addition to* potash; but, if only one form is given, it must be always that of potash (K_2O) soluble in distilled water. To state only the amount of sulphate of potash, or muriate of potash, or to use alone such expressions as "potash s." or "potash sul." is a clear violation of the provisions of the law.

(*d*) *Suggested Form of Statement of Guarantee-Analysis.*—For the sake of unformity and simplicity, we suggest to manufacturers of fertilizers the following form of statement of guarantee-analysis as one *which will be accepted by this Station as conforming to the provisions of the law:*

Nitrogen	.... per cent.
Available phosphoric acid..............................	.... per cent.
(Total phosphoric acid in case of undissolved bone)........	.... per cent.
Potash (K_2O) soluble in distilled water.................	.... per cent.

This form is simple, is all the law requires and is sufficiently complete to give consumers an intelligent idea of the chemical composition. Whatever is added to this is very apt to prove confusing to the average farmer. When any constituent is absent from a fertilizer, that constituent can be omitted from the guarantee-statement of chemical composition. Thus, if a fertilizer contains no nitrogen, it is not necessary to state that no nitrogen is present; the nitrogen is simply dropped from the statement.

(*e*) *Fixed Figures in Statement of Composition.*—In the interest of clearness and simplicity, we suggest that manufacturers give only the one figure representing the lower limit of guarantee instead of stating an upper and lower limit. Several manufacturers have voluntarily adopted this system already. In our publications of guarantee-analyses, we state only the lower limit, because this is the only figure officially recognized by us as representing the guarantee.

3. Filing of Statements.

The present fertilizer law provides that the statements called for by its first section shall be filed with the New York Agricultural Experiment Station at Geneva before any fertilizer can be sold, offered or exposed for sale. After this first statement is filed, such statement shall be filed after that annually during the month of January. The former law provided only for filing statements during the first twenty days of July each year. Under the provisions of the new law either the manufacturer or importer or person who causes the goods to be sold files the statement. When any manufacturer residing outside of the State fails to comply with the law in this respect, then every individual handling such manufacturer's goods in the State must file such statement or render himself liable to prosecution. Nonresident manufacturers will therefore always find it to their advantage to comply with the law promptly and protect their local agents.

It is to be observed that the statement is not to be filed merely once, but not less often than once every year.

This requirement applies to special goods as well as to others.

4. Requirements Regarding Inert Nitrogenous Materials.

Section 4 reads as follows: "No person shall sell, offer or expose for sale in this State leather or its products or other inert nitrogenous material in any form, as a fertilizer or as an ingredient of any fertilizer, unless an explicit printed statement of the fact shall be conspicuously affixed to every package of such fertilizer, and shall accompany every parcel or lot of the same."

5. What Constitutes Violation of the Law.

It is a violation of the New York Fertilization Law—

(1) To omit the net weight on packages or to place upon packages a number falsely representing the net weight;

(2) To omit upon packages the name, brand or trade-mark under which the fertilizer is sold;

(3) To omit or give falsely upon the packages the name and address of the manufacturer of the fertilizer;

(4) To give on packages an amount of nitrogen greater than the fertilizer contains, when such difference exceeds one-third of one per cent;

(5) To give on packages an amount of available phosphoric acid greater than the fertilizer contains, when such difference exceeds one-half of one per cent (or one per cent of total phosphoric acid in the case of undissolved bone);

(6) To give on packages an amount of potash soluble in distilled water greater than the fertilizer contains, when such difference exceeds one-half of one per cent;

(7) To state the amount of ammonia on packages without also stating the amount of nitrogen;

(8) To state the amount of soluble phosphoric acid, or reverted phosphoric acid, or insoluble phosphoric acid or total phosphoric acid (except in case of undissolved bone) without also stating the amount of available phosphoric acid;

(9) To state the amount of potash as sulphate of potash or muriate of potash or in any similar form without also stating the amount of potash (K_2O) soluble in distilled water;

(10) To omit any part of required statement on each and every package of fertilizer, whether the package weighs a fraction of a pound or several hundred pounds;

(11) To omit to file required statement with the New York Agricultural Experiment Station as often as once each year in January or before selling any fertilizers;

(12) To omit stating on packages that fertilizers contain inert nitrogenous matter when such matter is present.

6. WHAT PERSONS ARE REGARDED AS RESPONSIBLE PARTIES.

Manufacturers residing in the State will be held directly responsible for violations of the fertilizer law. In the case of non-resident manufacturers, the agents or sellers resident in the State will be held responsible for any violations. When residents of this State purchase goods for their own personal use from non-resident parties, they have no redress under this law for any violations on the part of the manufacturer.

PLATE V.

One of the Chemical Laboratories.

7. Brief Statement of Work Accomplished.

Since July, 1890, there have been collected and analyzed about 2,700 samples of commercial fertilizers. Over 120 firms are doing business in this State, nearly one-half of whom reside in other States.

Since October, 1890, there have been published 16 fertilizer bulletins containing 660 pages. These have been distributed among the farmers of the State in such numbers as to make an aggregate of 11,000,000 pages.

As a direct result of the information contained in the bulletins distributed among our farmers, there has been a very marked increase in the intelligence which farmers show in the purchase and use of fertilizers. Many farmers absolutely refuse to purchase any brand of fertilizer until they see the Station's analysis. The amount of correspondence created by inquiries on the part of farmers with reference to the purchase and use of fertilizers is very large.

The real and direct benefit coming to farmers from this line of the Station's work has been incalculable in its extent and value, for it touches a larger number than any other single line of work. When we consider that the farmers of this State are expending nearly five million dollars every year for commercial fertilizers, it can be readily appreciated how important it is that protection should be afforded them.

The provisions of the law have been explained in considerable detail, in order that farmers might more readily understand what provisions manufacturers are required to observe. Before purchasing fertilizers care should be taken to see that each package contains the required statement. It is important also for dealers to make sure that manufacturers have complied with the law in respect to filing proper statements with this Station, before they undertake to sell goods.

The attention of manufacturers, dealers and consumers is called to the provisions of this new law and their coöperation is desired in making the law effective in every way. It is hoped that the attention of the Station will be called to any violations of this law which may come under the observation of any residents of this State.

VI. REPORT OF ANALYSES OF COMMERCIAL FERTILIZERS FOR THE SPRING OF 1896.*

SUMMARY.

During the spring of 1896, there were collected 423 samples of commercial fertilizers, representing 313 different brands.

Of these 303 different brands, 273 contained nitrogen varying in amount from 0.78 to 15.59 per cent. The average of all the guarantee-analyses was 2.58 per cent of nitrogen, while the average amount found by the Station analysis was 2.86 per cent.

There were 301 brands which contained available phosphoric acid, varying in amount from 0.65 to 16.88 per cent. The average amount of available phosphoric acid found by Station analysis exceeded the average guarantee-analysis by 0.39 per cent, the average of all the guarantee-analyses being 7.89 per cent and the average actually found being 8.28 per cent.

There were 276 brands which contained potash, varying from 0.11 to 50.34 per cent. The average amount of potash found by our analysis exceeded the average guarantee-analysis by 0.33 per cent, the average of all the guarantee-analyses being 4.76 per cent, and the average actually found being 5.09 per cent.

Of the 313 different brands collected, 139 were below the manufacturer's guarantee-analysis in one or more constituents, in amounts varying from 0.03 to 4.41 per cent.

The amount of nitrogen was below the guarantee-analysis of the manufacturer in 40 brands, the deficiency varying from 0.03 to 0.93 per cent and averaging 0.28 per cent. In 20 of the 40 brands, the deficiency was not greater than 0.25 per cent; in 14 brands it was over 0.25 and below 0.50 per cent; in 6 brands it was over 0.50 and below 1 per cent.

The amount of phosphoric acid was below the manufacturer's guarantee-analysis in 84 brands, the deficiency varying from 0.04 to 4.41 per cent and averaging 0.77 per cent. In 26 of the 84 brands the deficiency was less than 0.25 per cent; in 13 cases it was above 0.25 and below 0.50 per cent; in 26 brands it was above 0.50 and below 1 per cent; in 13 brands the deficiency was

* Published also as Bulletin 107.

above 1 and below 2 per cent; in 2 brands it was above 2 and below 3 per cent; in 2 brands it was above 3 and below 4 per cent; and in 2 brands it was above 4 and below 5 per cent.

The amount of potash was below the manufacturer's guarantee-analysis in 57 different brands, the deficiency varying from 0.04 to 2.91 per cent and averaging 0.56 per cent. In 21 of the 57 brands the deficiency was below 0.25 per cent; in 13 brands it was above 0.25 and below 0.50 per cent; in 13 brands it was above 0.50 and below 1 per cent; in 9 brands the deficiency was above 1 and below 2 per cent; and in 1 brand it was above 2 and below 3 per cent.

The retail selling price of the brands collected varied from $6 to $65 a ton and averaged $28.96. The retail cost of the separate ingredients unmixed was $23.37 or $5.59 less than the selling price.

INTRODUCTION.

1. EXPLANATION OF TERMS USED IN STATING RESULTS OF CHEMICAL ANALYSIS OF FERTILIZERS.

In the tables which give the results of our analysis of fertilizers the following terms are used to express the results:

Nitrogen.

Phosphoric Acid $\left\{ \begin{array}{l} \textit{Total.} \\ \textit{Available.} \end{array} \right.$

Potash, soluble in water.

We give a brief explanation of these terms as used in our tables of analysis.

(*1*) *Nitrogen.*—The figures in the column headed "Nitrogen" state the number of pounds of the element nitrogen present in one hundred pounds of fertilizer. This form of statement does not distinguish the source from which the nitrogen comes, but simply states the total amount of nitrogen without regard to the form or forms in which it may be present.

(*2*) *Phosphoric Acid.*—There are usually present in fertilizers three different forms of phosphoric acid compounds knows as (1) "Soluble," (2) "Reverted," and (3) "Insoluble." All these different forms, taken together, are called "Total" phosphoric acid. The soluble and reverted forms taken together are called "Available," because both of these forms can more or less readily be used by plants.

To avoid confusion, we give in our tables of analysis only the amount of available phosphoric acid and of total phosphoric acid. The total includes the available plus the insoluble. The law holds manufacturers to the amount of available phosphoric acid guaranteed.

(3) *Potash.*—Potash may be present in a fertilizer in the form of muriate, sulphate or, less often, carbonate. Our statement of analysis does not distinguish the precise form in which the potash exists in the fertilizer, but simply states the amount of potash soluble in distilled water, without regard to the special form in which it may be present.

(4) *Comparison of Amounts Guaranteed and Found.*—In the first line under each brand of fertilizer we state the amount of nitrogen, phosphoric acid, and potash "guaranteed" by the manufacturer; and in the line below the amount of these constituents "found" by the Station analysis. In the third line we give the amounts "below guarantee," when we find less than the manufacturer guarantees, and the deficiency is greater than two-tenths of one per cent. Marked deficiencies are objectionable under any circumstances, and are especially so when they occur in the same brand of goods continuously for several seasons.

2. TRADE-VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS, ADOPTED BY EXPERIMENT STATIONS.

	1896. Cts. per lb.
Nitrogen in ammonia salts	15
Nitrogen in nitrates	13½
Organic nitrogen in dry and fine-ground fish, meat and blood, and in high-grade mixed fertilizers	14
Organic nitrogen in cotton-seed meal and castor-pomace	12
Organic nitrogen in fine-ground bone and tankage	13½
Organic nitrogen in fine-ground medium bone and tankage	12
Organic nitrogen in medium bone and tankage	9
Organic nitrogen in coarser bone and tankage	3
Organic nitrogen in hair, horn-shavings and coarse fish-scraps	3
Phosphoric acid, soluble in water	5½
Phosphoric acid, soluble in ammonium citrate	5½
Phosphoric acid in fine bone and tankage	5
Phosphoric acid in fine medium bone and tankage	4
Phosphoric acid in medium bone and tankage	2½
Phosphoric acid in coarser bone and tankage	2
Phosphoric acid in fine-ground fish, cotton-seed meal, castor-pomace and wood ashes	4½
Phosphoric acid insoluble in ammonium citrate, in mixed fertilizers	2

	1896. Cts. per lb.
Potash as high-grade sulphate, in forms free from muriates (chlorides) in ashes, etc	5
Potash in muriate	4½

3. Valuation of Fertilizing Ingredients in Fine Ground Foods.

Organic nitrogen	12
Phosphoric acid	4½
Potash	5

The trade-values in the foregoing schedule represent the average prices at which, in the six months preceding March, the respective ingredients, in the form of unmixed raw materials, could be bought at retail for cash in our large markets, Boston, New York and Philadelphia. These prices also correspond to the average wholesale prices for the six months preceding March, plus about 20 per cent in case of goods for which there are wholesale quotations.

4. Commercial Valuation of Fertilizers.

The commercial valuation of a fertilizer consists in estimating the approximate value or money-cost of the essential fertilizing constituents (nitrogen, phosphoric acid and potash) in one ton of fertilizer. This does not take into consideration cost of mixing, of transportation, storage, commissions to agents and dealers, etc., but only the one item of retail cash cost, in the market, of unmixed raw materials.

5. Simple Rule for Calculating the Approximate Commercial Valuation of a Fertilizer from the Results of Analyses.

Multiply the percentage of nitrogen by three and to the product add the percentage of available phosphoric acid and the percentage of potash. The total sum will express in dollars and cents the approximate commercial valuation of one ton (2,000 pounds) of the fertilizer.

Examples:—A fertilizer contains 3.44 per cent of nitrogen, 6.15 per cent of available phosphoric acid and 9.89 per cent of potash.

3.44 (percentage nitrogen) multiplied by three, equals	10.32
6.15 (percentage available phosphoric acid), equals	6.15
9.89 (percentage potash), equals	9.89
Total	$26.36

A fertilizer contains 11.30 per cent of nitrogen, 14.23 per cent of available phosphoric acid and 19.84 per cent of potash.

11.30 (percentage nitrogen) multiplied by three, equals	33.90
14.23 (percentage available phosphoric acid), equals	14.23
19.84 (percentage potash), equals	19.84
Total	$67.97

In case of fine bone-meal, use the total phosphoric acid in place of the available in making the calculation.

This extremely simple method will be found very convenient when one desires to get at the cost of the unmixed materials in a fertilizer. While not exact, it gives sufficiently approximate results to serve as a helpful guide.

6. Comparison of Selling Price and Commercial Valuation in Spring Goods.

An average of the composition of all the fertilizers, samples of which are included in our spring collection, is found to be as follows:

	Per cent
Nitrogen	2.86
Available phosphoric acid	8.28
Insoluble phosphoric acid	2.91
Potash	5.09

Rating the nitrogen at 14 cents a pound, the available phosphoric acid at 5½ cents a pound, the insoluble phosphoric acid at 2 cents a pound and the potash at 5 cents a pound, we find that the separate unmixed materials contained in one ton of a fertilizer having the foregoing composition could be purchased at retail at the seaboard for $23.37. The average retail price at which these commercial fertilizers sold was $28.96; this is $5.59 or about 24 per cent more than the commercial valuation. This difference covers the cost of mixing, freights, profits, etc. To the farmer purchasing these mixed materials, the ingredients cost as follows:

	Cost of one pound.
Nitrogen	17.3 cents.
Available phosphoric acid	6.8 cents.
Insoluble phosphoric acid	2.5 cents.
Potash	6.2 cents.

7. LIST OF MANUFACTURERS WHO HAVE FILED THE STATEMENTS REQUIRED BY LAW.

Manufacturers, to the number of 122, have filed with this Station the statement required by law. Of these there are 48 whose factories are located outside of New York State. These 122 manufacturers put on the market 1,090 different brands. Many of these brands are manufactured for special parties in other States, so that the number of different brands actually sold in this State is considerably short of the total given above. Frequently special goods are made for local dealers which have a limited sale in the dealer's immediate locality. This method is becoming very common, and, of course, increases largely the number of brands made and sold.

Name and address of manufacturer.	Number of brands reported.
Acme Fertilizer Company, 62 William street, New York city	6
American Reduction Company, 1516 Second avenue, Pittsburg, Pa.	1
Armour Fertilizer Works, 205 LaSalle street, Chicage, Ill	6
Edward J. Attwood, Andover, N. Y	5
Bachman & Co., Chester, Orange county, N. Y	1
A. M. Baker & Son, Mt. Morris, N. Y	6
H. J. Baker & Bro., 93 William street, New York city	22
Bancroft & Ewgert, Lincoln, N. Y	2
Bowker Fertilizer Company. 43 Chatham street, Boston, Mass	32
Bradley Fertilizer Company, 92 State street, Boston, Mass	28
The Bradley Fertilizer Company, 132 South Delaware avenue, Philadelphia, Pa	12
J. P. Butts, Oneonta, N. Y	3
Chandler, Russell & Chandler, Newark, N. J	9
E. B. Chapin, Rochester, N. Y	3
Chemical Company of Canton, Baltimore, Md	10
Chesapeake Guano Company, Baltimore, Md	3
Clark's Cove Fertilizer Company, 40 Exchange place, New York city	15
The Cleveland Dryer Company, 92 State street, Boston, Mass	8
Club and Grange Fertilizer Company, Syracuse, N. Y	3
E. Frank Coe Company, 135 Front street, New York city	26
Peter Cooper's Glue Factory, 13 Burling Slip, New York city	1
A. S. Core Fertilizer Works, White Plains, N. Y	14
Crocker Fertilizer and Chemical Company, Buffalo, N. Y	72
E. A. Cross, Hilton, N. Y	3
Cuba Fertilizer Company, Cuba, N. Y	12
Cumberland Bone Phosphate Company, Portland, Me	11
L. B. Darling Fertilizer Company, Pawtucket, R. I	8
P. P. Dunan, 310 Equitable Building, Baltimore, Md	8
Eastern Farm Supply Association, Montclair, N. J	11
Farmers' Fertilizer Company, Syracuse, N. Y	9

Name and address of manufacturer.	Number of brands reported.
Farmers and Builders' Supply Company, Owego, N. Y.	6
John Finster, Rome, N. Y.	1
George B. Forrester, 169 Front street, New York city	19
Geneva Coal Company, Geneva, N. Y.	12
A. C. Geslain, 131 Rutledge street, Brooklyn, N. Y.	1
Great Eastern Fertilizer Company, Rutland, Vt.	8
Griffith & Boyd, 9 South Gay street, Baltimore, Md.	7
John Haefele, Delaware avenue, Albany, N. Y.	1
The Hallock & Duryee Fertilizer Company, Mattituck, N. Y.	14
Hammond's Paint and Slug Shot Works, Fishkill, N. Y.	1
George L. Harding, 205 Water street, Binghamton, N. Y.	1
Isaac C. Hendrickson, Jamaica, N. Y.	2
S. M. Hess & Bro., Fourth and Chestnut streets, Philadelphia, Pa.	10
J. S. Hewitt & Sons, Locke, N. Y.	7
C. O. Hicks, Penn Yan, N. Y.	8
Hubbard & Co., 10 Light street, Baltimore, Md.	10
F. N. Isham, Avon, N. Y.	1
F. W. Jones, Jonesburg, N. Y.	4
The Lackawanna Fertilizer and Chemical Company, Moosic, Pa.	5
Lazaretto Guano Co., Baltimore, Md.	20
Liebig Manufacturing Company, 26 Broadway, New York city	23
Listers Agricultural Chemical Works, Newark, N. J.	23
Lonergan & Livingston, Albany, N. Y.	2
Lowell Fertilizer Company, Lowell, Mass.	7
Frederick Ludlam, 108 Water street, New York city	5
Mapes Formula and Peruvian Guano Company, 143 Liberty street, New York city	18
Maryland Fertilizing and Manufacturing Company, 30 South Halliday street, Baltimore, Md.	19
Maxson & Starin, Cortland, N. Y.	7
Robert L. Merwin & Co., 72 Wall street, New York city	5
Michigan Carbon Works, Detroit, Mich.	9
Miller Fertilizer Company, 411 East Pratt street, Baltimore, Md.	12
Milsom Rendering and Fertilizer Company, East Buffalo, N. Y.	12
Minot & Decker, Brockport, N. Y.	1
L. Mittenmaier & Son, Rome, N. Y.	2
Moller & Co., Maspeth, N. Y.	2
Monroe, Lalor & Co., Oswego, N. Y.	1
National Fertilizer Company, Bridgeport, Conn.	4
Newark Agricultural Company, Newark, N. J.	22
Niagara Fertilizer Works, Buffalo, N. Y.	7
Northwestern Fertilizing Company, Chicago, Ill.	15
Oakfield Fertilizer Company, Buffalo, N. Y.	11
Oneonta Fertilizer and Chemical Company, Oneonta, N. Y.	17
Pacific Guano Company, 27 William street, New York city	12
Packers' Union Fertilizer Company, New York city	6
Charles D. Parks, Danbury, Conn.	3
Patapsco Guano Company, Baltimore, Md.	2
G. A. Pearsall, Williamson, N. Y.	6

Name and address of manufacturer.	Number of brands reported.
A. W. Perkins & Co., Rutland, Vt.	1
A. Peterson, Penfield, N. Y.	2
J. E. Phelps, Jamaica, N. Y.	7
Moro Phillips Chemical Company, 131 South Third street, Philadelphia, Pa.	17
William W. Phipps, Albion, N. Y.	3
Pierce & Co., Armor, N. Y.	1
B. J. Pine, East Williston, N. Y.	1
Powers, Gibbs & Co., Wilmington, N. C.	10
Preston Fertilizer Company, Greenpoint, N. Y.	16
Quinnipiac Company, 83 Fulton street, New York city	16
Rasin Fertilizer Company, Baltimore, Md.	5
Read Fertilizer Company, Syracuse, N. Y.	18
John S. Reese & Co., Baltimore, Md.	21
J. L. Reynolds, Mount Vernon, N. Y.	2
Riverside Acid Works, Warren, Pa.	4
Rochester Fertilizer Works, Rochester, N. Y.	12
Rogers & Hubbard Company, Middletown, Conn.	9
L. Sanderson, 114 Church street, New Haven, Conn.	1
G. W. Sharretts & Co., Eighth street and Second avenue, Baltimore, Md.	4
Charles A. Sickler & Bro., Wilkes-Barre, Pa.	4
C. H. Skelton, Batavia, N. Y.	1
Isaac Smith, Columbiaville, N. Y.	1
W. W. Sprague Company, Union Stock Yards, Chicago, Ill.	1
W. H. Stamp, Warsaw, N. Y.	3
H. Stappenbeck, Utica, N. Y.	3
Standard Fertilizer Company, State street, Boston, Mass.	14
Sterling Oil Company, Greenport, N. Y.	1
Swift & Co., Chicago, Ill.	5
C. R. Sworts, Dundee, N. Y.	7
I. P. Thomas & Son, 2 South Delaware avenue, Philadelphia, Pa.	13
Edward D. Tolles, Attica, N. Y.	7
George O. P. Turner, Churchville, N. Y.	2
Ellsworth Tuthill & Co., Promised Land, N. Y.	6
George F. Tuthill & Co., Greenport, N. Y.	1
J. E. Tygert & Co., 42 South Delaware avenue, Philadelphia, Pa.	8
Tygert-Allen Fertilizer Company, 2 Chestnut street, Philadelphia, Pa.	13
F. G. Underwood, Oneida, N. Y.	1
Walker Fertilizer Company, Clifton Springs, N. Y.	15
Walker, Stratman & Co., Pittsburg, Pa.	7
W. E. Whann, William Penn, Pa.	7
M. E. Wheeler & Co., Rutland, Vt.	8
Wilkinson & Co., 29 South William street, New York city	1
Williams & Clark Fertilizer Company, 27 William street, New York city	16
Wooster & Mott, Union Hill, N. Y.	7
Zell Fertilizer Company, Baltimore, Md.	47

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Acme Fertilizer Co., Maspeth, L. I.	Acme E brand.	Calverton.	2417
Acme Fertilizer Co., Maspeth, L. I.	Acme fertilizer No. 1.	Jamaica.	2357
Acme Fertilizer Co., Maspeth, L. I.	Acme fertilizer No. 2.	Jamaica.	2337
Acme Fertilizer Co., Maspeth, L. I.	Acme special high-grade nine per cent.	Jamaica.	2351
Acme Fertilizer Co., Maspeth, L. I.	Nitrate of soda.	Jamaica.	2353
Acme Fertilizer Co., Maspeth, L. I.	Superior superphosphate.	Bridgehampton.	2438
Allison & Co., New York City.	Canada hardwood ashes.	East Marion.	2375
American Reduction Co., Pittsburg, Pa.	Pointer brand.	Fredonia.	2538
H. J. Baker & Bro., New York City.	A. A. ammoniated superphosphate.	Poughkeepsie.	2467
H. J. Baker & Bro., New York City.	Cabbage manure.	Jamaica.	2334
H. J. Baker & Bro., New York City.	Concentrated complete manure.	Poughkeepsie.	2470

LECTED IN NEW YORK STATE DURING THE SPRING OF 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	2.47	10	——	3.78
Found.	2.93	6.93	10.32	3.72
Below guarantee.		3.07		
Guaranteed.	3.70	8	——	9
Found.	3.59	6.56	8.30	7.82
Below guarantee.		1.44		1.18
Guaranteed.	4.95	8	——	5
Found.	6.57	6.03	6.92	3.98
Below guarantee.		1.97		1.02
Guaranteed.	7.40	7	——	4
Found.	6.91	5.87	6.70	4.03
Below guarantee.	0.49	1.13		
Guaranteed.	15.60			
Found.	15.32	——	——	——
Below guarantee.	0.28			
Guaranteed.	1.23	6	8	4
Found.	1.79	7.78	10.32	5.12
Guaranteed.	——	——	1.50	5
Found.		1.19	1.56	6.82
Guaranteed.	1.65	8	10	2
Found.	1.77	7.43	8.26	2.50
Below guarantee.		0.57		
Guaranteed.	2.47	10	——	2
Found.	2.94	10.67	11.66	3.15
Guaranteed.	4.75	5	6	7
Found.	5.22	6.69	6.94	7.10
Guaranteed.	2.06	8	9	2.25
Found.	2.25	8.87	10.01	2.99

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
H. J. Baker & Bro., New York City.	Odorless complete lawn dressing.	Poughkeepsie.	2469
H. J. Baker & Co., New York City.	Potato manure.	Jamaica. Poughkeepsie.	2333 2468
Bowker Fertilizer Co., Boston, Mass.	Ammoniated dissolved bone.	Stuyvesant. Carthage.	2620 2720
Bowker Fertilizer Co., Boston, Mass.	Farm and garden.	Stuyvesant.	2621
Bowker Fertilizer Co., Boston, Mass.	Fresh ground bone.	Fredonia.	2550
Bowker Fertilizer Co., Boston, Mass.	Hill and drill.	Fredonia. Carthage.	2549 2721
Bowker Fertilizer Co., Boston, Mass.	Hop and potato.	Pulaski.	2734
Bowker Fertilizer Co., Boston, Mass.	Lawn and garden dressing.	Southampton.	2428
Bowker Fertilizer Co., Boston. Mass.	Market garden manure.	Southampton.	2423
Bowker Fertilizer Co., Boston. Mass.	Potato phosphate.	Fredonia.	2551
Bowker Fertilizer Co., Boston. Mass.	Potato manure.	Southampton.	2422

lected in New York State During the Spring of 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	3.50	4.75	——	7
Found.	3.92	6.07	7	7.91
Guaranteed.	3.30	5.75	6.75	10
Found.	3.93	6.81	7.16	10.62
Guaranteed.	1.50	8	10	2
Found.	1.88	7.19	12.04	2.41
Below guarantee.		0.81		
Guaranteed.	1.50	8	10	2
Found.	1.79	7.05	12.44	2.43
Below guarantee.		0.95		
Guaranteed.	2.40	——	18	——
Found.	3.37	11.32	18.96	
Guaranteed.	2	8	10	2
Found.	2.02	7.12	12.28	2.44
Below guarantee.		0.88		
Guaranteed.	0.75	8	10	5
Found.	1.03	8.20	11.52	5.81
Guaranteed.	3.25	6	8	5
Found.	4.67	6.43	8.36	5.37
Guaranteed.	2.40	6	8	10
Found.	2.67	7.30	11.40	9.90
Guaranteed.	1.50	8	10	2
Found.	1.68	7.22	12.08	2.34
Below guarantee.		0.78		
Guaranteed.	2.40	8	10	4
Found.	2.54	7.27	11.01	5.54
Below guarantee.		0.73		

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Bowker Fertilizer Co., Boston. Mass.	Stockbridge potato and vegetable manure.	Poughkeepsie. Fredonia.	2464 2552
Bowker Fertilizer Co., Boston. Mass.	Stockbridge special manure.	Stuyvesant.	2619
Bowker Fertilizer Co., Boston, Mass.	Superphosphate with potash.	Watertown.	2732
Bowker Fertilizer Co., Boston, Mass.	Sure crop.	Fredonia. Stuyvesant.	2548 2618
Bradley Fertilizer Co., Boston, Mass.	Alkaline bone.	Claverack.	2609
Bradley Fertilizer Co., Boston, Mass.	Ammoniated dissolved bone.	Potsdam.	2727
Bradley Fertilizer Co., Boston, Mass.	B. D. sea fowl guano.	Cuba.	2504
Bradley Fertilizer Co., Boston, Mass.	Circle brand bone with potash.	Cuba. Albany.	2505 2626
Bradley Fertilizer Co., Boston, Mass.	Complete manure for potatoes and vegetables.	Jamaica. Jamesport.	2338 2415
Bradley Fertilizer Co., Boston, Mass.	Dissolved bone with potash.	Cuba.	2506
Bradley Fertilizer Co., Boston, Mass.	Farmer's new method.	Rhinebeck. Cuba. Claverack.	2472 2503 2607

lected in New York State During the Spring of 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	3.20	6	8	10
Found.	3.28	7.02	9.84	10.22
Guaranteed.	3.25	6	10	9.70
Found.	3.59	4.72	8.86	10.52
Below guarantee.		1.28		
Guaranteed.	——	10	12	1
Found.		9.96	14.93	1.26
Guaranteed.	0.75	8	10	1
Found.	0.96	8.71	12.71	1.32
Guaranteed.	——	11	12	2.43
Found.		11.92	13.84	2.14
Below guarantee.				0.29
Guaranteed.	1.65	7	8	1
Found.	1.71	8.19	10.13	1.26
Guaranteed.	2.06	8	10	1.50
Found.	2.35	8.42	10.59	2.06
Guaranteed.	1.85	6	10	2
Found.	2.31	5.35	14.75	2.39
Below guarantee.		0.65		
Guaranteed.	3.71	8.50	10	7
Found.	4.14	8.85	10.38	7.14
Guaranteed.	0.82	8	10	2
Found.	1.24	8.28	10.20	2
Guaranteed.	0.82	8	10	2.15
Found.	1.14	8.53	10.28	2.15

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Bradley Fertilizer Co., Boston, Mass.	Patent superphosphate.	Albany.	2624
Bradley Fertilizer Co., Boston, Mass.	Potato fertilizer.	Cuba. Albany. Oneonta.	2507 2625 2675
J. P. Butts, Oneonta, N. Y.	Hustler.	Oneonta.	2677
J. P. Butts, Oneonta, N. Y.	Standard No. 1.	Oneonta.	2678
Chandler, Russell & Chandler, Newark, N. J.	High grade 10 per cent. guano.	Jamaica.	2330
E. B. Chapin, Rochester, N. Y.	Monroe chief fertilizer.	Rochester.	2576
E. B. Chapin, Rochester, N. Y.	Potato fertilizer.	Rochester.	2577
Chicopee Guano Co., Baltimore, Md.	A No. 1 potato and vegetable.	Bainbridge.	2692
Clark's Cove Fertilizer Co., New York City.	Defiance complete manure.	Pulaski.	2733
Clark's Cove Fertilizer Co., New York City.	Good acre potato, hop and tobacco grower.	W. Lawrence.	2665
Clark's Cove Fertilizer Co., New York City.	King Philip alkaline guano.	Mellinville. West Lawrence.	2605 2667

LECTED IN NEW YORK STATE DURING THE SPRING OF 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	2.06	8	10	1.50
Found.	2.37	8.95	11.48	1.61
Guaranteed.	2.06	9	11	3.25
Found.	2.07	9.43	11.97	3.26
Guaranteed.	0.82	8	——	4
Found.	1.03	8.85	10.12	4.06
Guaranteed.	1.65	8	——	2
Found.	1.75	9.43	10.37	2.96
Guaranteed.	8.23	6	——	4
Found.	7.54	6.43	7.10	4.83
Below guarantee.	0.69			
Guaranteed.	1.23	6	——	5
Found.	1.11	5.82	9.93	4.95
Guaranteed.	1.23	7	——	5.40
Found.	0.90	2.63	8.46	4.81
Below guarantee.	0.33	4.37		0.59
Guaranteed.	2.88	7	8	5
Found.	2.32	8.62	9.72	3.83
Below guarantee.	0.56			1.17
Guaranteed.	0.82	6	8	2
Found.	1.47	9.35	12.05	2.22
Guaranteed.	2.06	8	9	3
Found.	2.15	8.69	12.30	3.31
Guaranteed.	1.23	6	7	3
Found.	1.68	6.53	9.22	3.75

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Cleveland Dryer Co., Cleveland, O.	Horsehead phosphate.	Fredonia.	2553
Cleveland Dryer Co., Cleveland, O.	Ohio seed maker with potash.	Fredonia.	2554
Cleveland Dryer Co., Cleveland, O.	Superior bone.	Fredonia.	2555
E. Frank Coe Fertilizer Co., New York City.	Alkaline bone.	Newburg.	2443
E. Frank Coe Fertilizer Co., New York City.	Ammoniated bone superphosphate.	Claverack.	2608
E. Frank Coe Fertilizer Co., New York City.	Columbian brand superphosphate.	Newburg. Philadelphia.	2445 2725
E. Frank Coe Fertilizer Co., New York City.	Excelsior guano.	Jamaica.	2342
E. Frank Coe Fertilizer Co., New York City.	Excelsior potato fertilizer.	Newburg.	2444
E. Frank Coe Fertilizer Co., New York City.	Gold brand.	Orient.	2376
E. Frank Coe Fertilizer Co., New York City.	Grass and grain fertilizer.	Philadelphia.	2724
E. Frank Coe Fertilizer Co., New York City.	Matchless grain fertilizer.	W. Oneonta.	2670

LECTED IN NEW YORK STATE DURING THE SPRING OF 1896.
turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	——	8	11	——
Found.	——	8.92	12.90	——
Guaranteed.	1.23	10	15	2.16
Found.	1.10	8.92	13.73	1.97
Below guarantee.		1.08		
Guaranteed.	3.29	——	22	——
Found.	3.05	7.72	20.29	
Below guarantee.	0.24		1.71	
Guaranteed.	1.20	9	11	1.85
Found.	1.38	9.63	12.33	1.96
Guaranteed.	1.65	8	9	1.35
Found.	1.83	9.04	12.66	1.58
Guaranteed.	1.20	9	11	1.85
Found.	1.61	10.04	12.60	1.89
Guaranteed.	3.30	9	10	3.40
Found.	3.40	8.66	10.20	3.95
Below guarantee.		0.34		
Guaranteed.	2.50	8	9	8
Found.	3.22	7.20	9.33	7.35
Below guarantee.		0.80		0.65
Guaranteed.	2.50	8	9	6
Found.	2.51	8.54	9.32	6.30
Guaranteed.	0.80	9	11	1.35
Found.	1.06	9.37	13.38	1.96
Guaranteed.	0.65	10	11	1
Found.	0.96	11.19	13.59	1.35
Below guarantee.				

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
E. Frank Coe Fertilizer Co., New York City.	Red brand.	Jamaica.	2343
E. Frank Coe Fertilizer Co., New York City.	Special corn fertilizer.	Newburg.	2447
E. Frank Coe Fertilizer Co., New York City.	Special potato fertilizer.	Newburg.	2446
E. Frank Coe Fertilizer Co., New York City.	XXV phosphate.	Claverack. W. Oneonta.	2610 2669
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Ammoniated wheat and corn phosphate.	Fredonia. Rhinebeck. Ballston Spa.	2533 2591 2648
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	General crop phosphate.	Abbotts.	2508
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	New rival ammoniated superphosphate.	Abbotts. Dunkirk. Kinderhook.	2510 2525 2617
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Potato, hop and tobacco phosphate.	Fredonia. Ballston Spa. Rhinebeck.	2534 2647 2590
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Practical ammoniated superphosphate.	Fredonia.	2535
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Superior rye and oats fertilizer.	Ballston Spa.	2649
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Thompson & Co. ammoniated dissolved bone.	Boonville.	2710

lected in New York State During the Spring of 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	3.30	9	10	6
Found.	3.36	8.07	9.98	6.42
		0.93		
Guaranteed.	1.75	9	10	3
Found.	1.85	9.66	12.25	3.41
Guaranteed.	1.65	9	11	3.50
Found.	1.91	9.02	12.25	3.43
Guaranteed.	1	9	———	1
Found.	1.22	10.06	13.80	1.31
Guaranteed.	2	10	11	1.60
Found.	2.25	10.20	11.97	1.90
Guaranteed.	0.82	7	8	1.08
Found.	0.91	6.74	9.55	1.21
Below guarantee.		0.26		
Guaranteed.	1.20	10	11	1.60
Found.	1.36	9.91	12.47	1.87
Guaranteed.	2	10	11	3.25
Found.	2.11	10.06	11.19	3.73
Guaranteed.	0.82	8	9	1.08
Found.	1.09	8.33	13.26	1.56
Guaranteed.	0.82	8	9	2
Found.	1.09	7.64	11.43	1.96
Below guarantee.		0.36		
Guaranteed.	2	7	8	1.60
Found.	2.68	7.17	9.02	2.09

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Thompson & Co. potato fertilizer.	Boonville.	2708
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Thompson & Co special potato fertilizer.	Boonville.	2709
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Thompson & Co standard fertilizer.	Boonville.	2711
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Universal grain grower.	Abbotts.	2509
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Vegetable and potato special.	Jamaica.	2358
Cuba Fertilizer Co., Cuba, N. Y.	Alkaline dissolved bone and potash.	Cuba.	2486
Cuba Fertilizer Co., Cuba, N. Y.	Bone and potash	Cuba.	2487
Cuba Fertilizer Co., Cuba, N. Y.	Composition.	Cuba.	2485
Cuba Fertilizer Co., Cuba, N. Y.	Corn and potato special.	Cuba.	2489
Cuba Fertilizer Co., Cuba, N. Y.	Hustler.	Cuba.	2484
Cuba Fertilizer Co., Cuba, N. Y.	N. Y. standard potato manure No. 1.	Cuba.	2483

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turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	1	8	9	1.60
Found.	1.12	7.62	11.38	3.35
Below guarantee.		0.38		
Guaranteed.	1.64	8	9	2.70
Found.	1.95	7.20	8.66	3.05
Below guarantee.		0.80		
Guaranteed.	0.82	7	8	1.80
Found.	1.08	6.47	10.29	2.45
Below guarantee.		0.53		
Guaranteed.	0.82	7	8	2.70
Found.	0.78	6.28	9.81	4.93
Below guarantee.		0.72		
Guaranteed.	2.46	7	8	7
Found.	2.33	6.37	8.82	9.19
Below guarantee.		0.63		
Guaranteed.	——	13	——	3
Found.		12.78	13.22	3.01
Guaranteed.	——	10	——	8
Found.		10.80	11.27	7.13
Below guarantee.				0.87
Guaranteed.	0.82	8	——	1
Found.	0.89	9.69	10.98	1.47
Guaranteed.	3.29	7	——	5
Found.	3.00	7.45	8.93	5.24
Below guarantee.	0.29			
Guaranteed.	0.82	8	——	4
Found.	1.40	9.39	11.15	2.51
Below guarantee.				1.49
Guaranteed.	2.47	7	——	8
Found.	2.14	6.84	8.19	8.52
Below guarantee.	0.33			

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Cuba Fertilizer Co., Cuba, N. Y.	N. Y. standard No. 1.	Cuba.	2481
Cuba Fertilizer Co., Cuba, N. Y.	N. Y. standard No. 2.	Cuba.	2482
E. F. Dibble Seed Co., Honeoye Falls, N. Y.	Grain special No. 1.	Honeoye Falls.	2573
E. F. Dibble Seed Co., Honeoye Falls, N. Y.	Grain special No. 2.	Lima.*	2303
E. F. Dibble Seed Co.. Honeoye Falls, N. Y.	Special potato manure.	Honeoye Falls.	2572
Darling Fertilizer Co., Pawtucket, R. I.	Animal fertilizer, special L. I. brand A.	Greenport.	2365
Darling Fertilizer Co., Pawtucket, R. I.	Animal manure, B. brand.	Greenport.	2364
Darling Fertilizer Co., Pawtucket, R. I.	Animal manure, special brand C.	Baiting Hollow.	2416
Darling Fertilizer Co., Pawtucket, R. I.	Animal manure, special L. I. brand C.	Greenport.	2366
Darling Fertilizer Co., Pawtucket, R. I.	L. I. special.	Jamaica.	2339
Farmers' Fertilizer Co., Syracuse, N. Y.	Mortgage lifter.	Ballston Spa.	2651

* Corrected from Bulletin 96.

lected in New York State During the Spring of 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	1.65	9	——	2
Found.	**1.69**	9.26	10.04	2.51
Guaranteed.	1.23	10	——	3
Found.	1.28	10.27	11.19	2.94
Below guarantee.				
Guaranteed.	0.82	9	10.50	4
Found.	**1.09**	7.60	9.82	4
Below guarantee.		1.40		
Guaranteed.	0.82	7	——	5
Found.	1.10	7.40	9.46	6.62
Guaranteed.	2.47	7	8	7
Found.	2.50	7.71	9.52	6.55
Below guarantee.				0.45
Guaranteed.	3	6	——	7
Found.	3.55	6.76	12.16	8.04
Guaranteed.	3.50	7	——	5
Found.	4.63	6.82	12.40	5.50
Guaranteed.	2	5	——	10
Found.	3.59	4.97	10.82	8.40
Below guarantee.				1.60
Guaranteed.	4	6	——	10
Found.	4.07	4.71	9.50	9.34
Below guarantee.		1.29		0.66
Guaranteed.	3.25	7.50	——	8
Found.	3.95	8.21	8.52	10.01
Guaranteed.	——	5	16	3.25
Found.		5.41	16.01	2.26
Below guarantee.				0.99

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Farmers' Fertilizer Co., Syracuse, N. Y.	Phoenix.	Mexico.	2737
Farmers' Fertilizer Co., Syracuse, N. Y.	Reaper.	Mexico.	2739
Farmers' Fertilizer Co., Syracuse, N. Y.	Soluble bone.	Mexico.	2738
John Finster, Rome, N. Y.	Hometrade eagle bone phosphate.	Rome.	2704
Florida Manufacturing Co., Syracuse, N. Y.	Mortgage lifter, bone and potash.	Potsdam.	2726
Geneva Coal Co., Geneva, N. Y.	Early trucker for onions and cabbage.	Geneva.	2742
Geneva Coal Co., Geneva, N. Y.	Mortgage lifter.	Geneva.	2744
Geneva Coal Co., Geneva, N. Y.	N. Y. standard wheat grower.	Geneva.	2745
Geneva Coal Co., Geneva, N. Y.	Oats and barley special.	Geneva.	2743
Geneva Coal Co., Geneva, N. Y.	Plant food dissolved bone phosphate.	Geneva.	2746
Geneva Coal Co., Geneva, N. Y.	Sixteen per cent. dissolved bone phosphate.	Geneva.	2741

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turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	1.23	5	6	1.62
Found.	1.47	5.18	6.66	2.03
Guaranteed.	1.65	5.50	7.50	4.32
Found.	2.32	5.32	6.88	4.44
Guaranteed.	———	6	7	2.17
Found.		7.42	7.83	1.74
Below guarantee.				0.43
Guaranteed.	0.82	8	9	2
Found.	1.07	7.75	10.81	0.92
Below guarantee.		0.25		1.08
Guaranteed.	———	5	16	3.25
Found.		7.49	16.84	2.68
Below guarantee.				0.57
Guaranteed.	3.30	7	———	8
Found.	3.16	7.77	8.16	8.22
Guaranteed.	0.82	10	———	8
Found.	0.88	10.11	10.64	8.39
Guaranteed.	1.65	9	———	2
Found.	1.82	9.45	10.66	2.31
Guaranteed.	0.82	8	———	4
Found.	0.92	8.74	9.32	4.35
Guaranteed.	———	13	———	3
Found.		12.21	13.43	3.01
Below guarantee.		0.79		
Guaranteed.	———	16	———	———
Found.		16.88	17.13	

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Geneva Coal Co., Geneva, N. Y.	Standard complete potato manure.	Geneva.	2740
Great Eastern Fertilizer Co., Rutland, Vt.	Dissolved bone.	Cuba.	2501
Great Eastern Fertilizer Co., Rutland, Vt.	Great eastern garden special.	Jamaica.	2352
Great Eastern Fertilizer Co., Rutland, Vt.	Great eastern general fertilizer.	Cuba. Westfield. Rhinebeck.	2502 2516 2594
Great Eastern Fertilizer Co., Rutland, Vt.	Northern corn special.	Westfield. Rhinebeck.	2518 2593
Great Eastern Fertilizer Co., Rutland, Vt.	Seeding down phosphate.	Lawrence. Carthage.	2668 2717
Great Eastern Fertilizer Co., Rutland, Vt.	Vegetable, vine and tobacco phosphate.	Riverhead. Westfield. Rhinebeck.	2420 2517 2592
Hallock & Duryee, Mattituck, L. I.	Lupton's cabbage fertilizer.	Mattituck.	2405
Hallock & Duryee, Mattituck, L. I.	Lupton's potato fertilizer.	Mattituck.	2403
Hallock & Duryee, Mattituck, L. I.	Mattituck fertilizer for corn and potatoes.	Mattituck.	2404
Hallock & Duryee, Mattituck, L. I.	No. 1 fertilizer for potatoes and asparagus.	Mattituck.	2402

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turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	2.47	7	——	8
Found.	2.41	7.16	7.81	8.50
Guaranteed.	——	13	——	——
Found.		14.17	15.08	
Guaranteed.	3.29	6	——	8
Found.	3.63	6.64	7.82	8.24
Guaranteed.	0.82	8	——	4
Found.	1.28	8.71	9.33	4.42
Guaranteed.	2.47	8	9	2
Found.	2.97	8.34	9.98	2.36
Guaranteed.	0.82	8	——	4
Found.	1.38	8.24	9.69	4.07
Guaranteed.	2.05	8	9	
Found.	2.27	8.27	9.91	3.25
Below guarantee.				3.36
Guaranteed.	4.10	6	——	6
Found.	4.41	5.88	6.74	6.24
Guaranteed.	3.30	7	——	9
Found.	3.18	6.93	8.02	8.89
Guaranteed.	3.30	5	——	7
Found.	3.43	5.42	5.94	8.07
Guaranteed.	3.30	7	——	9
Found.	4.06	6.08	6.91	11.38
Below guarantee.		0.92		

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Hallock & Duryee, Mattituck, L. I.	No. 2 fertilizer.	Mattituck.	2406
Hallock & Duryee, Mattituck, L. I.	No. 3 fertilizer.	Mattituck.	2407
Hallock & Duryee, Mattituck, L. I.	Special garden.	Mattituck.	2408
Geo. L. Harding, Binghamton, N. Y.	Special potato fertilizer.	Binghamton.	2693
A. L. Harkness, Detroit, Mich.	Unleached wood ashes.	Oneonta.	2676
Isaac C. Hendrickson, Jamaica, L. I.	Acid phosphate.	Jamaica.	2326
Isaac C. Hendrickson, Jamaica, L. I.	High grade fertilizer.	Jamaica.	2324
Isaac C. Hendrickson, Jamaica, L. I.	Long Island fertilizer.	Jamaica.	2325
Isaac C. Hendrickson, Jamaica, L. I.	Odorless phosphate.	Jamaica.	2327
S. M. Hess & Bro., Philadelphia, Pa.	Keystone bone phosphate.	Mattituck.	2410
S. M. Hess & Bro., Philadelphia, Pa.	Potato and truck manure.	Mattituck.	2411

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turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	4.10	6	———	7
Found.	3.98	5.94	6.70	8.50
Guaranteed.	1.60	7.50	———	12
Found.	2.17	7.26	7.49	12.18
Below guarantee.		0.24		
Guaranteed.	3.30	11	———	2
Found.	3.75	10.45	10.87	2.98
Below guarantee.		0.55		
Guaranteed.	3 10	6.25	10.25	4.50
Found.	3.92	7.88	11.32	5.10
Guaranteed.		———	———	5
Found.	———	0.65	1.18	4.48
Below guarantee.				0.52
Guaranteed.		14	———	———
Found.	———	13.76	14.11	
Below guarantee.		0.24		
Guaranteed.	3.25	8	———	7
Found.	3.28	9.91	10.29	5.41
Below guarantee.				1.59
Guaranteed.	2.46	6	———	6
Found.	2.76	4.91	12.16	4.36
Below guarantee.		1.09		1.64
Guaranteed.	———	———	19	———
Found.		6.75	19.29	
Guaranteed.	0.80	10	12	1
Found.	0.80	11.13	12.01	1.27
Guaranteed.	2.47	8	———	6
Found.	2.50	9.50	10.68	5.81

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Imperial Guano Co., Norfolk, Va.	L. I. special for potatoes.	Hollis.	2442
Imperial Guano Co., Norfolk, Va.	Top dressing for spinach.	Hollis.	2441
Lister's Agricultural Chemical Works, Newark, N. J.	Ammoniated dissolved bone phosphate.	Poughkeepsie.	2463
Lister's Agricultural Chemical Works, Newark, N. J.	Animal bone and potash.	Kinderhook.	2416
Lister's Agricultural Chemical Works, Newark, N. J.	Celebrated corn manure.	Laona. Gouverneur.	2543 2730
Lister's Agricultural Chemical Works, Newark, N. J.	Corn fertilizer No. 2.	Orient. Laona. Gouverneur.	2379 2545 2729
Lister's Agricultural Chemical Works, Newark, N. J.	Potato manure.	Jamaica. Orient. Poughkeepsie.	2329 2378 2466
Lister's Agricultural Chemical Works, Newark, N. J.	Special potato fertilizer.	Southampton. Poughkeepsie.	2425 2465
Lister's Agricultural Chemical Works, Newark, N. J.	Standard pure bone superphosphate.	Rhinebeck.	2474
Lister's Agricultural Chemical Works, Newark, N. J.	Success.	Newburg. Laona.	2453 2546
Lister's Agricultural Chemical Works, Newark, N. J.	U. S. superphosphate.	Southampton. Fort Edward.	2424 2635

LECTED IN NEW YORK STATE DURING THE SPRING OF 1896.
turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	3.70	7	9	7
Found.	3.92	6.78	9.44	7.01
Below guarantee.		0.22		
Guaranteed.	8.23	5	7	3
Found.	7.90	5.26	5.94	3.06
Below guarantee.	0.33			
Guaranteed.	1.81	9	11	1.50
Found.	2.12	9.17	12.02	2.17
Guaranteed.	———	9	11	5
Found.		9.57	10.10	4.86
Guaranteed.	3.70	7.50	8.50	7
Found.	3.93	7.57	8.96	7.63
Guaranteed.	1.84	9.25	12	4
Found.	1.86	9.61	11.33	4.03
Guaranteed.	3.70	7.50	8.50	7
Found.	3.82	8.11	9.20	7.14
Guaranteed.	1.65	8	9	3
Found.	1.78	8.88	11.47	3.51
Guaranteed.	2.35	10	12	1.50
Found.	2.30	9.41	12.29	2.43
Below guarantee.		0.59		
Guaranteed.	1.24	9.50	11.50	2
Found.	1.52	10.32	12.60	2.29
Guaranteed.	1.32	7	8	2
Found.	1.75	8.08	10.40	2.71

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Lowell Fertilizer Co., Lowell, Mass.	Bone fertilizer.	Saratoga Springs.	2637
Lowell Fertilizer Co., Lowell, Mass.	Dissolved bone and potash.	Saratoga Springs.	2638
Lowell Fertilizer Co., Lowell, Mass.	Potato phosphate.	Saratoga Springs.	2639
Frederick Ludlam, New York City.	Cereal brand.	Ballston Center.	2650
Frederick Ludlam, New York City.	Dragon's tooth.	Bridgehampton.	2437
Frederick Ludlam, New York City.	Kainit.	Bridgehampton.	2439
Frederick Ludlam, New York City.	Muriate of potash.	East Williston.	2356
Frederick Ludlam, New York City.	Special formula, 5, 8 and 10.	East Williston.	2355
Mapes Formula and Peruvian Guano Co., New York City.	Cabbage and cauliflower manure.	Little Neck.	2362
Mapes Formula and Peruvian Guano Co., New York City.	Cereal brand.	Southampton. Goshen.	2427 2452
Mapes Formula and Peruvian Guano Co., New York City.	Complete manure A brand.	Little Neck. Newburg. Ballston Spa.	2363 2449 2653

LECTED IN NEW YORK STATE DURING THE SPRING OF 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed. Found. Below guarantee.	2.47 2.83	5 9.22	6 12.06	3 2.73 0.27
Guaranteed. Found.	1.64 3.01	6 9.08	7 13.23	2 1.96
Guaranteed. Found.	3.29 3.98	7 11.37	8 13.46	6 6.06
Guaranteed. Found.	0.75 1.13	8 8.58	10 12.24	1 1.58
Guaranteed. Found.	3.29 3.40	7 8.71	—— 11.11	7 7.19
Guaranteed. Found.	——	——	——	11 12.46
Guaranteed. Found.	——	——	——	50 50.25
Guaranteed. Found. Below guarantee.	4.12 4.25	8 7.60 0.40	—— 9.43	10 10.15
Guaranteed. Found.	4.12 4.39	6 6.56	—— 7.92	6 7.64
Guaranteed. Found.	1.64 1.97	6 7.40	8 8.62	3 3.42
Guaranteed. Found.	2.47 2.87	10 9.83	12 12.88	2.50 3.18

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was found.	Station number.
Mapes Formula and Peruvian Guano Co., New York City.	Complete manure for general use.	Newburg.	2448
Mapes Formula and Peruvian Guano Co., New York City.	Corn manure.	Little Neck.	2361
Mapes Formula and Peruvian Guano Co., New York City.	Dissolved bone black.	Mattituck.	2398
Mapes Formula and Peruvian Guano Co., New York City.	Economical manure.	Southampton. Ballston.	2426 2652
Mapes Formula and Peruvian Guano Co., New York City.	Fish scrap.	Mattituck.	2399
Mapes Formula and Peruvian Guano Co., New York City.	Long Island special.	Little Neck.	2360
Mapes Formula and Peruvian Guano Co., New York City.	Potato manure.	Goshen.	2451
Mapes Formula and Peruvian Guano Co., New York City.	Pure ground bone.	Newburg.	2450
Mapes Formula and Peruvian Guano Co., New York City.	Sylvinit.	Westfield.	2515
Michigan Carbon Works, Detroit, Mich.	Desiccated bone.	Fredonia.	2542
Michigan Carbon Works, Detroit, Mich.	Homestead bone black.	Fillmore. Dunkirk.	2480 2526

lected in New York State During the Spring of 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	3.29	8	——	4
Found.	4.14	7.83	10.86	5.49
Guaranteed.	2.47	8	10	6
Found.	2.62	9.27	11.21	6.44
Guaranteed.	——	15	17	——
Found.		16.75	16.75	
Guaranteed.	2.47	6	8	8
Found.	2.47	6.87	9.31	8.56
Guaranteed.	8.23	——	6	——
Found.	8.64	4.67	7.51	
Guaranteed.	3.29	——	6	7
Found.	3.69	5.62	7.65	7.83
Guaranteed.	3.71	8	——	6
Found.	3.96	7.96	10.25	7.42
Guaranteed.	2.88	——	24	——
Found.	4.23	3.23	23.85	
Guaranteed.	——	——	——	18.80
Found.				18.57
Below guarantee.				0.23
Guaranteed.	1.23	——	25	——
Found.	1.64	14.41	30.23	
Guaranteed.	1.85	8	8.50	1.50
Found.	2.22	9.69	10.86	2.15

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Michigan Carbon Works, Detroit, Mich.	Jarves' drill phosphate.	Fillmore.	2479
Milsom Rendering and Fertilizer Co., East Buffalo, N. Y.	Bean special.	Boonville.	2713
Milsom Rendering and Fertilizer Co., East Buffalo, N. Y.	Buckwheat special.	Fort Edward.	2633
Milsom Rendering and Fertilizer Co., East Buffalo, N. Y.	Buffalo fertilizer.	Fredonia. West Lawrence.	2541 2664
Milsom Rendering and Fertilizer Co., East Buffalo, N. Y.	Buffalo guano.	Fort Edward Boonville.	2632 2712
Milsom Rendering and Fertilizer Co., East Buffalo, N. Y.	Cyclone pure bone meal.	Fredonia. Altamont.	2539 2627
Milsom Rendering and Fertilizer Co., East Buffalo, N. Y.	Dissolved bone.	Westfield.	2511
Milsom Rendering and Fertilizer Co., East Buffalo, N. Y.	Dissolved bone potash.	Mexico.	2736
Milsom Rendering and Fertilizer Co., East Buffalo, N. Y.	Potato, hop and tobacco phosphate.	Southold.	2385
Milsom Rendering and Fertilizer Co., East Buffalo, N. Y.	Vegetable bone fertilizer.	Boonville.	2714
Milsom Rendering and Fertilizer Co., East Buffalo, N. Y.	Wheat, oats and barley phosphate.	Westfield. Fredonia. Fort Edward.	2512 2540 2634

LECTED IN NEW YORK STATE DURING THE SPRING OF 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	1.03	8	10	———
Found.	1.52	9.30	10.57	
Guaranteed.	0.82	10	11	4
Found.	0.99	8.06	9.93	1.09
Below guarantee.		1.94		2.91
Guaranteed.	0.82	7	9	1.08
Found.	1.24	7.05	9.11	1.18
Guaranteed.	1.85	8	10	1.50
Found.	2.02	8.06	10.25	1.30
Guaranteed.	0.82	8	9	4
Found.	1.33	7.80	10.10	3.46
Below guarantee.				0.54
Guaranteed.	2.47	———	22	———
Found.	3.48	9.34	23.39	
Guaranteed.	———	11	12.37	———
Found.		9.25	9.78	
Below guarantee.		1.75		
Guaranteed.	———	9	11	1.65
Found.		7.70	8.48	1.36
Below guarantee.		1.30		0.29
Guaranteed.	2.46	8	9	6
Found.	2.43	8.21	8.79	6.26
Guaranteed.	4.10	8	9	5
Found.	3.63	9.20	9.60	5.26
Below guarantee.	0.47			
Guaranteed.	1.23	8	9	2
Found.	1.41	7.57	9.58	1.85
Below guarantee.		0.43		

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Mittenmaier & Son, Rome, N. Y.	Pride of America.	Rome.	2703
Moller & Co., Maspeth, L. I.	Champion No. 1 pure bone.	Flushing.	2359
National Fertilizer Co., Bridgeport, Conn.	Complete fertilizer.	East Marion. Southold. Mattituck.	2374 2386 2394
National Fertilizer Co., Bridgeport, Conn.	Fish and potash.	Mattituck.	2395
National Fertilizer Co., Bridgeport, Conn.	Market garden fertilizer.	Mattituck.	2396
National Fertilizer Co., Bridgeport, Conn.	Potato phosphate.	Mattituck.	2397
National Fertilizer Co., Bridgeport, Conn.	Root fertilizer.	Queens.	2349
Natural Plant Food Co., Washington, D. C.	Natural plant food.	Fayetteville.	2556
Natural Plant Food Co., Washington, D. C.	Natural plant food.	Saratoga Springs.	2643
Natural Plant Food Co., Washington, D. C.	Natural plant food.	Gouverneur.	2728
Niagara Fertilizer Co., Buffalo, N. Y.	Grain and grass grower.	Cuba.	2498

LECTED IN NEW YORK STATE DURING THE SPRING OF 1896.
turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	1	6	———	1
Found.	1.77	5.24	8.41	3.23
Below guarantee.		0.76		
Guaranteed.	3.29	6	7	6
Found.	3.38	6.23	7.45	6.81
Guaranteed.	3.30	8	10	6
Found.	3.51	8.89	9.71	5.85
Guaranteed.	2.88	———	8	4
Found.	3.63	4.84	7.45	5.57
Guaranteed.	2.47	7	9	6
Found.	2.50	6.74	9.03	6.33
Below guarantee.		0.26		
Guaranteed.	2.06	6	8	8
Found.	2.40	5.44	7.86	8.72
Below guarantee.		0.56		
Guaranteed.	3.30	8	10	6
Found.	3.50	9.01	10.05	5.78
Below guarantee.				0.22
Guaranteed.	———	———	21.60	1
Found.		2.22	26.09	0.11
Below guarantee.				0.89
Guaranteed.	———	———	21.60	1
Found.		1.06	20.02	0.17
Below guarantee.			1.58	0.83
Guaranteed.	———	———	21.60	1
Found.		0.93	20.53	0.12
Below guarantee.			1.07	0.88
Guaranteed.	0.82	7	8	1.08
Found.	0.89	7.16	10.86	1.12

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Niagara Fertilizer Co., Buffalo, N. Y.	Wheat and corn grower.	Cuba.	2497
Niagara Fertilizer Co., Buffalo, N. Y.	Potato, hop and tobacco fertilizer.	Cuba. Carlisle. Boonville.	2496 2662 2715
Oakfield Fertilizer Co., Buffalo, N. Y.	Domestic.	Oakfield.	2584
Oakfield Fertilizer Co., Buffalo, N. Y.	Golden sheaf.	Oakfield.	2585
Oakfield Fertilizer Co., Buffalo, N. Y.	Great value.	Fredonia. Oakfield.	2531 2586
Oakfield Fertilizer Co., Buffalo, N. Y.	High farming.	Oakfield.	2583
Oakfield Fertilizer Co., Buffalo, N. Y.	Potato and tobacco.	Oakfield. Fredonia.	2588 2529
Oakfield Fertilizer Co., Buffalo, N. Y.	Pure ground bone.	Oakfield.	2589
Oakfield Fertilizer Co., Buffalo, N. Y.	Special corn and wheat manure	Oakfield.	2587
Oakfield Fertilizer Co., Buffalo, N. Y.	Special vine fertilizer.	Fredonia.	2532
Oakfield Fertilizer Co., Buffalo, N. Y.	Standard fertilizer.	Fredonia. Oakfield.	2530 2582

LECTED IN NEW YORK STATE DURING THE SPRING OF 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	1.23	8	——	2.16
Found.	1.40	8.31	10	2.68
Guaranteed.	1.64	8	9	2.70
Found.	1.82	8.13	9.60	3.29
Guaranteed.	1.64	8	9	1.08
Found.	1.82	9.03	9.77	1.44
Guaranteed.	1.23	7	8	1.89
Found.	1.37	8.05	8.43	1.98
Guaranteed.	0.82	6	7	1.08
Found.	0.82	7.12	7.51	1.41
Guaranteed.	1.85	8.50	9.50	2.43
Found.	1.91	8.58	9.47	2.47
Guaranteed.	2.47	6	7	4.32
Found.	2.51	6.37	7.56	4.50
Guaranteed.	3.28	——	25	——
Found.	3.96	3.86	24.69	
Below guarantee.			0.31	
Guaranteed.	3.70	7	8	6
Found.	3.80	8.64	9.01	6.98
Guaranteed.	2.05	6	7	5.40
Found.	2.19	7.07	7.81	5.54
Guaranteed.	2.47	10	11	1.62
Found.	2.41	10.15	10.65	2.18

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Oneonta Fertilizer and Chemical Co., Oneonta, N. Y.	A. A. brand.	Oneonta.	2682
Oneonta Fertilizer and Chemical Co., Oneonta, N. Y.	Buckwheat fertilizer.	Oneonta.	2686
Oneonta Fertilizer and Chemical Co., Oneonta, N. Y.	Complete potato manure.	Oneonta.	2681
Oneonta Fertilizer and Chemical Co., Oneonta, N. Y.	Economical manure.	Oneonta.	2685
Oneonta Fertilizer and Chemical Co., Oneonta, N. Y.	Fruit and vine fertilizer.	Oneonta.	2683
Oneonta Fertilizer and Chemical Co., Oneonta, N. Y.	Grass and grain top dressing.	Oneonta.	2684
Oneonta Fertilizer and Chemical Co., Oneonta, N. Y.	Runk's complete corn manure.	Oneonta.	2674
Oneonta Fertilizer and Chemical Co., Oneonta, N. Y.	Standard superphosphate.	Oneonta.	2687
Pacific Guano Co., New York City.	Ammoniated dissolved bone.	Fillmore.	2477
Pacific Guano Co., New York City.	A No. 1 phosphate.	Cuba. North Franklyn.	2493 2672
Pacific Guano Co., New York City.	Fine ground bone.	Fillmore.	2478

lected in New York State During the Spring of 1896.
turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	2.47	10	12	2.50
Found.	2.41	8.95	10.83	3.33
Below guarantee.		1.05		
Guaranteed.	1.65	5	6	1
Found.	1.55	4.47	5.40	2.01
Below guarantee.		0.53		
Guaranteed.	3.70	7.50	8	7
Found.	3.52	8.54	9.54	6.62
Below guarantee.				0.38
Guaranteed.	1.65	5	6	5
Found.	1.82	5.15	6.80	4.95
Guaranteed.	1.65	5.50	7	10
Found.	1.95	6.72	8.36	11.17
Guaranteed.	4.10	5	7	5
Found.	4.40	5.34	6.95	5.41
Guaranteed.	3.70	7	9	6
Found.	3.65	6.68	7.85	6.16
Below guarantee.		0.32		
Guaranteed.	1.65	7	——	3
Found.	2.46	6.83	7.97	3.65
Guaranteed.	1.65	9	10	2
Found.	2.07	9.44	11.88	2.16
Guaranteed.	1.03	7	8	1.50
Found.	1.06	8.09	10.68	1.50
Guaranteed.	1.65	——	14	——
Found.	1.99	5.72	18.82	

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Pacific Guano Co., New York City.	Nobsque guano.	Fillmore. North Franklyn.	2476 2671
Pacific Guano Co., New York City.	Special potato manure.	Lowville.	2716
Packers' Union Fertilizer Co., New York City.	Animal corn fertilizer.	Southold.	2384
Packers' Union Fertilizer Co., New York City.	Potato manure.	Southold.	2380
Packers' Union Fertilizer Co., New York City.	Special potato fertilizer.	Southold.	2382
Packers' Union Fertilizer Co., New York City.	Vegetable compound.	Southold.	2381
Packers' Union Fertilizer Co., New York City.	Wheat, oats and clover fertilizer.	Southold.	2383
J. M. Pearson, Hudson, N. Y.	Emendo.	Hudson.	2601 2603
J. M. Pearson, Hudson, N. Y.	Ground bone.	Hudson.	2602
A. Peterson, Penfield, N. Y.	Farmers' benefit.	Penfield.	2575
A. Peterson, Penfield, N. Y.	Penfield standard fertilizer.	Penfield.	2574

lected in New York State During the Spring of 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	1.15	8	9	2
Found.	1.29	7.62	11.39	2.16
Below guarantee.		0.38		
Guaranteed.	2.47	5	7	5
Found.	2.92	5.77	7.32	5.63
Guaranteed.	2.47	8	9	2
Found.	2.49	8.65	10.08	2.41
Guaranteed.	2.06	8	9	6
Found.	2.67	9.25	9.97	5.59
Below guarantee.				0.41
Guaranteed.	1.65	8	9	3
Found.	1.73	8.77	11.30	3.25
Guaranteed.	3.70	7.75	8.75	7
Found.	3.77	8.51	9.35	7.40
Guaranteed.	——	11	——	2
Found.		11.45	12.15	2.21
Guaranteed.	0.82	6	8	2
Found.	1.90	6.54	9.33	2.93
Guaranteed.	2	——	7	——
Found.	3.70	5.94	18.35	
Guaranteed.	1.25	6	——	2
Found.	2.74	9.90	14.18	3.80
Guaranteed.	2.25	8	12	4
Found.	2.94	9.71	13.41	5.70

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Wm. W. Phipps, Albion, N. Y.	Dried blood.	Albion.	2581
Wm. W. Phipps, Albion, N. Y.	Eagle brand ammoniated dissolved bone.	Albion.	2579
Wm. W. Phipps, Albion, N. Y.	Eagle brand for potatoes, corn fruit and vine.	Albion.	2578
Wm. W. Phipps, Albion, N. Y.	Eagle brand superphosphate with potash.	Albion.	2580
B. J. Pine, East Williston, L. I.	Star raw bone superphosphate.	East Williston.	2354
Powers & Gibbs, Wilmington, N. C.	Special small grain guano.	Saratoga Springs.	2642
Preston Fertilizer Co., Greenpoint, L. I.	Ammoniated bone superphosphate.	Jamaica.	2350
Preston Fertilizer Co., Greenpoint, L. I.	Cabbage and cauliflower fertilizer.	Jamaica.	2340
Preston Fertilizer Co., Greenpoint, L. I.	Pioneer.	Poughkeepsie. Claverack.	2460 2611
Preston Fertilizer Co., Greenpoint, L. I.	Potato, hop and onion fertilizer.	Poughkeepsie. Poughkeepsie.	2458 2461
Preston Fertilizer Co., Greenpoint, L. I.	Special for potatoes and general garden use.	Jamaica. Poughkeepsie.	2341 2459

LECTED IN NEW YORK STATE DURING THE SPRING OF 1896.
turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	14.35			
Found.	13.82	———	———	———
Below guarantee.	0.53			
Guaranteed.	1.64	11	———	2
Found.	1.37	12.47	14.78	2.08
Below guarantee.	0.27			
Guaranteed.	2.47	9	———	7
Found.	2.19	9.59	11.34	6.45
Below guarantee.	0.28			0.55
Guaranteed.	———	13	———	2
Found.		13.80	16.26	2.17
Guaranteed.	2.47	6	8	7
Found.	2.76	6.71	7.98	8.50
Guaranteed.	0.82	8	———	2
Found.	1.99	8.03	10.65	2.02
Guaranteed.	2.47	9	———	2
Found.	2.82	9.10	14.07	2.45
Guaranteed.	3.29	5	———	7
Found.	3.44	6.77	10.58	7.77
Guaranteed.	1.44	10	———	1.75
Found.	2.81	9.09	15.18	2.29
Below guarantee.		0.91		
Guaranteed.	2.47	6	———	6
Found.	2.94	4.70	10.65	6.11
Below guarantee.		1.30		
Guaranteed.	3.29	5	———	10
Found.	3.36	5.06	9.46	9.73
Below guarantee.				0.27

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Preston Fertilizer Co., Greenpoint, L. I.	XXV brand.	Poughkeepsie. Claverack.	2457 2606
Quinnipiac Co., New York City.	Ammoniated dissolved bone.	Birchton.	2657
Quinnipiac Co., New York City.	Bone meal.	Birchton.	2654
Quinnipiac Co., New York City.	Climax phosphate.	Dunkirk. Birchton.	2527 2655
Quinnipiac Co., New York City.	Fish and potash—crossed fishes.	Jamesport.	2413
Quinnipiac Co., New York City.	Fish, bone and potash.	Cuba.	2499
Quinnipiac Co., New York City.	Mohawk fertilizer.	Cuba.	2500
Quinnipiac Co., New York City.	Market garden manure.	Queens.	2348
Quinnipiac Co., New York City.	Potato manure.	Southold.	2371
Quinnipiac Co., New York City.	Soluble dissolved bone.	Birchton.	2656
Read Fertilizer Co., New York City.	Dissolved bone.	Syracuse.	2564

lected in New York State During the Spring of 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	1.03	8	——	1
Found.	1.80	8.56	14.35	1.35
Guaranteed.	1.65	9	10	2
Found.	1.86	8.74	12.20	2.25
Below guarantee.		0.26		
Guaranteed.	2.48	——	20	——
Found.	2.67	4.98	22.64	
Guaranteed.	1.03	8	9	2
Found.	1.37	9.09	10.75	2.14
Guaranteed.	3.30	3	5	3
Found.	3.13	2.84	6.29	3.55
Guaranteed.	1.64	9	10	1
Found.	1.72	9.01	12.20	1.31
Guaranteed.	0.82	7	8	1
Found.	0.97	7.78	9.26	1.17
Guaranteed.	3.30	8	9	7
Found.	4.02	8.89	11.09	7.52
Guaranteed.	2.50	6	7	5
Found.	2.65	5.60	8.52	6.33
Below guarantee.		0.40		
Guaranteed.	——	12	13	——
Found.		14.60	15.66	
Guaranteed.	——	12	14	——
Found.		11.09	13.85	
Below guarantee.		0.91		

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Read Fertilizer Co., New York City.	High grade farmers' friend fertilizer.	Peconic. Mattituck.	2388 2393
Read Fertilizer Co., New York City.	Fish and potash.	Syracuse.	2568
Read Fertilizer Co., New York City.	Nitrate of soda.	Syracuse.	2561
Read Fertilizer Co., New York City.	Potato special.	Syracuse.	2565
Read Fertilizer Co., New York City.	Practical potato special.	Fayetteville. Philadelphia.	2566 2723
Read Fertilizer Co., New York City.	Standard fertilizer.	Mellinville.	2604
Read Fertilizer Co., New York City.	Sylvinit.	Syracuse.	2563
Read Fertilizer Co., New York City.	Vegetable and vine fertilizer.	Syracuse. Bainbridge.	2567 2691
John S. Reese & Co., Baltimore, Md.	Challenge crop grower.	Binghamton.	2697
John S. Reese & Co., Baltimore, Md.	Crown phosphate and potash.	Cuba. Fort Edward. Binghamton.	2494 2631 2696
John S. Reese & Co., Baltimore, Md.	Elm phosphate.	Carthage.	2719

LECTED IN NEW YORK STATE DURING THE SPRING OF 1896.
turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	3.30	7	——	7
Found.	3.51	7.85	9.04	7.21
Guaranteed.	2.47	4	——	4
Found.	2.52	5.17	6.64	4.38
Guaranteed.	14.80	——	——	——
Found.	15.59			
Guaranteed.	2.47	7	8	10
Found.	2.47	7.34	7.95	10.13
Guaranteed.	0.82	4	5	8
Found.	1.13	4.66	5.34	8.18
Guaranteed.	0.82	8	10	4
Found.	0.99	8.39	9.53	4.18
Guaranteed.	——	——	——	15
Found.				17.54
Guaranteed.	1.65	6	7	8
Found.	1.96	7.01	7.84	8.88
Guaranteed.	0.82	8	——	2
Found.	1.07	9.68	10.94	2.57
Guaranteed.		12	13	2
Found.	——	13.84	14.93	1.82
Guaranteed.		14	——	——
Found.	——	15.38	16.17	

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
John S. Reese & Co., Baltimore, Md.	Pilgrim fertilizer.	Fort Edward. Binghamton.	2629 2702
John S. Reese & Co., Baltimore, Md.	Potato phosphate.	Cuba.	2495
John S. Reese & Co., Baltimore, Md.	Potato special.	Fort Edward.	2630
L. Sanderson, New Haven, Conn.	Early cabbage fertilizer.	Jamaica.	2335
L. Sanderson, New Haven, Conn.	Early potato fertilizer.	Jamaica.	2336
Schaal Bros., Erie, Pa.	Pure ground bone.	Dunkirk.	2528
M. L. Shoemaker & Co., Philadelphia, Pa.	Bone meal.	Riverhead.	2389
M. L. Shoemaker & Co., Philadelphia, Pa.	Superphosphate.	Greenport.	2367
M. L. Shoemaker & Co., Philadelphia, Pa.	Superphosphate for potatoes.	Greenport.	2368
Isaac Smith, Stockport, N. Y.	Dissolved bone.	Columbiaville.	2614
Isaac Smith, Stockport, N. Y.	Ground bone.	Columbiaville.	2615

LECTED IN NEW YORK STATE DURING THE SPRING OF 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	1.23	6.50	7.50	3
Found.	1.39	8.93	14.43	3.15
Guaranteed.	2.06	8.50	9.50	6
Found.	1.70	9.03	11.65	5.18
Below guarantee.	0.36			0.82
Guaranteed.	2.88	6.50	———	7.50
Found.	3.41	7.58	8.64	7.89
Guaranteed.	4.11	5	8	5
Found.	3.38	7.23	9.82	5.42
Below guarantee.	0.73			
Guaranteed.	7.40	5	8	5
Found.	6.57	6.50	9.20	5.25
Below guarantee.	0.83			
Guaranteed.	2.47	———	20	———
Found.	4.09	7.53	21.70	
Guaranteed.	4.12	———	20.50	
Found.	5.51	7	21.10	———
Guaranteed.	2.47	9	———	4
Found.	2.88	9.11	13.40	4.97
Guaranteed.	2.47	8	11	6
Found.	2.92	7.84	13.48	7.02
Guaranteed.	3.24	12.39	16.37	
Found.	4.22	9.33	15.98	———
Below guarantee.		3.06		
Guaranteed.	2.28	———	16	———
Found.	3.78	6.60	17.25	

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Isaac Smith, Stockport, N. Y.	Potato fertilizer.	Columbiaville.	2613
Isaac Smith, Stockport, N. Y.	Superphosphate.	Columbiaville.	2612
Standard Fertilizer Co., Boston, Mass.	"A" brand.	Ballston Spa.	2645
Standard Fertilizer Co., Boston, Mass.	Bone and potash.	Carthage.	2722
Standard Fertilizer Co., Boston, Mass.	Guano.	Rhinebeck. Ballston Spa.	2475 2641
Standard Fertilizer Co., Boston, Mass.	Potato and tobacco fertilizer.	Ballston Spa.	2646
Sterling Oil Co., Promised Land, L. I.	Fish scrap.	Riverhead.	2421
H. Stappenbeck, Utica, N. Y.	Bone meal.	Utica.	2706
H. Stappenbeck, Utica, N. Y.	Home trade bone superphosphate.	Utica.	2705
H. Stappenbeck, Utica, N. Y.	Hop, fruit and vegetable fertilizer.	Utica.	2707
Swift & Co., Chicago, Ill.	Bone and potash.	Cuba. Fayetteville.	2491 2560

lected in New York State During the Spring of 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	2.46	5.67	7.84	6.53
Found.	2.58	5.48	8.06	4.81
Below guarantee.				1.72
Guaranteed.	2.68	6.51	9	1.91
Found.	2.64	6.34	8.80	1.69
Below guarantee.				0.22
Guaranteed.	0.82	7	9	1
Found.	1.38	8.12	10.37	2.09
Guaranteed.	———	8	10	2.50
Found.		11.09	14.18	2.04
Below guarantee.				0.46
Guaranteed.	1	8	10	2
Found.	1.37	8.19	10.25	2.25
Guaranteed.	2.05	8	9	3
Found.	2.28	8.73	11.93	3.24
Guaranteed.	8.20	———	6	———
Found.	8.21	3.36	6.66	
Guaranteed.	3.29	———	19	———
Found.	4.15	7.85	19.95	
Guaranteed.	2.05	10	———	2
Found.	2.59	10.60	12.06	2.74
Guaranteed.	2.05	9	———	6
Found.	2.25	10.36	11.95	6.68
Guaranteed.	2	———	24.50	3
Found.	2.65	6.76	24.90	3.32

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Swift & Co., Chicago, Ill.	Bone tankage and potash.	Cuba. Fayetteville.	2492 2559
Swift & Co., Chicago, Ill.	Ground steamed bone.	Westfield. Oneonta.	2514 2680
Swift & Co., Chicago, Ill.	Pure bone tankage.	Fredonia.	2536
Swift & Co., Chicago, Ill.	Pure raw bone meal.	Cuba. Westfield. Oneonta.	2490 2513 2679
I. P. Thomas & Son, Philadelphia, Pa.	Farmer's choice bone phosphate.	Calverton.	2418
I. P. Thomas & Son, Philadelphia, Pa.	Potato fertilizer.	Orient.	2377
I. P. Thomas & Son, Philadelphia, Pa.	Potato manure.	Greenport. Binghamton.	2372 2700
I. P. Thomas & Son, Philadelphia, Pa.	Potato and tomato manure.	Binghamton.	2701
I. P. Thomas & Son, Philadelphia, Pa.	S. C. phosphate	Binghamton.	2694
I. P. Thomas & Son, Philadelphia, Pa.	Tip top raw bone superphosphate.	Binghamton.	2698
E. Tuthill & Son, Promised Land, L. I.	Cutchogue club fertilizer.	Cutchogue.	2392

LECTED IN NEW YORK STATE DURING THE SPRING OF 1896.
turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	4.94	——	17	6
Found.	4.67	6.58	15.78	5.53
Below guarantee.	0.27			0.47
Guaranteed.	3.25	——	23.75	——
Found.	2.85	9.35	25.89	
Below guarantee.	0.40			
Guaranteed.	4.94	——	17	——
Found.	5.73	6.24	16.06	
Guaranteed.	3.75	——	23	
Found.	4	6.19	25.10	——
Guaranteed.	1.64	9.50	10	2
Found.	1.64	9.78	11.47	3.82
Guaranteed.	3.30	5	6.25	10
Found.	4.35	6.38	6.38	10.96
Guaranteed.	2.47	9	10	6
Found.	2.48	9.11	10.44	6.01
Guaranteed.	2	9	10.50	6
Found.	2.84	4.59	5.66	6.68
Below guarantee.		4.41		
Guaranteed.	——	13	14	——
Found.		13.85	15.95	
Guaranteed.	2.47	10	13	2.75
Found.	2.97	11.22	12.23	3.51
Guaranteed.	4.12	8	——	10
Found.	4.38	7.22	8.23	10.13
Below guarantee.		0.78		

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
E. Tuthill & Son, Promised Land, L. I.	E. T. & Co.'s special.	Southold.	2387
E. Tuthill & Son, Promised Land, L. I.	Kainit.	Baiting Hollow.	2419
E. Tuthill & Son, Promised Land, L. I.	Jones' special potato.	Promised Land.	2435
E. Tuthill & Son, Promised Land, L. I.	Nitrate of soda.	Jamesport.	2414
E. Tuthill & Son, Promised Land, L. I.	No. 1 fertilizer.	Promised Land.	2434
E. Tuthill & Son, Promised Land, L. I.	No. 2 fertilizer.	Promised Land.	2432
E. Tuthill & Son, Promised Land, L. I.	No. 3 fertilizer.	Promised Land.	2430
E. Tuthill & Son, Promised Land, L. I.	No. 4 fertilizer.	Promised Land.	2433
E. Tuthill & Son, Promised Land, L. I.	Reeve special.	Mattituck.	2412
E. Tuthill & Son, Promised Land, L. I.	Riverhead Club fertilizer.	Greenport. Promised Land.	2373 2436
E. Tuthill & Son, Promised Land, L. I.	Special fertilizer.	Mattituck.	2409

lected in New York State During the Spring of 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	4.12	8	—	10
Found.	4.05	5.85	7.57	12.24
Below guarantee.		2.15		
Guaranteed.	—	—	—	12
Found.				11.70
Below guarantee.				0.30
Guaranteed.	4.12	8	—	10
Found.	3.81	8.08	8.35	9.84
Below guarantee.	0.31			
Guaranteed.	15.50	—	—	—
Found.	15.48			
Guaranteed.	4.12	8	—	10
Found.	4.91	7.11	8.18	9.85
Below guarantee.		0.89		
Guaranteed.	4.12	5	—	7
Found.	4.03	4.08	5.62	8.12
Below guarantee.		0.92		
Guaranteed.	3.30	7	—	9
Found.	3.38	6.39	7.30	9.28
Below guarantee.		0.61		
Guaranteed.	3.30	7	—	7
Found.	3.36	6.74	7.50	7.74
Below guarantee.		0.26		
Guaranteed.	2.47	10	—	6
Found.	2.21	10.20	10.96	7.12
Below guarantee.	0.26			
Guaranteed.	4.12	8	—	10
Found.	4.38	7.91	8.79	10.21
Guaranteed.	4.12	8	—	10
Found.	4.17	5.29	7.53	10.55
Below guarantee.		2.71		

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
E. Tuthill & Son, Promised Land, L. I.	Wines and Lupton special.	Promised Land.	2431
Tygert-Allen Fertilizer Co., Philadelphia, Pa.	Cabbage manure.	Hollis.	2346
Tygert-Allen Fertilizer Co., Philadelphia, Pa.	Potato manure.	Hollis.	2347
Tygert-Allen Fertilizer Co., Philadelphia, Pa.	Ten per cent. guano.	Hollis.	2345
M. E. Wheeler & Co., Rutland, Vt.	Corn fertilizer.	Cobleskill.	2660
M. E. Wheeler & Co., Rutland, Vt.	Electrical dissolved bone.	Cobleskill.	2658
M. E. Wheeler & Co., Rutland, Vt.	Grass and oats fertilizer.	Cobleskill.	2659
M. E. Wheeler & Co., Rutland, Vt.	Potato manure.	Cobleskill.	2673
M. E. Wheeler & Co., Rutland, Vt.	Royal wheat grower.	Cobleskill.	2661
Williams & Clark Fertilizer Co., New York City.	Dissolved bone and potash.	Bainbridge.	2690
Williams & Clark Fertilizer Co., New York City.	Potato phosphate.	Jamaica. Riverhead. Stuyvesant.	2331 2390 2622

lected in New York State During the Spring of 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	4.12	8	——	10
Found.	3.19	8.16	8.80	10.51
Below guarantee.	0.93			
Guaranteed.	3.30	7	——	5
Found.	3.38	8.28	8.67	5.37
Guaranteed.	3.30	6	9	9
Found.	3.33	7.43	8.15	8.69
Below guarantee.				0.31
Guaranteed.	7.40	5	8	5
Found.	7.40	6.19	7.24	5.31
Guaranteed.	1.64	8	9	2
Found.	1.85	10.23	11.68	2.33
Guaranteed.	——	13	15	——
Found.		14.22	15.82	
Guaranteed.		11	12	2
Found.	——	10.60	13.24	2.43
Below guarantee.		0.40		
Guaranteed.	2.05	8	9	3.25
Found.	2.18	7.85	10.88	3.90
Guaranteed.	0.82	8	9	2
Found.	0.94	11.42	12.53	2.52
Guaranteed.	2.50	6	7	6
Found.	2.74	6.09	8.50	6.05
Guaranteed.	2.47	6	7	6
Found.	2.74	6.09	8.52	6.06

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Williams & Clark Fertilizer Co., New York City.	Prolific crop producer.	Hudson. Bainbridge.	2600 2689
Williams & Clark Fertilizer Co., New York City.	Royal bone phosphate.	Jamaica. Hudson. Bainbridge.	2332 2598 2688
Williams & Clark Fertilizer Co., New York City.	Special for corn.	Rhinecliff.	2597
Zell Fertilizer Co., Baltimore, Md.	Economizer.	Westfield.	2519
Zell Fertilizer Co., Baltimore, Md.	Fruit tree invigorator.	Westfield.	2524
Zell Fertilizer Co., Baltimore, Md.	Genesee fertilizer.	Westfield.	2522
Zell Fertilizer Co., Baltimore, Md.	Pure dissolved animal bone.	Westfield.	2520
Zell Fertilizer Co., Baltimore, Md.	Special compound for potatoes.	Westfield.	2523
Zell Fertilizer Co., Baltimore, Md.	Sulphate of potash.	Westfield.	2521
Zell Fertilizer Co., Baltimore, Md.	Wilson's special No. 2.	LeRoy.	*2184
Zell Fertilizer Co., Baltimore, Md.	Wilson's special No. 3.	East Avon.	*2295

* Corrected from Bulletin 96.

LECTED IN NEW YORK STATE DURING THE SPRING OF 1896.
turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed. Found.	0.82 1.06	6 6.72	7 9.21	1 1.31
Guaranteed. Found.	1.05 1.40	7 8.32	8 10.91	2 2.08
Guaranteed. Found.	3.95 4.02	8 8.49	—— 10.50	7 7.41
Guaranteed. Found.	0.82 1.06	9 10.17	11 12.24	2 2.27
Guaranteed. Found. Below guarantee.	——	10 10.30	12 12.64	8 7.72 0.28
Guaranteed. Found.	2.05 2.08	8 9.30	10 11.03	2 2.26
Guaranteed. Found.	1.65 1.90	14 15.74	15 16.24	——
Guaranteed. Found.	2.45 2.55	8 9.19	10 10.33	4 4.54
Guaranteed. Found.	——	——	——	26 26.22
Guaranteed. Found.	——	10 9.88	12 12.86	4 4.45
Guaranteed. Found.	——	14 14.29	15 15.71	——

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Not given.	Newbold's profitable business fertilizer.	Southold.	2369
Not given.	Newbold's summer King fertilizer.	Southold.	2370
Not given.	Wells & Hudson's high grade fertilizer.	Riverhead.	2391
Not given.	Clark's harmony.	Laona.	2547
Not given.	Russell's potato manure.	Jamaica.	2328

LECTED IN NEW YORK STATE DURING THE SPRING OF 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	3.29	7	9	6
Found.	3.30	7.81	11.84	6.18
Guaranteed.	3.29	7	9	7
Found.	3.13	9.28	11.44	6.47
Below guarantee.				0.53
Guaranteed.	3.29	7	9	7
Found.	3.46	9.43	11.09	7.24
Guaranteed.	0.82	9	10	2.25
Found.	0.95	9.83	11.29	2.46
Guaranteed.	3.70	7.50	———	7
Found.	3.79	7.84	9.75	7.59

VII. REPORT OF ANALYSES OF COMMERCIAL FERTILIZERS FOR THE FALL OF 1896.*

SUMMARY.

1. Samples Collected. During the fall of 1896 the Station collected 326 samples of commercial fertilizers, representing 261 different brands. Of these different brands, 174 were complete fertilizers; of the others, 35 contained phosphoric acid and potash without nitrogen; 17 contained nitrogen and phosphoric acid without potash; 26 contained phosphoric acid alone; 5, potash salts only; and 4, nitrogen compounds alone.

2. Nitrogen. The 174 brands of complete fertilizers contained nitrogen varying in amount from 0.51 to 6.30 per cent and averaging 1.82 per cent. The average amount of nitrogen found by the Station analysis exceeded the average amount guaranteed by 0.11 per cent, the average guaranteed being 1.71 per cent and the average found being 1.82 per cent.

In 124 brands of complete fertilizers, the amount of nitrogen found was equal to or above the amount guaranteed, the excess varying from 0.01 to 2.11 per cent and averaging 0.26 per cent.

In 50 brands, the nitrogen was below the guaranteed amount, the deficiency varying from 0.01 to 1.98 per cent and averaging 0.14 per cent. In 39 cases, the deficiency was less than 0.25 per cent; in eight cases, less than 0.50 and over 0.25; in one case, it was over 0.50 and below one per cent; and in two cases, it was over one and below two per cent.

3. Available Phosphoric Acid. The 174 brands of complete fertilizers contained available phosphoric acid varying in amount from 3.22 to 15.70 per cent and averaging 8.54 per cent. The average amount of available phosphoric acid found by the Station analysis exceeded the average amount guaranteed by 0.72 per cent, the average guaranteed being 7.82 per cent and the average found being 8.54 per cent.

* Published also as Bulletin No. 116.

In 120 brands of complete fertilizers, the amount of available phosphoric acid found was above the amount guaranteed, the excess varying from 0.02 to 4.33 per cent and averaging one per cent.

In 52 brands, the available phosphoric acid was below the guaranteed amount, the deficiency varying from 0.01 to 2.10 per cent and averaging 0.46 per cent. In 25 of these cases, the deficiency was below 0.25 per cent; in 10 cases, it was above 0.25 and below 0.50 per cent; in 12 cases it was above 0.50 below one per cent; in one case, it was above two and below three per cent.

4. Potash. The complete fertilizers contained potash varying in amount from 0.36 to 14.65 per cent and averaging 4.16 per cent. The average amount of potash found by the Station analysis exceeded the average amount guaranteed by 0.18 per cent, the average guaranteed being 3.98 per cent, and the average found being 4.16 per cent.

In 131 brands of complete fertilizers, the amount of potash found was above the amount guaranteed, the excess varying from 0.02 to 2.35 per cent and averaging 0.52 per cent.

In 43 brands, the potash was below the guaranteed amount, the deficiency varying from 0.01 to 3.98 per cent and averaging 0.60 per cent. In 20 of these cases, the deficiency was below 0.25 per cent; in eight cases, it was above 0.25 and below 0.50 per cent; in six cases, it was above 0.50 and below one per cent; in six cases, it was above one and below two per cent; in two cases, it was above two and below three per cent; and in one case it was above three and below four per cent.

In nine cases, the 174 brands of complete fertilizers contained the potash in the form of sulphate free from an excess of chlorides.

5. The retail selling price of the complete fertilizers varied from $20 to $51 a ton and averaged $30.25. The retail cost of the separate ingredients unmized was $21.22, or $9.03 less than the selling price.

1. NUMBER AND KINDS OF FERTILIZERS COLLECTED IN 1896.

During the entire year of 1896, we collected 749 samples of commercial fertilizers, representing 574 different brands. It is a matter of interest to notice to what extent dealers offer for sale complete fertilizers, (those containing nitrogen, phosphoric acid and potash), compared with those containing only one or two of these ingredients. It is also of interest to consider the different forms in which incomplete fertilizers are offered for sale. The following tabulated statement indicates the different kinds of complete and incomplete fertilizers collected during the year.

1896.	Brands containing only nitrogen.	Brands containing only phosphoric acid.	Brands containing only potash.	Brands containing nitrogen and phosphoric acid without potash.	Brands containing potash and phosphoric acid without nitrogen.	Brands of complete commercial fertilizers.
Spring collection........	4	13	6	21	23	246
Fall collection	4	26	5	17	35	174
Total for year.......	8	39	11	38	58	420

In the spring collection 78.6 per cent of the brands offered for sale consisted of complete fertilizers; in the fall, 66.6 per cent; and, during the year, an average of 73.2 per cent. Of unmixed materials, phosphoric acid was offered much more largely than nitrogen or potash, the average for the year being about 9.5 per cent of all brands offered. About the same number containing phosphoric acid and nitrogen was found. It will be seen that the mixture of phosphoric acid and potash was quite largely used, averaging for the year about 14 per cent of all the brands collected.

2. COMPOSITION OF FERTILIZERS COLLECTED IN 1896.

Below we present a tabulated statement showing the average composition of the complete fertilizers collected during the year, together with a comparison of the guaranteed composition and that found by our analysis.

	PER CENT GUARANTEED.			PER CENT FOUND.			Average per cent found above guarantee.
	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.	
Fall:							
Nitrogen	0.41	5.75	1.71	0.51	6.30	1.82	0.11
Available phosphoric acid ...	3.00	14.00	7.82	3.22	15.70	8.54	0.72
Insoluble phosphoric acid ...	......	......	......	......	......	2.18	....
Potash	0.35	15.00	3.98	0.36	14.65	4.16	0.18
Spring:							
Nitrogen	0.65	8.23	2.35	0.78	7.90	2.58	0.23
Available phosphoric acid ...	3.00	11.00	7.43	2.63	11.42	7.87	0.44
Insoluble phosphoric acid ...	......	......	......	......	......	2.27	....
Potash	1.00	12.00	4.53	0.92	12.24	4.93	0.40
Average for year:							
Nitrogen	......	......	2.08	......	......	2.27	0.19
Available phosphoric acid ...	......	......	7.59	......	......	8.15	0.56
Insoluble phosphoric acid ...	......	......	......	......	......	2.23	....
Potash	......	......	4.30	......	......	4.61	0.31

In the following tabulated statement we give the composition of the different kinds of incomplete fertilizers included in our year's collection:

CHEMICALS AND INCOMPLETE FERTILIZERS.	PER CENT GUARANTEED.			PER CENT FOUND.			Average per cent found above guarantee.
	Lowest.	Highest.	Average.	Lowest.	Highest.	Average	
Nitrogen in							
Nitrate of soda..	14.35	15.60	15.06	13.82	15 59	15.05	....
Dried blood	4.94	12.35	8.44	3.94	13.94	8.78	0.34
Dissolved phosphates.							
Phosphoric acid.							
Available	8.00	16.00	13.22	8.92	16.88	13.78	0.56
Insoluble	....	....	....	....	....	1.44	....
Potash in							
Kainit..........	11.00	12.42	11.77	11.70	13.43	12.52	0.75
Muriate	50.00	50.00	50.00	50.25	52.52	51.38	1.38
Sylvinite	15.00	18.80	16.90	17.54	18.57	18.05	1.15
Sulphate	26.00	49.24	37.62	26.22	49.20	37.71	0.09
Fish scrap.							
Nitrogen	8.20	8.23	8.21	8.21	8.64	8.43	0.22
Phosphoric acid.	6.00	6.00	6.00	6.66	7.51	7.08	1.08
Bone meal and tankage.							
Nitrogen	1.23	5.00	2.82	1.40	5.73	3.41	0.59
Phosphoric acid.	7.00	25.00	18.66	11.11	31.39	20.55	1.89
Mixtures containing phosphoric acid:							
Available	5.00	13.00	10.10	5.41	14.26	10.86	0.76
Insoluble	....	....	....	....	....	2.00	....
Potash	1.00	10.00	3.30	1.04	11.38	3.32	0.02

An examination of the foregoing tables shows that commercial fertilizers, both complete and incomplete, have an average composition exceeding the guaranteed composition. In some special cases there were marked deficiencies. One sample called "pure dried blood" was guaranteed to contain only 4.95 per cent of nitrogen and was found to contain less than four per cent. How serious this case was, we realize when we remember that good dried blood should contain 10 per cent or more of nitrogen.

3. COMPARISON OF SELLING PRICE AND COMMERCIAL VALUATION.

Giving to the different constituents the values assigned for mixed fertilizers, 14 cents a pound for nitrogen, 5½ cents a pound for available phosphoric acid, 2 cents a pound for insoluble phosphoric acid and 4½ cents a pound for potash, we can calculate the commercial valuation, or the price, at which the separate unmixed materials contained in one ton of fertilizers, having the composition indicated in the table on page 207 could be purchased for cash at retail at the seaboard. Knowing the retail prices at which these goods were offered for sale, we can also readily estimate the difference between the actual selling price of the mixed goods and the retail cash cost of the unmixed materials; the difference covers the cost of mixing, freights, profits, etc. We present these data in the following table, including only complete fertilizers.

	Commercial valuation of complete fertilizers.			Selling price of one ton of complete fertilizer.			Average increased cost of mixed materials over unmixed materials for one ton.
	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.	
1896.							
Spring	$11 87	$32 72	$21 22	$21 00	$46 00	$30 25	$9 03
Fall	12 56	35 87	19 10	20 00	51 00	27 80	8 70
Average for year.	......	......	$20 41	......	......	$29 24	$8 83

In the following tabulated statement, we give a comparison of the selling price and commercial valuation for the various incomplete fertilizers collected during the year, using the prices previously given as our basis of calculation.

CHEMICALS AND INCOMPLETE FERTILIZERS.	COMMERCIAL VALUATION.			SELLING PRICE.			Average increase of selling price over commercial valuation.
	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.	
Nitrate of soda....	$37 31	$42 10	$40 64	$40 00	$45 00	$43 00	$2 36
Dried blood.......	11 03	39 03	24 58	25 00	30 00	27 50	2 92
Dissolved phosphates..........	10 40	18 67	15 73	13 50	25 00	18 87	3 14
Kainit............	10 53	12 09	11 27	14 00	17 00	15 00	3 73
Muriate of potash.	45 22	47 26	46 24	39 00	40 00	39 50	6 74*
Sylvinite.........	15 79	16 71	16 25	17 00	20 00	18 50	2 25
Sulphate of potash.	26 22	49 20	37 71	33 50	46 50	40 00	2 29
Fish scrap........	29 65	31 86	30 75	23 00	24 50	23 75	7 00*
Bone-meal and tankage.........	24 67	35 98	29 76	24 00	35 00	30 20	44
Mixtures containing phosphoric acid and potash.	9 33	24 86	15 73	16 00	32 00	22 20	6 47
Wood-ashes.......	5 66	8 38	7 02	11 00	12 00	11 50	4 48

4. Cost of One Pound of Plant-Food in Different Materials as Purchased by Consumers.

It is a matter of importance to see how much a pound of plant-food costs the purchaser in different materials. The data contained in the table following are obtained from the preceding tables.

In reference to nitrogen, it will be noticed that its price in complete fertilizers varied from 11.5 to 43.4 cents a pound and averaged 20.2 cents for the goods collected during 1896. It is also noticeable that in unmixed materials, the average price varies from 10.9 in fish scraps to 15.6 cents in dried blood. The variation of price between lowest and highest was less in nitrate of soda and fish scraps than bone-meal, tankage, or dried blood.

In regard to available phosphoric acid, the price of one pound varied in the goods collected during the year from 4.5 to 17 cents and averaged nearly 8 cents. The price was less in the dissolved or acid phosphates, averaging 6.6 cents. The total phosphoric acid in bone-meal and tankage cost 5.6 cents a pound and in fish scraps, 4.1 cents. In mixtures of acid phosphates and potash

*Commercial valuation greater than price paid.

salts, the available phospohric acid cost the consumer nearly as much as in the complete fertilizers. In wood-ashes the phosphoric acid cost most, 8.6 cents a pound.

In complete fertilizers potash cost from 3.7 to 14 cents a pound and averaged 6.5 cents, and nearly as much in the acid phosphate and potash mixtures. The least cost was in case of high-grade muriate which cost 3.8 cents a pound. The highest price paid was 8.6 cents a pound for the potash in wood-ashes.

A careful study of the following table emphasizes two points: (1) That the variation of cost of a pound of plant-food in complete fertilizers is very wide, the highest price paid being over three times as much as the lowest price paid; and (2) that there is a marked difference in the cost of plant-food between complete and unmixed fertilizers in favor of the unmixed forms.

From the data contained in the two preceding tables, we calculate the cost of the different ingredients to the consumer purchasing at the prices paid.

	Cost of One Pound of Plant-Food to Consumer.		
	Lowest.	Highest.	Average.
	Cents.	Cents.	Cents.
Nitrogen in complete fertilizers.			
Spring goods	11.5	35.4	20
Fall goods	13.3	43.4	20.4
Average for year	....	....	20.2
Bone-meal and tankage	10.5	23.9	13.8
Dried blood	10.8	31.8	15.6
Fish scrap	10.8	10.9	10.9
Nitrate of soda	13.1	16.3	14.3
Phosphoric acid in complete fertilizers.			
Spring goods.			
Available	4.5	13.9	7.9
Insoluble	1.6	5.0	2.9
Fall goods.			
Available	5.2	17.0	8.0
Insoluble	1.9	6.2	2.9
Average for year.			
Available	....	....	7.95
Insoluble	....	....	2.9
Dissolved phosphates.			
Available	4.5	12.2	6.6
Insoluble	1.6	4.4	2.4
Fish-scrap	4.0	4.2	4.1
Bone-meal and tankage	4.3	9.7	5.6
Phosphoric acid and potash mixtures			
Available	5.0	12.4	7.8
Insoluble	1.8	4.5	2 8
Wood-ashes	6.6	10.6	8.6
Potash in complete fertilizers.			
Spring goods	3.7	11.4	6.4
Fall goods	4.3	14.0	6.6
Average for year	....	....	6.5
Kainit	5.6	6.3	6.0
Muriate of potash	3.7	4.0	3.8
Sulphate of potash	4.7	6.4	5.5
Sylvinite	4.9	5.4	5.1
Wood-ashes	6.6	10.6	8.6
Potash and phosphoric acid mixtures	4.0	10.1	6.3

5. Commercial Names used for Phosphoric Acid in Fertilizers.

Of the 39 samples containing only phosphoric acid, three were called dissolved bone-black. The remaining 36 samples were sold under 19 different names. Several were called "dissolved bone," "soluble bone," etc., introducing the word bone prominently in one form and another. It is noticeable that in only two samples collected during the year did the material contain nitrogen, when the name dissolved bone was used. There is reason, therefore, for believing that in every instance, when a fertilizer guarantees only available phosphoric acid without nitrogen, its source is dissolved rock and not dissolved bone, except perhaps when specifically called dissolved bone-black, bone-ash or some similar name.

The same feature occurs in the naming of mixtures of phosphoric acid and potash. During the year 58 of these were collected. These were sold under no less than 25 different names. Among these were "alkaline bone," "bone and potash," "genuine soluble bone and potash," "bone and potash superphosphate," "dissolved bone and potash," "alkaline dissolved bone phosphate," etc. In no case did one of these mixtures guarantee any nitrogen and there can be little doubt as to the source of the phosphoric acid.

The question naturally suggests itself as to why it is regarded necessary to call dissolved rock by so many different names, some of which are surely misleading and most of which rarely suggest the source of the material used.

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Armour Fertilizer Works, Chicago, Ill.	Bone and blood.	Oneida.	3027
A. M. Baker & Son, Mt. Morris, N. Y.	Golden grain grower.	Mt. Morris.	2949
A. M. Baker & Son, Mt. Morris, N. Y.	Restorer.	Mt. Morris.	2948
Bowker Fertilizer Co., Boston, Mass.	Alkaline bone.	Canandaigua.	2876
Bowker Fertilizer Co., Boston, Mass.	Brown's wheat special.	Mt. Morris.	2946
Bowker Fertilizer Co., Boston, Mass.	Clark's special.	La Grange.	2933
Bowker Fertilizer Co., Boston, Mass.	Chemung Valley special.	Horseheads.	3033
Bowker Fertilizer Co., Boston, Mass.	Chemung Valley special.	Horseheads.	3034
Bowker Fertilizer Co., Boston, Mass.	Dissolved bone.	Willow Creek. Geneseo.	2968 2958
Bowker Fertilizer Co., Boston, Mass.	Fresh ground bone.	Rochester.	2788
Bowker Fertilizer Co., Boston, Mass.	Fresh milled kainit.	Rochester. MacDougall.	2794 2971

LECTED IN NEW YORK STATE DURING THE FALL OF 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	5.75	5	10	———
Found.	5.64	5.51	12.71	
Guaranteed.	0.82	8	———	4
Found.	0.94	9.90	11.40	3.88
Guaranteed.	1.85	9	13.50	4
Found.	1.72	9.20	10.37	4.26
Guaranteed.		11	12	1
Found.	———	10.79	15.59	1.08
Below guarantee.		0.21		
Guaranteed.	1	10	11	3
Found.	1.39	10.28	12.25	3.28
Guaranteed.	———	12	———	3
Found.		11.94	14.07	2.89
Guaranteed.	2.47	7	———	7
Found.	2.56	10.26	11.96	*7.49
Guaranteed.	2.47	7	———	8
Found.	2.56	6.20	9.39	8.59
Below guarantee.		0.80		
Guaranteed.		13	15	———
Found.	———	12.16	15.22	
Below guarantee.		0.84		
Guaranteed.	2.50	5	18	———
Found.	2.87	6.99	22.72	
Guaranteed.	———	———	———	11
Found.				12.31

* Potash present in form of sulphate.

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-
Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Bowker Fertilizer Co., Boston, Mass.	Harvest bone.	Rochester.	2793
Bowker Fertilizer Co., Boston, Mass.	Hopkin's special.	Canandaigua.	2875
Bowker Fertilizer Co., Boston, Mass.	Humphrey & Holdridge best grain.	Honeoye Falls.	2879
Bowker Fertilizer Co., Boston, Mass.	Humphrey & Holdridge standard.	Honeoye Falls.	2878
Bowker Fertilizer Co., Boston, Mass.	Kinne's selected fertilizer.	Ovid.	2826
Bowker Fertilizer Co., Boston, Mass.	Lowe's bone and potash.	LeRoy.	2883
Bowker Fertilizer Co., Boston, Mass.	Market bone.	MacDougall.	2973
Bowker Fertilizer Co., Boston, Mass.	Nursery special.	Rochester.	2791
Bowker Fertilizer Co., Boston, Mass.	Onion manure.	Clyde.	3019
Bowker Fertilizer Co., Boston, Mass.	Ontario county standard.	Halls Corners.	3052
Bowker Fertilizer Co., Boston, Mass.	Potash phosphate.	Rochester.	2785

LECTED IN NEW YORK STATE DURING THE FALL OF 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.		12	13	——
Found.	——	11.79	15.33	
Below guarantee.		0.21		
Guaranteed.	1.25	10	——	4
Found.	1.31	9.69	12.21	4.36
Below guarantee.		0.31		
Guaranteed.	1	10	11	6
Found.	1.17	9.34	11.48	7.65
Below guarantee.		0.66		
Guaranteed.	1	10	11	3
Found.	1.26	10.65	13.23	3.34
Guaranteed.	1.03	9	11	2.50
Found.	1.15	8.02	11.97	3.57
Below guarantee.		0.98		
Guaranteed.	——	10	——	2
Found.		10.30	15.16	2.20
Guaranteed.	1.50	——	16	——
Found.	1.57	7.65	18.64	
Guaranteed.	0.82	6	8	10
Found.	0.85	6.02	10.43	12.35
Guaranteed.	0.82	7	——	15
Found.	1.11	6.94	10.20	14
Below guarantee.				1
Guaranteed.	0.75	8	10	4
Found.	0.85	7.80	11.37	5.45
Below guarantee.		0.20		
Guaranteed.	0.82	7	9	5
Found.	1.10	8.07	11.85	5.27

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Bowker Fertilizer Co., Boston, Mass.	Seneca county special.	MacDougall.	2972
Bowker Fertilizer Co., Boston, Mass.	Soluble bone.	Penn Yan.	3046
Bowker Fertilizer Co., Boston, Mass.	Special grain.	Penn Yan.	3044
Bowker Fertilizer Co., Boston, Mass.	Special high-grade wheat fertilizer.	Clyde.	3017
Bowker Fertilizer Co., Boston, Mass.	Special fertilizer.	Geneseo.	2959
Bowker Fertilizer Co., Boston, Mass.	Staple phosphate.	Phelps.	2869
Bowker Fertilizer Co., Boston, Mass.	Stockbridge cabbage manure.	Rochester. Syracuse.	2786 2862
Bowker Fertilizer Co., Boston, Mass.	Stockbridge celery manure.	Lockport.	2757
Bowker Fertilizer Co., Boston, Mass.	Stockbridge onion manure.	Rochester.	2792
Bowker Fertilizer Co., Boston, Mass.	Stockbridge pea and bean manure.	Syracuse.	2864
Bowker Fertilizer Co., Boston, Mass.	Stockbridge potato and vegetable manure.	Rochester.	2789

LECTED IN NEW YORK STATE DURING THE FALL OF 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	0.75	10	11	4
Found.	0.76	8.86	11.70	5.23
Below guarantee.		1.14		
Guaranteed.	——	14	15	
Found.		15.70	18.13	——
Guaranteed.	1	10	11	4
Found.	1.53	10.19	11.84	3.81
Guaranteed.	1.50	10	12	5
Found.	1.64	9.90	11.91	5.28
Guaranteed.	1.03	9	11	2.50
Found.	1.54	8.63	14.13	2.06
Below guarantee.		0.37		0.44
Guaranteed.	0.82	8	10	3
Found.	0.99	8.84	11.90	4.77
Guaranteed.	4	5	6	6
Found.	4.49	6.16	9.24	6.37
Guaranteed.	4.10	4	5	5.50
Found.	4.98	6.55	8.54	6.46
Guaranteed.	4.50	7	8	5
Found.	5.28	5.35	7.71	7.25
Below guarantee.		1.65		
Guaranteed.	2	6	——	6
Found.	2.13	9.37	12.65	6.45
Guaranteed.	3.25	5	8	10
Found.	3.91	5.40	7.93	11.03

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Bowker Fertilizer Co., Boston, Mass.	Stockbridge tobacco manure.	Painted Post.	3036
Bowker Fertilizer Co., Boston, Mass.	Stockbridge top dressing.	Rochester.	2787
Bowker Fertilizer Co., Boston, Mass.	Stockbridge vine manure.	Syracuse.	2865
Bowker Fertilizer Co., Boston, Mass.	Superphosphate with potash.	Mt. Morris.	2947
Bowker Fertilizer Co., Boston, Mass.	Ten per cent. manure.	Rochester.	2790
Bowker Fertilizer Co., Boston, Mass.	Tobacco grower.	Syracuse.	2866
Bowker Fertilizer Co., Boston, Mass.	Tobacco phosphate.	Syracuse.	2867
Bowker Fertilizer Co., Boston, Mass.	Yates county grain special.	Penn Yan.	3043
Bradley Fertilizer Co., Boston, Mass.	Acid phosphate.	Rochester.	2773
Bradley Fertilizer Co., Boston, Mass.	Ammoniated bone phosphate.	Brockport.	2768
Bradley Fertilizer Co., Boston, Mass.	Bean and potato phosphate.	Lockport.	2753

lected in New York State During the Fall of 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	5.75	4	6	10
Found.	6.30	3.99	8.94	*11.85
Guaranteed.	4.75	4	6	6
Found.	5.21	4.64	7.18	6.39
Guaranteed.	4.94	3	5	4
Found.	4.49	6.17	9.05	6.27
Below guarantee.	0.45			
Guaranteed.	——	10	12	1
Found.		12.35	16.06	1.87
Guaranteed.	0.82	6	8	10
Found.	0.92	8.60	11.71	6.02
Below guarantee.				3.98
Guaranteed.	2.25	7	9	4
Found.	2.23	9.85	12.59	3.09
Below guarantee.				0.91
Guaranteed.	1.03	8	9	1.08
Found.	1.20	8.71	13.19	1.38
Guaranteed.	0.75	10	12	8
Found.	0.76	9.21	11.97	7.98
Below guarantee.		0.79		
Guaranteed.	——	10	——	——
Found.		10.05	12.28	
Guaranteed.	1.03	11	13	1.62
Found.	1.05	11.77	13.64	1.43
Guaranteed.	0.82	8	10	3.25
Found.	1.14	8.90	10.39	3.65

* Potash present in form of sulphate.

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Bradley Fertilizer Co., Boston, Mass.	Concentrated flower food.	Rochester.	2774
Bradley Fertilizer Co., Boston, Mass.	Concentrated phosphate.	Rochester.	2808
Bradley Fertilizer Co., Boston, Mass.	Dissolved bone.	Brockport.	2769
Bradley Fertilizer Co., Boston, Mass.	English lawn fertilizer.	Rochester.	2783
Bradley Fertilizer Co., Boston, Mass.	Extra fine ground bone with potash.	Rochester.	2782
Bradley Fertilizer Co., Boston, Mass.	Farmers new method.	Lockport.	2754
Bradley Fertilizer Co., Boston, Mass.	Grain and grass grower.	Attica.	2918
Bradley Fertilizer Co., Boston, Mass.	Grape fertilizer.	Rochester.	2776
Bradley Fertilizer Co., Boston, Mass.	Justice dissolved bone.	Skaneateles.	2963
Bradley Fertilizer Co., Boston, Mass.	Kainit.	Rochester.	2784
Bradley Fertilizer Co., Boston, Mass.	Niagara phosphate.	Attica. Skaneateles.	2919 2962

lected in New York State During the Fall of 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	4.95	12	14	2.50
Found.	5.44	11.70	17.14	*3.09
Below guarantee.		0.30		
Guaranteed.	——	——	37.55	——
Found.			37.17	
Below guarantee.			0.38	
Guaranteed.	——	15	16	——
Found.		15.48	18.71	
Guaranteed.	4.95	5	6	2.50
Found.	5.16	4.76	6.30	*3.93
Below guarantee.		0.24		
Guaranteed.	1.23	——	11	1
Found.	1.51	5.10	14.64	1.73
Guaranteed.	0.82	8	10	2.15
Found.	0.86	8.37	11.61	2.07
Guaranteed.	1.23	8	——	3
Found.	1.85	7.91	10.73	*4.04
Guaranteed.	0.82	4	——	8
Found.	0.80	4.85	9.61	8.63
Guaranteed.	——	12	13	——
Found.		13.37	14.72	
Guaranteed.	——	——	——	12.42
Found.				12.70
Guaranteed.	0.82	7	8	1
Found.	0.84	7.95	10.83	1.24

* Potash present in the form of sulphate.

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Bradley Fertilizer Co., Boston, Mass.	Soluble dissolved bone.	Rochester.	2775
Bradley Fertilizer Co., Boston, Mass.	Treated blood-justice brand.	Rochester.	2779
Bradley Fertilizer Co., Boston, Mass.	Wheat and corn.	Attica.	2917
E. B. Chapin, Rochester, N. Y.	Standard fertilizer.	Rochester.	2797
Chesapeake Guano Co., Baltimore, Md.	Special New York potato manure.	Jamestown.	2943
Clark's Cove Fertilizer Co., New York City.	Potato phosphate.	Rochester. Owego.	2772 2841
Cleveland Dryer Co., Cleveland, Ohio.	Buckeye.	Jamestown.	2940
Cleveland Dryer Co., Cleveland, Ohio.	Forest City ammoniated bone superphosphate.	Jamestown.	2941
Cleveland Dryer Co., Cleveland, Ohio.	Forest City ammoniated superphosphate.	Cato.	2995
Cleveland Dryer Co., Cleveland, Ohio.	Ohio seed grower.	Jamestown.	2939
Cleveland Dryer Co., Cleveland, Ohio.	Superior bone.	Hamburg.	2904

LECTED IN NEW YORK STATE DURING THE FALL OF 1896.
turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.		14	———	———
Found.	———	14.44	17.88	
Guaranteed.	4.95	———	———	———
Found.	5.21			
Guaranteed.	1.64	8	———	5
Found.	1.72	8.45	10.55	6.11
Guaranteed.	1.75	7	———	3
Found.	2.40	7.23	11.49	3.42
Guaranteed.	1.65	7	8	8
Found.	3.76	8.56	10.77	7.64
Below guarantee.				0.36
Guaranteed.	2.47	6	7	5
Found.	2.89	6.21	9.51	5.31
Guaranteed.	2.47	9	11	1
Found.	2.37	9.36	12.14	0.36
Below guarantee.				0.64
Guaranteed.	2.88	9	11	3.24
Found.	2.40	8.61	11.31	3.76
Below guarantee.	0.48	0.39		
Guaranteed.	1.65	7	8	1
Found.	1.65	8.64	11.55	1.25
Guaranteed.	1.25	10	15	2.16
Found.	1.25	9.79	13.24	2.33
Below guarantee.		0.21		
Guaranteed.	3.29	———	22	———
Found.	3.20	11.98	21.61	

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Acid phosphate.	Batavia.	2913
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Ammoniated bone superphosphate.	Buffalo.	2901
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Blood and animal matter.	Brockport.	2766
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Dissolved bone black.	Batavia.	2912
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Buddington's electric dissolved fertilizer.	Holley.	2760
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Buddington's royal wheat grower.	Holley.	2762
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Cereal phosphate.	Clifton Springs.	2874
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Crocker's phosphate.	Mt. Morris.	2950
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Erie.	Lockport.	2752
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Ground bone meal.	Angola.	2945
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Hanlon Bros. special fertilizer.	Medina.	2758

LECTED IN NEW YORK STATE DURING THE FALL OF 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	—	13	—	—
Found.		13.04	14.84	
Guaranteed.	2.90	10	11	1.08
Found.	3.08	10.70	11.84	1.59
Guaranteed.	8.23	—	9	—
Found.	7.33	3.48	11.11	
Below guarantee.	0.90			
Guaranteed.	—	16	—	—
Found.		15.57	15.62	
Below guarantee.		0.43		
Guaranteed.		14	15	—
Found.	—	14.65	15.02	
Guaranteed.	0.82	8	9	3
Found.	1.11	9.04	13.14	2.60
Below guarantee.				0.40
Guaranteed.	0.82	8	9	3.24
Found.	1.46	10.67	12.38	2.01
Below guarantee.				1.23
Guaranteed.	1.23	10	11	1.76
Found.	1.35	9.82	12.66	2.03
Guaranteed.	—	11	13	—
Found.		12.48	14.82	
Guaranteed.	2	—	25	—
Found.	1.40	9.61	31.39	
Below guarantee.	0.60			
Guaranteed.	0.82	10	11	8.10
Found.	0.78	11.05	11.13	8.42

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Humphrey & Holdridge standard phosphate.	Honeoye Falls.	2880
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Lawn fertilizer.	Buffalo.	2902
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Lowe's special fertilizer.	Geneseo.	2957
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Potash salts.	Batavia.	2911
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Practical ammoniated superphosphate.	Lockport. Fredonia.	2751 2944
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Pure ground blood.	Batavia.	2910
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Special alkaline bone.	Himrods.	3041
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Special bean fertilizer.	Hilton.	3029
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Special potato fertilizer.	Lockport. Brockport.	2750 2765 2821
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Universal grain grower.	Farmer. Spencerport.	2820 3030
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Wheat grower special.	Weedsport.	3022

LECTED IN NEW YORK STATE DURING THE FALL OF 1896.
turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed. Found.	1.23 1.42	10 11.01	11 12.16	3 3.53
Guaranteed. Found.	1.85 2.25	—— 11.18	26 26.23	——
Guaranteed. Found.	——	10 11.45	—— 11.58	5 4.96
Guaranteed. Found.	——	——	——	50 52.52
Guaranteed. Found.	0.82 1.14	8 9.13	9 10.75	1.08 1.31
Guaranteed. Found.	12.35 13.94	——	——	——
Guaranteed. Found.	——	13 14.26	14 14.26	4 3.92
Guaranteed. Found.	0.82 0.71	8 9.45	9 12.39	3.24 3.36
Guaranteed. Found.	3.70 4.13	8 8.15	9 9.07	5.40 5.88
Guaranteed. Found.	0.82 0.93	7 7.97	8 10.78	2.70 3.02
Guaranteed. Found.	2 2.20	8 9.78	9 11.94	3.25 3.34

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Webster's fertilizers.	East Webster.	2810
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Weedsport phosphoric acid and potash.	Weedsport.	3021
E. A. Cross, Hilton, N. Y.	King superphosphate.	Hilton.	2817
E. A. Cross, Hilton, N. Y.	Parma superphosphate.	Hilton.	2815
E. A. Cross, Hilton, N. Y.	Queen superphosphate.	Hilton.	2816
Cuba Fertilizer Co., Cuba, N. Y.	Hustler.	Nunda.	2935
Cumberland Bone Phosphate Co., Portland, Me.	Bone and potash.	Fayette.	2980
Cumberland Bone Phosphate Co., Portland, Me.	Hawkeye fertilizer.	Fayette.	2981
Eureka Fertilizer Co., Avon, N. Y.	Eureka.	Avon.	2954
Farmers' & Builders' Supply Co., Owego, N. Y.	Ammoniated bone phosphate.	Owego.	2836
Farmers' & Builders' Supply Co., Owego, N. Y.	Bone and potash phosphate.	Owego.	2838

LECTED IN NEW YORK STATE DURING THE FALL OF 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	0.82	8	9	4
Found.	0.63	7.83	8.72	5.05
Guaranteed.	———	10	11	2.16
Found.		10.39	12.39	2.14
Guaranteed.	2.75	8.25	10.25	3.50
Found.	2.62	7.62	9.82	3.45
Below guarantee.		0.63		
Guaranteed.	1.75	7.50	9.50	3.50
Found.	1.72	7.70	9.50	3.97
Guaranteed.	2	8	10	3
Found.	2.32	7.81	10.32	3.44
Guaranteed.	0.82	8	———	4
Found.	0.76	8.12	10.41	3.88
Guaranteed.	———	8	10	2.50
Found.		11.42	12.17	*3.03
Guaranteed.	0.97	7	9	1
Found.	0.82	7.70	9.74	1.16
Guaranteed.	———	10	———	3.75
Found.		12.10	14.55	3.70
Guaranteed.	0.82	9	———	2
Found.	0.98	7.90	8.85	2.57
Below guarantee.		2.10		
Guaranteed.	———	13	———	3
Found.		12.39	13.56	3.18
Below guarantee.		0.61		

* Potash present in form of sulphate.

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Farmers' & Builders' Supply Co., Owego, N. Y.	Buckwheat special.	Owego.	2837
Farmers' & Builders' Supply Co., Owego, N. Y.	New York standard.	Owego.	2834
Farmers' & Builders' Supply Co., Owego, N. Y.	Tioga county standard.	Owego.	2835
Farmers' & Builders' Supply Co., Owego, N. Y.	XXV superphosphate.	Owego.	2839
Farmers' Fertilizer Co., Syracuse, N. Y.	Farmers' soluble bone.	Syracuse. Attica.	2863 2926
Farmers' Fertilizer Co., Syracuse, N. Y.	Ground bone.	Moravia.	2992
Farmers' Fertilizer Co., Syracuse, N. Y.	Onondaga special.	Moravia.	2990
Farmers' Fertilizer Co., Syracuse, N. Y.	Pure dried blood.	Moravia.	2991
Farmers' Fertilizer Co., Syracuse, N. Y.	Standard bone phosphate—special formula.	Syracuse. Angola.	2861 2905
Farmers' Fertilizer Co., Syracuse, N. Y.	Standard bone phosphate.	Syracuse.	2860
John Finster, Rome, N. Y.	Home trade bone eagle phosphate.	Rome.	3028

lected in New York State During the Fall of 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	——	14	——	——
Found.		14.48	17.14	
Guaranteed.	1.25	10	——	3
Found.	1.40	10.18	10.97	3.01
Guaranteed.	1.65	9	——	2
Found.	1.74	9.58	10.50	2.35
Guaranteed.	0.82	8	——	4
Found.	0.86	8.62	9.91	4.11
Guaranteed.	——	6	7	2.16
Found.		6.46	7.08	2.20
Guaranteed.	1.65	——	18	——
Found.	4.74	11.15	18.25	
Guaranteed.	0.82	8	——	4.32
Found.	1.29	7.39	9.79	2.45
Below guarantee.		0.61		1.87
Guaranteed.	4.95	——	——	——
Found.	3.94			
Below guarantee.	1.01			
Guaranteed.	0.82	8	——	2.16
Found.	0.91	8.20	9.04	2.53
Guaranteed.	0.82	9	11	3.24
Found.	0.79	9.63	10.64	3.38
Guaranteed.	0.82	8	9	2
Found.	1.15	7.97	11.86	1.03
Below guarantee.				0.97

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Flower City Reduction Co., Rochester, N. Y.	Garbage tankage.	Rochester.	2807
Flower City Reduction Co., Rochester, N. Y.	Sulphate potash.	Rochester.	2809
Geneva Coal Co., Geneva, N. Y.	Reclaimer.	Geneva.	3053
Great Eastern Fertilizer Co., Rutland, Vt.	Buckwheat and seeding down.	Oakfield.	2895
Great Eastern Fertilizer Co., Rutland, Vt.	Chautauqua grape fertilizer.	Brockport.	2763
Great Eastern Fertilizer Co., Rutland, Vt.	English wheat grower.	Warsaw.	2930
Great Eastern Fertilizer Co., Rutland, Vt.	General northern corn special.	Venice Center.	2983
Great Eastern Fertilizer Co., Rutland, Vt.	General soluble bone and potash.	Venice Center.	2984
Great Eastern Fertilizer Co., Rutland, Vt.	Great Eastern general.	Venice Center.	2985
Great Eastern Fertilizer Co., Rutland, Vt.	Schodack special.	Avon.	2955
Great Eastern Fertilizer Co., Rutland, Vt.	Soluble bone and potash.	Syracuse.	2859

LECTED IN NEW YORK STATE DURING THE FALL OF 1896.
turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	2.06	—	3	0.35
Found.	2	1.52	2.66	0.46
Guaranteed.	—	—	—	49.24
Found.				*49.20
Guaranteed.	1.85	9	13.50	4
Found.	1.84	9.73	13.36	3.87
Guaranteed.	0.82	8	9	4
Found.	0.88	9.03	9.27	4.23
Guaranteed.	—	10	12	8
Found.		9.95	11.33	7.63
Below guarantee.				0.37
Guaranteed.	0.91	8	9	2
Found.	0.82	8.51	11.88	2.74
Guaranteed.	2.50	8	9	2
Found.	2.60	9.27	11.54	2.30
Guaranteed.	—	11	—	2
Found.		12.54	14.63	2.24
Guaranteed.	0.80	8	9	4
Found.	0.91	9.92	13.28	3.43
Below guarantee.				0.57
Guaranteed.	0.83	8	10	8
Found.	1.02	8.24	9.10	8.62
Guaranteed.	—	11	12	2
Found.		10.72	11.66	2.09
Below guarantee.		0.28		

* Potash present in form of sulphate.

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Great Eastern Fertilizer Co., Rutland, Vt.	Wheat special.	Syracuse. Avon.	2857 2956
Ira C. Hall, Farmer, N. Y.	Dissolved bone.	Farmer.	2970
Ira C. Hall, Farmer, N. Y.	Home rule.	Farmer.	2823
Ira C. Hall, Farmer, N. Y.	Special wheat grower.	Farmer.	2969
J. S. Hewitt & Sons, Locke, N. Y.	Bone and potash superphosphate.	Locke.	2994
J. S. Hewitt & Sons, Locke, N. Y.	Special grain and grass.	Locke.	2993
C. C. Hicks, Penn Yan, N. Y.	Ontario wheat special.	Penn Yan.	3048
C. C. Hicks, Penn Yan, N. Y.	Prolific fertilizer.	Penn Yan.	3049
Lazaretto Guano Co., Baltimore, Md.	A. A. superphosphate.	Ovid.	2827
Lazaretto Guano Co., Baltimore, Md.	Extra ammoniated bone phosphate.	Weedsport.	3023
Lazaretto Guano Co., Baltimore, Md.	Kinne's selected fertilizer.	Ovid.	2825

lected in New York State During the Fall of 1896.
turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	1.65	8	9	2
Found.	1.78	8.28	9.71	2.23
Guaranteed.	———	14	———	———
Found.		13.95	15.24	
Guaranteed.	0.82	9	10	2.50
Found.	1.01	9.44	11.75	2.95
Guaranteed.	1.64	8	———	2
Found.	1.63	9.40	11.25	2.68
Guaranteed.	———	10	———	2
Found.		10.57	11.43	1.97
Guaranteed.	0.82	8	———	4
Found.	0.95	8.38	11.43	4.30
Guaranteed.	1.65	10	———	5
Found.	1.46	10.57	11.89	4.74
Below guarantee.				0.26
Guaranteed.	0.82	10	11	8
Found.	0.70	9.93	10.85	7.56
Below guarantee.				0.44
Guaranteed.	1.85	9	———	4
Found.	1.80	8.91	9.87	4.69
Guaranteed.	0.82	8	———	4
Found.	0.88	9.09	10.73	4.13
Guaranteed.	1	9	———	4.25
Found.	1.03	9.68	11.20	2.82
Below guarantee.				1.43

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Lazaretto Guano Co., Baltimore, Md.	New York standard potato manure.	Weedsport.	3024
Lazaretto Guano Co., Baltimore, Md.	Retriever animal bone.	Canandaigua. Weedsport.	2877 3025
Lazaretto Guano Co., Baltimore, Md.	Special onion and cabbage manure.	Medina.	2759
Lazaretto Guano Co., Baltimore, Md.	Tolles' alkaline bone.	Attica.	2924
Lazaretto Guano Co., Baltimore, Md.	Tolles' barnyard manure.	Attica.	2921
Lazaretto Guano Co., Baltimore, Md.	Tolles' guano.	Attica.	2922
Lazaretto Guano Co., Baltimore, Md.	Tolles' standard bone.	Attica.	2923
Liebig Manufacturing Co., Carteret, N. J.	High-grade bone and potash.	Moravia.	2982
Lister's Agricultural Chemical Works, Newark, N. J.	Ammoniated bone.	Batavia.	2915
Lister's Agricultural Chemical Works, Newark, N. J.	Perfect.	LeRoy.	2884
Lister's Agricultural Chemical Works, Newark, N. J.	Plain dissolved bone black.	Batavia.	2916

lected in New York State During the Fall of 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphhric acid in 100 pounds of fertilizer.	Pounds of water-solubie potash in 100 pounds of fertilizer.
Guaranteed.	2.47	7	9	8
Found.	2.31	6.99	8.30	8.19
Guaranteed.	1.85	9	13.50	4
Found.	1.92	10.31	12.98	3.89
Guaranteed.	3.29	7	——	8
Found.	2.07	8.59	10.19	5.04
Below guarantee.	1.22			2.96
Guaranteed.	——	13	——	3
Found.		13.24	13.72	3.08
Guaranteed.	0.82	8	——	4
Found.	0.84	9.78	10.86	4.27
Guaranteed.	1.85	9	——	4
Found.	1.78	9.90	10.72	3.95
Guaranteed.	1.23	10	——	3
Found.	1.80	10.23	11.26	3.05
Guaranteed.	——	10	——	5
Found.		11.60	13.74	5.23
Guaranteed.	1.81	9	11	1.50
Found.	1.51	9.18	11.97	2.76
Below guarantee.	0.30			
Guaranteed.	1.24	9.50	11.50	2
Found.	1.52	9.61	12.40	2.20
Guaranteed.	——	16	——	——
Found.		15.97	16.33	

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Lister's Agricultural Chemical Works, Newark, N. J.	Potato No. 2.	Rochester.	2795
Lister's Agricultural Chemical Works, Newark, N. J.	Special wheat fertilizer.	Warsaw.	2931
Lister's Agricultural Chemical Works, Newark, N. J.	Standard pure bone superphosphate of lime.	Rochester.	2796
Lister's Agricultural Chemical Works, Newark, N. J.	U. S. superphosphate.	Kendaia. Dresden.	2830 3050
Fred'k Ludlam, New York City.	Sickle brand.	Moravia.	2986
Maryland Fertilizer Co., Baltimore, Md.	Alkaline bone.	Fairport.	2803
Maryland Fertilizer Co., Baltimore, Md.	Globe complete manure.	Fairport.	2801
Maryland Fertilizer Co., Baltimore, Md.	Potato food.	Fairport.	2799
Maryland Fertilizer Co., Baltimore, Md.	Sangston's C. & P. food.	Fairport.	2800
Maryland Fertilizer Co., Baltimore, Md.	Tornado fertilizer.	Fairport.	2802
Maxson & Starin, Cortland, N. Y.	Complete manure for fruit and vine.	Cortland.	2842

LECTED IN NEW YORK STATE DURING THE FALL OF 1896.
turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	1.81	9.25	12	4
Found.	1.89	10.18	12.94	4.51
Guaranteed.	1.65	8	9	3
Found.	1.58	8.98	11.71	2.99
Guaranteed.	2.35	10	12	1.50
Found.	2.51	10.11	12.88	1.68
Guaranteed.	1.32	7	8	2
Found.	1.77	9.25	11.35	*2.59
Guaranteed.	———	10	12	1
Found.		10.17	14.77	1.32
Guaranteed.		11.75	12.75	3.50
Found.	———	11.92	13.65	2.33
Below guarantee.				1.17
Guaranteed.	1.65	9	10	1.50
Found.	1.70	8.79	12.95	1.57
Below guarantee.		0.21		
Guaranteed.	1.85	6	7.50	10
Found.	1.84	8.66	9.87	*10.08
Guaranteed.	1	10	11	2.25
Found.	1.28	9.14	12.33	2.44
Below guarantee.		0.86		
Guaranteed.	0.41	11	12	3.25
Found.	0.51	12.09	12.65	4.01
Guaranteed.	1.65	7	———	9
Found.	1.85	9.74	11.16	8.79
Below guarantee.				0.21

* Potash present in form of sulphate.

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Maxson & Starin, Cortland, N. Y.	Cortland county special for corn, potatoes and grain.	Cortland.	2843
Maxson & Starin, Cortland, N. Y.	Special potato and cabbage guano.	Cortland.	2845
Maxson & Starin, Cortland, N. Y.	Vegetable and onion special.	Cortland.	2844
Maxson & Starin, Cortland, N. Y.	XXX guano.	Cortland.	2846
Michigan Carbon Works, Detroit, Mich.	Homestead.	Seneca.	3051
Miller Fertilizer Co., Baltimore, Md.	Ground bone.	Moravia.	2987
Miller Fertilizer Co., Baltimore, Md.	Harvest queen phosphate.	Moravia.	2989
Miller Fertilizer Co., Baltimore, Md.	No. 1 potato phosphate.	Farmer.	2822
Miller Fertilizer Co., Baltimore, Md.	Special mixture.	Moravia.	2988
Miller Fertilizer Co., Baltimore, Md.	Seneca queen phosphate.	MacDougall.	2974
Milsom Rendering and Fertilizer Co., Buffalo, N. Y.	Buffalo guano.	Buffalo. Warsaw.	2898 2927

LECTED IN NEW YORK STATE DURING THE FALL OF 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	2.05	9	——	2
Found.	2.09	10.54	12.28	2.50
Guaranteed.	3.70	8	——	6
Found.	3.10	8.39	9.56	7.90
Below guarantee.	0.60			
Guaranteed.	4.95	8	——	6
Found.	4.51	7.98	9.44	7.82
Below guarantee.	0.44			
Guaranteed.	0.82	8	——	4
Found.	1.23	8.97	10.27	4.03
Guaranteed.	1.85	8	8.50	1.50
Found.	2.24	9.43	11.07	1.80
Guaranteed.	2.46	——	15	——
Found.	3.13	10.86	17.12	
Guaranteed.	1	10	11.50	2.25
Found.	0.97	9.97	13.72	2.18
Guaranteed.	3.70	8	——	7
Found.	3.75	8.88	9.60	7.18
Guaranteed.	——	12	——	5
Found.		12.46	13.28	4.59
Below guarantee.				0.41
Guaranteed.	——	14	——	——
Found.		15.40	15.58	
Guaranteed.	0.82	8	9	4
Found.	1.10	8.43	10.23	3.66
Below guarantee.				0.34

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Milsom Rendering and Fertilizer Co., Buffalo, N. Y.	Cyclone bone meal.	Buffalo. Attica. Sodus.	2900 2925 2999
Milsom Rendering and Fertilizer Co., Buffalo, N. Y.	Dissolved bone.	Buffalo.	2896
Milsom Rendering and Fertilizer Co., Buffalo, N. Y.	Erie king.	Perry. Romulus. Sodus.	2932 2828 2998
Milsom Rendering and Fertilizer Co., Buffalo, N. Y.	S. W. & S. grain special.	East Groveland.	2961
Milsom Rendering and Fertilizer Co., Buffalo, N. Y.	S. W. & S. wheat special.	East Groveland.	2960
Milsom Rendering and Fertilizer Co., Buffalo, N. Y.	Special guano.	Penn Yan.	3045
Milsom Rendering and Fertilizer Co., Buffalo, N. Y.	Wheat, oats and barley phosphate.	Waterloo. International. Sodus.	2818 2906 2997
Newark Agricultural Co., Newark, N. J.	Lawn dressing.	Batavia.	2890
Newark Agricultural Co., Newark, N. J.	Oat, wheat and barley manure.	Batavia.	2885
Newark Agricultural Co., Newark, N. J.	Pea and bean manure.	Batavia.	2891
Newark Agricultural Co., Newark, N. J.	Special manure.	Batavia.	2888

lected in New York State During the Fall of 1896.
turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	2.47	——	22	——
Found.	3.29	10.53	23.23	
Guaranteed.	——	11	12.37	——
Found.		10.39	10.68	
Below guarantee.		0.61		
Guaranteed.	0.80	7	9	2
Found.	1.08	6.94	9.12	1.76
Below guarantee.				0.24
Guaranteed.	1	10	11	6
Found.	1.05	10.39	10.39	5.05
Below guarantee.				0.95
Guaranteed.	1.85	8	9	4
Found.	1.38	7.49	10.24	2.98
Below guarantee.	0.47	0.51		1.02
Guaranteed.	0.82	10	11	1
Found.	0.73	9.90	11.79	0.85
Guaranteed.	1.20	8	9	2
Found.	1.42	8.52	10.67	1.83
Guaranteed.	3.29	6	——	5
Found.	1.31	5.38	7.77	2.55
Below guarantee.	1.98	0.62		2.45
Guaranteed.	1.25	9	——	2
Found.	1.22	8.12	10.21	2.64
Below guarantee.		0.88		
Guaranteed.	0.82	10	11	4
Found.	0.95	8.14	10.04	3.89
Below guarantee.		1.86		
Guaranteed.	0.82	6	7.50	1.50
Found.	1.16	8.15	10.78	1.57

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Newark Agricultural Co., Newark, N. J.	Special potato manure.	Batavia.	2886
Newark Agricultural Co., Newark, N. J.	Vegetable manure.	Batavia.	2889
Newark Agricultural Co., Newark, N. J.	Wheat and corn manure.	Batavia.	2887
Niagara Fertilizer Co., Buffalo, N. Y.	Potato, tobacco and hop fertilizer.	Parma.	2814
Niagara Fertilizer Co., Buffalo, N. Y.	Wheat and corn.	Romulus.	2829
Oakfield Fertilizer Co., Buffalo, N. Y.	Domestic fertilizer.	International. Sodus.	2907 3007
Oakfield Fertilizer Co., Buffalo, N. Y.	Golden sheaf fertilizer.	Sodus.	3006
Oakfield Fertilizer Co., Buffalo, N. Y.	Highfarming fertilizer.	Sodus.	3003
Oakfield Fertilizer Co., Buffalo, N. Y.	Potato and tobacco fertilizer.	Sodus.	3005
Oakfield Fertilizer Co., Buffalo, N. Y.	Special wheat and corn.	Oakfield.	2893
Oakfield Fertilizer Co., Buffalo, N. Y.	Special hop "A."	Sodus.	3004

LECTED IN NEW YORK STATE DURING THE FALL OF 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	1.65	8	9.25	8
Found.	1.80	7.02	9.12	8.62
Below guarantee.		0.98		
Guaranteed.	3.10	8.25	9.75	7
Found.	2.66	8.03	9.71	6.90
Below guarantee.	0.44	0.22		
Guaranteed.	1.25	7	8.75	2
Found.	1.20	6.56	8.25	2.11
Below guarantee.		0.44		
Guaranteed.	1.64	8	9	2.70
Found.	1.52	8.49	9.98	3.00
Guaranteed.	1.23	8	9	2.16
Found.	1.89	8.41	10.86	2.44
Guaranteed.	1.65	8	9	1.08
Found.	1.58	8.21	9.19	1.48
Guaranteed.	1.23	7	8	1.89
Found.	1.43	7.64	8.47	2.18
Guaranteed.	1.85	8	9	2.43
Found.	1.66	7.97	8.83	2.56
Guaranteed.	2.47	6	7	4.32
Found.	2.60	6.61	7.57	*4.66
Guaranteed.	3.70	8	9	6
Found.	3.86	8.07	8.73	6.91
Guaranteed.	0.82	6	8	6.50
Found.	0.79	5.91	7.76	6.28
Below guarantee.				0.22

* Potash present in form of sulphate.

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Oakfield Fertilizer Co., Buffalo, N. Y.	Special vine.	Fairport. Oakfield.	2804 2894
Oakfield Fertilizer Co., Buffalo, N. Y.	Standard.	Oakfield.	2892
Pacific Guano Co., New York City.	Dissolved bone and potash.	Rochester.	2780
G. A. Pearsall, Williamson, N. Y.	Bean special.	Williamson.	3009
G. A. Pearsall, Williamson, N. Y.	Fruit special.	Williamson.	3010
G. A. Pearsall, Williamson, N. Y.	Wheat and corn special.	Williamson.	3008
A. Peterson, Rochester, N. Y.	Farmers' benefit.	Rochester.	2806
A. Peterson, Rochester, N. Y.	Penfield standard.	Rochester.	2805
Moro Phillips Chemical Co., Philadelphia, Pa.	C. & G. complete fertilizer.	Dansville.	2748
Moro Phillips Chemical Co., Philadelphia, Pa.	Dissolved phosphate.	Skaneateles.	2965
Moro Phillips Chemical Co., Philadelphia, Pa.	Farmers' phosphate.	Skaneateles. Himrods.	2964 3039

lected in New York State During the Fall of 1896.
turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	2.05	6	7	5.40
Found.	2.33	6.15	7.27	5.49
Guaranteed.	2.47	10	11	1.62
Found.	2.31	9.79	10.30	2.22
Below guarantee.		0.21		
Guaranteed.	——	10	——	2
Found.		12.76	14.34	*2.34
Guaranteed.	0.82	8	9	4
Found.	1.24	8.27	12.26	3.93
Guaranteed.	——	8	——	10
Found.		8.12	8.52	11.38
Guaranteed.	2.05	9	10	2
Found.	2.26	10.86	12.61	2.65
Guaranteed.	1.25	6	——	2
Found.	2.13	10.33	14.51	2.26
Guaranteed.	2.25	8	——	4
Found.	2.90	8.80	13.29	4.65
Guaranteed.	1	8	9	1.50
Found.	0.93	9.28	10.49	1.23
Below guarantee.				0.27
Guaranteed.	——	12	13	——
Found.		13.36	14.14	
Guaranteed.	0.80	7	8	1
Found.	1.13	8.83	10.52	1.45

* Potash present in form of sulphate.

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Moro Phillips Chemical Co., Philadelphia, Pa.	Guaranteed guano.	Willow Creek.	2967
Moro Phillips Chemical Co., Philadelphia, Pa.	Genuine German kainit.	Kendaia.	2833
Moro Phillips Chemical Co., Philadelphia, Pa.	Half and half.	Kendaia.	2832
Moro Phillips Chemical Co., Philadelphia, Pa.	Kinne's selected fertilizer.	Ovid.	2824
Moro Phillips Chemical Co., Philadelphia, Pa.	Soluble bone phosphate.	Dansville.	2747
Moro Phillips Chemical Co., Philadelphia, Pa.	Special fertilizer.	Willow Creek.	2966
Quinnipiac Company, New York City.	Mohawk.	Skaneateles.	2868
Quinnipiac Company, New York City.	Uncas bone meal.	Rochester.	2778
Read Fertilizer Co., New York City.	Acid phosphate.	Syracuse.	2855
Read Fertilizer Co., New York City.	Farmers' friend superphosphate..	Syracuse.	2848
Read Fertilizer Co., New York City.	High grade farmers' friend.	Syracuse.	2856

LECTED IN NEW YORK STATE DURING THE FALL OF 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer,	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	1.25	9.25	10.25	1.40
Found.	1.40	8.75	10.74	1.46
Below guarantee.		0.50		
Guaranteed.	——	——	——	12.42
Found.				13.43
Guaranteed.	——	10	11	5.50
Found.		11.16	12.13	*6.55
Guaranteed.	1.25	9	11	2.50
Found.	1.27	9.81	11.07	3.32
Guaranteed.	——	14	15	——
Found.		14.27	15.42	
Guaranteed.	1.85	9	10	4.75
Found.	1.85	8.57	10.19	5.13
Below guarantee.		0.43		
Guaranteed.	0.82	7	8	1
Found.	0.96	6.82	9.63	1.38
Guaranteed.	1.65	——	14	——
Found.	2.16	4.71	15.43	
Guaranteed.	——	10	12	——
Found.		9.81	11.28	
Guaranteed.	2.05	9	11	2
Found.	2.05	9.10	10.52	2.03
Guaranteed.	3.25	5	6	10
Found.	2.94	5.45	6.80	10.21
Below guarantee.	0.31			

* Potash present in form of sulphate.

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Read Fertilizer Co., New York City.	Leader guano.	Farmer. Syracuse. Himrods.	2819 2847 3042
Read Fertilizer Co., New York City.	New York State superphosphate.	Syracuse.	2849
Read Fertilizer Co., New York City.	Original alkaline bone.	Syracuse.	2851
Read Fertilizer Co., New York City.	Practical potato special.	Syracuse.	2854
Read Fertilizer Co., New York City.	Prime wheat and rye.	Syracuse.	2850
Read Fertilizer Co., New York City.	Pure ground bone.	Syracuse.	2853
Read Fertilizer Co., New York City.	Soluble bone.	Syracuse.	2852
Jno. S. Reese & Co., Baltimore, Md.	Challenge crop grower.	Fayette.	2976
Jno. S. Reese & Co., Baltimore, Md.	Crown phosphate and potash.	Fayette.	2975
Jno. S. Reese & Co., Baltimore, Md.	Potato phosphate.	Painted Post.	3035
Jno. S. Reese & Co., Baltimore, Md.	Special alkaline bone.	Albion.	2749

LECTED IN NEW YORK STATE DURING THE FALL OF 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	0.82	7	8	2
Found.	1.12	7.21	8.03	2.40
Guaranteed.	1.25	9	10	2
Found.	1.59	8.93	10.06	2.31
Guaranteed.	———	10	11	3
Found.		9.71	10.82	2.59
Below guarantee.		0.29		0.41
Guaranteed.	0.82	4	5	8
Found.	1.17	4.86	5.50	8.24
Guaranteed.	1.64	8	9	4
Found.	1.84	7.99	9.84	4.17
Guaranteed.	2.05	———	22	———
Found.	2.86	7.27	24.86	
Guaranteed.	———	16	17	
Found.		14.54	17.73	———
Below guarantee.		1.46		
Guaranteed.	0.82	8.50	11.25	2
Found.	1.13	10.96	12.64	2.21
Guaranteed.	———	12	13	2
Found.		13.02	15.32	1.69
Below guarantee.				0.31
Guaranteed.	2.06	8.50	———	6
Found.	2.10	10.00	10.83	5.47
Below guarantee.				0.53
Guaranteed.	———	10	12	1
Found.		10.21	12.63	1.25

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Jno. S. Reese & Co., Baltimore, Md.	Wheat special.	Fayette.	2977
Standard Fertilizer Co., Boston, Mass.	Ammoniated dissolved bone.	Jamestown.	2942
Standard Fertilizer Co., Boston, Mass.	Bone and potash.	Fayette.	2979
Standard Fertilizer Co., Boston, Mass.	Dissolved bone.	Warsaw.	2928
Standard Fertilizer Co., Boston, Mass.	Extra fine ground bone.	Hamburg.	2903
Swift & Co., Chicago, Ill.	Bone tankage.	Hinsdale.	2937
Swift & Co., Chicago, Ill.	Ground steamed bone.	Olean.	2938
Swift & Co., Chicago, Ill.	Pure raw bone meal.	Olean.	2936
C. R. Sworts, Dundee, N. Y.	Alkaline dissolved bone phosphate.	Dundee.	3038
C. R. Sworts, Dundee, N. Y.	Dissolved bone.	Dundee.	3037
C. R. Sworts, Dundee, N. Y.	Special guano.	Dundee.	3040

lected in New York State During the Fall of 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	——	10	——	1
Found.		11.94	14.90	1.04
Guaranteed.	1.64	9	10	2
Found.	2.91	9.35	12.52	2.02
Guaranteed.	——	8	10	2.50
Found.		10.42	11.16	2.61
Guaranteed.	——	10	12	
Found.		10.83	12.31	——
Guaranteed.	1.65	——	14	
Found.	2.07	8.62	18.14	——
Guaranteed.	5	——	17	
Found.	5.21	9.44	17.45	——
Guaranteed.	3.25	——	23.25	
Found.	3.00	9.10	25.86	——
Below guarantee.	0.25			
Guaranteed.	3.75	——	23	
Found.	3.84	8.03	24.22	——
Guaranteed.	——	13	——	3
Found.		13.34	13.84	2.70
Below guarantee.				0.30
Guaranteed.	——	14	——	——
Found.		14.70	16.52	
Guaranteed.	0.82	10	——	8
Found.	0.74	11.30	12.59	6.47
Below guarantee.				1.53

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Tassel & Engleson, Williamson, N. Y.	Wheat and seeding fertilizer.	Williamson.	3011
I. P. Thomas & Son, Philadelphia, Pa.	Special dissolved bone and potash.	East Avon.	2951
G. O. P. Turner, Churchville, N. Y.	High-grade guano.	Churchville.	3031
G. O. P. Turner, Churchville, N. Y.	Blood.	Churchville.	3032
Tygert-Allen Fertilizer Co., Philadelphia, Pa.	Acidulated phosphate.	Owego.	2840
F. G. Underwood, Oneida, N. Y.	Underwood fertilizer.	Oneida.	3026
Walker Fertilizer Co., Clifton Springs, N. Y.	Acme potato and vegetable manure.	Lyons.	3016
Walker Fertilizer Co., Clifton Springs, N. Y.	Ammoniated phosphate.	Lockport. Sodus.	2756 3002
Walker Fertilizer Co., Clifton Springs, N. Y.	Clifton.	Sodus.	3001
Walker Fertilizer Co., Clifton Springs, N. Y.	Lawn fertilizer.	Clifton Springs.	2872
Walker Fertilizer Co., Clifton Springs, N. Y.	Old Pittsburg.	Clifton Springs.	2870

LECTED IN NEW YORK STATE DURING THE FALL OF 1896.
turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	2.25	8	——	3.24
Found.	2.25	8.95	11.28	*3.98
Guaranteed.	——	8	9	2
Found.		11.77	13.03	2.15
Guaranteed.	2.50	9	10	4.75
Found.	2.70	9.41	10.30	5.57
Guaranteed.	11.50	——	——	——
Found.	**12.01**			
Guaranteed.	——	14	——	——
Found.		14.53	16.01	
Guaranteed.	2.50	——	10	4.50
Found.	2.61	7.10	11.45	7.30
Guaranteed.	3.10	5.50	——	15
Found.	3.24	5.01	6.88	14.65
Below guarantee.		0.49		0.35
Guaranteed.	1.65	8	——	1
Found.	1.58	7.76	9.16	1.66
Below guarantee.		0.24		
Guaranteed.	2.47	10	——	2.50
Found.	2.63	8.91	11.25	2.65
Below guarantee.		1.09		
Guaranteed.	4.10	3	——	5
Found.	4.35	3.22	3.45	5.34
Guaranteed.	1.65	8	10	3
Found.	1.57	8.35	9.16	2.83

* Potash present in form of sulphate.

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Walker Fertilizer Co., Clifton Springs, N. Y.	Potato and vegetable grower.	Sodus.	3000
Walker Fertilizer Co., Clifton Springs, N. Y.	Pure ground bone.	Clifton Springs.	2871
Walker Fertilizer Co., Clifton Springs, N. Y.	Victoria bone.	Lyons.	3015
Walker Fertilizer Co., Clifton Springs, N. Y.	Wheat special No. 2.	Lockport.	2755
M. E. Wheeler & Co., Rutland, Vt.	Electrical dissolved bone.	East Williamson.	3013
M. E. Wheeler & Co., Rutland, Vt.	Fruit fertilizer.	Wethersfield Springs.	2929
M. E. Wheeler & Co., Rutland, Vt.	Royal wheat grower.	East Williamson.	3012
Williams & Clark Fertilizer Co., New York City.	Ammoniated bone superphosphate.	Rochester. Avon.	2770 2953
Williams & Clark Fertilizer Co., New York City.	Dissolved bone and potash.	Rochester. Caledonia.	2771 2881
Williams & Clark Fertilizer Co., New York City.	Carteret ground bone.	Rochester.	2781
Williams & Clark Fertilizer Co., New York City.	Genesee valley formula.	Avon.	2952

LECTED IN NEW YORK STATE DURING THE FALL OF 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	2.47	6	———	7
Found.	2.59	6.21	7.15	8.11
Guaranteed.	3.70	———	21	———
Found.	4.16	9.79	21.75	
Guaranteed.	0.82	8	———	1.50
Found.	1.09	7.29	9.20	1.53
Below guarantee.		0.71		
Guaranteed.	1.65	11	———	5
Found.	1.31	12.51	12.51	4.85
Below guarantee.	0.34			
Guaranteed.	———	14	15	———
Found.		15.36	15.77	
Guaranteed.	———	10	———	8
Found.		10.32	11.04	9
Guaranteed.	0.82	8	9	2
Found.	1.18	7.51	11.85	2.05
Below guarantee.		0.49		
Guaranteed.	2.47	9	10	2
Found.	2.45	9.63	11.91	2.04
Guaranteed.	———	10	———	2
Found.		9.98	12.81	*2.18
Guaranteed.	2	———	14	———
Found.	2.01	16.18	17.50	
Guaranteed.	———	10	———	6
Found.		9.57	14.78	6.38
Below guarantee.		0.43		

* Potash present in form of sulphate.

RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS COL-

Composition of fertilizers as guaranteed by manufac-

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Williams & Clark Fertilizer Co., New York City.	Universal.	Caledonia.	2882
Worcester & Mott, Union Hill, N. Y.	Alkaline bone.	Union Hill.	2811
Worcester & Mott, Union Hill, N. Y.	Grain and grass.	Union Hill.	2812
Worcester & Mott, Union Hill, N. Y.	Storm king.	Lincoln.	2813
Zell Guano Co., Baltimore, Md.	Crop insurer.	Cato.	2996
Zell Guano Co., Baltimore, Md.	Special grain fertilizer.	Clyde.	3020
Zell Guano Co., Baltimore, Md.	Wilson's special No. 1.	LeRoy.	2908
Zell Guano Co., Baltimore, Md.	Wilson's special No 3.	LeRoy.	2909

LECTED IN NEW YORK STATE DURING THE FALL OF 1896.

turers and as found by chemical analysis at this Station.

	Pounds of nitrogen in 100 pounds of fertilizer.	Pounds of available phosphoric acid in 100 pounds of fertilizer.	Pounds of total phosphoric acid in 100 pounds of fertilizer.	Pounds of water-soluble potash in 100 pounds of fertilizer.
Guaranteed.	1.64	8	9	2
Found.	2.05	9.13	12.88	2.55
Guaranteed.	———	13	———	3
Found.		13.12	13.71	2.65
Below guarantee.				0.35
Guaranteed.	1.23	10	———	3
Found.	1.13	9.86	11.09	3.09
Guaranteed.	1.85	9	———	4
Found.	1.78	9.23	10.37	3.99
Guaranteed.	0.80	7	9	1
Found.	0.86	9.94	12.25	1.32
Guaranteed.	0.80	8	10	4
Found.	0.86	8.30	11.86	4.32
Guaranteed.	0.80	8	10	4
Found.	0.86	9.79	12.74	4.40
Guaranteed.	———	14	15	———
Found.		15.09	16.95	

PLATE VI.

Partial View of Station Orchards.

REPORT

OF THE

HORTICULTURAL DEPARTMENT

S. A. BEACH, M. S., Horticulturist.

WENDELL PADDOCK, B. S., First Assistant.

C. P. CLOSE, B. S., Assistant.

Table of Contents.

REPORT OF THE HORTICULTURIST.

S. A. BEACH.

During 1896 the Station Horticulturist and his assistants have been occupied chiefly with work pertaining to (1) the testing of the many hundreds of varieties of fruits which are included in the Station collections, and keeping a permanent record for each variety; (2) the origination of new fruits for the purpose of securing improved sorts; (3) the investigation of certain subjects concerning the growing of vegetables under glass; (4) the prevention of various plant diseases by spraying and otherwise; (5) a comparison of different kinds of spraying apparatus; (6) a comparison of the amount of winter injury in 1895-6, which was sustained by different varieties of fruit throughout the State; (7) experiments in thinning fruit; (8) trial of different plants for cover crops in orchards.

Addresses on horticultural subjects were given in various places in the State; exhibits of fruit were made at the State Fair; the American Institute Fair, held in Madison Square Garden, New York city; the annual meeting of the Western New York Horticultural Society, Rochester, N. Y., and in other places.

Mr. Paddock has given special attention to testing strawberries, blackberries and raspberries, girdling grapes, and a comparison of spraying apparatus. He has also continued his investigations in treating raspberry anthracnose. The bulletins and reports on these subjects are prepared by him.

Mr. Close has given special attention to the correspondence concerning winter injury to fruits and to photographing and describing fruits, particularly apples.

These gentlemen have also assisted in various other parts of the horticultural work with fidelity and efficiency.

The following bulletins on horticultural topics were prepared in 1896:

No. 98. Plum leaf spot, cherry leaf spot and fruit rot. S. A. Beach.

No. 109. Strawberries. W. Paddock.

No. 111. Variety tests with blackberries, dewberries and raspberries. W. Paddock.

No. 114. Gooseberries. S. A. Beach.

I. TESTING FRUITS.

S. A. BEACH.

From the very beginning of experiment work at this Station, i. e., since 1882, the testing of varieties of fruits and vegetables has been given considerable prominence here. Because more immediate results may be obtained with vegetables than with fruits, the testing of vegetables was for several years given special attention, and the value of much of the work that was done in this line, notably the investigations concerning corn, beans and tomatoes, soon became widely recognized. Early in the history of the Station the planting of varieties of fruits was begun, and it has been constantly extended till now. The testing of fruits absorbs so much time that with the force at present available for the work but little attention can be given to testing vegetables.

OBJECT OF THE WORK.

The principal reasons for continuing the work with testing varieties, as I apprehend them, are:

First. To give the people of the State a trustworthy and unbiased account of the character of the varieties, so far as their record at this Station is concerned, especially comparing recently introduced or little known varieties or novelties, with standard sorts, and calling attention to such of them as appear to be worthy of more extended trial.

Second. To preserve for future reference a record of all varieties which have been tested together with drawings, photographs, models and herbarium specimens of them.

Third. To determine the true names of varieties for the many people who make application to the Station for such information and to publish synonyms. This will have a tendency to check the dissemination of old varieties under new names.

Fourth. To furnish the Horticulturist or Botanist with material for the study of any particular group of fruits or vegetables which he may be investigating as to hardiness, productiveness, ability to fertilize their own blossoms, methods of propagation, immunity from disease, the evolution of different types or any other feature of botanical or horticultural interest.

Some idea of the extent to which fruit testing has developed at this Station may be gained from the following tabulated statement of the number of varieties of ordinary kinds of fruit now in the Station collections; the number which were added to the list in the fall of 1895 and the spring of 1896; and the number of seedlings that have originated at the Station which are now being tested:

FRUIT VARIETIES UNDER TEST.

KIND OF FRUIT.	Station seedlings now being tested.	Varieties added in fall of 1896 and spring of 1897.	Total varieties now under test.
Pomaceous fruits:			
Apples	49	117	593
Crab apples	....	1	31
Pears	39	23	164
Quinces	....	....	10
Stone fruits:			
Almond	....	....	1
Apricots	....	4	24
Cherries	1	13	57
Peaches	....	22	133
Plums	27	13	244
Small fruits:			
Grapes	451	5	690
Currants	53	10	103
Gooseberries	259	6	484
Blackberries	1	2	42
Dewberries	43	....	49
Raspberries	18	17	123
Strawberries	170	32	340
Total	1,111	265	3,088

Besides the fruits just enumerated there are growing at the Station some novelties or fruits that are little grown, such as the Wineberry, Golden Mayberry, Mulberry, Juneberry, Strawberry, Raspberry, etc.

APPLES AND CRAB APPLES.

S. A. BEACH, W. PADDOCK, C. P. CLOSE.

With few exceptions the varieties of apples and crab apples which have been received for testing at this Station have been topworked on bearing trees of Baldwin and Rhode Island Greening, sometimes they have been worked on young trees of some other varieties, and in many cases root-grafted or budded trees of the varieties designed for testing have been planted. Many old varieties have been included in the orchards that new or little-known kinds may be compared with them.

Notes on a few varieties based on their records at this Station are given below. Some of them may do better elsewhere than they have done here; others may not do so well. It is not expected that these notes will give a complete report as to the merits of the fruits, but they give their records at the Station up to the present time.

NOTES ON VARIETIES.—APPLES.

In the following pages synonyms and temporary names or numbers of unnamed fruits are printed in italics.

Amasia.—Cions received from Ellwanger & Barry, Rochester, N. Y., in 1883, were topworked on a bearing tree. The tree bore one good crop in 1894 and a light crop in 1896. It makes a slow upright growth, and has not yet been very productive here. The fruit is not as attractive as more highly-colored varieties are, but it is about the right size for a table apple, and, on account of its good quality, is desirable for dessert use for those who prefer a very mild sub-acid or sweet apple. Season, December to March.

Fruit medium or below, roundish-conic, sometimes oblique and somewhat ribbed; skin pale yellow nearly overspread with red, splashed and striped with carmine, and thickly sprinkled with light straw-colored dots; cavity narrow, deep, slightly russeted; stem short, slender; basin abrupt, moderately broad and deep; calyx small, closed; flesh nearly white, crisp, rather coarse, juicy, sweet or nearly so, agreeable aroma and flavor, very good quality.

Andrews Winter.—From Benj. Buckman, Farmingdale, Ills., 1889. It was topworked on a bearing tree and bore its first fruit six years later. It has made a vigorous, somewhat spreading growth. It came into bearing early and has been quite productive. The fruit, which is in season from late winter to June, may prove valuable where a very late keeper is desirable.

Fruit small, roundish-conic, faintly ribbed, often unsymmetrical, flattened at the base; cavity moderately broad and deep, slightly ribbed, slightly russeted; stem short; basin abrupt, moderately deep, coarsely corrugated; calyx small and closed. Skin yellowish green overlaid with a dull purplish-red and dotted with pale straw-colored dots. Flesh greenish white, firm, moderately juicy, rather fine-grained, very mild sub-acid, fair to good quality and flavor.

August.—Originated from seed of Wealthy, by P. M. Gidron, Excelsior, Minn., from whom it was received in 1888. It was topworked on a bearing tree and bore a few fruits in 1893 for the first time. The tree is of spreading habit and makes a moderate growth. It came into bearing early and has given satisfactory yields.

Fruit medium or below roundish-oblate, slightly conic; skin yellow covered with abundant bloom and striped and splashed with bright dark red and sprinkled with small whitish dots, stalk rather short set in a medium to deep, regular cavity. Calyx with long recurved segments set in a moderately shallow basin. Flesh yellowish, half fine, moderately juicy, breaking, mild sub-acid, with slight crab apple flavor, good quality. Season, August.

Benninger.— From W. H. Benninger, Walnutport, Pa., 1889. —Under date of April, 1892, Mr. Benninger writes:

"The original tree came up as a natural tree sixty years ago on the farm of my grandfather, Uhlie Benninger. It has been topgrafted for over thirty years in Lehigh and Northampton counties. It is a good grower, an annual and very prolific bearer; the fruit is very large and uniform in size; flesh yellow and good flavor."

As grown here it has a spreading habit and makes a moderate growth. It was topworked on a bearing tree in 1889, and it bore a few fruits in 1894, 3 bushels in 1895 and 6¾ bushels in 1896, thus confirming the claim that it is productive. It seems to be a really valuable apple for dessert use but it is too mild in flavor when cooked to make it desirable for culinary use. It is medium or above in size and attractive in appearance, having a fine blush over a yellow background. Basin broad, shallow, wrinkled; calyx lobes rather large and long; cavity moderately deep, slightly russeted; stem medium; flesh tinged with yellow, fine grained, moderately juicy, mild sub-acid, good quality. Season, September.

Colton. — Received cions from Ellwanger & Barry, Rochester, N. Y., in 1888 and topworked them on a bearing tree. The tree is upright in habit, has made a good growth but has not, as yet, been productive. Season, last ofAugust.

Fruit medium size, roundish, narrowing towards either end; skin pale greenish yellow, dotted with large faint greenish dots when ripe. Calyx medium, nearly closed; segments rather long, recurved; basin small, corrugated; stalk medium, stout; cavity small, shallow. Flesh whitish, mild sub-acid, juicy, rather coarse-grained, crisp, fair quality.

Edwards Favorite. — Received cions from Benj. Buckman, Farmingdale, Ill., and topworked them on a bearing tree in 1889. It came into bearing six years later and since then has given satisfactory yields. The tree makes a vigorous, spreading growth.

Fruit medium size, oblate, symmetrical, slightly ribbed at basin. Cavity may be narrow, deep and sometimes russeted, or it may be rather broad and shallow; stem long, slender; basin moderately narrow and deep; calyx closed; skin greenish yellow largely striped and washed with pale red and sprinkled with russet dots. Flesh white, slightly tinted with yellow, moderately juicy, rather coarse, breaking, sub-acid, fair to good quality. Keeps well till June, and specimens have been kept here till the following fall without putting them in cold storage.

Glass Green. — A Russian apple received from T. H. Hoskins, Newport, Vt. Topgrafted in 1888 and bore its first fruit in 1895. The tree makes a vigorous growth with spreading branches.

Fruit large, oblate to oblate-conic, or oblong, very irregular, sides unequal; cavity moderately broad, shallow, thinly russeted; stem short, slender, tomentose; basin broad, deep, abrupt corrugated; calyx large, open, lobes slightly reflexed. Skin green, sometimes has a faint blush where exposed, dotted with whitish or russeted dots and covered with a very thin white bloom. Flesh greenish, moderately juicy, coarse, sub-acid, fair quality and flavor; liable to water cores; core large, closed. Season last of July and first of August. Cannot be recommended.

Kalkidouskœ. — A Russian variety, cions of which were received from Ellwanger & Barry, Rochester, N. Y., and topworked on a bearing tree in 1884. The tree has a spreading habit. It has made a rather slow growth, and has not been very productive. The fruit shows a tendency to water-core, and, although it ranks good to very good in quality, it is not, on the whole, equal to other varieties of its season, and cannot be recommended for planting in this state. Season, September and early October.

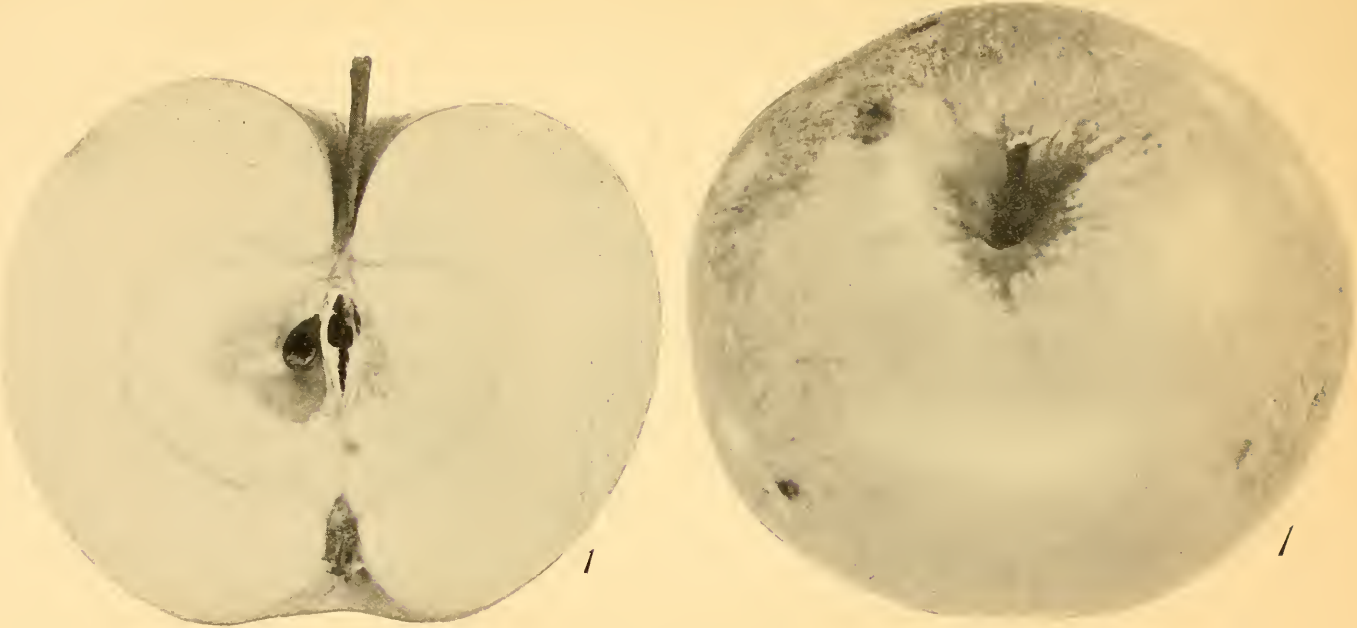
Fruit medium to large, obtuse conic wide at base. Skin dull pale yellow with numerous light colored dots, blushed and striped with dull red; cavity moderately broad, shallow, somewhat russeted; stem very short; basin narrow, shallow, wrinkled; calyx half open, lobes reflexed. Flesh yellowish, fine-grained, juicy, mild, sub-acid, fair in quality and flavor; core small and open.

Lawver.—This variety has been received here under the names of *Delaware Winter* and *Delaware Red Winter*. It is a brilliant, deep red fruit that keeps well into early summer. As grown here it is only fair in quality, although in sections further south it is ranked as very good. The tree has a moderately spreading habit, is a good grower and productive. It was introduced many years ago in Missouri, and has been grown to a considerable extent from Delaware to Kansas. Not recommended for this state.

Fruit medium, roundish-oblate, obscurely ribbed; symmetrical; cavity rather narrow, deep russeted; stem long and slender; basin shallow, slightly plaited, calyx small and closed. Skin smooth, bright deep red. occasionally showing a yellow background and thickly sprinkled with whitish dots. Flesh yellowish, firm, crisp, fine-grained, juicy, mild, sub-acid, fair quality. Will keep till June or later.

Lou.— Originated from seed of Oldenburg, by Peter M. Gideon, Excelsior, Minn., from whom cions were received and topworked on a bearing tree in 1888. Tree a good grower with strong, upright branches. It came into bearing five years after it was topworked and has been quite productive. The fruit is not highly colored and ranks only fair to good in quality. Season, last of July and first of August. Mr. Gideon speaks of it as a very hardy variety, which might make it desirable in some localities.

PLATE VII.



McMahon. From Life-size Photographs.

NEW YORK AGRICULTURAL EXPERIMENT STATION.

FIFTEENTH ANNUAL REPORT.

Corrections.

Plate VIII.	Mzensk Sweet *should be* Reinette de Caux.
Plate IX.	Reinette de Caux *should be* Swenker.
Plate XI.	Swenker *should be* Mzensk Sweet.

PLATE VIII.

Mzensk Sweet. From Life-size Photographs.

Fruit small to above medium, oblong-conic, somewhat ribbed, sides unequal. Stem medium, slender set in a moderately deep cavity; basin shallow, somewhat corrugated; calyx small, half-open; skin pale yellow or green thinly washed with bright red and striped with carmine, dotted with light or russet dots, covered with a very thin white bloom. Flesh nearly white, a little coarse, juicy, sub-acid, fair to good; core small, open.

McMahon. *McMahon White.*— This variety originated some years ago in Richland county, Wis., and has attained considerable prominence in that and adjoining states on account of its size, appearance and reputed hardiness. Cions of it received from G. J. Kellogg, Janesville, Wis., were topworked on a bearing tree in 1888 and fruited for the first time in 1892. Tree is spreading in habit, a good grower, productive.

Fruit large, roundish-conic, ribbed. (See plate VII.) Skin pale greenish-yellow or nearly white, with irregular patches of light grey extending outward from cavity and sometimes blushed on exposed side and dotted with greenish or russet dots; stem medium, set in a narrow deep russeted cavity; basin narrow, abrupt, slightly wrinkled, moderately deep. Flesh white, tender, fine-grained, juicy, pleasant sprightly sub-acid, fair to good quality and flavor; core small, partially open. Season, October and November.

Magog Red Streak.—A Russian variety, cions of which were received in 1888 and topworked on a bearing tree. Tree is upright in habit, a fair grower and moderately productive, so far as tested here.

Fruit medium to large, oblate-conic to roundish-oblong, very faintly ribbed; skin rich yellow, slightly washed and sparsely striped or splashed with red, dotted with brown and russet; cavity moderately broad, usually deep, sometimes russeted; stem medium; basin moderately broad, moderately deep, coarsely wrinkled; calyx small, closed, lobes narrow. Flesh yellowish, juicy, half fine, sub-acid much like Bellflower, aromatic, good quality and flavor. It is very good for culinary use, cooks evenly and quickly and retains its shape. Season, October.

Mzensk Sweet.—(*No. 595 Russian.*) A Russian variety which was topworked on a bearing tree in 1888 and bore its first crop here in 1895. It gave a good yield in 1896. Tree has a spreading habit and makes a slow growth. The fruit is fairly good for culinary use, but quite inferior to other varieties of its season which thrive here. Season, September to November.

Fruit large to very large, roundish, slightly oblong, symmetrical. (See plate VIII.) Cavity moderately broad, but varies from broad to narrow and from moderately deep to deep, thinly russeted; stem medium, stout, basin moderately broad, abrupt, deep, somewhat wrinkled; calyx medium, partly open, lobes long and reflexed. Skin pale yellow, thinly washed and mottled over entire surface with faint red and striped and splashed with light carmine, thickly marked with small irregular dark brown dots. Flesh white, fine, juicy, peculiar aroma, very mild sub-acid, fair quality and flavor; core large.

Newman Seedling.— From George Townsend, Gordon, O., 1890. It was topworked on a bearing tree and came into bearing four years later. Thus far it has been quite productive, and the fruit keeps well. Season, from December to May. It is not attractive in color and not first class either for cooking or for a dessert fruit.

Fruit medium or above, oblong, inclined to conic; skin straw color, faintly or sometimes deeply blushed with light red; stem slender, set in a narrow, shallow cavity; calyx open, set in a shallow, narrow basin. Flesh very firm, crisp, juicy, rather coarse, mild sub-acid, or nearly sweet, fair to good in flavor and quality; core large, open.

Northwestern Greening. — Cions from G. J. Kellogg, Janesville, Wis., were topworked on a bearing tree in 1888. It came into bearing six years later and since then has proved productive. The tree makes a vigorous spreading growth. Season, December to April.

Fruit above medium to large, oblate, inclined to conic; stem less than an inch long, set in a deep cavity; calyx closed, set in an abrupt moderately shallow basin. Skin green, till it begins to ripen, when it turns to pale yellow. Flesh rather coarse, juicy, aromatic, mild sub-acid, good flavor, fair to good quality. Not acid enough to make a good cooking apple.

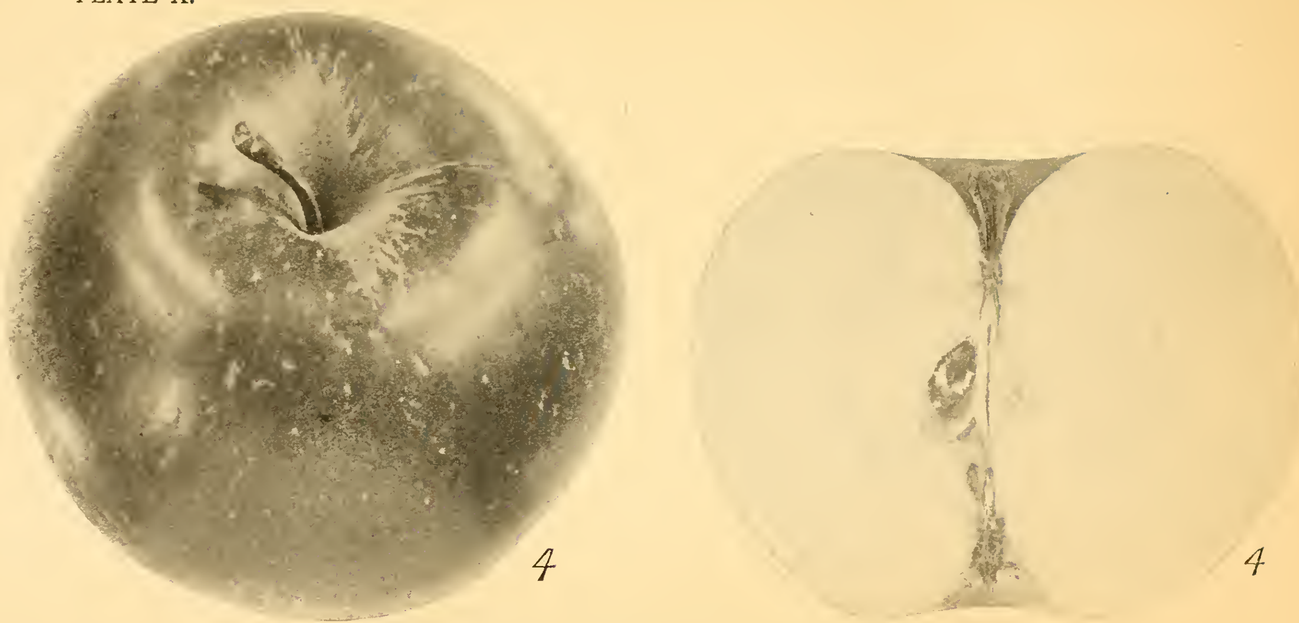
Pride of Texas. — From Benj. Buckman, Farmingdale, Ill., 1889. Topworked on bearing tree it bore a fair crop in 1895 and a very large one in 1896. The tree has a somewhat spreading habit, is a good grower and promises to be productive. Last season it was one of the best fruits in the Station collection for use in May and June. It seems to be worthy of trial where a late keeping fruit is wanted.

Fruit medium size, roundish conical, symmetrical; cavity moderately broad, rather deep, russeted; stem long; basin very shallow, corrugated; calyx small, closed. Skin smooth, light yellow, largely washed with faint red and splashed with carmine, sprinkled with white dots and roughened

PLATE IX.

Reinette de Caux. From Life-size Photographs.

PLATE X.



SUGAR BARBEL. FROM LIFE-SIZE PHOTOGRAPHS.

whitish blotches towards the stem. Flesh yellowish, firm, moderately juicy, breaking, mild sub-acid; quality and flavor good. Season, January to June.

Reinette de Caux.—A variety of French origin. Cions from Ellwanger & Barry, Rochester, N. Y., were topworked on a bearing tree in 1883. The tree has a somewhat spreading habit and makes a vigorous growth. It has been very productive on alternate years. The fruit is not very attractive in color, good medium size (see plate IX), excellent for cooking and good for dessert use. Season, December to May. Worthy of extended trial. It is said that it has been recommended as a very hardy variety by pomological societies of Russia and Germany.

Fruit medium size, round oblate; skin pale greenish yellow, blushed with light red where exposed, thickly sprinkled with grey dots; stem long, slender, set in a moderately deep cavity; calyx open; basin wide, shallow, wrinkled. Flesh crisp, juicy, sub-acid, good flavor and quality. Excellent for culinary use, cooks evenly and quickly, has a rich yellow color and good quality.

Romna.— A Russian variety from T. H. Hoskins, Newport, Vt. Topworked on a bearing tree in 1888 and bore its first crop six years later. Tree slow growing, branches spreading, productive.

Fruit small to medium, ribbed, very irregular, oblate; stem stout, set in a narrow, shallow, russeted cavity; calyx rather large, half closed, lobes reflexed, set in a moderately broad, deep, wrinkled basin. Skin green, turning to yellow, washed and striped with red, dotted with numerous small pale yellow dots, covered with a very thin lilac bloom. Flesh yellowish, juicy, a little coarse, mild sub-acid, fair quality, with a slightly astringent or crab apple flavor, not desirable for dessert; core small, closed. Season last of August and first of September.

Sugar Barbel.— A Russian winter apple of no special value for this region. Cions were received from Dr. T. H. Hoskins, Newport, Vt., and topworked on a bearing tree in 1888. It came into bearing in 1895 and bore a good crop in 1896. The fruit is attractive, having a good dark red color, but it ranks no higher than good in quality. The tree makes a vigorous spreading growth.

Fruit medium to large, oblate-conic; symmetrical, slightly ribbed, smooth. (See plate X.) Cavity rather wide, deep, russeted; stem usually long, slender, sometimes short and thick; basin broad, rather abrupt, moderately deep, corrugated; calyx broad, open. Skin dull yellow, largely overlaid with dark red, thickly specked with small yellow dots or flecked with russet. Flesh yellowish, firm, crisp, rather coarse, moderately juicy, mild sub-acid, good flavor and quality, slightly aromatic.

Swenker. — An early winter fruit not good enough in quality to be valuable in this section.

Cions received in 1890 from J. G. Youngken, Richlandtown, Pa., were topworked on a bearing tree and came into bearing in 1895. The tree has a spreading habit, and, so far as tested here, is vigorous and productive. Fruit medium to large, oblate-conic, faintly ribbed. (See plate XI.) Skin pale lemon yellow, washed with light red over one-half or more of the surface, penciled and splashed with light carmine, light grey patches extend from cavity and cover one-fourth or more of the surface, thickly sprinkled with small russet dots; cavity rather broad, deep, often russeted; stem short or medium, slender; basin moderately narrow, abrupt, nearly always smooth; calyx small, half open, reflexed. Flesh yellowish, juicy, mild sub-acid, peculiar aroma, fair quality and flavor; core medium, slightly open.

Van Hoy No-Core. — This variety seems to be remarkable chiefly because the core is small and usually contains no well-developed seeds. It is not attractive in appearance, ranks only good in quality and lacks in flavor. It cannot be recommended for any purpose.

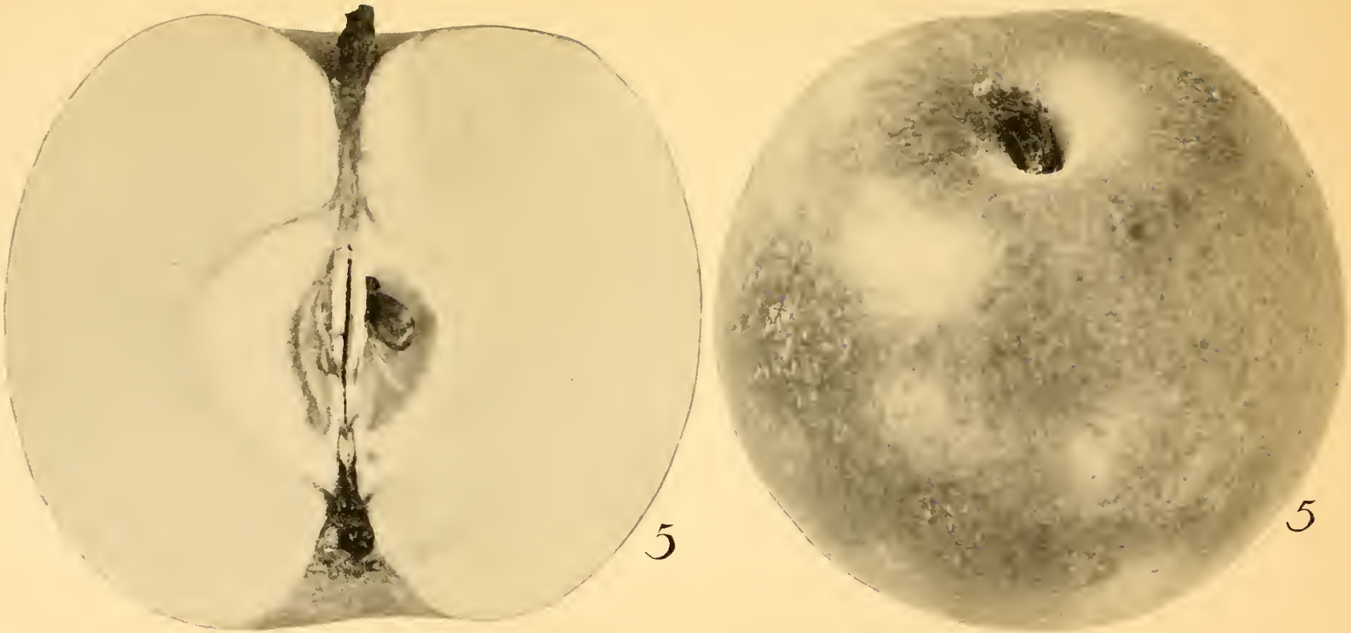
The tree is a vigorous grower with spreading branches. Fruit medium or above, oblate, ribbed, frequently unsymmetrical; cavity rather narrow, deep, thinly russeted; basin broad, abrupt, deep; calyx closed. Skin dull yellowish-green, overlaid and splashed with dull red, flecked with yellowish dots on the red and dark spots on the yellowish-green. Flesh tinged with greenish yellow, moderately juicy, breaking, mild sub-acid, quality good, flavor lacks sprightliness or decided character. Season, January to May.

CRAB APPLES.

Blood Red. — This variety originated with Peter M. Gideon, Excelsior, Minn., from mixed seed of Wealthy, Peter and several other kinds. Cions received from Mr. Gideon were topworked on a bearing apple tree in 1888. The tree is a slow grower, has a spreading habit and has been but moderately productive here. It does not seem to be worth testing in this state.

Fruit medium in size, oblate; skin pale yellow, but is nearly covered with a beautiful deep red when fully ripe; calyx nearly closed, presistent, set in a broad, shallow slightly corrugated basin; cavity moderately narrow and deep; stalk short and slender. Flesh yellowish, juicy, mild sub-acid, good quality and flavor. Season, September and October.

PLATE XI.



SWENKER. FROM LIFE-SIZE PHOTOGRAPHS.

Dartmouth. — Topworked on a bearing tree in 1888 and produced its first fruit in 1894. The tree is a slow grower with almost erect branches. It has not as yet been productive here.

Fruit medium to large, very attractive, oblate or roundish oblate, ribbed; stem long and slender, often bracted, set in a broad, deep russeted cavity; basin rather broad, shallow; calyx small, with lobes long and reflexed; skin pale yellow, almost entirely overlaid with bright red deepening to a dark red or purple on exposed side, dotted with yellow and covered with a heavy bluish bloom. Flesh yellowish, tinged with red next to the skin, fine-grained, juicy, mild sub-acid, good quality and flavor; core large, open. Season, August.

Minnesota.—Fruit large, roundish, sides usually unequal, ribbed; cavity narrow, shallow; stem slender, medium long, often bracted; basin very shallow, corrugated; calyx large, closed, lobes reflexed. Skin pale yellow, blushed or mottled on sunny side, dotted with small yellow or russet dots, covered with a vey thin white bloom. Flesh white, crisp, juicy, nearly sweet, slightly astringent; core large, closed. Season, September. The tree makes a moderate growth, branches spreading. It has not been productive here.

TABLE SHOWING (1) YIELD OF APPLES IN 1896; (2) NUMBER OF YEARS SINCE EACH VARIETY WAS TOPWORKED ON A YOUNG BEARING TREE, OR SINCE IT WAS PLANTED, AND (3) SEASON OF RIPENING AT GENEVA.

NOTE.—The following abbreviations are used to denote the season of ripening: E. S., for early summer; S., for summer; E. F., for early fall; F., for fall; E. W., for early winter: W., for winter; L. W., for late winter and spring. Synonyms are printed in italics.

NAME.	Yield in 1896.	Years since top-worked on bearing tree.	Years since tree was planted.	Season at Geneva.
Alexander	Good	13	....	F.
Amasia	Few	13	....	W.
American Best	Few	6	....	S.
American Newtown Pippin, see Green Newtown Pippin.				
Amos Jackson	Fair	7	....	E. W.
Aporta, see Alexander.				
Ananarnœ	Few	......	12	F.
Andrews Winter	Very large.	7	....	L. W.
Aport Oriental	Few	8	....	F.
Astravaskœ, see Ostrakoff.				
Arabian	Few	8	....	S.
Arthur	Few	4	....	....
Aucuba-leaf Reinette	Very large.	13	....	E. W.
August	Fair	8	....	S.
Aunt Ginnie	Fair	13	....	F.
Aurora, see Twenty Ounce.				
Autumn Streaked	Good	8	....	F.
Baker	Few	6	....	....
Baldwin	Very large.	13	....	W.
Baltimore Pippin, see Ben Davis.				
Baltimore Red, see Ben Davis.				
Baltimore Red Streak, see Ben Davis.				
Beitigheimer	Good	13	....	F.
Belboradaoskœ	Few	......	12	S.
Belle de Boskoop	Very large.	8	....	E. W.
Belle Fleur, see Yellow Bellflower.				
Bell Early, see Sops of Wine.				
Ben Davis	Very large.	13	....	L. W.
Benninger	Very large.	7	....	F.
Bennington, see Sops of Wine.				
Benoni	Few	8	....	E. F.
Boston Russet, see Roxbury Russet.				
Brooke Pippin, see Green Newtown Pippin.				
Berkoff	Few	......	12	....
Birth	Few	8	....	L. F.
Blenheim	Very large.	8	....	E. W.
Boiken	Few	......	6	W.
Borovinkink	Few	......	6	S.
Borsdorf	Few	8	....	F.
Brownlee Russett	Fair	13	....	L. W.
Buckingham	Good	8	....	W.
Buckley see, Chenango Strawberry.				
Byer's Best, see Buckingham.				
Canada Baldwin	Good	8	....	W.
Canada Reinette	Very large.	8	....	L. W.

TABLE SHOWING THE YIELD OF APPLES, ETC., IN 1896 — (*Continued.*)

NAME.	Yield in 1896.	Years since top-worked on bearing tree.	Years since tree was planted.	Season at Geneva.
Carolina Red June	Fair	13	....	S.
Carolina Red Streak, see Ben Davis.				
Cayuga Red Streak, see Twenty Ounce.				
Celestia	Fair	7	....	W.
Champaign	Few	6	....	E. S.
Charlamof	Few	4	....	....
Chenango Strawberry	Very large.	13	....	S.
Coleman, see Twenty Ounce.				
Clark	Fair	8	....	F.
Cogswell	Very large.	8	....	F.
Colton	Fair	8	....	E. S.
Colvert	Fair	8	....	F.
Coon Red	Very large.	7	....	W.
Cooper Market	Good	13	....	L. W.
Cooper Red Wing, see Cooper Market.				
Count Orloff	Few	......	12	E. S.
Cox Pomona	Few	13	....	E. F.
Crimean	Few	......	6	S.
Crotts	Few	6	....	F.
Czar Thorn	Few	......	12	E. F.
Delaware and *Delaware Red Winter*, see Lawver.				
Dickinson	Very large.	7	....	W.
Disharoon	Very large.	7	....	L. F.
Dodge Early Red, see Sops of Wine				
Dominie	Very large.	11	....	W.
Downing's Winter Maiden's Blush, see Greenville.				
Duchess of Oldenburg, see Oldenburg.				
Dudley	Good	4	....	F.
Dudley Winter, see Dudley.				
Duke of Devonshire	Good	13	....	W.
Dumelow	Very large.	13	....	W.
Duncan	Very large.	7	....	L. W.
Early French Reinette, see Early Harvest.				
Early Harvest	Fair	13	....	E. S.
Early Joe	Few	6	....	S.
Earley Ripe	Good	8	....	E. S.
Early Strawberry	Fair	13	....	S.
Edgar Red Streak, see Walbridge.				
Edwards	Large	7	....	L. W.
Ella	Few	10	....	E. F.
Elgin Pippin	Few	7	....	L. F.
Emperor Alexander, see Alexander.				
English Golden, see Golden Russet.				
English Golden Russet, see Golden Russet.				
English Pippin	Very large.	8	....	L. F.
Enormous	Few	8	....	E. S.
Ernst Pippin, see Ohio Pippin.				
Esopus Spitzenburg	Few	13	....	W.
Etowah	Fair	7	....	F.
Everbearing	Few	7	....	F.
Ewalt	Good	8	....	W.
Falix	Few	7	....	....

TABLES SHOWING THE YIELD OF APPLES, ETC., IN 1896—(*Continued.*)

NAME.	Yield in 1896.	Years since top-worked on bearing tree.	Years since tree was planted.	Season at Geneva.
Fallawater	Good	13	....	L. W.
Fall Pippin	Very large.	13	....	F.
Fall Queen, see Haas.				
Fall Queen, see Buckingham.				
Fall Wine	Good	13	....	F.
Fameuse	Good	13	....	F.
Family	Good	7	....	E. W.
Fanny	Few	8	....	....
Farris	Very large	7	....	W.
Faust's Rome Beauty, see Rome Beauty.				
Ferdinand	Few	7	....	F.
Fishkill	Few	4	....	....
Flory	Very large.	8	....	F.
Fourth of July	Few	6	....	E. F.
Frank, see Chenango Strawberry.				
French Pippin	Few	6	....	F.
Gardener, see Mother.				
Gideon	Very large.	8	....	F.
Gideon No. 7	Very large.	8	....	S.
Gideon No. 30	Fair	8	....	E. S.
Gideon Sweet	Good	13	....	W.
Gillett's Seedling, see Rome Beauty.				
Gladstone	Fair	4	....	S.
Glass Green	Fair	8	....	E. S.
Golden Medal	Very large.	8	....	W.
Golden Russet	Good	13	....	L. W.
Golden Sweet	Few	13	....	E. F.
Golden White	Fair	8	....	E. F.
Gracie	Large	8	....	E. F.
Grand Duke Constantine	Few	......	12	S.
Grandmother	Few	8	....	F.
Grand Sultan	Few	13	....	E. S.
Gravenstein	Good	13	....	F.
Gray Apple, see Pomme Grise.				
Green Newtown Pippin	Fair	13	....	L. W.
Greenville	Good	9	....	W.
Green Vandevere, see Vandevere.				
Grimes Golden	Very large.	8	....	E. W.
Groscoe Selenka Gruner	Good	13	....	E. S.
Gros Pomier, see Haas				
Haas	Good	13	....	F.
Hagloe	Good	6	....	S.
Hartford Rose	Few	8	....	F.
Haskell Sweet	Very large.	8	....	F.
Haywood	Few	4	....	L. W.
Heidorn	Few	8	....	S.
Hicks	Good	7	....	E. S.
Holland	Few	8	....	E. W.
Holland Pippin, see Holland.				
Hominy, see Sops of Wine.				
Haas or *Horse*, see Haas.				
Howard Aport	Fair	8	....	E. F.
Hower or *House*, see Fall Wine.				
Howes Russet, see Roxbury Russet.				

Table Showing the Yield of Apples, Etc., in 1896—(*Continued.*)

NAME.	Yield in 1896.	Years since top-worked in bearing tree.	Years since tree was planted.	Season at Geneva.
Hubbardston Nonesuch	Few	10	....	E. W.
Hurlbut	Very large.	13	....	W.
Hurlbut Stripe, see Hurlbut.				
Indian	Few	8	....	......
Jackson Apple, see Chenango Strawberry.				
Jacob's Sweet	Very large.	8	....	W.
Jefferies	Good	13	....	F.
Jersey Sweeting	Good	13	....	E. F.
Jewett Fine Red	Very large.	8	....	W.
Jonathan	Very large.	8	....	W.
Jonathan Buler	Fair	7	....	L. F.
Jones Seedling	Fair	4	....	W.
July Apple, see Primate.				
July Cluster	Few	7	....	S.
July Pippin, see Early Harvest.				
Kalkidouskœ	Fair	......	12	F.
Kansas Greening	Very large.	7	....	L. W.
Kansas Keeper	Very large.	7	....	L. W.
Karabawka	Few	......	12	S.
Kentucky Pippin, see Ben Davis.				
Kentucky Queen, see Buckingham.				
Keswick	Good	13	....	E. F.
King, see Tompkins King.				
King of Tompkins Co., see Tompkins King.				
Kittageskee	Good	7	....	L. W.
Lady Henniker	Good	13	....	W.
Lady Sweet	Fair	13	....	L. W.
Landon	Few	8	....	L. W.
Laukford	Few	8	....	W.
Large White Juneating, see Early Harvest.				
Late Dutchess	Good	8	....	S.
Lawver	Very large.	8	....	L. W.
Lima, see Twenty-Ounce.				
Longfield	Few	8	....	F.
Longworth	Good	7	....	F.
Lord Nelson, see Blenheim.				
Lou	Few	8	....	S.
Lyman's Pumpkin Sweet, see Pumpkin Sweet.				
Magog Red Streak	Good	8	....	L. F.
Maiden Blush	Fair	13	....	F.
Mann	Few	8	....	W.
Marietta Russet, see Roxbury Russett.				
Maryland Queen, see Haas.				
McIntosh Red	Very large.	8	....	E. W.
McMahan's White	Good	8	....	E. W.
Melinda	Few	4	....	....
Melon	Good	13	....	E. W.
Melonen	Fair	8	....	S
Mellott	Few	6	....	....
Menagere	Few	13	....	W.
Milding	Fair	8	....	E. W.
Milligen	Very large.	8	....	W.
Missouri Pippin	Large	8	....	E. F.

TABLE SHOWING THE YIELD OF APPLES, ETC., IN 1896 — (*Continued.*)

NAME.	Yield in 1896.	Years since top-worked on bearing tree.	Years since tree was planted.	Season at Geneva.
Molly Whopper, see Fallawater.				
Monmouth	Fair	13	....	W.
Moon	Fair	7	....	W.
Moore Sweet	Fair	6	....	W.
Morgan's Favorite, see Twenty-Ounce.				
Moshier	Large	8	....	F.
Mother	Very large.	13	....	E. W.
Mountain Sweet	Few	6	....	S.
Mountain Pippin, see Fallawater.				
Mush Spice, see Fall Wine.				
Mzensk Sweet	Large	8	....	F.
Nelson Sweet	Very large.	7	....	L. W.
Never Fail, see Rawles Janet.				
Newtown Pippin, see Green Newtown Pippin.				
New Brunswick, see Oldenburg.				
Newman	Very large.	6	....	L, W.
New York Pippin, see Ben Davis.				
Nodhead, see Jewett's Fine Red.				
North American Best, see Primate.				
Northern Spy	Fair	13	....	L. W.
Northwestern Greening	Very large.	8	....	L. W.
Norton's Melon, see Melon.				
No. 21, *Voronesh*, see Yellow Colville.				
No. 161 *M. Russian*, see Birth.				
No. 199	Few	8	....	E. F.
No. 228 *Dept.*, see Vochin's Crimean.				
No. 238	Few	8	....	E. S.
No. 447 *Dept. Russian*, see Birth.				
No. 595 *Russian*, see Mzensh Sweet.				
Occident	Good	13	....	L. W.
Ohio Pippin	Very large.	8	....	E. W.
Oldenburg	Fair	13	....	S.
Ohio Wine, see Fall Wine.				
Olive	Fair	7	....	W.
Ontario	Good	13	....	L. W.
Ornament de Table	Large	7	....	E. W.
Ostrakoff	Fair	12	....	F.
Palmer's Greening, see Washington Royal.				
Parry White	Fair	......	7	E. F.
Peach	Fair	8	....	F.
Peck Pleasant	Fair	13	....	W.
Peter	Fair	8	....	F.
Petersburg Pippin, see Green Newtown Pippin.				
Pewaukee	Good	13	....	W.
Pine Stump	Few	4	....	....
Piper	Fair	7	....	L. W.
Pomme Grise	Few	13	....	E. W.
Pomeroy, see Lady Sweet.				
Pound, see Fallawater.				
Pound Sweet, see Pumpkin Sweet.				
Powers, see Primate.				
Pride of Texas	Very large.	7	....	L. W.
Prince Harvest, see Early Harvest.				

TABLE SHOWING THE YIELD OF APPLES, ETC., IN 1896 — (*Continued*).

NAME.	Yield in 1896.	Years since top-worked in bearing tree.	Years since tree was planted.	Season at Geneva.
Prolific Sweeting	Few	8	....	E. F.
Prussian, see Twenty-Ounce.				
Pumpkin Russet	Good	13	....	F.
Pumpkin Sweet	Very large.	8	....	F.
Putnam Russet, see Roxbury Russet.				
Queen Ann, see Mother.				
Queen, see Buckingham.				
Rambo	Fair	13	....	L. W.
Ralls Genet	Very large.	13	....	W.
Red Astrachan	Fair	13	....	E. S.
Red Beitigheimer, see Beitigheimer.				
Red Canada	Few	7	....	....
Red Pippin	Few	6	....	E. F.
Red Cheek Pippin, see Monmouth.				
Red Pippin, see Ben Davis,				
Red Russet	Very large.	13	....	L. W.
Red Stainer	Fair	6	....	E. F.
Red Vandevere, see Vandevere				
Reinette a feuille d' Aucuba, see Aucubaleaf Reinette.				
Red Transparent	Few	......	12	E. S.
Reinette de Caux	Few	13	....	W.
Repka	Few	......	12	S.
Reschestwenskoe, see Birth.				
Rhode Island Greening	Fair	13	....	W.
Rhodes Orange	Very large.	7	....	E. W.
Rome Beauty	Very large.	7	....	L. W.
Romna	Large	8	....	F.
Ronk	Good	6	....	W.
Roxbury Russet	Good	13	....	W.
St. Lawrence	Few	13	....	F.
St. Peters	Fair	8	....	S.
Salome	Fair	8	....	L. W.
Sandy Glass	Few	......	6	....
Saukermanky	Fair	8	....	F.
Scott Winter	Fair	8	....	L. W.
Sharp	Very large.	7	....	E. W.
Skalanka Bogdanoff	Few	......	4	......
Small Admirable	Good	13	....	F.
Smelling	Few	8	....	E. S.
Smith Cider	Fair	8	....	L. W.
Sops of Wine	Fair	13	....	F.
Standard	Very large.	7	....	F.
Starbuck	Good	4	....	F.
Stark	Few	8	....	L. W.
Strodes Birmingham	Very large.	6	....	E. F.
Stump	Few	13	....	E. F.
Sugar Barbel	Good	8	....	E. W.
Summer Hagloe, see Hagloe.				
Summer Red Colville	Fair	8	....	S.
Sutton Beauty	Very large.	13	....	W.
Swaar	Very large.	8	....	L. W.
Sweet Bough	Fair	8	....	S.
Swenker	Good	6	....	W.

TABLE SHOWING THE YIELD OF APPLES, ETC., IN 1896 — (*Continued*).

NAME.	Yield in 1896.	Years since top-worked on bearing tree.	Years since tree was planted.	Season at Geneva.
Switzer	Few	8	....	E. F.
Talman Sweet	Very large.	13	....	W.
Tetofsky	Fair.	13	....	E. S.
Thornton	Few	4	....	....
Titivoka	Very large.	6	....	S.
Titvoka	Fair.	13	....	E. F.
Titus Pippin	Few	6	....	....
Tobias	Few	8	....	E. W.
Tobias Black	Few	8	....	....
Tobias Pippin	Very large.	8	....	E. W.
Tompkins King	Very large.	13	....	E. W.
Tufts	Good	13	....	W.
Twenty-Ounce	Good	13	....	F.
Vandevere	Good	13	....	W.
Van Hoy No-Core	Few	7	....	L. W.
Victoria Sweet	Large	8	....	E. W.
Vochin Crimeau	Fair	8	....	E. S.
Wagener	Large	13	....	L. W.
Walbridge	Very large.	8	....	L. W.
Walker Beauty	Few	4	....	....
Wallace Howard	Fair	7	....	F.
Washington, see Sops of Wine.				
Washington Royal	Very large.	8	....	L. W.
Washington Strawberry	Good	8	....	S.
Wealthy	Very large.	8	....	F.
Western Beauty	Very large.	8	....	W.
White Canada Pippin	Few	6	....	E. W.
White Doctor	Very large.	7	....	L. W.
White Pigeon	Fair	8	....	S.
White Pippin	Good	13	....	W.
White Zurdel	Fair	7	....	E. F.
White Vanderere, see Vandevere.				
Wells, see Dominie.				
Williams' Early, see William Favorite.				
William Favorite	Few	13	....	E. S.
William Red, see William Favorite.				
William Prince	Fair	7	....	S.
Wine Rubets	Few	8	....	E. F.
Winesap	Very large.	13	....	L. W.
Winter Blush, see Fallawater.				
Winter Queen, see Buckingham.				
Wolf River	Good	8	....	L. F.
Workaroe	Few	......	12	S.
Yellow Bellflower	Very large.	13	....	W.
Yellow Colville	Good	8	....	S.
Yellow Forest	Few	8	....	L. W.
Yellow Transparent	Very large.	8	....	E. S.
Yopp Favorite	Very large.	7	....	F.
York Imperial	Good	8	....	L. W.
Zolotoreff	Few	8	....	S.
CRAB APPLES.				
Blood Red	Fair	8	....	F.
Briar Sweet	Large	4	....	S.

Table Showing the Yield of Apples, Etc., in 1896 — (*Concluded*).

NAME.	Yield in 1896.	Years since top-worked on bearing tree.	Years since tree was planted.	Season at Geneva.
Cherry Red	Few	7	....	S.
Chicago	Few	8	....	W.
Coral	Large	13	....	E. W.
Dartmouth	Few	8	....	S.
Excelsior	Good	8	....	S.
Gideon No. 2	Few	8	....	F.
Hyslop	Fair	13	....	F.
Lady	Few	8	....	L. F.
Large Red Siberian	Few	8	....	F.
Large Yellow Siberian	Fair	8	....	F.
Marengo	Few	8	....	F.
Martha	Very large.	8	....	E. F.
Minnesota	Fair	8	....	E. F.
Paul Imperial	Few	8	....	E. F.
Picta Striata	Few	8	....	E. F.
Red Siberian	Few	8	....	E. F.
September	Good	8	....	E. F.
Transcendent	Fair	13	....	E. F.
Whitney	Fair	13	....	S.

PEARS.

List of Pears in Station Orchard in 1896, not including Station Seedlings.

Angel.
Angouleme.
Anjou.
Anna Nellis.
Ansault.
Arkansas Mammoth.
Assomption.
Autumn Bergamot (No. 122).
Ayer No. 1.
Bartlett.
Bartseckel.
Bessemianka.
Bezi de la Motte.
Bon Chretien Fred Baudry.
Bordeaux.
Bosc.
Boussock.
Brandywine.
Briffont.
Brignais.
B. S. Fox.
Buffum.
Centennial.
Chinese Sand.
Clairgeau.
Cocklin.
Coles.
Colonel Wilder.
Columbia.
Comet.
Comice.
Congress.
Craig.
Crow Choice.
Daimyo.
Dana Hovey.
Dearborn Seedling.
Delices de Louvenjal.
Dempsey.
Dewey Premium.
Directeur Alphande.
Dix.
Dr. Hoskins.
Dr. Farley.
Dorset.
Dula.
Early Bergamot.
Early Harvest.
Easter Beurre.
Ellis.
Elsa.
Emile de Heyst.
E. No. 47.
Esperen.
Exeitier.
Fitzwater.
Flat Bergamot.
Flemish Beauty.
Fondante de Automne.
Fondante de Bihorel.
Fortuneé Boisselot.
Frederic Clapp.
Gakovsky.
Gans.
Gansel Seckel.
Garber.
Giffard.
Goodale.
Grand Isle.
Henry.
Hosenschenck.
Howell.
Idaho.
Japan.
Japan Golden Russet.
Jaques Molet.
Jlinka.
Jones.
Josephine de Malines.
Kieffer.

King.
Kingsessing.
Kinsman.
Koonce.
Kurskaya.
Lady Clapp.
Lamartine.
Late Bartlett.
Lawrence.
Lawson.
Le Conte.
Lemon.
Le Lectier.
Liegel.
Limbertwig.
Lincoln.
Lincoln Coreless.
Little Gem.
Long.
Longworth No. 1.
Lucy Duke.
Macomber No. 6.
Madam Hemmingway.
Madam Millet.
Madam Treyve.
Madam von Siebold.
Manning Elizabeth.
Marie Benoist.
Marshall.
Maurice Desportes.
Maynard.
Miriam.
Mount Vernon.
Nickerson.
No. 439.
Old Crassane.
Oliver Des Serres.
Ontario.
Osband Summer.
Passans du Portugal.
P. Barry.
Peffer.
Peffer No. 3.
Pitmaston Duchess.
Pound.
President Drouard.
Ravenwood.
Raymond de Montlaur.
Refreshing.
Ritson.
Rutter.
St. Crispin.
Seckel.
Seneca.
Sheldon.
Shull.
Slutsk.
Stout.
Sudduth.
Superfin.
Theresa Appert.
Triomphe de Touraine.
Tyson.
Ulmer Butter.
Urbaniste.
Van Cott.
Vermont Beauty.
Victor.
V. 22.
White Doynné.
Wilder Early.
Winter Nellis.
W. 23.
Youngken Favorite.
Zuckerbirn.

QUINCES.

List of Quinces in the Station Orchards in 1896.

Borgeat.
Champion.
D'Alger.
Fuller.
Meech Prolific.
Missouri Mammoth.
Santa Rosa.
Sweet Winter.
Van Deman.

APRICOTS.

None of the Apricots in the Station Collection fruited in 1896 for the fruit-buds were killed the previous winter. The following is a list of varieties which were growing at this Station in 1896:

Alexander.
Alberge Montgamet.
Black.
Bongoume.
Budd.
Catharine.
De Coulange.
Early Moorpark.
Golden Russian.
Harris.
Hubbard.
Japan.
Large Early.
Moorpark.
Oullin Early.
St. Ambroise.
Shense.
Smith Triumph.
Uvadale.
Victor.

CHERRIES.

None of the Sweet Cherries fruited at this Station in 1896 because the fruit-buds were winter-killed. Some of the Sour Cherries bore very well. The following is a list of the varieties grown at the Station in 1896:

Abbesse de Orgnies.
Amarelle Bunt.
Auburn Duke.
Bay-State.
Bessarabian.
Begarreau.
Black Mastodon.
Black Tartarian.
Brusseler Braune.
Catskill.
Cerise de Ostheim.
Cleveland.
Coe Transparent.
Double Natte.
Downer Late.
Dyehouse.
Early Lamaurie.
Early Purple Guigne.
Early Richmond.
Empress Eugene.
English Morello.
Esel Kirche.
Florence.
George Glass.
Governor Wood.
Heart Shaped Weichsel.
Hoke.
Ida.
King Amarelle.
Knight Early Black.
Late Duke.
Lithaur Weichsel.
Luelling.
Lutovka.
May Duke.
Mercer.
Mezel.
Montmorency Ordinaire.
Napoleon.
Orel 23.

Orel 26.
Orel 27.
Ostheimer.
Riene Hortense.
Rockport Bigarreau.
Rostraver Bigarreau.
Royal Duke.
Schmidt Bigarreau.
Sklanka.
Spate Amarelle.
Sparhawk Honey.
Station Seedling.
Transcendent.
Vilne Sweet.
White Bigarreau.
White Caroon.
Windsor.
Wragg.

PEACHES.

None of the Peaches in the Station Collection fruited in 1896 for the fruit buds were all winter-killed. The following is a list of Peaches growing in the Station Orchards in 1896:

Alberge Yellow.
Alexander.
Alexandra.
American Apricot.
Amsden.
Atlanta.
Babcock.
Bailey.
Beatrice.
Bishop Early.
Blood (Dwarf Japan).
Bokara No. 1.
Bokara No. 2.
Bokara No. 3.
Brigden.
Butler Late.
Cambrian.
Capt. Eads.
Caroline Beauty.
Catharine Cling.
C. Cling.
Chairs Choice.
Champion.
Champion No. 1.
Chapman.
Chinese Free.
Columbian.
Conkling.
Connett Early.
Cooledge.
Crawford Early.
Crawford Late.
Crosbey.
Diamond.
Dr. McGill.
Early Champion.
Early Charlotte.
Early Free.
Early Rivers.
Elberta.
Ellison.
Floss.
Ford Choice.
Foster.
Fox Seedling.
G and A.
Globe.
Gold Drop.
Goshawk.
Haines Early.
Hale Early.
Henrietta Landon.
Hyatt.
Hill Chili.
Hynes Surprise.
Japanese Early.

Jenny Worthen.
Jones No. 34.
Kalamazoo.
Kibby Golden.
Knowles Hybrid.
Lemon Free.
Lewis.
Lorentz.
Magdala.
Malta.
Marcella.
Midseason Favorite.
Millhisen.
Moore Favorite.
Moore Seedling.
Mountain Rose.
Myers Seedling.
New Prolific.
North China No. 2.
Northern Apricot.
No. 11744.
No. 11745.
No. 11746.
Ostrander Early.
Ostrander Late.
Patterson.
Paul Boynton.
Pendleton.
Picquet Late.
Pratt.
Pride of Idaho.
Princess of Wales.
Prize.
Red Cheek Melocoton.
Reeves Favorite.
Rivers Early York.
Royal George.
Saint Marie.
Salway.
Sargent.
Scruggs.
Sneed.
Stark Heath.
Stevens Rareripe.
Stewart No. 1.
Stewart No. 2.
Stump the World.
Summer Snow.
Surpasse Melocoton.
Susquehanna.
Thurber.
Triumph.
Tyhurst.
Utah Free.
Wager.
Walker.
Washington.
Wheatland.
Wilder.
Willett.
Wonderful.
Woodman Choice.
Yellow St. John.
Yensi. Total, 124

PLUMS.

The experience of the past season brought out very clearly the superiority of native Plums in hardiness of fruit-bud when compared with European or Japanese sorts. Many of the native varieties bore good crops in 1896; none of the Japanese kinds fruited except the Ogon, which bore one fruit, and that was imperfect; some of the European kinds bore a few scattering fruits, but many of them had no fruit. The fruit-buds were formed in abundance the previous season but, as already stated, they were nearly all winter-killed, except those of native varieties.

The following is a list of Plums growing in Station Orchards in 1896, not including Station Seedlings:

Abundance.
Arch Duke.
Arkansas Lombard.
Autumn Compote.
Bailey.
Bavay Green Gage.
Belgian Purple.
Belle de September.
Berckmans.
Blackman.
Black Prune.
Botan.
Botankio No. 1.
Bouloff.
Bradshaw.
Bryanston Gage.
Burbank.
Chabot.
Charles Downing.
Cheney.
Clingstem.
Coe Golden Drop.
Copper.
Czar.
Dame Aubert.
De Caradeuc.
Desoto.
Diamond.
Duane Purple.
Early Orange.
Early Red.
Empire.
Engre.
Field.
Forest Garden.
Forest Rose.
Freestone Damson.
French Damson.
Frogmore Damson.
Garfield.
General Hand.
Georgeson.
German Prune.
Giant Prune.
Gold.
Golden Beauty.
Golden Gage.
Goliath.
G. No. 44 Jones.
Guii.
Grand Duke.
Guthrie Late.
Hale.
Hammer.
Harriet.
Hatankio.
Hawkeye.
Hudson River Purple.
Huling Superb.
Hungarian.
Hunt No. 1.
Hytankio.
Ickworth Imperatrice.
Imperial Gage.
Italian Prune.
Japan Seedling.
Jefferson.
Kerr.
King of Damsons.
Kirks.
Lafayette.
Late Black Orleans.
Lincoln.
Lombard.
Long Fruit.
Lucomb Nonesuch.
Maquoketa.
Mariana Seedling.
Mariana.
Marcus.
Maru.
McLaughlin.

Merunka.
Middleburg.
Mikado.
Miller Superb.
Milton.
Miner.
Minnesota.
Missouri Apricot.
Mogul.
Moldovka.
Monarch.
Monroe.
Moore Arctic.
Moreman.
Myrobolan.
Newman.
New Ulm.
Niagara.
Normand No. 1.
Normand No. 2.
Normand No. 3.
Normand No. 4.
Normand No. 5.
Normand No. 6.
Normand No. 7.
Normand No. 8.
Normand No. 9.
Normand No. 10.
Normand No. 11.
Normand No. 12.
Normand No. 13.
Normand No. 14.
Normand No. 15.
Normand No. 16.
Normand No. 17.
Normand No. 18.
Normand No. 19.
Normand No. 20.
Ocheeda.
Ogon.
Orange.
Oswego (Pond Seedling).
Oulin Golden.
Palatine.
Paragon.
Paul Earliest.
Peter Yellow Gage.
Pilot.
Poole.
Pond Seedling.
Pottawattamie.
Prairie Flower.
Prince Engelbert.
Prince of Wales.
Pringle Blue.
Pringle Purple.
Prune D'Agen.
Prunus Pissardi.
Prunus Simoni.
Purple Egg.
Quackenboss.
Quaker.
Reed.
Riene Claude de Hatham.
Riene Claude Violette.
Robinson.
Rockford.
Rollingstone.
Royal Hative.
Ruby.
Saint Lawrence.
Satsuma.
Saratoga.
Saunders.
Seedling No 2.
Shiro Smomo.
Shippers Pride.
Shropshire Damson.
Simpson.
Smith Orleans.
Smith Prune.
Sophie.
Spaulding.
Splendor.
Stanton.
Strawberry.
Stoddard.
Sweet Damson.
Tobias Gage.
Transparent.

Uchi Beni.
Ungarish Prune.
Union Purple.
Victoria.
Warner Late.
Washington.
Wayland.
Weaver.
Weedsport German Prune.
White Kelsey.
White Nicholas.
Wickson.
Wild Goose.
Willard.
Wolf.
World Beater.
Wyant.
Wyzerka.
Yeddo.
Yellow Egg.
Yellow Gage.
Yellow Japan.
Yellow Voronesh.
Yosebe.
Youngken Golden.

GRAPES.

S. A. BEACH.

Some of the newer varieties of grapes which have fruited in the Station vineyards are described below; comment is also made on a few older and better known grapes and references are given to the reports of varieties which have been noted in previous publications of this Station.

The botanical classification of a variety is indicated by an italicized abbreviation of the name of the species to which it belongs.*

A hybrid is indicated by an "X" separating the names of the species of which it is the offspring; thus, *vin.* X *Lab.* indicates a hybrid of *vinifera* fertilized by *Labrusca.* When it is known to which of the two species the female parent belongs, this parent is named first.

When a hybrid is more closely related to one species than to any other this relationship is indicated by an "X" following

* The following abbreviations are used, viz.: *Lab.* for *Labrusca*, L. the wild Fox grapes; *vulp.* for *vulpina*, L. (*riparia*, of Mx.), the wild grape of the river banks; *cand.* for *candican* Engel., the Mustang grape of Texas; *æst.* for *æstivalis*, Mx., the wild Summer grape; *vin.* for *vinifera*, L., the cultivated grape of Europe; *Lin.* for *Lincecumii*, Buck., the Post oak grape of Texas; *Bourq.* for *Bourquiniana*, Mun. and *rup.* for *rupestris*, Scheele, the Rock or Sand grape of Western Mississippi Valley and Texas.

the name of the species to which it is most closely related; thus, "*Lab.* X" shows that the hybrid is most closely related to the *Labrusca* species.

The names of the species represented in a hybrid are also frequently given in parentheses following the name of the hybrid; thus, Bailey, (*Lab.*, *Lin. vulp.*) indicates that the three species named are represented in the parentage of this variety; Brighton, *Lab.* X (*Lab.*, *Vin.*) indicates that Brighton is a hybrid of *Labrusca* and *vinifera*, with more of *Labrusca* than of *vinifera* blood.

Synonyms are printed in italics and inclosed in parentheses.

Antoinette. — *Lab.* A seedling of Concord, originated by T. B. Miner, Linden, N. J. Bunch small to medium, compact, sometimes slightly shouldered. Berry medium, round, light yellowish-green with white bloom; skin thin, tough; pulp rather tough, moderately juicy, does not release the seeds readily, nearly sweet, vinous, agreeable flavor, good quality. Vine fairly vigorous. Has not shown sufficient merit here to justify its being recommended for trial.

Grein Golden. —*Vul. Lab.* A seedling of Taylor, originated by N. Grein, Hermann, Mo. Received from Bush and Sons and Meisner, Bushburg, Mo., 1893. Cluster attractive, medium to large, compact, often shouldered, conic; berry above medium, round, pale greenish-yellow, or yellow, with white bloom and often a decided pink shade; skin thin, tender; pulp moderately tender releasing the seeds readily, very juicy, mild sub-acid, vinous. It resembles Elvira somewhat in flavor, but like that variety it lacks the high quality desirable in dessert fruit. Vine a vigorous grower and produced a good crop of fruit this season.

Hopkins. — *Lin.* X *Bourq.* Vine vigorous and productive. Cluster large, very compact, often shouldered, conic; berry below medium, round, dull black with thick bluish bloom. The numerous large seeds form a large part of the berry. Skin thick, tough; pulp tough, moderately juicy; juice colored, mild sub-acid, vinous, good flavor, fair quality; clusters often wither as soon as ripe and soon decay. Is perfectly able to fertilize its own blossoms. Not desirable for this section.

Leader. — This variety was introduced by the Storrs Harrison Co., Painesville, O. It is a chance seedling. As grown here it lacks in vigor of vine and attractiveness of the cluster.

Bunch medium, often slightly shouldered, very loose; berry round, medium size, good yellow with white bloom and sometimes a shade of pink; pulp juicy, sweet, except at center, rather tough, not parting easily from the seeds, vinous flavor, good quality.

Marie Louise. — Originated by Theophile Huber, Illinois City, Ill. Parentage unknown. A yellowish-green grape of very good quality but only medium in size and less attractive in appearance than such kinds as Niagara, Diamond and Pocklington. It has not been tested long enough to decide as to its productiveness.

Bunch medium size, rather loose, sometimes slightly shouldered. Berry medium, round, pale yellowish-green, with white bloom; pulp tender, juicy, sprightly, somewhat vinous flavor, very good quality, separates readily from the seeds. Ripens about with Worden. So far as tested does not seem to be worthy of disseminating.

Randall.— Received for testing, in 1893, from Peter Henderson & Co., New York. It proves to be identical with Agawam.

Trask.— Received for testing, in 1893, from Peter Henderson & Co., New York. It resembles Brighton very much.

The following is a list of grapes growing in Station vineyards in 1896, not including Station seedlings:

Adirondack.
Agawam.
Aledo.
Alexander Winter.
Alice.
Amber.
Amber Queen.
Ambrosia.
America.
Aminia.
Antoinette.
Arkansaw.
August Giant.
Bacchus.
Bailey.
Barry.
Beagle.
Bell.
Berckmans.
Bertha.
Big B. Con.
Big Extra.
Big Hope.
Black Eagle.
Blanco.
Brighton.
Brilliant.
Brown.
Burnet.
Burrows.
Butler No. 1.
Canada.
Canonicus.
Carman.
Catawba.
Cayuga.

Caywood No. 50.
Centennial.
Chambrill.
Champion.
Chandler.
Chautauqua.
Clevener.
Clinton.
Cochee.
Colerain.
Columbia.
Columbian.
Concord.
Cortland, see Champion.
Cottage.
Crance.
Creveling.
Croton.
Daisy.
Delaware.
Denison.
Diamond.
Diana.
Dr. Collier.
Dr. Hexamer.
Dr. Warder.
Downing.
Dracut Amber.
Duchess.
Early Dawn.
Early Golden.
Early Market.
Early Ohio.
Early Victor.
Eaton.
Eclipse.
Edmeston.
Eldorado.
Elsinburgh.
Elvibach.
Elvicand.
Elvicand.
Elvira.
Emerald.
Emma.
Empire State.
Essex.
Esther.
Etta.
Eumedel.
Eumelan.
Faith.
Fern Munson.
Fox Grape.
Gaertner.
Geneva.
Gerbig No. 2.
Gerbig No. 10.
Glenfeld.
Gold Coin.
Gold Dust.
Golden Grain.
Governor Ross.
Grein Golden.
Guest No. 1.
Harriet.
Hartford.
Hayes.
Helen Keller.
Herald.
Herbert.
Hercules.
Herman Jaeger
Hopican.
Hopkins.
Horner No. 1.
Hosford.
Illinois City.
Iona.
Isabella.
Isabella Seedling.
Janesville.
Jefferson.
Jessica.
Jewel.
Juno.
Kensington.
Kentucky.
Lady Washington.
Leader.
Leavenworth.
Lindley.

Lindmar.
Linn.
Little Blue.
Livingston.
Long John.
Lucile.
Lutie.
Mabel.
Magnate.
Marie Louise.
Marion.
Marvin Seedling.
Mary Favorite.
Massasoit.
Mathilde.
Maxatawney.
Mendota.
Merrimack.
Metternich.
Mills.
Missouri Riessling.
Monroe.
Montefiore.
Moore Early.
Nectar.
Niagara.
Noah.
Northern Muscadine.
Norwood.
Olita.
Omega.
Oneida.
Opal.
Osage.
Ozark.
Paradox.
Paragon.
Peabody.
Pearl.
Perfection.
Perkins.
Pocklington.
Poughkeepsie.
Prentiss.
Presley.
Profitable.
Pulaski.
Pulliat.
Reagan.
Rebecca.
Red Bird.
Red Eagle.
Regal.
Requa.
Rochester.
Rockwood.
Roenbeck.
Rogers No. 5.
Rogers No. 13.
Rogers No. 24.
Rogers No. 32.
Rommel.
Roscoe.
Rupert.
Rustler.
Rutland.
R. W. Munson.
Salem.
Secretary.
Senasque.
Shelby.
Shull No. 2.
Standard.
Superb.
Telegraph.
Thompson No. 2.
Thompson No. 5.
Thompson No. 7.
Triumph.
Ulster.
Vergennes.
Victoria.
Vitis Aestivalis.
Vitis Arizonica.
Vitis Berlanderi.
Vitis Bourquiniana.
Vitis Candicans.
Vitis Champini.
Vitis Cinerea.
Vitis Cordifolia.
Vitis Doaniana.
Vitis Heterophylla.

Vitis Labrusca.
Vitis Lincecumii.
Vitis Monticola.
Vitis Romancti.
Vitis Rotundifolia.
Vitis Rubra.
Vitis Rupestris.
Vitis Solonis.
Vitis Vinifera.
Vitis Virginiana.
Vitis Vulpina.
W. B. Munson.
Wheaton.
White Imperial.
White Jewel.
Wilder.
Winchell.
Witt.
Woodruff Red.
Worden.
Wyoming Red.

CURRANTS.

S. A. BEACH.

The winter of 1895-6 was so severe that the fruit-buds of currants were killed to a considerable extent. On this account the yield was much less than usual. The following lists give the average yield in pounds per bush of those kinds which were planted in 1888, except where otherwise stated; also their average yield for the last four years for red and black varieties and for the last three years for the white kinds.

BLACK CURRANTS.

NAME.	AVERAGE YIELD PER BUSH IN POUNDS.	
	1896.	Last four years.
Baldwin	3.84	3.86
Black Grape	.95	*1.75
Champion	2.51	*3.69
Common Black	4.92	4.67
Lee	1.77	3.67
Naples	5.51	3.91
Prince of Wales	1.90	4.56
Saunders	1.55	3.49
Saunders No. 2	2.29	2.85

* Excepting 1894.

Victoria Black which was planted in 1894 came into bearing in 1896. This seems to be a variety worthy of special notice. It yields large clusters of very large fruit, good in flavor and quality. It has not been tested here long enough to justify an opinion as to its productiveness.

NATIVE CURRANTS.

The varieties of the native Missouri currant, *R. aureum*, Pursh, such as Crandall, Jelly, etc., gave no yield to amount to anything in 1896.

RED AND WHITE CURRANTS.

NAME.	AVERAGE YIELD PER BUSH IN POUNDS.	
	1896.	Last four years.
Cherry	2.21	4.42
Eclipse *	1.62	....
Fay	2.85	3.06
London Red	5.04	6.62
Mills No. 20 †	2.37	....
North Star *	1.54	....
Prince Albert	4.71	7.82
Red Dutch	1.39	....
Versaillaise	1.25	....
Victoria	2.94	5.42
Wilder *	1.65	....
Caywood White	0	3.25
Champion	2.79	2.99
Marvin White *	0	....
White Dutch	3.35	4.84
White Grape	1.49	5.07
White Versaillaise	.40	....
Gloire des Sablons	.90	....

Comparing these records with those published in the last annual report, it appears that among the red and white kinds Prince Albert still leads in the average yield since 1892; London Red stands second and Victoria third, the same as before. These three varieties also proved the most productive after the severe winter of 1895-6.

* Planted 1892. † Planted 1891.

The following is a list of currants on Station grounds in 1896, not including Station seedlings:

Black—

Ribes nigrum, L.

Baldwin.
Black Grape.
Champion.
Common Black.
Lee.
Naples.
Prince of Wales.
Saunders.
Saunders No. 2.
Victoria.

Red and White—

Ribes rubrum, L.

Caywood Seedling.
Champion.
Cherry.
Eclipse.
Empire.
Fay.
Glorie des Sablons.
Gondouin White.
Knight Improved.
Knight Sweet Red.
London Red.
Marvin White.
Mills No. 20.
Mills No. 22.
Mills No. 28.
Mills No. 29.
Moore Ruby.
North Star.
Prince Albert.
Red Cross.
Red Dutch.
Ruby.
Storrs and Harrison No. 1.
Versaillaise.
Victoria.
Pomona.
Purity.
White Dutch.
White Grape.
White Imperial.
White Versaillaise.
Wilder.

Native Missouri Currant—

Ribes aurum, Pursh.

Crandall.
Jelly.
Missouri Large Fruited.
Utah Golden.

Other Species—

Ribes floridum, L'Her.

Missouri Sweet Fruited.

Ribes Gordonianum.

Gordon.

Ribes sanguineum, Pursh.

Red flowering.

GOOSEBERRIES.

S. A. BEACH.

COMPARISON OF NATIVE WITH EUROPEAN VARIETIES.

Names of classes.—The Pale Red, Houghton, Downing and other similar gooseberries which are commonly grown in American gardens are descended, either wholly or partly, from wild or native species, and so may be properly called American varieties.

The foreign kinds as well as their seedlings that have originated in this country are properly called European gooseberries. As a class they are often called English gooseberries because so many of them have originated in England, but fine varieties of gooseberries are grown in other parts of Europe, and this designation of the class is objectionable.

Size of fruit.— Some of the European kinds bear the largest gooseberries known and, as a class, they yield much larger fruit than do any of the American sorts. Compare plate XIV, which shows the natural size of the fruit of some varieties of the American class, with plates XV to XX inclusive, which show the natural size of some European sorts. European gooseberries have been grown here which measured over one and a half inches long and an inch thick, and this is not an extraordinary size for some varieties. The fruit of the Downing, a well-known American sort, averages about three-quarters of an inch in diameter, and that is large for an American gooseberry. At gooseberry shows in England, single specimens weighing over an ounce and a half avoirdupois have been exhibited. The large fruit sells better in market than the small fruit, as may be seen by examining the market quotations for 1896, given on a subsequent page.

Color of fruit.— The European varieties possess another advantage in having a much wider range of colors than do the American kinds. They may be either dark red, dull green or clear yellow, or they may vary through various combinations and paler shades of these colors to nearly white, while American varieties show only green or red in the colors of their fruit. Some of the latter, as Houghton, have fruit of a beautiful clear red color that is unrivalled by any of the European gooseberries that I have seen.

Marketing the green fruit.— The gooseberry holds a unique position among cultivated fruits because its fruit may be marketed either green or ripe. The large European gooseberries reach marketable size for unripe fruit somewhat earlier than the American kinds do, and this gives them another advantage over American gooseberries, for the early prices are usually much better than those which rule after the bulk of the crop is ready to market. The accompanying market quotations taken from the *Rural New Yorker* and the *American Gardening* give some idea of the prices at which gooseberries sold in the New York market 1896. See page 303.

In some localities the most of the gooseberry crop is marketed unripe. Some growers strip the green fruit from the bushes, which can be done very rapidly, run it through a fanning mill to free it from leaves, twigs, etc., and then pack it in baskets for market. The reasons advanced in favor of marketing gooseberries unripe are: (1) The hard green fruit is not as easily injured in picking and packing as the pulpy ripe fruit is and it will stand transportation better. (2) The fruit that is allowed to ripen on the bushes is exposed longer to attacks of sun scald and mildew and, should long continued rain follow a period of drought, the ripening fruit is liable to crack and spoil. (3) The ripening of the fruit and seed is an exhaustive process from which the bush is partly relieved when the fruit is marketed green. (4) The proceeds from the green fruit usually compare favorably with the proceeds from the ripe fruit, although the large ripe English varieties sometimes bring the highest prices of the season.

Marketing the ripe fruit.— The European gooseberries have another advantage in that they are preferred to American kinds at fruit preserving establishments where they are made into jam. The reason for this preference, I suppose, is because the jam made from them resembles more closely the article put up by English firms which already has a well-established reputation. The fact is, the American kinds have a thinner skin and more delicate flavor than the European kinds and fully equal or are superior to them in quality. According to the following market quotations the large ripe English gooseberries commanded from two to three cents more per quart than did the large ripe Downing fruit.

NEW YORK MARKET QUOTATIONS FOR 1896.

	MAY 30.	JUNE 6.	JUNE 13.		JUNE 20.	JUNE 27.		JULY 4.		JULY 11.	JULY 18.		JULY 25.	
	Rural.	Rural.	Rural.	Amer. Gard.	Rural.	Rural.	Amer. Gard.	Rural.	Amer. Gard.	Amer. Gard.	Rural.	Amer. Gard.	Rural.	Amer. Gard.
Green, per quart	8 -	8-10c.	6-7c.	......	......	3-5c.	......	3-4c.	......	......	3-4c.	......	3-5c.	......
Ordinary green, per quart	......	......	......	......	......	......	......	......	3-4c.	3-4c.	......	3-4c.	......	......
Prime green, per quart	......	......	......	5-6c.	5-6c.	......	3-5c.	......	......	......	......	......	......	......
Prime green, per bushel	......	......	......	$1 62-$1 75	$1 50-$1 75	$1 25-$1 50	......	$1 00-$1 25	......	......	$1 00	......	$1 00	......
Large Downing, per quart	......	......	......	......	......	......	......	......	5c.	4-5c.	......	4-5c.	......	4-5c.
Extra large English, per quart	......	......	......	......	......	......	5-7c.	......	7-8c.	7-8c.	......	......	......	......
Extra large, per quart	......	......	......	......	......	......	......	6-10c.	......	......	6-8c.	......	6-8c.	......

Hardiness and productiveness.—A comparison of English and American gooseberries would not be complete without some reference to their relative productiveness, hardiness and freedom from diseases.

Currants and gooseberries are commonly classed among the hardiest fruits of the temperate zone, but the unusually severe winter of 1895-6 injured their buds in various sections of the state so much that the crop of fruit the following summer was a partial failure, although in other portions of the state they yielded a full crop. It was noticeable that the European varieties of gooseberries were injured more than the American varieties at this Station and similar observations were reported from other places. The following table gives a statement as the average yield per bush in 1896 of some American and European varieties which were planted here in 1888. The average yield per bush for the past four seasons is also given for the purpose of showing the comparative productiveness of these varieties here.

EUROPEAN CLASS.

	Average weight per bush for 1896 in pounds.	Average weight per bush for four years in pounds.
Chautauqua	0.47	1.99
Crown Bob	a few fruits	2 28
Dagwell's No. 1	0.19	2.20
Golden Prolific	a few fruits	2.13
Industry	2.37	8.27
Puyallup	2.94	5.03
Triumph	3.55	6.24
Wellington Glory	1.25	8.35
Whitesmith	2.42	4.54
AMERICAN CLASS.		
Crystal	7.75	13.13
Downing	7.30	9 95
Houghton	5.33	6.85
Mountain	2 50	2.67
Pale Red	5.68	10.58
Pearl	3.58	4.37
Smith (Improved)	0.69	2.13

This table gives evidence that in the very important characters of hardiness and productiveness the best of the American varieties excel the best of the European varieties.

Summary.—Summarizing what has been said of the two general classes of cultivated gooseberries as to their value for commercial fruit growing, it may be said that the European class shows superiority in:

1. *The large size and variety of colors of the fruit.*
2. *The early marketable condition of the green crop. This is an advantage because the green fruit is not as easily injured in handling as is the ripe fruit; it is exposed for a shorter time to sunscald, cracking and attacks of mildew; the early prices are usually as good as or even better than the prices of the ripe fruit; when the fruit is marketed green the plant is partially relieved from the exhausting process of ripening the fruit and the seed.*
3. *That European varieties are preferred at fruit preserving establishments.*

The best of the American varieties are superior to the European gooseberries as a class in:

1. *Productiveness.*
2. *Hardiness.*
3. *The ease with which they may be propagated.*
4. *Quality, delicacy of flavor and thin texture of the skin of the fruit.*
5. *Freedom from mildew.*

PRODUCTIVENESS OF SOME AMERICAN VARIETIES.

Some inquiry has been made among good fruit growers in widely separated sections of the state to learn what is the average yield of gooseberries under good cultivation. Messrs. C. A. Sharp & Co., located in Niagara county, write as follows: "With us the Downing has averaged about one-half ton per acre and the Houghton about one ton. Some years they will go from 25 per cent. to 33 per cent. better, but it would be offset in other years by a lighter yield. The above figures are about the average for six years past."

Mr. W. D. Barns, Middle Hope, Orange county, N. Y., writes that from 800 Downing plants set between vineyard rows in the spring of 1892 he gathered 2,362 quarts in 1896. This he considers a full crop. Were the plants set 5 x 5 ft. an acre would contain 1,742 plants, and at the rate of yield which was realized from these plants would produce 5,143¼ lbs., or a little more than two and a half tons per acre. Mr. E. B. Lewis, Lockport, N. Y., reports even better results than this with the American Red Jacket. From an acre of stooled plants, averaging about three bearing canes per plant, he reports a yield of four tons of fruit. For profit he would plant but three kinds, namely, Downing, Pearl and Red Jacket.

BOTANICAL FEATURES OF THE SPECIES FROM WHICH CULTIVATED GOOSEBERRIES ARE DERIVED.

Susceptibility to mildew.—The one great hindrance to the cultivation of European gooseberries in this country is their susceptibility to attacks of the mildew, *Sphærotheca Mors-uvæ.* Figure 4 plate I shows a branch of mildewed fruit of Industry. From the standpoint of the American fruit grower gooseberries fall into two classes, namely, those which suffer from the mildew and those which do not. The former class includes all European varieties and their American grown seedlings, or, in other words, all varieties of the species *Ribes Grossularia*, L. The latter class includes the cultivated varieties of the native American species *oxyacanthoides*, L. and *Cynosbati*, L. and some hybrids between them and the European species.

New or little known sorts are from time to time advertised and urged for planting. Since many of them belong to the European class which, in this country, has always been subject to severe injury from attacks of the mildew, and which no well informed fruit grower cares to plant extensively unless he is prepared to fight that disease, it is important that nurserymen and fruit growers learn to distinguish the European species from the two American species from which cultivated varieties have been developed, namely, *R. oxyacanthoides*, L. and *R. Cynosbati*, L.

Some characters of the European gooseberry, R. Grossularia.—During the four hundred years or more that the European gooseberry has been cultivated hundreds of named varieties of that

PLATE XII.

FIGURE 1.—WHITESMITH, TREE FORM, 9 YEARS PLANTED.

FIGURE 2.—PALE RED, BUSH FORM, 9 YEARS PLANTED.

PLATE XIII.

FIGURE 3.—RIBES CYNOSEATI, 2 YEARS PLANTED.

FIGURE 4.—MILDEW ON INDUSTRY. *From photograph of oil painting from nature, by W. P. Wheeler.*

PLATE XIV.

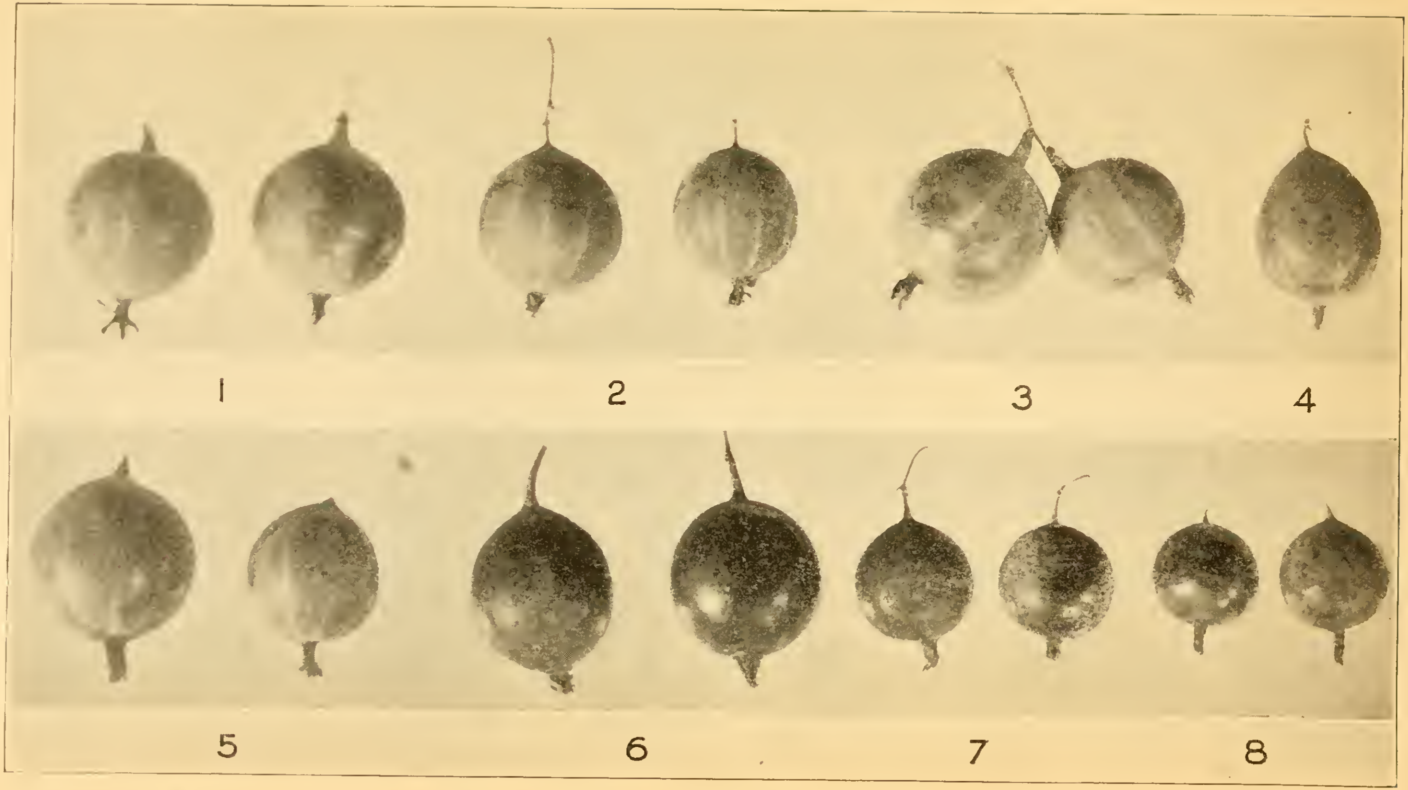


FIGURE 1.—DOWNING; 2, CRYSTAL; 3, PEARL; 4, SMITH; 5, RED JACKET (AMERICAN); 6, MOUNTAIN; 7, HOUGHTON, ; 8, PAL RED. ALL FROM LIFE-SIZE PHOTOGRAPH.

PLATE XV.

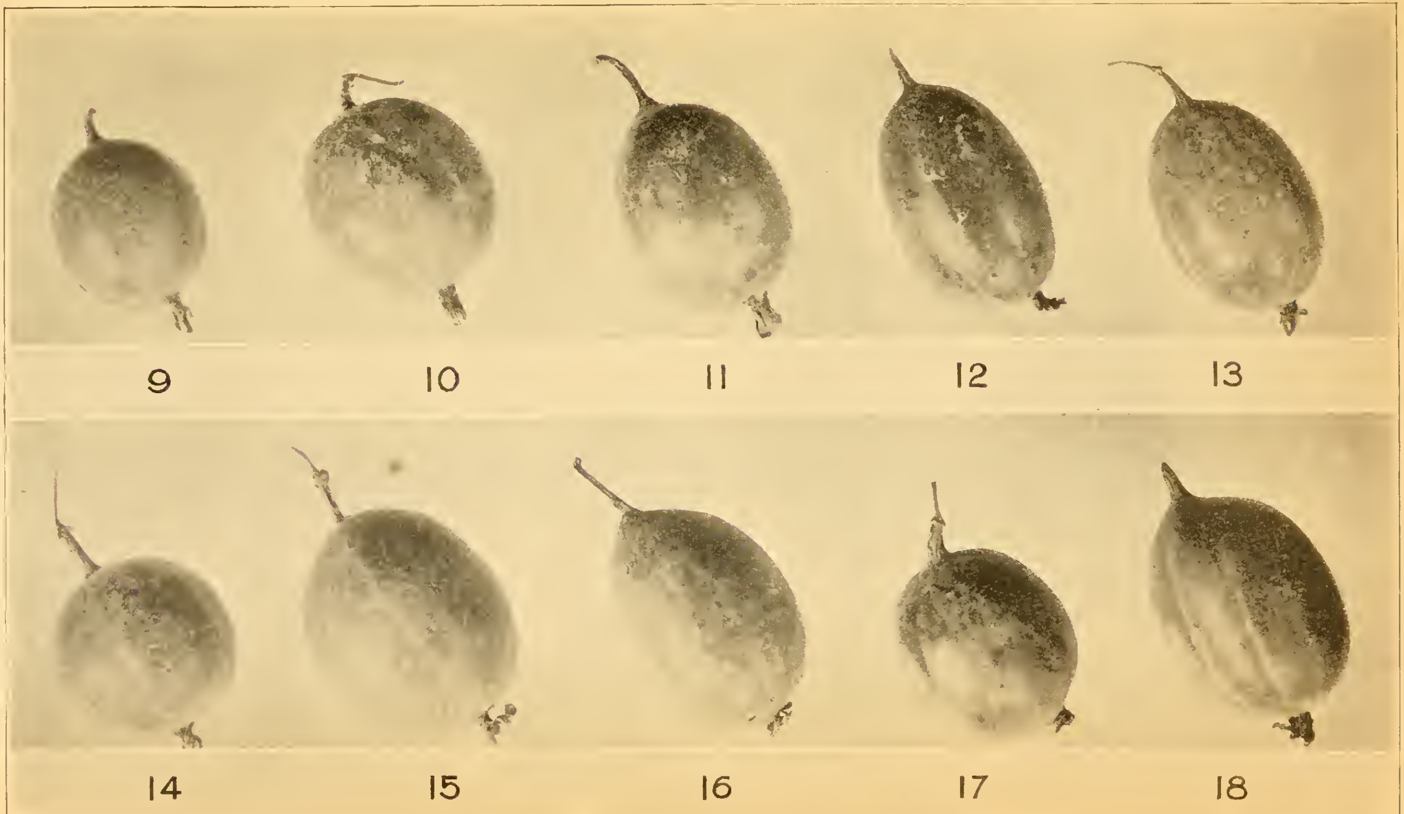


FIGURE 9.—FREEDOM; 10, BERRY EARLY KENT; 11, ALICE; 12, POMONA; 13, ESKENDER BEY; 14, HIT OR MISS; 15, BURY LANE; 16, APOLOGY; 17, GENERAL; 18, HUNTSMAN. ALL FROM LIFE-SIZE PHOTOGRAPH.

PLATE XVI.

Figure 19.—Jolly Angler; 20, Duster; 21, Greenock; 22, Antagonist; 23, Clayton; 24, Gypsy Queen; 25, Duke of Sutherland; 26, Briton; 27, Italy; 28, Improved Early Hedgehog; 29, Jolly Sailor; 30, Broom Girl.
All from Life-size Photograph.

PLATE XVII.

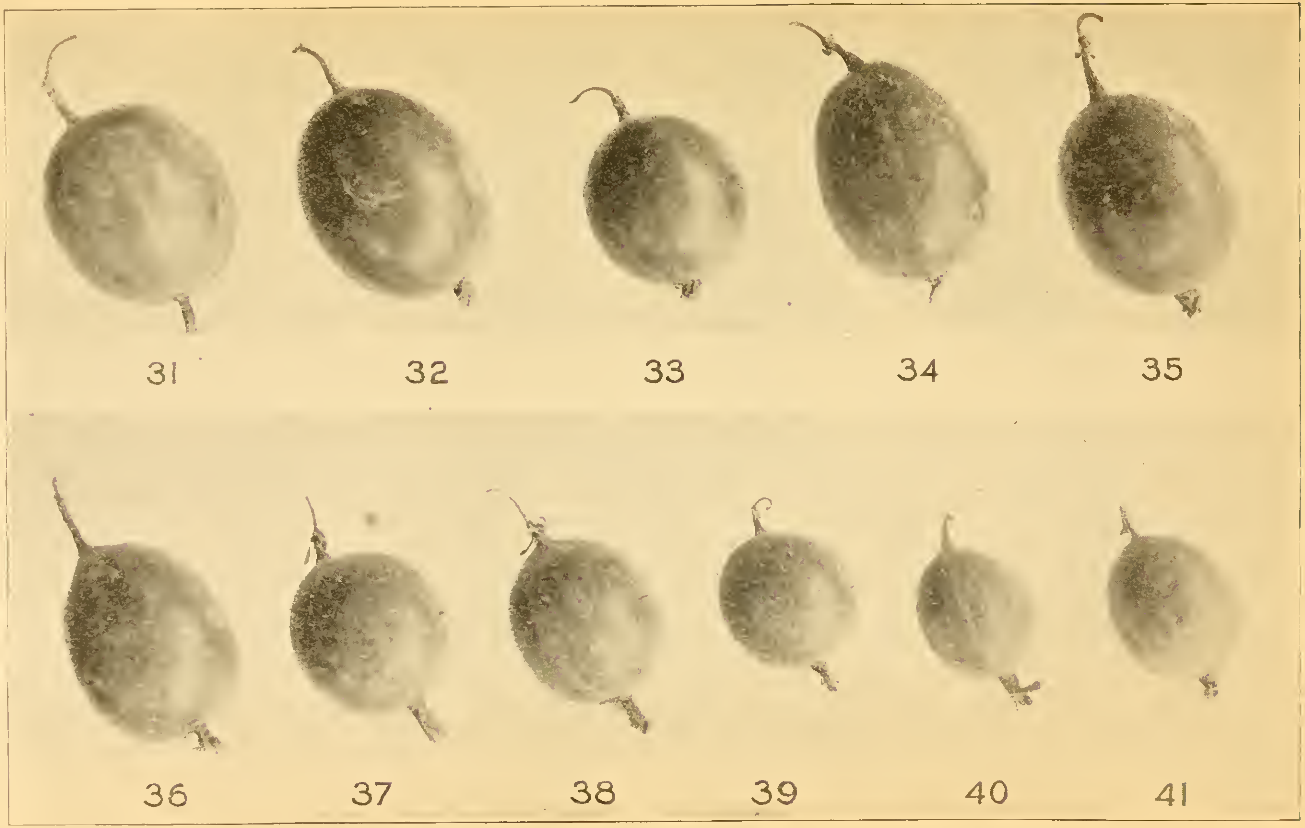
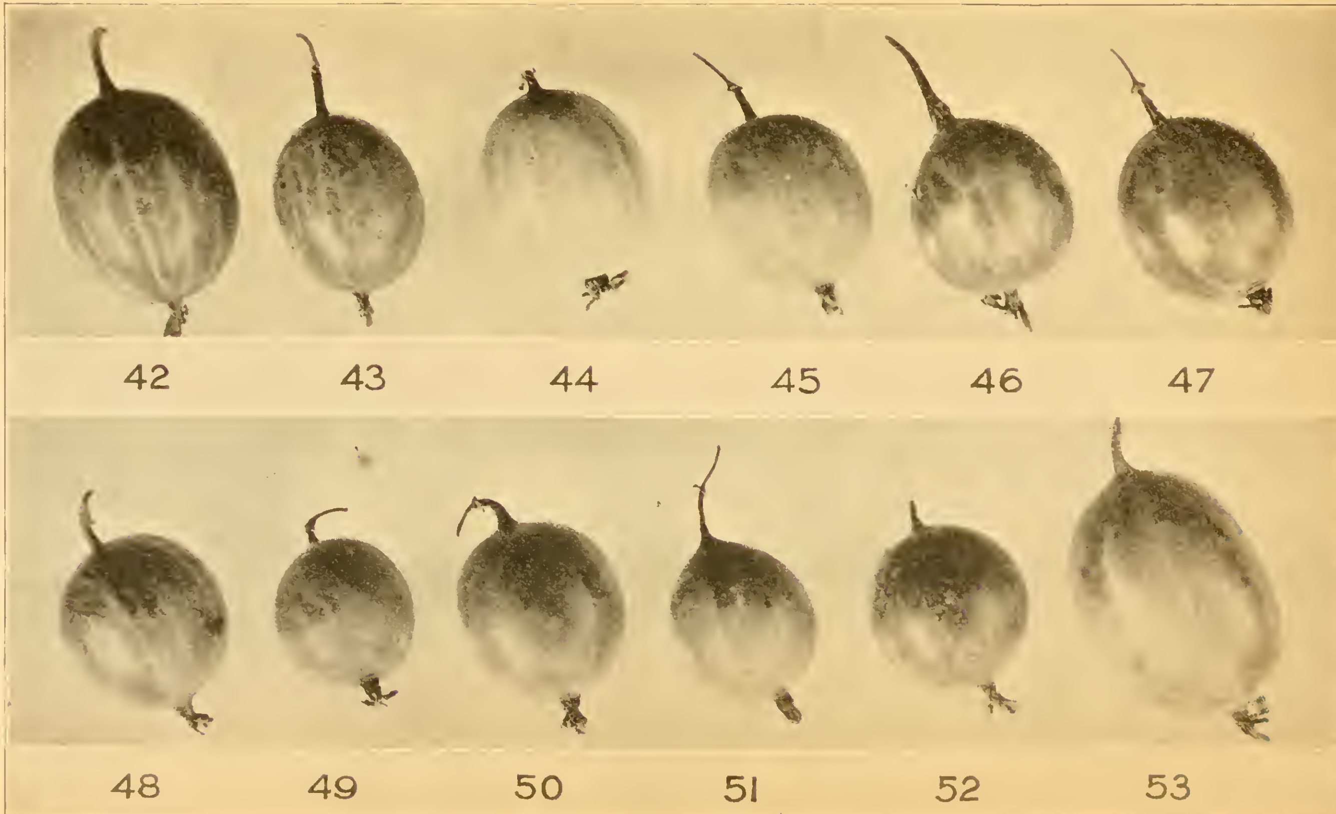


FIGURE 31. —JOHN HALL; 32, CRITERION; 33, GRETNA GREEN; 34, BLUCHER; 35, CYPRUS; 36, GOLBORNE; 37, HIGHLANDER; 38, EXCELLENT; 39, KEEN; 40, GOLDEN DROP; 41, EXCELSIOR. ALL FROM LIFE-SIZE PHOTOGRAPH.



FIGURES 42 AND 43. — WHITE EAGLE; 44, WELLINGTON GLORY; 45, WHITESMITH; 46, VIPER; 47, UNITY; 48, SNOWDRIFT; 49, RUMBULLION; 50, OVERALL; 51, PRISCILLA; 52, QUEEN VICTORIA; 53, LAVINIA.
ALL FROM LIFE-SIZE PHOTOGRAPH.

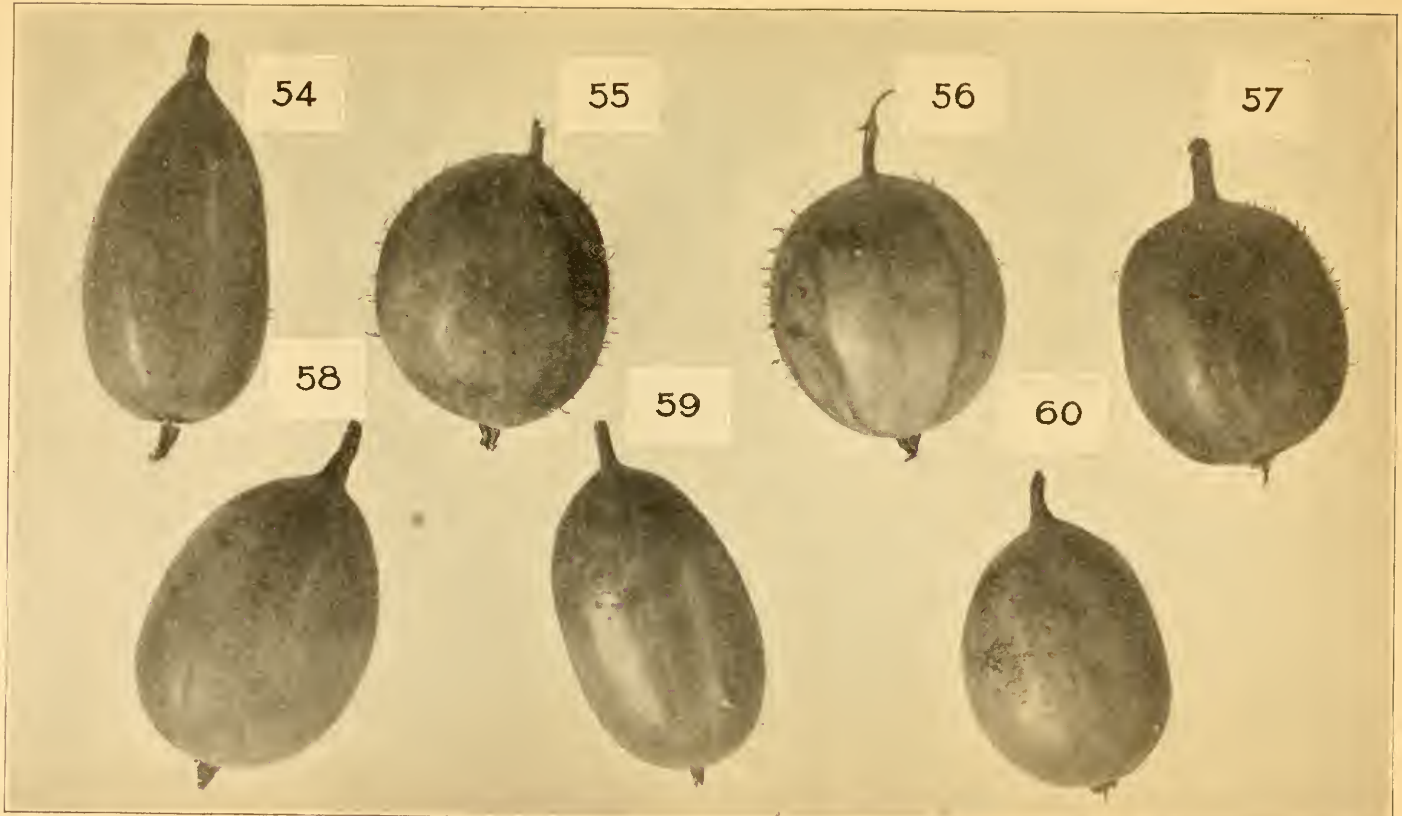


FIGURE 54.—GEORGE RIDLEY; 55, HIGH SHERIFF; 56, JERRY; 57, HIT OR MISS; 58, JOHN HALL; 59, HELPMATE; 60, HERO OF THE NILE. ALL FROM LIFE-SIZE PHOTOGRAPH.

FIGURE 61.—CHAUTAUQUA; 62, WHITESMITH; 63, WELLINGTON GLORY; 64, PUYALLUP; 65, COLUMBUS; 66, TRIUMPH; 67, DOMINION. ALL FROM LIFE-SIZE PHOTOGRAPH.

species have been developed. These naturally show marked differences among themselves yet there are distinctive features which one soon learns to recognize as characteristic of the species. The new growth in autumn has a light gray color which gradually changes to the dark gray or dull brown of the older wood. The bushes are usually stocky with upright, straight, thick branches as shown in figure 1, plate XII, and figures 1 to 4, plates XXII and XXIII. Sometimes the branches curve slightly or droop but they never assume the graceful habit of the American *oxyacanthoides* with its slender arching or drooping branches as illustrated in Pale Red, see figure 2, plate XII, neither do they resemble the *Cynosbati* which has tall slender canes with slender spreading branches and drooping branchlets. Figure 3, plate XIII, shows young bushes of this species. When full grown they are taller than either of the other species referred to, often being from three to four feet high.

The European species usually bears from one to three light-colored spines at the base of the leaf which are generally large and thick, as shown in the accompanying cut of a Chautauqua leaf, see figure 1, and sometimes smaller spines are scattered irregularly along the stem. Spineless varieties of this species have been recently placed on the market, in which the spines are represented by mere bristles or are altogether wanting. Such instances are quite exceptional, however, and can not be called characteristic of the species. The leaves, which are often clustered on short side branches or spurs, are glossy on the upper surface, rather thick, roundish, one or two inches wide, with from three to five lobes as shown in figure 1. The fruit, see plates XV and XXI, is from one-half inch to an inch or more in diameter, smooth or bristly, and red, green, yellow or nearly white in color. The greenish drooping flowers, one-fourth inch in diameter, have purplish, reflexed, pubescent calyx lobes and pubescent ovary and peduncles. The latter are short, one to three flowered and one to three bracteate about the middle.

Some characters of the American species R. oxyacanthoides.—The American species *oxyacanthoides*, which is represented in cultivation by Pale Red, figure 2, plate XII, has thinner smooth leaves, lobes plaited and toothed and leaf stalks hairy and a little rough. In autumn the bark of the new shoots is of a pale straw color; the two year old bark is gray, and as it peels off it leaves the smooth reddish brown bark of the older canes.

The spines when present are commonly short and borne singly beneath the axil of the leaf, or smaller ones may be scattered irregularly along the stem. The fruit is small to medium in size, smooth, of a clear reddish green color deepening to purple when fully ripe. The greenish flowers, one or more on very short peduncles, have a smooth ovary, and the style and stamens are hardly longer than the bell-shaped, smooth calyx. Houghton, which is one of the best known varieties of this species, has stronger and more numerous spines than are typical; see figure 2. Downing, a seedling of Houghton, has shorter spines and leaves plaited or folded towards the midrib and main veins more like the typical *oxyacanthoides*, see figure 2, but the characters of its pure seedlings have proved it to be a hybrid between this species and *Grossularia*. Its hybrid origin is indicated by its shorter and thicker buds and spines and its rather stout, scarcely curving canes. Smith (Improved), Pearl and the American Red Jacket are also considered hybrids between this species and the European species. Pale Red is probably the best type of this species found among the named varieties.

Some characters of the American species Cynosbati.—The gooseberry which is most commonly found wild in many portions of New York state has rather large fruit for a native species. The fruit is dull brownish-purple when fully ripe; skin thin and almost always prickly; pulp dull dark green, good in quality, pleasant flavored. This species, *R. Cynosbati*, L., is characterized by tall or sprawling bushes, see figure 3, plate XIII, as described on page 307. The young canes for some distance from the ground are thickly covered with prickles or bristles. The bark of the new growth becomes reddish-brown as autumn approaches, as also do the long thin spines which are usually found singly un-

FIGURE 1.—LEAF OF CHAUTAUQUA.
(*R. Grossularia*, L.)

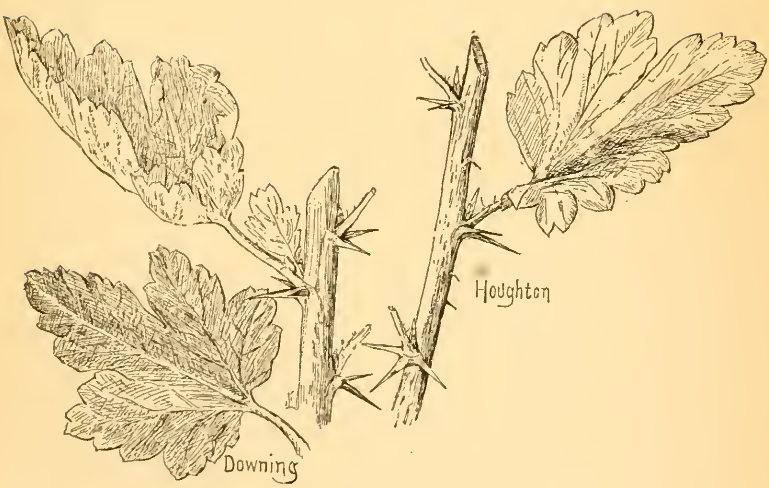


FIGURE 2.—LEAVES OF HOUGHTON (*R. Oxyacanthoides*, L.) AND DOWNING (*hybrid of R. Oxyacanthoides by R. Grossularia*).

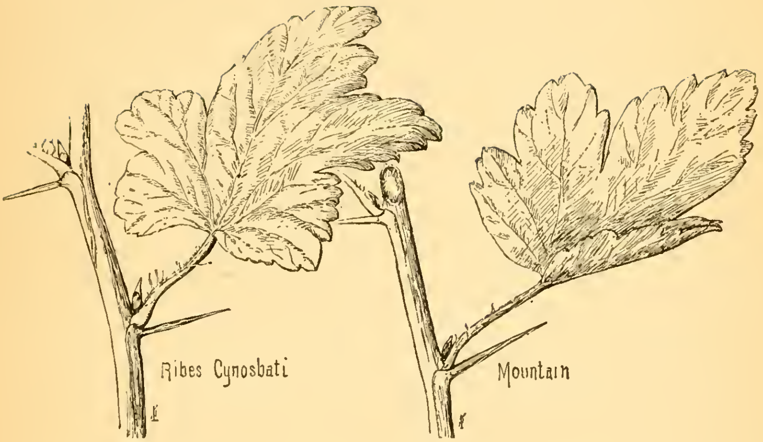


FIGURE 3.—LEAVES OF RIBES CYNOSBATI AND MOUNTAIN
(*hybrid of R. Cynosbati by R. Grossularia*).

der the rather long and slender pointed leaf buds, see figure 3. The downy leaves, one to two inches in diameter, and borne on slender leaf stalks, are roundish, slightly heart-shaped with from three to five rather blunt lobes.

So far as I know there is only one cultivated variety which has been derived from this species, namely, the Mountain, and even this is not a pure *Cynosbati*, but is clearly a hybrid between it and the European species *Grossularia*.

The differences between the three species described above may be summarized as follows:

CHARACTERS OF RIBES CYNOSBATI, R. GROSSULARIA AND R. OXYACANTHOIDES COMPARED.

Name of species.	Bush.	Spines.	Leaves.	Fruit.	Ovary.	Peduncles.	Calyx-lobes.	Flowers.
Cynosbati. Wild prickly-fruited.	Three to four feet high, with spreading branches and slender, drooping branchlets.	Reddish-brown, sub-axillary, single, slender, sometimes two to three; often wanting. Spinescent or bristly along the internodes, especially the lower ones.	On slender petioles, roundish, slightly cordate, one to two inches in diameter, three to five blunt lobes, downy.	Large for a native, prickly like a burr, or rarely smooth. Color, dull purple. Pulp, dull dark green.	Prickly.	Slender, one to three flowered, glandular hairy, bracteate.	Shorter than the tube, broad glandular hairy.	Greenish-white. Style, two-lobed. Stamens hardly longer than calyx.
Grossularia. European species.	Stocky, two to three feet high. Branches usually thick and straight.	Whitish or straw-colored. Usually strong, thick, one to three at the nodes; smaller ones are scattered along the internodes.	Roundish, rather thick, shining above, glandular hairy, one to two inches in diameter, three to five lobes, largely clustered on short spurs or side branches.	One-half to one inch or more thick; smooth or bristly: red, yellow, green or white.	Pubescent.	Short, one to three flowered, one to three bracteate about the middle, pubescent.	Purplish, reflexed, pubescent.	Greenish, drooping. One-quarter inch in diameter.
Oxyacanthoides. Wild smooth-fruited.	Two to three feet high, with slender, curving branches.	Rather small or none. At the nodes they are often solitary. Smaller ones are scattered along the interlodes.	Rather thin, smooth, plaited; lobes toothed; petioles hairy and slightly rough. Sometimes leaves are slightly pubescent, especially underneath the veins.	Smooth, small to medium size; reddish-green or purplish color.	Smooth.	Very short, one to three flowered, one to three bracteate. Smooth or slightly pubescent.	Broadly oblong. Longer than the tube. Smooth or nearly so.	Petals white. Calyx and filaments green or purple tinged. Style, two cleft or two parted.

Gooseberry Culture at this Station.

The investigations of Dr. Arthur and Prof. Goff, which showed that gooseberry mildew could be prevented by spraying with potassium sulphide,* were made here nearly ten years ago. At that time but thirteen kinds of gooseberries were cultivated at this Station, and about half of them belonged to the European species. The discovery of a remedy for the mildew aroused new interest in the European sorts, in consequence of which the Station in 1892 imported 187 European varieties. Since then, other varieties of both native and European species have been secured from various sources and pure bred seedlings, hybrids and crosses have been originated at the Station, so that the Station collection now contains the following:

Cultivated varieties of native species	2
Cultivated varieties, hybrids between native and European species	17
Cultivated varieties of the European species	200
Cultivated varieties, unclassified	3
Station seedlings	259
Specimen plants of the following native species: *Cynosbati*, L., *divaricatum*, Dougl., *gracile*. Mx., *lacustre*, Poir., *Lobbii*, Gray, *oxyacanthoides*, L., *Palousensis*. Piper, *rotundifolium*. Mx	8
Total	489

These varieties are being carefully tested here in order to learn as much as possible concerning their value to American fruit-growers. Although but few of them have been tried here long enough to permit of a satisfactory comparison between them and the kinds most commonly grown in America, yet it is thought best to give herewith preliminary descriptions of them based on the records which they have made at this Station. More complete reports are given on varieties which have been grown here for several years.

* Annual Report of this Station 1887: 253. 1888: 153.

In the following descriptive list the varieties are arranged alphabetically in two classes.

1. The American class, including the cultivated hybrids between American and European gooseberries which are not generally subject to attacks of mildew.

2. The European class including all European kinds and all American-grown seedlings of the European species, *R. Grossularia.*

DESCRIPTIVE LIST OF VARIETIES.

American Class.

Champion.—Received for testing at this Station from J. H. Haynes, Delphi, Ind., in 1893. It has not fruited here enough to justify a comparison with other varieties in the Station collection. Prof. Troop, of the Indiana Experiment Station, informs me that this variety is considered very valuable in that state. The bush makes a good growth and has not mildewed here. Fruit smooth, whitish.

It is said to have originated with Mr. O. Dickinson, Salem, Oregon. Mr. Haynes furnished the following description in 1893: "An immense bearer of large uniform berries; transparent, tender skin. Plant upright even under its immense fruitage. Have never seen a trace of mildew on fruit or plant in the ten years I have fruited it."

Crystal.—Received for testing at this Station in 1888 from J. M. Ogle, Puyallup, Wash. It is exceedingly productive, having given the highest average yield per bush during the past four years of any of the varieties fruited here during that time. Its average yield per bush for that period has been 13⅛ pounds. Notwithstanding its great productiveness, it can hardly be called a desirable variety, because the fruit has a dull green, unattractive color and the flavor is not good. Besides this the fruit is rather soft when fully ripe. It will average slightly larger in size than Downing. See figure 2, plate XIV.

This variety appears to be a hybrid between the European gooseberry, *Ribes Grossularia*, L, and some American species, possibly *R. Cynosbati*, L. Its European parentage is indicated by the general appearance and character of the fruit and by the habit of growth. The skin of the fruit is covered with pubescence like that of Wellington Glory or Whitesmith. The canes are not stout like those of European gooseberries but are tall, slender and often curved. The rather thin leaves have neither the leathery texture nor the glossy upper surface which characterizes European sorts. The buds, too, are shorter than those of typical *Ribes Grossularia.* These, together with other less prominent characters, indicate the hybrid origin of this variety.

Downing.—This variety is generally conceded to be the standard of excellence among gooseberries of the American class. It is highly esteemed for home and market use not only in this country but even in some parts of Europe where it comes in competition with the handsomely colored, large fruit of European varieties.

The fruit, which has a diameter of about three-fourths of an inch, see figure 1, plate XIV, is large for a native but would be called small to medium when compared with European kinds. It is roundish-oval, pale green and covered with a thin white bloom. The skin is thin and smooth. The pulp soft, juicy, sprightly and sweet, ranks among the best in flavor and quality whether compared with native or European varieties. The rather stout canes resemble somewhat those of European sorts although more slender and often slightly curved. The bush is a strong grower and very productive. At this Station it has averaged almost ten pounds of fruit per bush for the last four years, and one season the average was almost fifteen pounds per bush. It is rarely troubled with mildew.

Downing* says that the variety originated at Newburg, N. Y., from seed of Houghton. The pure seedlings of Downing which have been grown at this station usually show a marked similarity to each other in foliage and habit of growth and resemble the Downing in these characters, but some of them have characters like Houghton and Pale Red while others of them give evidence of European parentage so that we have good reason for classing the Downing as a hybrid partly of native and partly of European ancestry.

Excelsior.—Received for testing from J. H. Haynes, Delphi, Ind., 1893, with whom it originated. It is a seedling of Champion. Bush a strong grower and has not mildewed here. Fruit light green, roundish, smooth. See figure 41, plate XVII. It has not been tested sufficiently to justify a description of the variety from specimens grown here.

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* Fruits and fruit trees of America 1890: 503.

Houghton.—This has long been a favorite variety in American gardens on account of its vigorous growth and productiveness even under adverse conditions. It originated with Abel Houghton, Lynn, Mass., and is generally thought to be of purely native origin. Smith (Improved), and Downing are its best known seedlings, and both of them are hybrids of the native *R. oxyacanthoides* and the European *R. Grossularia.* The canes are rather upright or somewhat curved, with rather slender, drooping branches. The fruit is small, handsome dark red with whitish bloom, thin skinned, smooth, juicy, sweet and very good to best in flavor and quality. See figure 7, plate XIV.

Mountain. —This variety, which originated with the Shakers, of Lebanon, N. Y., has long been in cultivation, but is comparatively little grown and should be superseded entirely by more productive sorts. The dull brownish-purple fruit is somewhat larger than that of the Downing, oblong, smooth, thick skinned, moderately juicy, sweet. See figure 6, plate XIV. The tall bush has slender, sprawling branches which should be pruned short and the bush kept well headed-in to secure the highest productiveness.

This variety is of especial interest botanically as it is the only cultivated variety I know which has been derived from that native species which is most commonly found wild in this and many other sections of New York State, namely, *Ribes Cynosbati.* It is clearly a hybrid between this and the European species. The long slender solitary spines, see figure 3, the tall canes, sprawling branches, dull brownish-purple color of the fruit, and the very dark green pulp are like *Cynosbati* as are also the beautiful brown and red colors of its autumn foliage which are quite unlike the yellow or occasional dull brown tints of the European kinds. The fruit is very large for an American variety and its skin is smooth and thick which indicates *Grossularia* parentage, for the fruit of *Cynosbati* has a thin skin usually beset with prickles. The glossy upper surface and somewhat leathery texture of the foliage and comparatively short thick buds are inherited from *Grossularia* for *Cynosbati* has slender buds and soft, pubescent leaves which are not at all leathery nor glossy.

Pale Red.—This variety, which has long been cultivated, is also known by the names American, Cluster and has several other synonyms. It belongs to the smooth, reddish-fruited native species *R. oxyacanthoides*, being quite similar to Houghton in the color and character of its fruit, although the fruit is somewhat smaller. See figure 8, plate XIV. The spines are less prominent and the slender branches have more of a drooping habit than have those of the Houghton. See figure 2, plate XII. The bush is a strong grower and very productive. Its average yield per bush for the last four years has been slightly more than ten and one-half pounds.

Pearl.—Received in 1888 from Smith and Kernans, St. Catharines, Ontario. The fruit resembles Downing so closely that an expert can scarcely tell one variety from the other. See figure 3, plate XIV. In habit of bush the Pearl is also much like Downing. In foliage it resembles Downing almost as closely as in fruit. In some localities it is said to be superior to its parent, the Downing, which it so closely resembles, but as grown here it has not equaled Downing in productiveness.

The erroneous statement of the *Canadian Horticulturist*, Vol. XIV, 162, that Pearl originated as a cross between Houghton and Whitesmith has been copied in other publications. Prof. William Saunders, who originated the variety, writes me that the true statement of the parentage is "Downing crossed with an English variety known as Aston's Seedling." The latter is a synonym for Red Warrington.

Red Jacket. — The American Red Jacket was received here for testing in 1892 from C. S. Curtice Co., Portland, N. Y. It was originated more than twenty years ago by Prof. Wm. Saunders, now of the Central Experiment Farm, Ottawa, Canada, and was named and introduced by Geo. S. Josselyn, Fredonia, N. Y., about 1890 or 1891. Prof. Saunders writes us that, although his records are not sufficiently clear to enable him to be quite positive as to the origin of this variety, he feels tolerably certain that the female parent is Houghton and the male parent an English variety called Red Warrington, also known as Warrington and Aston Seedling. If this be true the American Red Jacket is a hybrid between *Ribes oxyacanthoides*, L., and *Ribes Grossularia*, L. The character of the plant indicates that it is such a hybrid. The bush is a very strong grower and productive. Mr. E. B. Lewis, of Lockport, writes that he finds it some larger and a better shipper than Pearl, although Pearl is a little the better cropper. From an acre of Red Jacket stools, having about three shoots per stool not buried, he got four tons of fruit in 1896.

The fruit of Red Jacket is large for an American variety, roundish, smooth, good pale red color. See figure 5, plate XIV.

Smith. — *Smith's Improved.* This variety has been cultivated many years. It originated in Vermont from seed of Houghton. As grown here it is not nearly so productive as Downing, Pale Red or Houghton. Sometimes the fruit is larger than Downing, but more often its size is medium or below. See figure 4, plate XIV. The berry is dull pale green, sometimes spotted with red and having a slight bloom. Skin smooth, thin; pulp, sweet, good. Bush vigorous with somewhat curving canes and slender branches. The foliage is firmer or more leathery than that of Downing, with a more glossy upper surface.

The character of the foliage and color of the fruit are indications that this is a hybrid between *Grossularia* and *oxyacanthoides.* Its seedlings derived from crosses with Pale Red, which is presumably purely of *oxyacanthoides* species, have occasionally a plant with marked *Grossularia* characters. None of the pure seedlings of Pale Red which we have grown have shown any indications of European ancestry, and it is quite probable that the *Grossularia* characters which have appeared in the crosses with Smith, have come through Smith rather than through Pale Red.

Strubler Nos. 1, 2, 4, 5, 6, 7 and *10.*—These seedlings which originated with Phil. Strubler, Naperville, Ill., have not been grown here long enough to justify an expression of opinion as to their value. All except No. 1 are seedlings of either Downing or Smith and so are hybrids of *Grossularia* by *Oxyacanthoides.*

No. 1. Parentage unknown. It evidently belongs in part to a native species. Bush a strong grower, with rather upright, moderately stout branches. It has mildewed but very slightly here. Fruit medium size, nearly round, green, smooth, sweet, good.

No. 2. A very strong grower, rather upright and stocky. It has mildewed but slightly here. Season early. Fruit medium size, round, smooth, pale green, sweet, good.

No. 4. A moderate grower with branches more slender and curving than those of No. 2. Fruit small to medium, nearly round, smooth, dark red, sweet, fair quality.

No. 5. A moderate grower with moderately slender branches. Fruit medium size, oblong, dull green, sub-acid, not very good quality.

No. 6. A strong grower with moderately slender branches. Fruit below medium, egg-shaped, smooth, dark red, not first-class quality.

No. 7. Bush slightly less vigorous than No. 6, which it resembles in foliage and habit of growth. It has mildewed but slightly. Fruit medium size, nearly round, smooth, dark red, nearly like that of Strubler No. 10, but less sweet.

No. 10. Bush a strong grower with slender branches. Fruit medium, nearly round, smooth, dark red, sweet.

European Class.

Alderman.—Fruit medium to large, green shaded with pale red, somewhat hairy, sweet, fair to good quality. Bush a moderate grower; has mildewed some.

Alice.—Fruit medium to large, oblong, smooth, clear pale green color, sweet, good. See figure 11, plate XV. Bush a moderate grower. Foliage healthy.

Antagonist.—Fruit medium to large, somewhat oblong, moderately thin skin, smooth, sweet, good. See figure 22, plate XVI. Bush a strong grower. Foliage healthy.

Apology.—Fruit medium to large, oblong, smooth, pale green tinged with red, rather thin skin, sweet, good flavor. See figure 16, plate XV. Foliage healthy.

Auburn.—An English variety introduced in this country by Mr. J. Elletson, Auburn, N. Y., by whom it was renamed Auburn. Bush a strong grower. Foliage healthy. Fruit medium to large, oblong, smooth, good.

Beauty.—Fruit medium to large, oblong, pale red, smooth, sweet, good. Has mildewed some.

Berry Early Kent.—Fruit medium to large, pale green, smooth, roundish, somewhat acid, good. See figure 10, plate XV. Bush a strong grower, but quite subject to mildew; appears to be very productive.

Blucher.—Fruit very large, dark red, oblong or roundish oblong, nearly smooth, sweet, thin skin, very good flavor. See figure 34, plate XVII. Bush a strong grower, has shown but little mildew and appears to be productive. Worthy of trial.

Bollin Hall.—Fruit medium to large, oblong, smooth, dark green tough skin, very good flavor, nearly sweet. Bush a medium grower; has shown but little indications of mildew.

British Queen.—Fruit small, roundish, dark green, nearly smooth, thin skin, sweet, good. Bush a strong grower; productive; has shown but little mildew.

Briton.—Fruit medium to very large, oblong, light yellow, smooth rather thick skin, sweet, good. See figure 26, plate XVI. Bush a moderate grower; has mildewed considerably; appears to be moderately productive.

Broom Girl.—Fruit medium or above, nearly round, smooth yellowish green, nearly sweet, good flavor. See figure 30, plate XVI. Bush a strong grower; has mildewed but slightly.

Bull Dog.—Fruit medium to large, oblong, nearly smooth, red, poor flavor. Bush is not a strong grower; has mildewed but very little.

Bury Lane.—Fruit large to very large, oblong, pale green, smooth or nearly smooth, sweet, very good to best. See figure 15, plate XV. Bush a moderate grower; has mildewed some.

Candidate.—Fruit large, dark green shaded with yellow, smooth, good. Bush a moderate grower; has mildewed slightly.

Careless.—Fruit very large, oblong, smooth, pale green, sweet, best quality. Bush a moderately strong grower; has mildewed some. An exhibition variety.

Catherine.—Fruit medium to large, oblong, nearly smooth, yellow, nearly sweet, good. Bush not a strong grower; has mildewed very slightly.

Chautauqua.—Received at this Station in 1888 for testing from Louis Roesch, Fredonia, Chautauqua county, N. Y. Mr. Roesch obtained it from a garden in Dunkirk, N. Y. Its name was unknown, so he decided to introduce it under the name Chautauqua. The bush is a vigorous grower, and generally healthy, although sometimes subject to mildew. The fruit is large, roundish oblong, smooth, pale green, best quality. See figure 61, plate XX. Although it has not been as productive as some other varieties here we have no hesitation in recommending it for trial for home use. In other localities it may be productive enough to make it valuable for market, but it has not been so here when compared with Industry, Wellington Glory and some other European kinds.

Cheerful.—Fruit medium size, green, sweet, very good flavor. Bush not a strong grower.

Clayton.—Fruit suitable for exhibitions, very large, nearly oblong, dark green tinged with red, smooth, sweet, good quality. See figure 23, plate XVI. Bush has mildewed badly this season. It is a strong grower.

Columbus.—Received in 1892 for testing from Ellwanger & Barry, Rochester, N. Y. It is a very strong grower and has mildewed but slightly. Fruit large, oblong or roundish oblong, smooth, white, sweet, best quality. See figure 65, plate XX.

Countess of Amsdale.—Fruit above medium size, smooth, dark green shaded with red, nearly sweet, good quality. Bush not a strong grower; has mildewed some.

Crank.—Fruit very large, smooth, green, sweet, best quality. Suitable for exhibitions.

Cremore.—Fruit medium to large, nearly smooth, green, sweet, good, Bush a moderate grower; has mildewed slightly.

Criterion.—Fruit very large, oblong or somewhat pyriform, smooth, dark green, sweet, very good quality. See figure 32, plate XVII. Bush a moderate grower. It mildewed badly in 1896.

Crown Bob.—Fruit medium to large, nearly round, nearly smooth, dark red, almost sweet, very good quality. The fruit is much like Industry in color but it is not quite so large. The bush is dwarfish in habit but vigorous and productive. It has long been known in England as a desirable variety either for home use or market. We do not consider it as desirable as the Industry, which is a much stronger grower and more productive. Sometimes it is attacked quite severely by the mildew.

Cyprus.—Fruit large, oblong, nearly smooth, dark red, rather tough skin, sweet pulp, very good quality. See figure 35, plate XVII. Bush a moderately strong grower. It has been but slightly troubled with mildew.

Dagwell No. 1.—Received for testing in 1888 from S. L. Dagwell, Utica, N. Y. Fruit medium to large, nearly round, nearly smooth, red, tough skin, sweet pulp. A shade lighter in color than Industry and a few days later in ripening. Bush a moderately strong grower, moderately productive. It has been troubled but little with mildew.

Dan's Mistake.—Fruit medium to large, round or roundish-oblong, smooth, red, sub-acid, good quality. Bush a strong grower. It has mildewed but slightly.

Diadem.—Fruit medium size, smooth, green tinged with yellow, somewhat acid, fair quality, ripens late. Bush is not a strong grower; has mildewed but slightly.

Dominion. —Received in 1892 for testing from E. C. Pierson, Waterloo, N. Y. Fruit large, varying from round to oblong, a size larger than Whitesmith, pale greenish white, nearly transparent. See figure 67, plate XX. Skin thin for a berry of the European Class. Pulp sweet and very good in quality. It ripens a few days later than Whitesmith. Bush vigorous and promises to be productive. It has not mildewed here.

Drill.—Fruit medium size, pyriform, smooth, yellowish, moderately thick skin, sweet pulp, good quality. Bush not a strong grower. Mildewed badly in 1896.

Duck Wing.—Fruit medium size, somewhat pyriform, dark green tinged with yellow and sometimes mottled with red. Skin rather thin. Pulp sweet and very good. Bush a moderate grower. It has mildewed but slightly here.

Duke of Sutherland.—Fruit medium to large, oblong, nearly smooth, red, sweet, very good. See figure 25, plate XVI. Bush a strong grower. It has mildewed but slightly here.

Duster.—Fruit medium size, ovate or oblong, pale green, nearly smooth, nearly sweet. See figure 20, plate XVI. Bush a moderately strong grower. It mildewed some in 1896.

Excellent. — Fruit medium to large, round, nearly smooth, light red, sweet, very good. See figure 38, plate XVII. Bush a strong grower, somewhat subject to mildew. Promises to be productive.

Faithful.—Fruit medium to large, somewhat oblong, nearly smooth, pale green, thick skin, poor quality. Bush a moderate grower; has mildewed considerably.

Falstaff.—Fruit large, pyriform, smooth, dark green tinged with red, sweet, good. Bush has mildewed slightly.

Fascination.—Fruit medium size, roundish, pale green mottled with red, nearly smooth, nearly sweet, fair flavor. Bush not a strong grower. It mildewed slightly in 1896.

Flextonia.—Fruit medium or above, handsome pale red, smooth, sweet, very good. Bush appears to be a moderately strong grower, somewhat subject to mildew.

Flora.—Fruit medium to very large, oblong, smooth, green, Skin rather tough. Pulp sweet, good. Bush a strong grower; has mildewed but slightly.

Forester.—Fruit above medium, pale red, nearly smooth, sweet, good. Bush a moderately strong grower, somewhat subject to mildew.

Foworius.—Fruit large, roundish, white, nearly smooth, almost sweet, good. Bush a strong grower. It has mildewed slightly.

Foxhunter.—Fruit above medium size, oblong, dark green tinged with red, smooth, sweet, good. Bush a moderate grower. It has mildewed slightly.

Freedom.—Fruit medium to large, nearly white, sweet, best quality. Bush a moderately strong grower. It has mildewed but slightly. Suitable for exhibitions. Fruit of medium size is illustrated in figure 9, plate XV.

Frontenac. — This was received in 1892 for testing from H. S. Anderson, Union Springs, N. Y. Fruit large, oblong, smooth, pale green, sweet, good. Bush a very strong grower. It mildewed some in 1896.

Galopin.—Fruit large pyriform, dark green, smooth, tough skin, sweet pulp, good. Bush a strong grower. It has mildewed slightly.

Garibaldi.—Fruit medium to large, roundish, fine yellow, nearly sweet, good.

General.—An exhibition variety. Fruit medium to large, oblong, smooth, green, sweet, good. See figure 17, plate XV. Bush a moderate grower. It has mildewed slightly.

George Ridley.—Fruit medium to large, pyriform, pale green, slightly acid, poor quality. See figure 54, plate XIX. Bush a strong grower. It has mildewed considerably.

Gipsy Queen.—Fruit medium to large, nearly round, smooth, yellow, slightly sweet, fair quality. See figure 24, plate XVI. Bush is not a strong grower. It has mildewed very slightly.

Golborne.—Fruit medium to large, oblong, smooth, light red, sub-acid, good. See figure 36, plate XVII. Bush a strong grower. It has mildewed slightly.

Golden Drop.—Fruit small to medium, roundish-oblong, nearly smooth, yellowish, good. See figure 40, plate XVII. Season early. Bush a moderately strong grower. It has mildewed but slightly.

Golden Prolific.—Received for testing from John Charlton, Rochester, N. Y., in 1890. Fruit medium size, slightly oblong, smooth, beautiful golden yellow, sub-acid, fair to good quality. It ripens rather late. Not productive enough here nor good enough in quality to be worthy of recommending for trial. It mildewed badly in 1896.

Governor.—Fruit smooth, dark red, nearly sweet, good. Bush a moderate grower, somewhat subject to mildew.

Great Rock.—Fruit large, nearly smooth, oblong, dark red, sweet, good. Bush not a vigorous grower and somewhat subject to mildew.

Greenock.—Fruit medium to large, nearly round, smooth, green, fair flavor, somewhat acid. See figure 21, plate XVI. Bush not a strong grower. It was attacked quite seriously by mildew in 1896.

Green Walnut.—Fruit medium size, nearly round, smooth, green, sweet, good. Bush a moderate grower. Has been troubled but slightly with mildew.

Gretna Green.—Fruit medium to large, smooth, nearly round, dark green. Very good quality. See figure 33, plate XVII. Bush not a strong grower, somewhat subject to mildew.

Harriet.—Fruit medium size, oblong, hairy, green tinged with red, sub-acid, poor quality. Bush not vigorous, and but slightly troubled with mildew.

Helpmate.—Fruit large, oblong, smooth, light green, nearly sweet, good. See figure 59, plate XIX. Bush not a strong grower and quite subject to mildew.

Hero of the Nile.—Fruit medium to large, roundish-oblong, smooth, green, sub-acid, good. See figure 60, plate XIX. Bush a moderate grower. It has shown considerable mildew.

Highlander.—Fruit medium, round, slightly hairy, dark red, nearly sweet, good quality. See figure 37, plate XVII. Bush a moderately strong grower. It has mildewed but slightly. Season early.

High Sheriff.—Fruit medium to large, round, slightly hairy, yellow, sub-acid, fair quality. See figure 55, plate XIX. Bush a moderate grower. It has mildewed but slightly.

Hit or Miss.—Fruit large, somewhat pyriform or roundish, yellowish, nearly smooth, sweet, good. See figures 14, plate XV, and 57, plate XIX. Bush a moderate grower. It showed considerable mildew in 1896.

Hue and Cry.—Fruit large, oblong, pale green, smooth, sweet, good quality. Bush a moderate grower. It has suffered considerably from mildew.

Huntsman. — Fruit medium to large, oblong, smooth, pale green, sweet, good. See figure 18, plate XV. Bush a strong grower and apparently productive. It has mildewed very slightly.

Improved Early Hedgehog. — Fruit below medium, nearly round, somewhat hairy, yellowish-green, sweet, fair quality. See figure 28, plate XVI. Bush a vigorous grower and productive. It has mildewed but slightly.

Industry. — The first plants of this variety which were grown at this Station were received from Ellwanger & Barry, Rochester, N. Y., in 1885. Other plantings were made in 1888 and 1892. In some years when no treatment was given to prevent the mildew it has suffered quite seriously from this disease. The bush, see figures 3 and 4, plate XXIII, is a strong grower and one of the most productive of the European varieties which we have tested. Fruit medium to large, varies from pear shape to roundish oblong, smooth or nearly so, dark red, mild sub-acid or sweet, very good flavor. This is one of the best of the European varieties to grow for marketing either green or ripe. Figure 1, plate XXI, which is reproduced from a photograph shows a basket of Industry near the center, set a little in front of the rest.

Ironmonger.—Fruit small, round, smooth, or nearly so, dark red, sweet, good. Bush a strong grower. So far as tested here it has been free from mildew.

Italy.—Fruit medium size, nearly round, smooth, green tinged with red, sweet, fair quality. See figure 27, plate XVI. Bush not a good grower. It has mildewed but slightly.

Jem Mace.—Fruit medium, nearly round, smooth, yellow, sweet, good. Bush a moderate grower. It has shown no mildew here.

Jerry.—Fruit medium to large, nearly round, slightly hairy, almost white, sweet, good quality. See figure 56, plate XIX.

Jessie.—Fruit medium to large, nearly smooth, very pale green, sweet, good. Bush not a good grower. It has mildewed but slightly.

John Anderson.—Fruit medium to large, nearly round, slightly hairy, light red, sweet, good. The bush is not a good grower. It has mildewed slightly.

John Hall.—Fruit medium to large, pale green, oblong, narrowing towards the stem, smooth, sweet, good. See figures 31, plate XVII, and 58, plate XIX. Bush a moderate grower and somewhat subject to mildew. It appears to be productive.

Jolly Angler. — Fruit medium to large, oblong or roundish-oblong, smooth, light green, sweet, good. See figure 19, plate XVI. So far as tested here it appears to be productive. Bush a very vigorous grower. It has mildewed but slightly.

Jolly Sailor.—Fruit medium or below, nearly round, smooth, yellow, sweet, poor quality. See figure 29, plate XVI. Bush a moderate grower. It has mildewed very slightly.

Keen Seedling.—Fruit medium size, nearly round, red, hairy, sweet, good. See figure 39, plate XVII. Bush a moderate grower. It has mildewed slightly.

Keepsake. — Fruit medium or above, nearly round, smooth, greenish white, sweet or nearly so, very good. Bush a strong grower, somewhat subject to mildew. So far as tested here it gives promise of great productiveness.

King of Trumps.—Fruit medium to large, oblong or roundish oblong, smooth, pale green, sub-acid, good. Bush a moderate grower. It mildewed very badly in 1896.

Lady Houghton.—Medium to large, oblong, slightly hairy, yellowish-green, sweet, good. Bush a moderate grower. It has mildewed very slightly.

Lady Popham. — Fruit medium to large, oblong, smooth, yellow, very sweet, good. A good variety for exhibition purposes. Bush a moderate grower, productive so far as tested here and but slightly troubled with mildew.

Lady Stanley.—Fruit medium size, oblong, slightly hairy, green tinged with red, sub-acid, good. Bush a moderate grower. It has mildewed but slightly.

Lancashire Lad.— Fruit medium to large, nearly round, dark red, almost wine colored, slightly hairy, good quality, sub-acid or nearly sweet. Bush a strong grower. It has mildewed but slightly.

Largo.—Fruit medium, nearly round, dark red, almost smooth, sub-acid, fair quality. Bush a moderate grower. It has mildewed very slightly here.

Lavinia.—Fruit medium to large, oblong, green, smooth, nearly sweet, good. See figure 53, plate XVIII. Bush a strong grower. It has mildewed but slightly here.

Leader.—Fruit medium to large, slightly oblong, yellowish, smooth, sweet, good. Bush a moderate grower. It has mildewed badly.

Leveller. — Fruit medium to large, oblong, smooth, yellowish, slightly acid, good. Bush a moderate grower, has mildewed but slightly and promises to be productive.

Leviathan.—Fruit below medium, nearly round, smooth, poor in flavor and quality. It has mildewed but slightly.

Lion's Provider.—Fruit medium size, red, nearly smooth. Bush not a strong grower, and somewhat subject to mildew. Has shown no indications of great productiveness here.

Lizzard.—Fruit medium size, oblong, smooth, light green, sweet, good. Bush a moderate grower. It has mildewed but slightly.

London.—Fruit large to very large, oblong, almost smooth, dark red, sweet, good. Bush a moderate grower. It has mildewed but slightly.

Long Barney.—Fruit medium to large, oblong, smooth, light red, sweet, good. Bush a strong grower. It has mildewed but slightly.

Lord Beaconsfield.— Fruit below medium size, nearly round, green, smooth, sweet, good. Bush a good grower and gives indications of being very productive. It mildewed somewhat in 1896.

Lord Leigh.—Fruit large, oblong, red, slightly hairy, sweet, good. Bush a strong grower. It has mildewed but slightly here.

Lord Rancliffe.—Fruit medium to large, oblong, smooth, yellowish-green, sub-acid, good. Bush a strong grower. It has mildewed some.

Lord Scarborough.—Fruit large, pear-shaped, yellowish-green, nearly sweet, poor quality. Bush a moderate grower. It has mildewed but slightly here.

Lowton.—Fruit medium size, oblong or nearly round, dark red or wine colored, slightly hairy, sub-acid, good. Ripens rather early. Bush a strong grower. It has mildewed but slightly.

Major Hibbert.—Fruit small, nearly round, pale green, slightly hairy, sweet, good. Bush a strong grower. Somewhat subject to mildew.

Marlboro.—Fruit large, oblong, smooth, pale red, sweet, fair quality. Bush a moderate grower and slightly subject to midew here.

Mary Ann.—Fruit medium to large, light green, nearly round, nearly smooth, sweet, poor quality. Bush a moderate grower. It has mildewed but slightly.

Matchless. — Fruit large, oblong, green, slightly hairy, sweet, very good. Bush a strong grower, and gives indications of being very productive. It has mildewed but slightly.

Miss Chester.—Fruit medium to large, nearly round, nearly smooth, greenish-white, sub-acid, poor quality. Bush not a strong grower. It has mildewed very slightly.

Mitchell.—Fruit medium to large, pale green, oblong, smooth, sweet, good. Bush a strong grower. It has mildewed but slightly.

Mitre.—Fruit above medium, pale green, smooth, sweet, good. Bush a strong grower. It has midewed but slightly.

Monarch.—Fruit medium size, oblong, red, slightly hairy, nearly sweet, good. Bush a slow grower. It has been free from mildew here.

Monument.—Fruit medium to large, oblong, pale red, smooth, sweet, good. Bush a moderate grower. It has mildewed but slightly.

Mount Pleasant.—Fruit medium to large, nearly round, nearly smooth, tinged with yellow, sweet, fair quality. Bush a moderate grower. It has mildewed very slightly.

Mrs. Bowcock.—Fruit medium to large, slightly oblong, smooth, nearly yellow, sweet, good. Bush a moderate grower. It has mildewed very slightly here.

Mrs. Whittaker.—Fruit medium to large, slightly pear-shaped, nearly smooth, yellowish-green, sweet, good. Bush a moderate grower. It has mildewed some.

Nailor.—Fruit medium or above, greenish-white, smooth, sweet, good.

Nancy.—Fruit large to very large, nearly round, slightly hairy, almost white, sweet, good. Bush not a strong grower, but gives indications of being very productive. It has mildewed some.

Napoleon le Grand.—Fruit medium size, oblong, red, slightly hairy, sweet, good. Bush a moderate grower. It has shown but very little mildew here.

Nottingham.—Fruit medium size, slightly oblong, red, somewhat hairy, sub-acid, good quality. Bush a moderate grower, and but slightly troubled with mildew.

Overseer.—Fruit medium to large, pale green, smooth, sweet, very good quality. Bush not a strong grower and but little subject to mildew here.

Overall.—Fruit medium to large, nearly round, pale green, smooth, sweet, good. See figure 50, plate XVIII. Bush a strong grower and but slightly subject to mildew.

Peru.—Fruit medium to large, oblong, slightly hairy, yellowish-white, sweet, good.

Peto.—Fruit medium size, smooth, oblong, greenish white, sub-acid, poor quality. Bush a strong grower, and somewhat troubled with mildew.

Pilot.—Fruit small, roundish-oblong, green, smooth, sub-acid, poor quality. Bush a fair grower, and slightly subject to mildew. It does not appear to be worth growing so far as tested here.

Plowboy.—Fruit large, oblong, smooth, light red, sub-acid, good. Bush a moderately strong grower. It has shown some mildew.

Postman.—Fruit medium to large, oblong, smooth, pale green, sweet, good. Bush a strong grower and has mildewed but very slightly.

President.—Fruit large, long, red, slightly hairy, sub-acid, good. Bush a strong grower. It has shown some mildew.

Pretender.—Fruit medium size, yellow, smooth. The bush is a fair grower and has mildewed but slightly.

Priscilla.—Fruit medium size, oblong, light green slightly spotted or mottled with red, slightly hairy, almost sweet, not good in quality. See figure 51, plate XVIII. Bush not a strong grower. It has mildewed very slightly here.

Puyallup. — Received for testing from the introducer J. M. Ogle, Puyallup, Washington, in 1888. Mr. Ogle gives the following account of its origin: "Mr. W. M. Lee and his wife of Tacoma, Wash., dug the parent bush in 1881 at an old Indian camp on the bank of the Puyallup river one mile below the town of Puyallup." It was introduced in 1887.

In the report of the United States Pomologist for 1891, p. 395, it is stated that this variety is apparently identical with Triumph, but this is an error. While the two varieties do resemble each other quite closely in fruit, the Puyallup begins to blossom a little earlier than the Triumph and the bush is not so strong a grower as is the Triumph. The fruit of Puyallup is not so much inclined to be round as is that of Triumph; it is large, pale green, smooth, sweet, very good quality. See figure 64, plate XX. Its average yield per bush for the past four years has been 5.03 pounds while the average for Triumph during the same period has been 6.24 pounds per bush.

Queen Anne.—Medium sized fruit, oblong, smooth, green tinged with yellow, sub-acid, good. Bush a moderate grower. It has mildewed but very slightly here.

Queen of Trumps.—Fruit large, pale green, smooth, sweet, very good quality, suitable for exhibitions. Bush is a strong grower and has mildewed but slightly here.

Queen of the Whites.— Fruit medium size, nearly round, smooth, pale yellowish-green, sweet, good. Bush a strong grower. It has shown scarcely a trace of mildew here.

Queen Victoria.—Fruit medium size, nearly round, green, smooth, sub-acid, not very good quality. See figure 52, plate XVIII. Season early. Bush not a strong grower. It has mildewed but very slightly here.

Red Champagne.— Fruit small to medium, nearly round, slightly hairy, dark red, sweet, good. The bush is a strong grower and has shown but a trace of mildew here.

Red Jacket (English).— This English variety is not identical with an American variety which has been introduced under the name "Red Jacket" by George S. Josselyn, Fredonia, N. Y. See page 315.

Fruit large to very large, often narrowed towards the stem, much larger than the fruit of the American Red Jacket which in shape, texture of skin, quality and the thin light bloom on the fruit, is more like Downing. The English Red Jacket has thicker skin and thicker and more glossy leaves than the American variety, but the latter has a brighter red and more attractive fruit, is a stronger grower and has a more spreading habit of growth. The English Red Jacket is not a strong grower, but has given indications of being very productive and has shown but very little mildew here.

Red Robin.—Fruit medium to large, oblong, slightly hairy, light red, sweet, not very good. Bush not a strong grower. It has mildewed but slightly here.

Red Warrington.—Fruit medium to large, oblong, delicate pale red, hairy, sweet, best quality. Bush is a strong grower and has mildewed but slightly here. This is also known as Aston's Seedling and Warrington.

Ringer.—Fruit medium size, nearly round, yellowish-green, smooth, sweet, not very good. Bush a moderate grower. It has mildewed but very slightly here.

Roaring Lion.—Fruit medium size, oblong, smooth, light red, sub-acid, good. Bush not a strong grower. It mildewed considerably in 1896.

Rough Red.—Fruit medium to large, oblong, slightly hairy, red, acid, good. Season early. Bush a strong grower. It has mildewed but slightly here.

Rover.—Fruit large to very large, smooth, poor color, dull green slightly tinged with red. Bush not a strong grower. It has mildewed but slightly here.

Rumbullion.—Fruit small to medium, nearly round, slightly hairy, green, sweet, good. See figure 49, plate VI. Bush a very strong grower. It has mildewed but very slightly here.

Shiner.—Fruit medium to large, slightly pear-shaped, pale green, smooth, sweet, good. Bush makes a moderate growth. It has mildewed but slightly here.

Sir George Brown.—Fruit large, oblong, greenish-white, nearly smooth, sweet, good. Bush makes a strong growth. It has mildewed considerably here.

Slaughterman.—Fruit medium to large, oblong, smooth, red, good. Bush not a strong grower. It mildewed considerably in 1896.

Smiling Beauty.—Fruit medium to large, nearly round, greenish-yellow, sweet, best quality. Bush makes a good growth and has mildewed but slightly here.

Snowdrop.—Fruit medium to large, pear-shaped, smooth, light green, sub-acid, fair quality. Bush a moderate grower. It has mildewed but slightly here.

Speedwell.—Fruit medium to large, nearly, round, nearly smooth, red, sweet, fair quality. Bush a moderate grower. It has mildewed very slightly here.

Sportsman.—Fruit medium size, nearly round, nearly smooth, red, sub-acid, good. Bush makes a strong growth and has mildewed but slightly here.

Stella.—Fruit medium to large, oblong, smooth, pale green, sub-acid, fair quality. Bush makes a fair growth and has mildewed but slightly here.

Stockwell. — Fruit medium to very large, oblong, smooth, light green, sweet, good. Bush a moderate grower. It has mildewed but slightly here.

Succeed. — Fruit medium to large, oblong, smooth, yellowish-green, sweet, good. Bush makes a fair growth and has been free from mildew here. It gives indications of being productive.

Sulphur. — Fruit medium size, round, nearly smooth, fine yellow color, sweet, good. Bush a strong grower. It has mildewed but very slightly here.

Sunset. — Fruit medium to large, oblong, nearly smooth, yellowish green, sweet, best quality. Bush makes a good growth and has not mildewed here.

Tally Ho. — Fruit medium to large, pear-shaped, pale green, nearly smooth, sweet, good. Bush makes a strong growth and has not mildewed here.

Telegraph.—Fruit medium to large, oblong, smooth, pale green, sweet, fair quality. Season late.

Thatcher.—Fruit medium to large, oblong, smooth, greenish-yellow, sub-acid, good. Season early. Bush makes a fair growth and has mildewed but slightly here.

Thomas Williams.—Fruit medium to large, oblong, yellow, smooth, sweet, very good. Bush makes a fair growth, and has not mildewed here.

Thompson Seedling.—Received for testing from J. T. Thompson, Oneida, N. Y., 1893. Fruit medium to large, round, smooth, yellow, slightly acid, fair quality. Has fruited here but one season. Bush a very strong grower, and but very slightly affected with mildew here.

Thumper. — Fruit medium to large, oblong, smooth, light green, sweet, good. Bush makes a moderate growth and has mildewed but slightly here. It gives indications of being very productive.

Tichborne.—Medium to large, oblong, smooth, light red, sub-acid, poor, quality. Bush makes a strong growth and has mildewed but very slightly here.

Transparent.—Fruit medium to large, nearly round, nearly smooth, light green, acid, poor quality. Bush makes a moderate growth and has not mildewed here. So far as tested here it does not seem to be worthy of trial for any purpose.

Triumph. — Received for testing at this Station in 1888 from F. C. Biddle, Chad's Ford, Pa. Fruit large, oblong or roundish, pale yellow, smooth, sweet, very good. See figure 66, plate XX. See description of Puyallup for comparison of Triumph with that variety. Although it has not been as productive here as Wellington Glory, still it has been considered one of the most desirable of the green or yellow varieties of the European class. The bush is a strong grower and usually quite free from mildew, although it has occasionally shown a considerable amount of this disease.

Try Me Oh.—Fruit medium size, oblong, pale green, nearly smooth, sub-acid, good. Bush makes a medium growth and has mildewed but slightly here.

Unity.—Fruit large and smooth, green, roundish-oblong or pear-shaped, sweet, good. See figure 47, plate XVIII. Bush makes a moderate growth and has mildewed but very slightly here.

Veteran.—Fruit medium size, pear-shaped, nearly smooth, dark red, sweet, poor quality. Bush a fair grower and nearly free from mildew here.

Village Green.—Fruit medium size, oblong, smooth, pale green, sub-acid, good. Bush makes a strong growth and has mildewed but slightly here.

Viper.—Fruit medium size, roundish-oblong, smooth, yellowish-green, nearly sweet, fair quality. See figure 46, plate XVIII. Bush makes a moderate growth and has mildewed but very slightly here.

Visit.—Fruit large, oblong, nearly smooth, pale green, sub-acid, fair quality. Bush makes a fair growth and has mildewed but very slightly here.

Wakeful.—Fruit medium to large, nearly smooth, yellow, sweet, good. Bush makes a moderate growth and has mildewed but slightly here.

Watson. *Watson's Tree.*—Received for testing in 1893 from Samuel Wilson, Mechanicsville, Pa. The bush is a very strong grower with wide-spreading branches. See figures 1 and 2, plate XXII. It has not mildewed here. It has not been tried here long enough to determine its productiveness. Fruit medium to large, oblong, smooth, dark red, sweet, very good.

Weathercock.—Fruit large, nearly round, nearly smooth, yellowish-green, sweet, good. Bush makes a moderate growth, has shown but slight traces of mildew here and gives evidence of being productive.

Wellington Glory.—This has been the most productive variety of the European class at this Station during the last four years. The average yield in pounds per bush was 13.69 in 1893, 11.85 in 1894, 6.60 in 1895 and 1.25 in 1896, making an average of 8.35 pounds per bush during the past four years. It should be remembered that the yield of all European gooseberries at this Station was very small in 1896 on account of the unusually trying climatic conditions of the preceding fall and winter.

This variety was received here for testing in 1882 from Benj. G. Smith, Cambridge, Mass., and again in 1892 from J. Watkins, Withington, Eng. The bush makes a very strong growth and has usually been troubled but little with mildew although occasionally it has suffered quite severely.

The fruit is attractive in appearance, medium to large, oblong, smooth with slight bloom, pale yellow nearly white, sweet, very good quality. See figures 44, plate XVIII, and 63, plate XX.

White Eagle.—Fruit medium to large, oblong or pear-shaped, smooth, greenish white, sweet, good. See figures 42 and 43, plate XVIII. Bush makes a moderate growth and has mildewed but slightly here. It gives evidence of being productive.

White Hare.—Fruit large, round, smooth, greenish-white, sub-acid, good. Bush makes a moderate growth. It has mildewed considerably.

Whitesmith.—Received in 1888 from Ellwanger & Barry, Rochester, N. Y., for testing here, and again in 1892 from J. Watkins, Withington, England.

Fruit medium to large, nearly round, smooth; skin thin and tender for an English sort, pale yellowish-green. See figures 45, plate XVIII, and 62, plate XX. Pulp sweet and very good. Bush makes a strong growth. It has mildewed some here. Its average productiveness for the past four years at this Station has been below that of Wellington Glory, Industry, Triumph and Puyallup, nevertheless it is recommended as a desirable variety for the home garden.

William Watson.—Fruit medium size, oblong, nearly smooth, yellow, sweet, very good quality. Bush makes a moderate growth and has had scarcely a trace of mildew here.

Wonderful.—Fruit medium size, round, nearly smooth, dark red, nearly sweet, good. Bush makes a moderate growth and has had but a trace of mildew here.

Yaxley Hero.—Fruit medium to large, not uniform in size, nearly round, nearly smooth, red, sweet, good. Bush makes a moderate growth and has shown but slight traces of mildew here.

SUMMARY.

In the foregoing list the descriptions of those varieties which have thus far attracted especial attention on the trial grounds are printed in large type. So far as we are able to judge at present, Industry, Crown Bob and Lancashire Lad are among the best of the large European kinds to grow for marketing green fruit. Wellington Glory has made an excellent record here and Whitesmith is also generally considered good and productive, but has not done as well as Wellington Glory.

Among the American grown seedlings of the European class which have been fruited here Dominion and Triumph deserve especial mention as worthy of extended trial.

It has already been observed that the best of the American class of gooseberries are unexcelled in flavor, quality, hardiness and productiveness. They do not have the objectionable thick, tough skin which is common to varieties of the European class, but are inferior to them in size. Downing has long been considered the standard of excellence in the American class. Among the recently introduced varieties of this class the American Red Jacket, Champion and Pearl deserve especial mention.

PROPAGATION.

The cultivated varieties of gooseberries cannot be depended on to reproduce themselves true from seed, so whenever new plants of a variety are wanted it is necessary to divide the plants in some way, as by taking suckers, layers or cuttings from it.

The remarkable way in which seedlings vary from the parent gooseberry is well illustrated by some seedlings of the Industry which have been raised at this station. The Industry is an English variety with nearly smooth red fruit. Twenty-nine of its seedlings were fruited here in 1893 and the different plants varied greatly in the color and smoothness of their fruit as is shown by the following statement: Eight plants had dark-red fruit, eight red, two light red, three pale green, four green shaded with yellow, one yellow, two pale yellow, and one nearly white. Nine plants had smooth fruit, fourteen nearly smooth, five somewhat hairy and one very hairy. The fruit of the different plants also showed great difference in size, shape and quality. Figure 1, plate XXI is from a photograph of twenty-seven of these Industry seedlings. The Industry appears in the basket which is set forward near the center of the front line of the group. The four baskets in the row at the extreme left contain the native varieties, Pale Red, Downing, Pearl and Mountain (?) which were placed there for comparison with the Industry seedlings. In one plant the color of the calyx was pale green; in the others it varied from light to dark red. Considerable variation was seen also in the habit of growth and in the character of the foliage. While some of the seedlings showed a marked resemblance to the parent, each was clearly distinct from it and probably none of them will equal it as a desirable kind for cultivation. Occasionally a gooseberry seedling resembles the parent very closely, as is the case with the Pearl, which can scarcely be distinguished from its parent the Downing, either in foliage or in fruit, but such instances are exceptional.

When gooseberries are raised from seed the chances are that many of the plants thus secured will not be worth cultivating and few or none of them may equal in value the best of the well known cultivated sorts. For this reason the practice of growing gooseberries from seed can be recommended only to persons interested in the origination of new varieties, while those who wish to grow gooseberries for home use or for market should select for this purpose the best of the kinds which are already known in cultivation. Gooseberries are readily grown from seed by sowing the seed in boxes or beds as soon as the fruit is ripe. The seedlings begin to fruit when three or four years old. As previously stated, a gooseberry variety is propagated by taking suckers, layers or cuttings from the old plants.

Propagation from Suckers.—Sometimes gooseberries are propagated in small quantities by separating rooted canes from old plants, but this practice is not followed to any extent except in gardens. The plants thus secured will in turn throw up suckers

PLATE XXI.

FIGURE 1.—FRUIT OF INDUSTRY AND 27 OF ITS SEEDLINGS. THE BASKET OF INDUSTRY SETS IN FRONT OF THE REST. THE FOUR BASKETS IN THE LEFT ROW CONTAIN FOUR VARIETIES OF AMERICAN GOOSEBERRIES, VIZ., DOWNING, PALE RED, PEARL AND (MOUNTAIN ?).

FIGURE 2.—MOUND LAYERING. STOCK DRESSED READY FOR COVERING WITH EARTH IN FALL.
FIGURE 3.—BUSH MOUNDED SO AS TO COVER THE BASES OF THE NEW SHOOTS.
FIGURE 4.—THE SAME WITH EARTH REMOVED TO SHOW HOW THESE SHOOTS HAVE ROOTED.

after they are planted, unless the buds are removed from all parts of the plant, which are covered by the soil in planting.

Propagation by Layering.—In the northeastern section of the United States the nurserymen commonly propagate all gooseberries by mound-layering. They find it the only successful method for propagating varieties of the European species, such as Industry, Triumph, Whitesmith, etc. American gooseberries, such as Downing, Pale Red, Houghton, etc., grow more readily from cuttings, but even varieties of this class are in this section commonly grown by nurserymen from mound-layers.

By this method the old plants, called stools, are headed back so that they may send out many strong shoots near the surface of the ground, as shown in figure 2, plate XXI. When the new shoots have become somewhat hardened, which in this section of the country occurs about the last of June, they are mounded with fresh earth so that they will send out roots. See figure 3, plate XXI. The shoots are crowded outwards and the center of the stool is covered with earth to a depth of about four inches above the bases of the shoots. The mound is packed quite firmly with the back of a spade and then covered with loose soil so that it will not readily dry out. If they are mounded too early in the season the shoots may rot.

In the fall the earth is taken away from the stools, as shown in figure 4, plate XXI, and then the rooted shoots are cut off, care being taken to leave good buds on the stools for growing another crop of shoots the following season, as shown in figure 2, plate XXI. The earth is then thrown over the stools to protect them during the winter. Propagation from the old stools under proper management may be continued from year to year for an indefinite period. The rooted shoots are planted at once in well prepared fertile soil, or they may be tied in bundles and kept till spring before being planted, but the former way is preferable. The cultivation and pruning is much the same as that described hereafter for cuttings.

Another method of layering, which is occasionally practiced, consists in pegging branches to the ground, covering them just back of the tips with fresh earth. In the fall, after the covered portion has rooted, it is cut away from the old plant and cared for in the way described for other layers.

Propagation from Cuttings.—Gooseberries are readily grown from cuttings in England and that method is commonly practiced there, but, as has already been explained, the European gooseberries are not easily grown from cuttings in this climate. Varieties like Pale Red, Downing, etc., which have descended wholly or in part from native American species, are sometimes propagated from cuttings in this state and are commonly grown by this method in some portions of the southern and western states. The cuttings, which are about eight inches long, are made from the new wood, that is to say, from the new shoots of the past season. They should be made as soon as the new growth is ripe and hard, which in this section is usually soon after the first of October. Some nurserymen make the cuttings earlier, even when it is necessary to strip the leaves from the canes to do so, because they find it more convenient to do the work before the fall delivery season opens. It is thought that the hard, well-ripened wood roots more readily and gives a larger percentage of good plants than do cuttings which are made from immature wood, but when the cuttings are made early in the fall, and planted at once, if the season proves favorable, they send out roots before winter and are ready to start growth as soon as spring opens, which insures a long season for growth, and so favors the production of stronger plants than can be grown from spring set cuttings.

When the cuttings are not to be planted before spring they are tied in bunches with wire or willows, as twine may rot and break, properly labeled and buried in well drained soil. They are set in the pit tops downward, so as to keep the top buds dormant till planting time, and are covered about six inches deep with soil. Trenches are opened if necessary to lead surface water away, so that it will not settle around the pit. By covering with coarse manure or other mulch, while the ground is frozen, the pit may be kept frozen so that the planting of the cuttings may be delayed for some time after spring opens.

Sometimes the cuttings are packed with sand in boxes and kept in caves or cellars during the winter, but fall planting in this section of the country is generally preferable.

Cuttings should be planted in well drained, fertile soil, plowed from ten to twelve inches deep and made thoroughly mellow. A trench about eight inches deep is made with the spade against the perpendicular side of which the cuttings are placed from one and a half to two inches apart, having the top buds just above the surface of the ground. A little earth is then thrown over the bases of the cuttings and tramped very firmly. It is very important that the soil should be made very firm around the bases of the cuttings, but this cannot be done if the trench is filled before any tramping is done. After the first layer of earth has been tramped the trench is filled and tramped again.

The cuttings which are planted in the fall should be completely covered when the ground begins to freeze to prevent heaving by frost. Earth, coarse manure or some other mulch may be used. When they are covered with earth there is more danger of the cuttings being injured in uncovering them than when they are covered with straw or manure. If the cuttings are heaved or loosened by the frost the earth should be tramped around them after the frost has left the ground in the spring.

During the growing season the earth around the cuttings should be kept loose and free from weeds by frequent cultivation. When the branches begin to start the lower ones should be removed so as to leave the stem free from branches to a height of about four inches from the ground.

The plants are commonly grown in the nursery two years before being planted in the place where they are to be fruited, but the desirability of a plant is not to be determined by its size, for strong one-year plants are far preferable to older scrub stock even though the latter be much larger in size.

FIELD AND GARDEN CULTURE.

Gooseberries are especially recommended for culture in localities where the season is not long enough to ripen grapes successfully. Under good culture they succeed well on a variety of soils. In order to have the plants do well the land should be well drained and at least fertile enough to grow a first-class crop of corn till they come into bearing, after which they should be liberally fertilized. It is unreasonable to expect regular crops of large fine flavored fruit from bushes which stand in poor soil or in tough old sod, where they struggle for existence in ground that is crowded with the roots of grass, weeds, trees and shrubs, yet it is not unusual to find that such bushes are depended on for the family supply of gooseberries. It is much better to give gooseberries clean cultivation when they are grown for home use the same as when grown for market. On this account it is best to plant them so that a horse cultivator may be used in keeping the ground mellow and free from weeds. A heavy mulch of coal ashes sufficient to keep down the weeds, is better than utter neglect.

As a commercial crop gooseberries are often grown as a secondary crop in well cultivated orchards especially when the orchards are young. Abundant yields cannot be secured from gooseberries set in this way after the orchard trees are large enough to shade the bushes and fill the soil with their roots. Sometimes gooseberries are set between vineyard trellises or, where the vines are grown on the Kniffen system, under the trellises, alternating with the vines. In the latter position the gooseberries are liable to be spotted by the spraying mixture when the vineyard is sprayed.

Distance apart.—When gooseberries are set in vineyards the trellises should be at least ten feet apart, thus leaving the gooseberries five feet from the trellis when they are planted midway between the vineyard rows. The gooseberry plants should then stand five feet apart in the row, although some advocate closer setting. In orchards they should not be set nearer the trees than six feet. In the open field if they are are set so that the

PLATE XXII.

FIGURE 1.—WATSON, TREE FORM BEFORE PRUNING.

FIGURE 2.—THE SAME AFTER PRUNING.
[Both figures reproduced from photographs.]

PLATE XXIII.

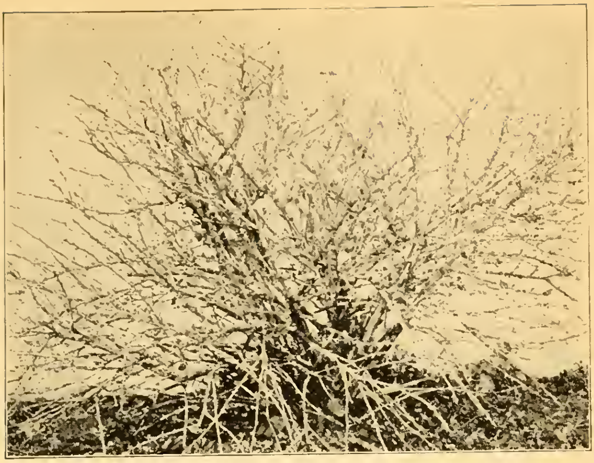

FIGURE 3.—BUSH FORM BEFORE PRUNING; 9 YEARS PLANTED.

FIGURE 4.—THE SAME AFTER PRUNING.
(*Both Figures reproduced from Photographs.*)

cultivator may run both ways, the gooseberries should stand at least five by five feet apart. If the cultivator is to run but one way the rows should be six feet apart and the plants four feet apart in the row. Strong growing varieties may be planted at greater distances apart than those just given.

Planting.—In preparing the plants for setting out the broken or bruised parts of the roots should be removed with a clean cut because the smooth surface will heal more readily than will the rough bruised surfaces. The tops should be shortened to correspond with the amount of roots. New branches will push out later as the roots develop. When the hole is prepared the roots should be spread out and covered with an inch or more of earth which should be tramped firmly. The hole is then filled and after the earth has been tramped again it is covered with a layer of loose earth to prevent the rapid evaporation which takes place when the hard surface is exposed to the air.

Pruning.—English writers usually recommend that gooseberries be trained in tree form, that is, with a single main stem for each plant, and that method is largely followed in the old country. On account of their neat symmetrical appearance such plants are well adapted to well cultivated gardens. Figure 1, plate XII, is from a photograph of Whitesmith pruned in this way. The bush was planted nine seasons before the photograph was taken. Figures 1 and 2, plate XXII, illustrate a younger bush of more spreading habit before and after pruning. This variety is the Watson. It was planted four seasons before the photograph was taken. A bush grown in this form does not produce suckers and if it is broken off accidentally it cannot be renewed by letting new sprouts grow, but must be removed and a new plant set in its place. After they have borne five or six good crops it is generally best to replace them with new bushes, for they gradually become less productive than plants which are grown in the bush form because the latter may be renewed from suckers whenever it is thought desirable to do so.

To grow bushes in tree form, it is simply necessary to remove all buds or eyes from the portion of the cutting or layer which is covered with earth in planting. No underground shoots, or suckers, will then be formed and the plant will have but one main stem or trunk. By annually cutting back new shoots to about three eyes and removing all weak or crowded branches the tree form may easily be kept in symmetrical shape.

For general purposes it is best to set plants that will send up suckers. The older canes which have passed their period of highest productiveness may then be removed annually and their places taken by young vigorous ones which have been allowed to grow for this purpose. By this method of renewal, the skillful grower may keep his plantation in a high state of productiveness for an indefinite period. Including the young canes which are to be used for renewal as above suggested there will usually be five or six canes to a bush, or even a greater number than this with varieties of the American class which have more slender canes. Figure 3, plate XXIII, shows the bush form of Industry before pruning and after a season of very vigorous growth. Figure 4, plate XXIII, shows the same bush after being pruned. This bush was planted nine years ago.

Gooseberries generally require but little pruning during the first two or three years after they are planted except to clip a few inches off from the strong new shoots and a less amount from the less vigorous ones. This may be done at any time after the leaves fall. The object is to favor the development of the fruit spurs all along the cane. If it is not done the strong buds at or near the end of the cane will start into such vigorous growth in spring that the lower buds will not start or will make but little growth, so that eventually most of the fruiting branches and spurs will be developed near the upper end of a long cane which, when loaded with fruit, is apt to bend nearly or quite to the ground.

Besides heading in the bushes in the way just described the pruning consists in removing weak or broken branches and those which have made an excessively vigorous growth. Old canes that have passed the age of greatest productiveness, and branches that are close to the ground should also be taken away.

No definite rule can be given for pruning gooseberries because the kind and amount required varies with the individual habits and condition of growth of the bush. A little attention each year is necessary to keep the bushes in best shape for cultivating, spraying, fruit picking and for the free circulation of air through and especially underneath the branches. It is a mistake to think that the center of the bush must be kept open to let the sunlight in as is sometimes advocated. In this climate the fruit may be ruined by such unnatural exposure to direct sunlight and it is better to have it shaded by the foliage.

Summer Pruning.—This is sometimes practiced with good results. It consists in pinching off the ends of the vigorous shoots at the period of active growth in early summer. The object is to favor the development of fruit spurs.

Cultivation.—In the spring as soon as the ground is fit to work it is our practice to fork lightly into the soil the manure which was placed around the plants the fall previous. Shallow cultivation is given near the bushes and somewhat deeper, perhaps three or four inches deep, midway between the rows. It is not well to disturb the roots by deep cultivation. Frequent shallow cultivation is given till about the middle of August when it is discontinued so that the growth may be checked and the wood become well ripened before winter.

Fertilizing.— The soil must be kept very fertile in order to secure annual heavy crops of fruit and still keep the plants in vigorous condition. At this Station gooseberries are grown on a rather heavy clay loam and stable manure is used for fertilizing them, not only on account of the plant food which it furnishes, but also because of its beneficial effect in loosening the soil. One or two forkfuls of manure are given to each plant in the fall and turned under by shallow cultivation in the spring. For a discussion of the use of commercial fertilizers the reader is referred to Bulletin 94 of this Station.

Injurious Insects.

Currant Worm.— The insect that is most troublesome to gooseberries in New York state is the larva of a saw fly which is commonly known as the currant worm. This saw fly has four wings and the female is somewhat larger than the common house fly, her body being mostly yellow. The front wings are characterized by a dark spot in each as shown in the accompanying illustration, figure 4, which was prepared from a drawing by Mr. V. H. Lowe, Station Entomologist.

On warm days in early spring these saw flies begin to appear and deposit their eggs in chains along the midrib and veins on the underside of the leaf. The time of the appearing of the first brood extends over a period of several weeks, and later in the season a second brood appears so that constant watchfulness is necessary to prevent the depredations of these insects. About ten days after the eggs are laid they hatch into minute white larvæ, commonly called worms, which feed on the leaves, grow rapidly and spread over the bushes often stripping them of foliage in a few days. The growing worms soon assume a light green color which afterwards becomes several shades darker. At one period of growth they are marked with many black dots. When full grown they are about three-quarters of an inch long.

Early in the season before the fruit has attained much size, London purple or Paris green may be used against these insects with good success, but later it is best to use powdered hellebore which may be applied even when the fruit is ripening without any fear of rendering it unfit for food. These substances may be dusted on the foliage or applied in the form of a spray. The latter method is preferable, especially if many bushes are to be treated. The London purple or Paris green should be mixed at the rate of one pound to from one hundred and fifty to two hundred gallons of water. Hellebore is used at the rate of one pound to fifty gallons of water. Care should be taken to get fresh hellebore or pure Paris green. When the insects begin to appear the poison should be applied at once.

The currant borer sometimes attacks gooseberry as well as currant canes. The adult is a small bluish-black moth with three bright yellow bands across the abdomen. It lays the eggs on or near the buds and when hatched the larva enters the cane and

FIGURE 4.—CURRANT SAW-FLY.
(*From Photograph of Drawing by V. H. Lowe.*)

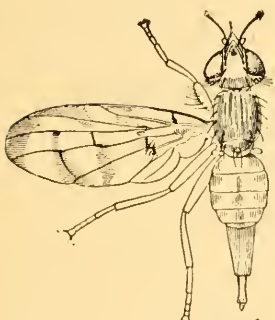

Fig. 5.

GOOSEBERRY FRUIT-FLY.

Fig. 6

LARVA OF SAME.

Figures 5 *and* 6 *are enlarged about five times after Figures* 1 *and* 3, *plate* 1, *Annual Report Maine State College*, 1895.

bores downward through the pith. There is but one brood a year of this insect. Pruning and burning the infested canes in autumn seems to be the only way to fight it.

The four-lined leaf bug, or yellow lined currant bug, sometimes attacks gooseberries, though more frequently it is found on currants. It infests the leaves of the new growth. Slingerland advocates* the pruning and burning of the tips of infested shoots in autumn, jarring the insects into a dish of kerosene and water and spraying the young red nymphs as soon as they appear in spring using kerosene emulsion diluted with five parts of water.

The *San Jose scale* does much injury when its gets established on gooseberries. It has been found on the gooseberry in a few localities on Long Island, and it should be especially watched for in that section of the state and adjacent territory. For an account of its habits and best methods of fighting it the reader is referred to Bulletin 87 of this Station.

The *gooseberry fruit fly*, also called the currant fly (*Epochra Canadensis*, Loew.) causes considerable injury to the fruit of currants and gooseberries in some sections of the country. According to Harvey † the adult is a two-winged fly about the size of a house fly, pale yellow with dark bands across the wings as shown in Fig. 5. The fly appears in June and stings the fruit depositing an egg under the skin. This hatches into a small white maggot, Fig. 6, which feeds on the seeds and causes the fruit to turn red and drop prematurely. When the maggot is full grown it enters the ground, pupates and the following June emerges as a fly.

Speaking of their attacks on currants Harvey says‡ a radical remedy would be to pick the entire crop while green and before the flies appear. Since gooseberries are frequently marketed green this would seem to be the best method of fighting this insect whenever it attacks that fruit.

We are indebted to Dr. Lintner for the information that this insect was noticed in Camden, N. Y., in 1893, and for several years previous. Up to the present time it has attracted little attention in this state.

* Bull 58, Cornell Exp. Station, Oct., 1893. † Annual Rep. Maine State College, 1895; 118
‡ l. c. ; 124.

DISEASES.

Leaf Spot.— The worst of the diseases which attack the native varieties of gooseberries is a leaf spot which is due to a fungus parasite called *Septoria Ribis,* Desm. It causes small irregular or circular dead spots to appear in the leaves and weakens them so that they are apt to fall off. By midsummer or later the bushes sometimes lose nearly all their leaves in this way, and whenever this happens the vigor and productive power of such bushes certainly is lessened.

Pammel, who has treated this disease on black currants, finds* that it may be controlled by five applications of Bordeaux mixture, making the first treatment early in May. In treating gooseberries this plan should be changed because the Bordeaux mixture would stick to the fruit and show plainly enough to injure its sale. Since the disease is most troublesome in this section of the country after midsummer it seems best to make one spraying before the fruit begins to grow and defer the rest of the treatment till the fruit has been picked, but so far as I know, no experiments have been made in treating bearing gooseberry bushes to prevent the leaf spot.

Mildew.—This disease seldom troubles the native varieties, but in this country is often destructive to European gooseberries and their American grown seedlings. Its attacks have been so severe as to largely prevent the cultivation of European gooseberries in America in spite of the fact that some of these varieties bear fruit of largest size, attractive in color and of excellent quality. The mildew is a fungus which grows on the surface of the green shoots, the foliage and the fruit, injuring the appearance of the fruit and stunting the diseased shoots. At first it has a white, frost-like appearance, but later it covers the affected parts with brown, felt-like patches made up of the mildew threads and thick-walled, dark spore cases. Figure 4, plate XIII, illustrates a mildewed branch of the Industry. It is now known that the mildew may be largely prevented by paying

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*Treatment of Currants to prevent Spot Diseases, Bull. 30, Iowa Expt. Station: 289.

attention to sanitary principles in the location, cultivation and pruning of the plants and by spraying with fungicides.

The location should be one that gives good air drainage as well as good soil drainage. Low or flat lands, where dews and rains do not readily evaporate, or places where the free circulation of air is prevented by groves, hedges, high fences or other obstructions should be avoided. Small gardens with high inclosures, and low branched, crowded orchards, especially when located on flat lands, furnish ideal conditions for the growth of the mildew, because they lack good air drainage.

It is best to continue frequent shallow cultivation till after the fruit is gathered, keeping the ground perfectly free from weeds, especially underneath the bushes, where they check the free circulation of air around the plant. Prune back low, drooping branches because they interfere with clean cultivation, and their fruit is liable to become spattered with dirt during heavy rains. After the first of August cease cultivating, so that the new growth may become ripe and hard before winter. The ground may be kept free from weeds by mulching, though cultivation is preferable. Coal ashes make a good mulch for currants or gooseberries.

Spraying to prevent mildew should begin as soon as the buds begin to unfold, using one ounce of potassium sulphide for every two gallons of water. Repeat the applications at intervals of ten days till the fruit is nearly ready to market. Should frequent heavy rains occur spray more frequently. Be sure the spray reaches all the foliage, especially on the inner and under parts of the bush, which are usually slighted. The poisons recommended for killing the leaf-eating worms, or larvæ, may be combined with the potassium sulphide solution and both may be applied at once. The use of Bordeaux mixture is objectionable, because it is apt to stick to the fruit and injure its market value, even though the application be made several weeks before the crop is marketed.

When Bordeaux mixture is used, the 1-11 formula is recommended; that is, one pound of copper sulphate and two-thirds as much fresh lime, are used to make eleven gallons of the mixture. The preparation of Bordeaux mixture is fully explained in Bulletin 86 of this Station, which may be had free by applying to the Station Director.

BLACKBERRIES.

W. PADDOCK.

The results of the variety tests with Blackberries are given below. Most of the varieties came through the winter in good condition and set a full crop, which, because of abundant rains, they were able to bring to full maturity. The soil is rather heavy clay loam, fertilized with stable manure and well tile drained.

The yields, season and ages of the different varieties are given in the tables. Brief notes follow which supplement the data given in the tables.

TABLE 1. YIELD OF BLACKBERRIES IN 1896.

Rank as to yield.	NAME.	When set.	Yield of five hills, ounces.	In marketable condition.	Per cent. of canes winter killed.
1	Ancient Briton	1889	800½	July 15 to Aug. 18.	10
2	Stone Hardy	1888	522	July 17 to Aug. 13.	10
3	Early Harvest	1889	421½	July 14 to Aug. 10.	5
4	Agawam	1888	406	July 14 to Aug. 10.	10
5	Success	1892	278½	July 17 to Aug. 21.	10
6	Snyder	1888	261½	July 15 to July 31.	0
7	Mersereau	1893	250½	July 15 to July 21.	0
8	Taylor	1888	245	July 17 to Aug. 10.	5
9	*Ford No. 1*	1892	234	July 17 to Aug. 18.	10
10	Minnewaski	1889	226	July 15 to Aug. 10.	40
11	Wilson, Jr	1893	173½	July 21 to Aug. 13.	25
12	Eldorado	1890	165½	July 14 to Aug. 10.	5
13	Luther	1891	147½	July 17 to Aug. 15.	15
14	Kittatinny	1888	117½	July 17 to Aug. 15.	5
15	Lincoln	1888	115	July 17 to Aug. 13.	0
16	Dorchester	1889	108½	July 13 to July 31.	40
17	Sanford	1894	107	July 21 to Aug. 13.	0
18	Early Mammoth	1892	103	July 15 to Aug. 13.	75
19	Erie	1893	96½	July 15 to Aug. 10.	10
20	Barnard	1888	80	July 17 to Aug. 3.	10
21	Wachusett	1889	68½	July 14 to Aug. 10.	3
22	Woodland	1892	62½	July 21 to Aug. 13.	50
23	Early King	1892	47½	July 7 to July 21.	10
24	Lovett	1892	34	July 27 to Aug. 10.	50
25	Carlo	1890	30	July 17 to Aug. 3.	10
26	Western Triumph	1894	11	July 17 to July 29.	10
27	Black Chief	1893	9	July 24 to Aug. 10.	5

Notes on Varieties.

The following brief notes will supplement the data given in the tables. More complete descriptions of the older varieties may be found in former bulletins and reports of this Station.

Agawam has been fruited here several seasons and has proven to be quite satisfactory. The canes are medium size but vigorous; fruit medium size, good quality.

Ancient Briton is a standard variety in many localities. It has always done well on our grounds, and this season it was by far the most productive of all. The fruit is only of medium size.

Barnard is not worth propagating in this locality.

Black Chief, received from J. H. Haynes, Delphi, Ind., 1893. Canes rather small but vigorous, green, with numerous small prickles. Berries medium size, roundish, grains medium, core small, sweet, good quality. Last season all varieties were so badly winter killed that the crop was a failure, so this season we obtained the first record of yield that we have of this variety. It ranks twenty-seventh in productiveness, yielding nine ounces.

Carlo is evidently not suited to this locality. It ranks twenty-fifth in productiveness.

Dorchester is one of the old varieties. It took first rank as to yield in 1893, but this season it proved to be less hardy than many other kinds.

Early Harvest has been quite satisfactory on our grounds, being but little injured by the winter, and producing satisfactory crops. The berries are rather small for marketing.

Early King ripened its first fruit a week earlier than did any other variety, but as is usual with early varieties, it is unproductive, while the fruit is medium or below in size.

Early Mammoth is too tender to be grown in this locality without protection. It very much resembles Wilson Jr. Many of the berries are imperfect, and vary from small to largest size.

Eldorado was injured but little by the winter, and was only moderately productive. The fruit is medium size.

Erie has been only moderately productive on our soil. The fruit varies from medium to large.

Ford No. 1. From F. Ford & Son, Ravenna, O. We have not fruited this variety long enough to decide as to its merits, but it is considered worthy of further testing. It was moderately productive this season, and was injured but comparatively little by the winter. The fruit is from medium to large and of good quality.

Fruitland. From W. N. Scarf, New Carlisle, O. The canes were injured twenty-five per cent. by the winter, and it stands twenty-eighth in productiveness. Evidently it is not suited to this locality.

Kittatinny has been as hardy as most varieties on our soil, but is only moderately productive.

Lincoln is not as good as other varieties for this locality.

Lovett was injured fifty per cent. by the winter. It is unproductive here.

Luther is no improvement on better known varieties.

Mersereau is a new variety, said to be a seedling of Snyder. The canes were uninjured by the winter, and it stands seventh in productiveness this season. The berries are large, long and rather irregular, with medium grains, quality good, mildly sweet, sprightly; canes medium size, with medium prickles, vigorous and hardy. A promising variety.

Minnewaski is not hardy here. It ranks tenth in productiveness, although the canes were injured fifty per cent. by the winter.

Sanford. Received from C. W. Graham, Afton, N. Y. Has not been sufficiently tested to determine its merits, but it is not a promising variety.

Snyder is one of the hardiest of blackberries. The canes are of the largest size, vigorous and productive. Much of the fruit averages small in size, and many of the berries turn to a dull, brownish-red color when ripe, which makes them unattractive.

Stone Hardy was injured but little by the winter, and takes second rank as to productiveness this season. The fruit is of medium size and good in quality.

Success is considered to be worthy of further testing on account of its hardiness, productiveness and good-sized fruit.

Taylor is not as good for this locality as are some of the other well-known varieties. It is moderately productive of small to medium sized fruit.

Wachusett is unproductive here.

Wilson Jr. has a low habit of growth and its canes need protection in winter. The berries vary from medium to very large, some of them being imperfect.

Woodland was injured fifty per cent. by the winter. The berries are medium size.

The following is a list of blackberries growing on Station Grounds in 1896.

Agawam.
Ancient Briton.
Barnard.
Black Chief.
Carlo.
Childs Tree.
Dorchester.
Early Cluster.
Early Harvest.
Early King.
Early Mammoth.
Eldorado.
Erie.
Evergreen.
Ford No. 1.
Fruitland.
King.
Kittatinny.
Lincoln.
Lovett.
Luther.
Maxwell.
Mersereau.
Minnewaski.
New Rochelle.
Ohmer.
Piasa.
Reyner.
Sable Queen.
Sanford.
Snyder.
Stone Hardy.
Success.
Taylor.
Wachusett.
Western Triumph.
Wilson Early.
Wilson Jr.
Woodland.

DEWBERRIES.

W. PADDOCK.

The value of dewberries for commercial purposes lies in the fact that their fruiting season is earlier than the blackberries. Ripening as they do before the blackberries, their large size and attractive appearance usually command for them a ready sale. As a class the cultivated dewberries are less productive than the blackberries, and bear larger fruit of poorer quality. In this locality they require winter protection which is easily given them by throwing a few shovelfuls of earth on the prostrate vines.

The only variety that has as yet attained any commercial importance is the Lucretia.

Austin Improved, from J. W. Austin, Pilot Point, Texas, is a new candidate for public favor. It produced a few fruits this season which were of the largest size and good in quality. This is a promising variety.

TABLE II. YIELD OF DEWBERRIES IN 1896.

Rank as to yield.	NAME.	Yield of row 20 feet long, ounces.	In marketable condition.
1	Lucretia	314	July 2 to August 3.
2	Mammoth	90½	June 30 to July 24.
3	Bartel	82	June 30 to July 25.
—	Austin Improved	....	....

The following is a list of dewberries growing on the Station grounds in 1896, not including Station seedlings:

Austin.	Lucretia.
Bartel.	Mammoth.
Bauer.	Maynard.

RASPBERRIES.

W. PADDOCK.

The raspberry crop was very satisfactory this season; this was no doubt due to the fact that most of the varieties came through the winter with but little injury and the weather conditions were favorable to the setting and maturing of a large crop of fruit. The soil on which they are grown here is a rather heavy clay loam, well tile drained and fertilized with stable manures.

BLACK RASPBERRIES.

TABLE III. LIST OF BLACK RASPBERRIES FRUITED IN 1896, WITH A COMPARATIVE STATEMENT OF THE PERCENTAGE OF EARLY AND LATE YIELD OF EACH VARIETY.

Rank as to yield.	NAME.	When set.	Yield of row 25 feet long.	Per cent of crop picked before June 30.	Per cent of crop picked after July 15.	Per cent of canes winter killed.
1	Mohler	1893	393½	7	1	5
2	Hilborn	1893	388	5	5	5
3	*Babcock No.* 5	1893	323	6	4	5
4	Pioneer	1894	291½	13	1	5
5	Kansas	1893	267	3	3	5
6	Ohio	1893	244	0	20	10
7	*Poscharsky No.* 15	1894	249	10	2	0
9	*Poscharsky No.* 9	1894	221½	29	0	5
9	Arctic	1893	217	2	7	5
10	Mills	1894	204	0	24	5
11	Hopkins	1894	193	20	6	5
12	*Babcock No.* 3	1893	177	0	6	10
13	Eureka	1894	163	24	0	5
14	Onondaga	1894	159	0	26	5
15	*Poscharsky No.* 3	1894	147	29	0	0
16	*Townsend No* 2	1894	142	4	0	2
17	*Haynes Seedling*	1893	139	0	13	25
18	Palmer	1894	136	9	4	0
19	Older	1893	97½	0	5	0
20	Lovett	1893	93½	6	3	5
21	*Smith No.* 2	1893	83	17	0	0
22	*Babcock No.* 9	1893	73½	0	13	5
23	American Everbearing	1893	65	35	0	5
24	Lotta	1893	57	0	21	10
25	Carman	1893	52	2	5	5
26	Spry Early	1893	44½	39	0	0
27	*Manwaring No.* 1	1893	33	0	0	15

Early Black Raspberries.

The majority of the black raspberries ripened a large proportion of their crop between the dates of June 30 and July 16. Those varieties that ripened a fifth or more of their crop before June 30 may be called early for this season.

TABLE IV.—EARLY BLACK RASPBERRIES ARRANGED ACCORDING TO THEIR YIELD BEFORE JUNE 30TH.

NAME.	Date of first picking.	Yield before June 30, ounces.	Total yield, ounces.	Rank as to total yield.
Poscharsky No. 9	June 23	65	221½	7
Poscharsky No. 3	June 23	42	147	14
Eureka	June 24	41	163	12
Hopkins	June 25	39	193	10
American Everbearing	June 23	22	65	22
Spry Early	June 24	17	44½	25

Of the above varieties *Poscharsky No. 3, Poscharsky No. 9,* American Everbearing and Spry Early are not as good for this locality as are other well known sorts.

Eureka is an early berry of large size, firm and of good color and quality. As is usual with very early varieties it is only moderately productive.

Hopkins is also of large size, moderately firm and of good quality. Both of these varieties received favorable notice in our report for 1895.

Late Black Raspberries.

Again referring to table III. we find four varieties ripened a fifth or more of their crop after July 15. These may be called late for this season.

TABLE V.—LATE BLACK RASPBERRIES ARRANGED ACCORDING TO THEIR YIELD AFTER JULY 15TH.

NAME.	Date of last picking.	Yield after July 15, ounces.	Total yield, ounces.	Rank as to total yield.
Mills	July 27	59	204	9
Ohio	July 23	49½	244	5
Onondaga	July 27	41	159	13
Lotta	July 23	12	57	23

Mills has received favorable notice in former reports of this Station. Its fruit is somewhat larger than that of the Ohio, of good quality, firm and somewhat seedy. It is worthy of a trial as an evaporating berry.

Ohio is one of the standard varieties, and is much used for evaporating. It does not thrive in many localities.

Onondaga has also received favorable notice in former reports. The berries are large and attractive and of good quality.

Lotta is only moderately productive of medium size fruit.

Artic is moderately productive of medium to large size fruit.

Babcock No. 3 is an attractive berry of large size, good quality and somewhat seedy. It was moderately productive this season.

Babcock No. 5 received favorable notice in last year's report. This season it takes third rank as to productiveness; the fruit is medium to large in size, good quality and attractive in appearance.

Carman has received favorable notice in former reports of this Station as an early berry. The plants now in fruiting for some reason have not done well, so that this year's record cannot be regarded as showing what the variety is really worth.

Haynes Seedling as grown here has shown no points of superiority over well known kinds.

Hilborn has been fruited here since 1890, and has been very satisfactory as a mid-season berry. The fruit is large, attractive and of good quality.

Kansas ranks fourth in productiveness this season. It has become quite popular in many sections as a productive market berry.

Lovett produces large, attractive fruit, but it has not been productive enough here to warrant its being recommended for extensive planting.

Manwaring No. 1 though planted in the fall of 1893, the plants have not yet become established. Much of the fruit dried up on the bushes this season.

Mohler is said by many to be identical with Eureka. This season Eureka ripened its first fruit fully a week earlier, and was much less productive than Mohler. The fact that the

Eureka plants are younger, and that the two varieties occupy different locations in the plat may have influenced both the season of ripening and the yield.

Older produced its full crop this year, and ranks eighteenth in productiveness. It should be further tested before deciding as to its merits.

Palmer also bore its first full crop this season, and stands seventeenth in productiveness. It holds a high rank in many places.

Pioneer produced its first full crop this year. The berries are medium size, good black color, moderately firm, fair flavor and quality. The canes are moderately vigorous.

Smith No. 2 has as yet shown no points of excellence. It takes twentieth rank as to productiveness this season.

Townsend No. 2 was unproductive this season, but it should be tested longer before being rejected.

PURPLE RASPBERRIES.

TABLE VI. LIST OF PURPLE RASPBERRIES FRUITED IN 1896, WITH A COMPARATIVE STATEMENT OF THE PERCENTAGE OF EARLY AND LATE YIELD OF EACH VARIETY.

Rank as to yield.	NAME.	When set.	Yield of row 25 feet long, ounces.	Per cent. of crop picked before July 4.	Per cent. of crop picked after July 21.	Per cent. of canes winter killed.
1	Cardinal	1893	590	4	14	5
2	Addison	1893	382½	24	0	25
3	Columbian	1894	382	0	25	55
4	Shaffer	1893	239	0	11	45
5	*Beckwith Seedling*	1894	188	0	40	3
6	Smith Purple	1895	171½	23	2	0
7	Redfield	1895	106½	0	10	0

Addison is not as valuable as are some of the other varieties. While it has been productive, much of the fruit is small and imperfect.

Beckwith Seedling is very late, but unless it proves to be much more productive than this season's test would indicate, it will not compare favorably with other vareties for this locality.

Cardinal was by far the most productive of the purple berries. The fruit is large, soft and juicy, and not so dark colored as Shaffer.

Columbian was winter-killed fifty-five per cent., but still it ranks third in productiveness among the purple varieties. It produced its first crop last year and ranked second in productiveness among all the raspberries.

Redfield is said to be a very vigorous grower in some localities, but it makes only a moderate growth here. The fruit is medium size, dull purple, soft, sub-acid, and fair quality. Thus far it shows no points of superiority over better known sorts.

Shaffer has long been the standard purple berry. The canes are quite susceptible to attacks of anthracnose in some localities.

Smith Purple was received from B. F. Smith, Lawrence, Kan., 1891, but it has since been transplanted so that the plants have never become established. It shows no indication of being any improvement on better known varieties for this locality.

RED RASPBERRIES.

TABLE VII. LIST OF RED RASPBERRIES FRUITED IN 1896, WITH A COMPARATIVE STATEMENT OF THE PERCENTAGE OF EARLY AND LATE YIELD OF EACH VARIETY.

Rank as to yield.	NAME.	When set.	Yield of matted row 25 feet long, ounces.	Per cent. of crop picked before July 1.	Per cent. of crop picked after July 22.	Per cent. of canes winter lled.
1	Pride of Kent	1893	555	6	16	0
2	Cuthbert	1892	535	0	21	5
3	Royal Church	1892	452	0	34	25
4	Talbot	1894	421½	1	17	0
5	Loudon	1894	412	1	24	0
6	Pomona	1892	405	23	2	0
7	Clarke	1894	380	3	15	0
8	Superb	1892	378½	1	22	5
9	Olathe	1893	354	0	39	0
10	Turner	1892	338½	4	7	0
11	Cline	1893	336½	42	0	0
12	King	1894	302	0	14	5
13	Harris	1893	292½	3	22	0
14	Brandywine	1892	281	0	32	0
15	Reliance	1893	267½	4	6	0
16	Reder	1893	255½	0	25	0
17	Miller Woodland	1892	239½	0	19	10
18	I. X. L	1894	246	1	13	0
19	Thompson	1892	205	1	13	25
20	Pride	1893	176	19	1	0
21	Naomi	1893	155	0	40	40
22	Crimson Beauty	1893	93	0	15	2
23	Superlative	1894	45½	0	22	60

Early Red Raspberries.

The larger part of the crop of red raspberries was picked between the dates of July 6 and July 23. Those varieties that produced a considerable portion of their fruit before July 6 may be called early. Table VII shows three varieties that may be classed in this list. These are given below in Table VIII.

TABLE VIII. EARLY VARIETIES RANKED ACCORDING TO THEIR YIELD BEFORE JULY 6.

NAME.	Date of first picking.	Yield before July 6, ounces.	Total yield, ounces.	Rank as to total yield.
Cline	June 23	143	336½	11
Pomona	June 23	94	405	6
Pride	June 23	55	176	21

Cline was very satisfactory this season as an extra early berry; the fruit is of medium size and good quality.

Pomona is valuable as a home or local market berry. It is always productive, of good color and quality, but too soft to ship long distances.

Pride has been moderately productive in former years, but this season it ranks twenty-first in productiveness. Not as good as others for this locality.

Late Red Raspberries.

Observing July 23 as the end of mid-season, we may class those varieties that yielded a fifth or more of their crop after this date among the late berries.

TABLE IX. LATE VARIETIES RANKED ACCORDING TO THEIR YIELD AFTER JULY 22.

NAME	Date of last picking.	Yield after July 22, ounces	Total yield, ounces.	Rank as to total yield.
Royal Church	Aug. 10	153	452	3
Olathe	Aug. 10	139	354	9
Cuthbert	Aug. 3	111	535	2
London	Aug. 6	99	412	5
Superb	Aug. 6	85	378½	8
Brandywine	Aug. 6	74	281	15
Reder	Aug. 6	65	255½	17
Harris	July 31	64	292½	13
Naomi	Aug. 10	52	155	22
Superlative	Aug. 6	10	45½	24

Brandywine is one of the standard old varieties, but it has never been productive on our grounds.

Cuthbert is one of the most satisfactory of the red berries for home and local market. It is always productive; the berries are of large size and of very good quality.

Harris has received favorable notice in former reports of this Station. The plants now in bearing have not become fully established, so that this year's yield is below the average.

Loudon produced its first full crop this season and ranks fifth in productiveness among the red berries, many of which have been longer established. The fruit is large, of bright red color and will evidently stand shipping well. It was uninjured by the winter.

Naomi is of no particular value for this locality.

Olathe ranks second in yield among the late berries this season and ninth among all the red berries. It has been satisfactory as a late berry in former years.

Royal Church is valuable only for home use.

Superlative is not yet established, but it produced a small amount of fruit. The berries are of the largest size, light red color, juicy and moderately firm. It has the peculiar flavor of the English berries, which is much esteemed by some, but it is not relished by those persons who regard the Cuthbert as the standard of quality.

Mid-Season Varieties.

Clarke is one of the most productive of the old varieties. It is valuable for home use only.

Crimson Beauty is of no value in this locality.

I. X. L. shows no points of superiority.

King produced its first crop of fruit this season. If it proves to be productive it will no doubt be valuable for a mid-season market berry on account of the size and color of the fruit.

Miller Woodland is unproductive here.

Pride of Kent was the most productive of the red raspberries this season, and the canes were uninjured by the winter. The berries are too soft to bear shipping.

Reliance is of but little worth as tested here.

Talbot ranks fourth in productiveness this season. It is valuable for local market or the home garden.

Thompson is not productive here.

Turner is noted for its hardiness. It is moderately productive here; the fruit is medium in size and of good quality.

YELLOW RASPBERRIES.

TABLE X. LIST OF YELLOW RASPBERRIES FRUITED IN 1896, WITH A COMPARATIVE STATEMENT OF THE EARLY AND LATE YIELD OF EACH VARIETY.

Rank as to yield.	NAME.	When set.	Yield of matted row 25 feet long, ounces.	Per cent. of crop picked before July 3.	Per cent. of crop picked after July 21.	Per cent. of canes winter killed.
1	Caroline	1892	651	2	25	0
2	Golden Queen	1892	338½	0	17	0
3	Crystal	1893	231	10	8	15
4	Golden Thornless	1893	153	22	10	2
5	Vermont	1893	122½	13	16	15
6	Champlain	1893	86	3	11	20

The yellow raspberries are valuable only for the home garden or local market. Caroline, Golden Queen and Crystal have been the most satisfactory, and for several seasons Caroline has been the most productive raspberry on our grounds.

The following is a list of raspberries grown at this Station in 1896, not including the Station seedlings:

Addison.
American Everbearing.
Arctic.
Babcock No. 3.
Babcock No. 5.
Babcock No. 9.
Beckwith Seedling.
Black Diamond.
Brandwine.
Cardinal.
Carman.
Caroline.
Clarke.
Cline.
Champlain.
Columbian.
Coutant No. 1.
Coutant No. 2.
Crimson Beauty.
Cromwell.
Crystal.
English Giant.
Eureka.
Gault.
Golden Prague.
Golden Queen.
Golden Thornless.
Gregg.
Harris.
Haynes Seedling.
Hilborn.
Hopkins.
I. X. L.
Kansas.
Kenyon.
King.
Koch No. 1.
Lawrence.
Lotta.
Loudon.
Lovett.
Manwaring No. 1.
Marlboro.
Miller.
Miller Woodland.
Mills.
Mohler.
Morrison Seedling.
Naomi.
Ohio.
Older.
Olathe.
Onondaga.
Orange.
Palmer.
Percy.
Phœnix.
Pioneer, see Progress.
Pomona.
Poscharsky No. 3.
Poscharsky No. 9.
Poscharsky No. 15.
Pride.
Pride of Geneva.
Pride of Kent.
Progress.
Reder.
Redfield.
Red Sweet.
Reliance.
Royal Church.
Sarah.
Shaffer.
Smith No. 2.
Smith Purple.
Spry Early.
Success.
Superb.
Superlative.
Talbot.
Teletaugh.
Thompson.
Townsend No. 2.
Turner.
Vermont.
Viking.

Whyte No. 6.
Whyte No. 7.
Whyte No. 13.
Whyte No. 17.
Woodland.

STRAWBERRIES.

W. PADDOCK.

Strawberries are grown on the Station grounds in matted rows. Plants are set in either spring or fall, according as they are received. As soon as the ground freezes in the early winter the plants are covered with a few inches of straw or coarse manure. When growth starts in the spring most of the covering is removed from the beds, enough being left to serve as a light mulch and to prevent the berries from becoming soiled.

In the following notes the imperfect or pistillate varieties are marked "P," while the perfect or staminate varieties are marked "S." The blossoms of the pistillate varieties produce no pollen and on this account are unable to form any fruit when planted by themselves. The flowers of the staminate varieties produce pollen and so are able to form fruit of themselves. In any plantation where pistillate varieties are used, staminate varieties that blossom at the same time should be set in every third or fourth row in order that all may be well supplied with pollen. Too great stress cannot be laid on having plenty of good pollen producers that blossom at the same time as do the varieties which they are to fertilize. For example we would not expect that Michel would make a good fertilizer for Bubach because the former is usually in full bloom by the time the first blossoms of the latter are open.

The yield of strawberries on the Station grounds as well as in many localities throughout the state was very unsatisfactory this season. This result was brought about by a variety of causes. among which may be mentioned the dry season of 1895, the severe winter following, and the very dry weather early this spring. Copious rains later brought on the crop in this locality much better than was at first anticipated. Though such seasons are discouraging from a financial point of view, yet they are not without value, as they aid in determining our reliable varieties, But after all the value of a variety is entirely a local question and no grower should plant largely of any kind until it has first been tested in his locality, as the number of varieties that succeed well in a large number of localities is very small. Yet variety tests are not without value as the results obtained in one locality may justly serve as an indication of what the variety will do in other portions of the state. While the results published in this bulletin cannot be regarded as being conclusive, they are an indication of what the berries are worth.

In the following pages the varieties that were fruited in one-year-old beds are discussed first, next those that fruited in spring-set two-year-old beds and last the varieties in fall-set two-year-old beds.

Notes on Varieties on One-year-old Beds.

Beecher, H. W., S. — *From Thompson's Sons, Rio Vista, Va.* Fruit large, roundish wedge shape, scarlet color, poor quality, firm; fruit stems short; foliage good; runners abundant. Not productive this season.

Bissell, P. — *From Thompson's Sons, Rio Vista, Va.* Blossoms with Sharpless. Fruit medium to large, round, inclined to conic, light scarlet color, firm, quality fair. Fruit stems long, prostrate; foliage good, runners abundant. It ranks first in productiveness among the varieties fruited here for the first time in 1896. Considered worthy of further testing.

Canada Wilson, S. — *From Birdseye & Son, Hopewell, N. Y.* Evidently a strain of the old Wilson. Fruit small to medium. good scarlet color, roundish conic, very firm, quality good. Foliage good, runners abundant, fruit stems long prostrate. Productive and firm, but too small to be profitable.

Champion of England, S. — *From R. S. Johnston, Shortsville, N. Y.* Fruit medium to large, irregular wedge shape, bright scarlet color, moderately firm, fair quality. Fruit stems medium length; runners abundant; foliage moderately good. A large and attractive berry when well grown but it has not done well on the Station grounds.

Columbian, S.—*From W. F. Allen, Salisbury, Md.* Plants vigorous, runners abundant, fruit stems medium; fruit small to medium, roundish, light scarlet color, firm, fair quality. Its rank as to yield cannot be given this season.

Earliest, S.—*From Thompson's Sons, Rio Vista, Va.* Among varieties fruited for the first time this season Earliest takes eighth place as to productiveness. This is a good showing when we take into account the fact that it produced a greater per centage of its crop early in the season than did any other variety. Fruit medium or below in size, roundish conic, light scarlet color, firm, fair quality. Foliage good, fruit stems short, runners abundant. Deserves further testing.

Eleanor, S.—*From Thompson's Sons, Rio Vista, Va.* Fruit medium or above, roundish, bright scarlet, firm, good quality; runners abundant, fruit stems medium, plants vigorous. Productiveness cannot be given this season. An early variety and worthy of further testing.

Enormous, P.—*From Thompson's Sons, Rio Vista, Va., and W. F. Allen, Salisbury, Md.* Runners abundant, fruit stems medium, foliage good. Fruit large to very large, irregular wedge shape, bright scarlet color, firm, quality fair. Though only moderately productive this season it should be tested further on account of its size and attractive appearance.

Hersey, S.—*From S. Hersey, Higham, Mass.* Fruit small to medium in size, roundish with a slight neck, light scarlet color, firm, fair quality. Fruit stems medium, runners abundant, plants vigorous. Productiveness cannot be given this season.

Hull No. 3, **S.**—*From E. J. Hull, Olyphant, Pa.* Plants moderately vigorous, runners abundant, fruit stems medium. Fruit large roundish, light scarlet color, firm, good quality. Rank as to yield cannot be given this season.

Maple Bank, S.—*From E. B. Stevenson, Lowville, Canada.* Blossoms with Sharpless. Plants vigorous, runners abundant, fruit stems medium. Fruit medium to very large, roundish wedge shape, good dark scarlet color, firm, fair quality. Productiveness cannot be given this season, but on account of its size and attractive appearance it is considered worthy of further testing.

Margaret, S.—*From M. Crawford, Cuyahoga Falls, O.* Medium size, inclined to conic, dark scarlet color, firm, fair quality. Fruit stems short, runners abundant, foliage moderately vigorous. The plants have not done very well this season.

Mary, P.—*From Thompson's Sons, Rio Vista, Va.* Blossoms with Gandy. Very few runners, foliage good, plants strong and vigorous, fruit stems medium. Fruits large to very large, irregular in shape, many of them being coxcombed, firm, good quality. Its rank as to productiveness cannot be given this season.

Murray, P.—*From Thompson's Sons, Rio Vista, Va.* Foliage good, runners abundant, fruit stems medium length, productive. Fruit medium to large, dark scarlet color, roundish, firm, fair quality. Not productive this season in a one-year-old bed.

Omega, P.—*From Thompson's Sons, Rio Vista, Va.* Blossoms with Sharpless. Plants moderately vigorous, fruit stems short, runners abundant. Fruit large, irregular wedge shape, light scarlet color, firm, fair quality. Will probably be productive; on this account and because of its attractive appearance it is considered to be worthy of further testing.

Robinson, S.—*From Thompson's Sons, Rio Vista, Va.* Fruit medium to large, roundish conic in form, scarlet color, moderately firm, fair quality; fruit stems medium, runners abundant, foliage good. Yield cannot be given this season, but it will evidently be productive. Considered worthy of further testing.

See No. 3, P.—*From H. S. and A. J. See, Geneva, Pa.* Fruit stems medium, runners abundant, plants vigorous. Fruit medium to large, good light scarlet color, roundish, firm, quality fair. Will evidently prove to be productive. Worthy of further testing.

See No. 4, P.—*From H. S. and A. J. See, Geneva, Pa.* Fruit large to very large, good scarlet color, somewhat irregular in shape, quality poor, firm. Runners abundant, fruit stems long and prostrate; plants moderately vigorous. No. 4 stands second in productiveness among the varieties fruited for the first time this season. Considered worthy of further testing on account of size and productiveness.

See No. 5, P.—*From H. S. and A. J. See, Geneva, Pa.* Fruit medium to large, light scarlet color, long conic, firm, quality good. Plants moderately vigorous; fruit stems long and prostrate, runners abundant. Moderately productive this season. Considered worthy of further testing on account of size and productiveness.

Staples, S.—*From M. Crawford, Cuyahoga Falls, O.* Fruit medium size, roundish, dark scarlet color, firm, quality fair. Fruit stems short; runners abundant; plants moderately vigorous. It no doubt will prove to be of value as an early variety.

Thompson (Lady Thompson), S.—*From Slaymaker and Son, Dover, Del.* Fruit medium size, roundish, good scarlet color, firm, fair quality; fruit stems long prostrate, plants moderately vigorous, runners abundant. Productiveness cannot be given this season. Evidently not suited to this locality.

Thompson No. 100.—From Thompson's Sons, Rio Vista, Va. Plants moderately vigorous, fruit stems long, runners abundant. Fruit medium or above in size, conical with a slight neck, bright scarlet color, firm. Productiveness cannot be given this season.

Thompson No. 101, S.—*From Thompson's Sons, Rio Vista, Va.* Fruit above medium in size, round, conic, scarlet, firm, good quality. Fruit stems long and prostrate, runners abundant, foliage good. Gives evidence of being productive. Considered worthy of further testing.

Tubbs, S.—*From R. S. Cole, Harmons, Md.* Season medium early. Foliage good, fruit stems medium, runners abundant. Fruit medium to large, round conic, dark scarlet color, firm, good quality. Stands fifth in productiveness among varieties fruited for the first time this season. Worthy of further testing.

Wilder No. 5, P.—*From H. A. Wilder, Akron, N. Y.* Fruit medium size, round, conic, dark scarlet color, firm, quality fair. Fruit stems long, prostrate, runners abundant, foliage fairly good. Only moderately productive this season.

Wilder No. 7, S.—*From H. A. Wilder, Akron, N. Y.* Fruit above medium size, roundish conic, good scarlet color, firm, good quality. Fruit stems medium, runners abundant, foliage good.

PLATE XXIV.

William Belt, Natural Size.

Stands third in productiveness among varieties fruited here for the first time this season.

William Belt, S.—*From M. Crawford, Cuyahoga Falls, O.* Plants vigorous and healthy, fruit stems medium, runners abundant. Fruit medium to very large, many of the first berries to ripen being coxcombed and very large, the others are of a more regular conical form; fine scarlet color; moderately firm; good quality. Ranks second in productiveness among varieties fruited for the first time this season. Considered worthy of further testing. (See plate XXIV.)

Williams, S.—*From Ellwanger and Barry, Rochester, N. Y.* Fruit medium to large, not uniform in shape, firm, fair quality; fruit stems medium, runners abundant. Plants moderately vigorous. Gives evidence of being productive.

TABLE I.—LIST OF STRAWBERRIES FRUITED IN ONE-YEAR-OLD BEDS, WITH A COMPARATIVE STATEMENT OF THE PERCENTAGE OF EARLY AND LATE YIELD OF EACH VARIETY.

Rank as to yield, 1896.	NAME OF VARIETY.	Yield of 33 sq. ft. in ounces.	Per cent. of crop picked before June 15.	Per cent. of crop picked after June 27.
1	Bissel	296	7	6
2	*See No.* 4	185	2	5
3	*Wilder No.* 7	178	0	24
4	Tubbs	154	27	0
5	William Belt	145	0	13
6	Canada Wilson	129	12	3
7	*Wilder No.* 5	121	20	0
8	Staples	103	52	0
8	Earliest	103	63	0
9	Margaret	100	0	7
9	*See No.* 5	100	14	2
10	*Thompson No.* 101	97	2	2
11	Enormous	96	7	6
12	Murray	80½	23	0
13	Beecher, H. W.	59	0	16
*	Columbian	....	....	....
*	Eleanor	....	....	....
*	Hersey	....	....	....
*	Maple Bank	....	....	....
*	Mary	....	....	....
*	Omega	....	....	....
*	Robinson	....	....	....
*	*See No.* 3	....	....	....
*	Thompson (Lady)	....	....	....
*	*Thompson No.* 100	....	....	....
*	Williams	....	....	....

* Only a few plants were received or else a part died so that a full row was not obtained.

EARLY VARIETIES.

Table I shows that five varieties yielded a fifth or more of their crop before June 15th; these may be called early for this season. These are arranged in Table II in the order of their productiveness.

TABLE II. EARLY VARIETIES RANKED ACCORDING TO YIELD BEFORE JUNE 15TH.

NAME.	Date of first Picking.	Yield before June 15, ounces.	Total yield. 1896.	Rank as to yield. 1896.
Earliest	June 6	65	103	9
Staples	June 6	54	103	9
Tubbs	June 8	41	154	5
Murray	June 6	18	80½	13

As is usual with very early varieties, Earliest does not take a high rank as to yield, yet where very early berries are desired, it is worthy of a trial. Its season is about the same as Michel, and in productiveness it ranks about the same as that variety. Staples takes the same rank as to yield, and, like Earliest, it produced over half of its fruit before June 15, which date is taken this year as the beginning of "mid-season." Tubbs is one of the promising new varieties, not quite as early as the two just mentioned, but more productive. Murray was not productive this season.

LATE VARIETIES.

June 27 is taken this year as the end of "mid-season." Those varieties that yielded a fifth or more of their crop after this date may be called late. Table I shows that of the berries fruited in one-year-old beds only the one variety, *Wilder No. 7*, can be classed in this list. This berry stands third in productiveness among the varieties that fruited here for the first time this season and yielded 44 ounces of its crop after June 27.

NOTES ON VARIETIES ON SPRING-SET TWO-YEAR-OLD BEDS.

In the notes on varieties that were fruited in spring-set two-year-old beds we have attempted to sum up the data collected during the two years' test, and give a brief statement of the value of the varieties as they appear to us on our soil. More complete descriptions may be found in Bulletin No. 91, or in the annual report of this Station for 1895.

Aldridge No. 25, S.—*From Slaymaker and Son, Dover, Del.* Fruit medium to large, scarlet color. Too unproductive in this locality to be of any value.

Annie Laurie, S. — *From M. Crawford, Cuyahoga Falls, O.* Fruit medium size, bright scarlet color. Unproductive.

Blonde, S. — *From G. Cowing, Muncie, Ind.* Fruit medium. to large, pale scarlet color. Moderately productive.

Bostonian, P. — *From B. F. Lincoln, West Hingham, Mass.* Blossoms with Sharpless. Attractive scarlet color, but soft and only fair in quality. Has been productive in both one and two-year-old beds. Worthy of further testing.

Brunette, S. — *From G. Cowing, Muncie, Ind.* Fruit medium. size, dark scarlet color. Moderately productive.

Charlie, P. — *From Cleveland Nursery Co., Rio Vista, Va.* Fruit medium size, good scarlet color, firm, moderately productive.

Dew Drop, S. — *From B. F. Smith, Lawrence, Kansas.* Fruit scarlet color, good quality. Has been only moderately productive here as yet.

Eicholtz Seedling, S. — *From the U. S. Division of Pomology, Washington.* Fruit medium to large, light scarlet color. Unproductive this season in a two-year-old bed.

Equinox, S. — *From Cleveland Nursery Co., Rio Vista, Va.* Fruit medium to large, unattractive. Only moderately productive this season in two-year-old beds.

Giant, S.— *From W. Y. Velie, Marlboro, N. Y.* Fruit large, light color, soft.

Iowa Beauty, S. — *From E. J. Hull, Olyphant, Pa.* Unproductive this season in a two-year-old bed. Fruit medium to large, dark scarlet color.

Jay Gould, P. — *From C. A. Green, Rochester, N. Y.* Unproductive this season the same as last. Fruit medium or below in size, good scarlet color.

Marshall, S. — *From L. J. Farmer, Pulaski, N. Y.* Foliage large, plants vigorous. Fruit averages large, good scarlet color, firm, very good quality. It has been only moderately productive on our soil, but it is thought to be worthy of extended trial for a mid-season market berry on account of its fine appearance and firmness. One of the best for home use.

Marston, P. — *From C. S. Pratt, Reading, Mass.* Fruit medium size, conic, good scarlet color. Retains its reputation of last year for being productive. Worthy of further testing on account of its earliness and productiveness.

Nan, S. — *From T. J. Dwyer, Cornwall, N. Y.* Fruit medium to large, good scarlet color. Unproductive this season in a two-year-old bed.

Ona, P. — *From E. J. Hull, Olyphant, Pa.* Fruit medium or above in size, good scarlet color. Only moderately productive this season in a bed fruited for the second time.

Orange County, P.—*From E. J. Hull, Olyphant, Pa.* Unproductive this season in a two-year-old bed. Fruit medium to large, light scarlet color.

Tennessee, S. — *From W. T. Wood and Co., Richmond, Va.* Fruit medium to large, bright scarlet color, attractive. It sustains its reputation of last season as being a productive variety. Will no doubt prove to be a valuable mid-season berry in many localities.

Young Seedling, **S.** — *From R. D. McGeehon, Atlantic, Iowa.* Fruit medium size, scarlet color. Unproductive this season in two-year-old bed.

TABLE III. LIST OF VARIETIES FRUITED IN SPRING-SET TWO-YEAR-OLD BEDS WITH A COMPARATIVE STATEMENT OF THE PERCENTAGE OF EARLY AND LATE YIELD OF EACH VARIETY.

Rank as to yield, 1896.	NAME OF VARIETY.	Yield of 33 sq. ft. in ounces.	Per cent. of crop picked before June 15.	Per cent. of crop picked after June 27.
1	Marston	266	24	1
2	Bostonian	260	2	19
3	Tennessee	236	8	2
4	Greenville	221	10	2
5	Hunn	207	0	88
6	Crescent	197	18	2
7	Beder Wood	188	31	1
8	Beauty	169	0	32
9	Equinox	167	0	45
10	*Townsend No.* 30	161	0	10
11	Blonde	159	0	20
12	Haverland	152½	35	3
13	Marshall	148	5	9
14	*Townsend No.* 20	146½	2	14
15	Charlie	144	8	6
16	Sharpless	137	9	5
17	*Haynes No.* 31	131	18	1
18	Brunette	129	0	8
19	Champion of England	119	3	8
20	Ona	117½	35	0
21	*Allen No.* 14	107	5	3
22	Giant	96½	0	59
23	Michel	91½	53	0
24	*Eicholtz Seedling*	86½	0	14
25	Orange County	79¼	11	5
26	*Young Seedling*	77	23	1
27	Jay Gould	76½	11	0
28	Iowa Beauty	70½	4	6
29	*Allen No.* 5	61	17	0
30	Sherman	59	20	3
31	Dew Drop	56	23	0
32	Nan	46	0	24
33	Annie Laurie	18½	0	11

EARLY VARIETIES.

Again observing June 15 as the beginning of mid-season, we find eight varieties that bore a fifth or more of their crop before that date, so they may be called early for this season.

TABLE IV. EARLY VARIETIES RANKED ACCORDING TO YIELD BEFORE JUNE 15, 1896.

NAME.	Date of first picking.	Yield before June 15, ounces.	Total yield, 1896.	Rank as to yield, 1896.
Marston	June 6	64	266	1
Beder Wood	June 6	59	188	7
Haverland	June 8	53	152½	12
Ona	June 8	41	117½	20
Michel	June 6	49	91½	23
Young Seedling	June 8	18	77	26
Dew Drop	June 8	13	58	31
Sherman	June 8	12	59	30

Marston was very satisfactory in 1895 when fruited in a one-year-old bed. This year it heads the list among the varieties in two-year-old beds in both productiveness and the amount of fruit produced early. Beder Wood is usually rather under size but can be relied on for a full crop. Haverland is of good size and medium early. Michel is one of the best of the very early berries.

LATE VARIETIES.

Table III shows that six varieties may be called late for this season, having produced a fifth or more of their crop after June 27. They are given below in Table V.

TABLE V. LATE VARIETIES RANKED ACCORDING TO YIELD AFTER JUNE 27.

NAME.	Date of last picking.	Yield after June 27, ounces.	Total yield, 1896.	Rank as to yield, 1896.
Hunn	July 21	182	207	5
Equinox	July 11	76	167	9
Giant	July 11	57	96½	22
Beauty	July 13	53	169	8
Blonde	July 7	32	159	11
Nan	July 7	11	46	32

Equinox, Giant, Blonde and Nan have not done as well on our soil as have some of the well known varieties. Beauty is an excellent berry for home use or for local market; it is medium early and moderately productive.

This season's test of the Hunn only serves to confirm our good opinion of this berry. Not only was it by far the latest berry fruited on the Station grounds, but it ranks fifth in productiveness among the varieties fruited in two-year-old beds. Its first fruit ripened on June 24 and the last berries were picked on July 21st, eight days later than any other variety. In order that we might learn how this variety would thrive in another locality and on different soil, plants of the Hunn together with Station seedling No. 208 were sent to Mr. W. D. Barns, of Middle Hope, N. Y., to be tested on his farm. Mr. Barns is a fruit grower of wide experience and in whose judgment we place implicit confidence. His report, which is self-explanatory, is appended:

"I will now report concerning the Hunn, and Station seedling No. 208 strawberries which were sent to us for testing.

"The plants, one thousand of each variety, were received in good order and set April 23d, 1895. They were put in a vineyard, the grape rows being ten and a half feet apart, and running nearly north and south. There was a low ridge extending across the plat from south-east to north-west, so that a part of each row had a southern and a part northern exposure. The soil is a sandy or gravelly loam, the top of the ridge being nearly clean slaty gravel.

"The runners of each variety started early in the season, and gave promise of large beds of well rooted plants. But the drought which commenced early in July and continued till late in the fall prevented most of the runners taking root, and weakened the plants of varieties so that the strawberry crop this season in the Hudson River valley was one of the lighest ever known. Doubtless the moisture absorbed by the grape roots aggravated the evil effects of the drought.

"On the same day that the plants from the Station were set, plants of Lady Thompson, Bubach and Sharpless were set in the same vineyard, adjoining the Station berries. None of the plants of these varieties resisted the drought as well as those from the Station. They neither made as many good plants nor produced as much fruit this season.

"Last spring thirty-five hundred plants of the Hunn were sent to the Station for distribution among applicants for them. About one thousand were taken for starting another field. This necessarily left the rows for fruiting very narrow.

"From the fact that the rows of No. 208 were so much wider than those of the Hunn, no plants having been taken from them, they should have yielded much more fruit. As it was the Hunn yielded one third more fruit. The first few pickings the fruit of No. 208 was nearly as large and firm as that of the Hunn, but of lighter color. The quality of each was excellent, some visitors giving the preference to one, and others to the other variety. After the first week No. 208 fell off in size and the berries were softer.

"On June 19th a sixteen-quart crate of each variety was shipped to a party in Gansevoort market, New York, and the same day a shipment was made to a firm in Washington street, near Washington market, New York. The former sold No. 208 at 15 cents per quart, and the Hunn at 18 cents. Good Sharpless berries were selling for 12 cents. He wrote, 'Both varieties were received in good order but this is not a good place to get fancy prices.' The down town firm sold No. 208 for 18 cents, and Hunn for 20 cents per quart. Concerning them they wrote: 'Both these varieties arrived in excellent order, but the Hunn is the better of the two, and a remarkable berry for which we predict a wonderful success, as it is superior to anything we have seen in color, shipping qualifications and delicacy of flavor.'

"The foliage of each variety is stronger, and seems to resist fungous diseases better than either Bubach, Sharpless or Lady Thompson.

"The following list will show the time of ripening of the several varieties:

NAME.	First ripe.	First shipment.	Last shipment.
Michel	May 20	May 23	June 10
Beder Wood	May 24	May 27	June 15
Bubach	May 31	June 4	June 24
Sharpless	June 3	June 6	June 24
Hunn	June 9	June 13	July 8
No. 208	June 9	June 13	July 6

"The Lady Thompson plants had been heated when received, and made such feeble growth that no record was made of their shipping qualities. This season they have made a fine growth and now promise well for next season's crop.

"From this season's experience we are led to consider the Hunn a most promising berry for late market. The No. 208 seems hardly worth introducing. Still, another season's test may be more favorable. It is remarkable for the number and perfection of its blossoms, as well as for the extreme length of time that it continues to put them out. This feature may render it extremely valuable for fertilizing late varieties that bear imperfect flowers. We have no Gandy on our place, but a neighbor, on ground considered a few days later than ours, commenced shipping them nearly a week before the Hunn was fit.

"All of which is respectfully submitted by

"Yours truly,

"W. D. BARNS & SON."

BEDS FRUITED FOR THE SECOND TIME BUT PLANTED IN THE FALL OF 1893.

In October of 1893 a few new varieties were received for testing. They were planted at once, together with a few of the standard berries, for comparing with them. Such large yields were obtained this season from some of these varieties, as compared with varieties that were set in the spring of 1894, that it has been thought best to treat the two lots separately.

In the following discussion an attempt has been made to sum up the data that have been collected during the seasons that the varieties have been under test on our grounds.

Aldridge No. 25, S.—*From Slaymaker & Son, Dover, Del.* Of no value for this locality.

Beder Wood, P.—This variety has been fruited here since 1891 and has been very satisfactory as a mid-season local market berry. The berries are of medium size, conical, good scarlet color, too soft to ship long distances; plants very productive and produce runners abundantly.

Bubach, P.—A standard variety in many localities. Berries large, irregular, light scarlet color, soft. Valuable for local market, but rather soft for shipping long distances.

Crosby, S.—*From P. Crosby, Clinton, Wis.* Fruit medium size, firm, good quality, only moderately productive. Not as good for this locality as other well-known varieties.

Crosby No. 10, S.—*From P. Crosby, Clinton, Wis.* Plants vigorous, producing runners freely. Fruit of medium size, good quality and firm, mid-season to late; ripens somewhat unevenly. More productive than Sharpless on our grounds.

Crosby No. 91, S.—*From P. Crosby, Clinton, Wis.* Fruit medium to large, good quality, firm; moderately productive. Not as good as other well-known varieties for this locality.

Feicht No. 2, S.—*From D. Feicht, Dayton, O.* Plants very vigorous, producing runners freely; fruit stalks stiff and of medium length. Fruit large, scarlet color, good quality, firm. Not as productive as other well-known sorts.

Feicht No. 3, P.—*From D. Feicht, Dayton, O.* The report of this Station for 1892 contains the following estimate of this variety: "Growth vigorous; foliage light green; leaves medium size on long, slim leaf stalks; fruit stalks long and stiff, but not strong enough to hold fruit from the ground. Makes a moderate number of runners; fruits cubical, large specimens coxcombed, average large, bright red; flesh white, firm; quality fine." This variety has fruited here every season since, and has proven to be quite satisfactory as a mid-season to late berry.

Gandy, S.—A standard late market berry in many localities, but it has never been very productive on our soil. During the time that this variety has been under test on our grounds it has been excelled by a number of kinds in both yield and the percentage of fruit produced late in the season.

Lovett, S.—Plants vigorous, runners abundant, moderately productive; berries medium to large, dark scarlet color, too soft to ship long distances. Of especial value as a fertilizer, as it produces an abundant supply of pollen, and has a long blossoming period.

Middlefield, P.— A well-known variety, one of the best for home use. A vigorous grower, producing many runners. Berries large, brilliantly colored, handsome; has been moderately productive on our grounds.

Phillips Seedling, S.—*From W. H. Phillips, Staunton, Ind.* Plants vigorous, producing large berries, firm and of good quality, moderately productive. Not as good as well-known sorts.

Princeton Chief, P.— *From F. W. Poscharsky and Son, Princeton, Ill.* The report of this Station for 1893 contains the following account of this berry: "Blosoms about with Manchester. Foliage good; runners abundant; stems long; fruit mid-season to late, medium size, moderately firm, good quality and of good color, although rather dark when fully ripe. Among the strawberries fruited at this Station for the first time in 1893, Princeton Chief ranks fifth in productiveness. It was much more productive on our soil that Bubach and will probably ship as well as that variety." Only moderately productive in a two-year-old bed, but on the whole has been quite satisfactory.

Sadie, P.—Berries average small, but of good color and quality, firm. Plants strong and healthy, productive. The size of the fruit is against it.

Sunny Side, P.—*From C. S. Pratt, Reading, Mass.* This variety has received favorable notice in former reports of this Station. The plants are vigorous and productive; the berries are medium to large, fair quality, moderately firm, attractive, mid-season. Should be better known.

Townsend No. 2, S.—*From T. T. Lyon, South Haven, Mich.* Fruit medium to large, dark scarlet color, good quality, moderately productive. Not as good as other well-known sorts for this locality.

Walton, P.—Not as good as well-known varieties for this locality. Fruit small and soft; moderately productive.

TABLE VI. LIST OF VARIETIES FRUITED IN TWO-YEAR-OLD BEDS, BUT SET IN THE FALL OF 1893, WITH A COMPARATIVE STATEMENT OF THE PERCENTAGE OF EARLY AND LATE YIELD OF EACH VARIETY.

Rank as to yield 1896.	NAME OF VARIETY.	Yield of 33 square feet in ounces.	Per cent. of crop picked before June 15.	Per cent. of crop picked after June 27
1	Sadie	331	11	6
2	Beder Wood	320	20	3
3	Lovett	299	12	2
4	Sunny Side	290	2	16
5	*Feicht No. 3*	286	0	31
6	*Phillips Seedling*	285	4	9
7	*Crosby No. 10*	223	1	9
8	*Feicht No. 2*	219	20	3
9	Sharpless	194	4	7
10	Walton	190	5	19
11	Waldron	176½	1	16
12	Middlefield	171	12	6
13	Bubach	146	9	10
14	Princeton Chief	145	0	39
15	*Crosby No. 91*	124	0	16
16	*Townsend No. 2*	110	0	45
17	Gandy	101	0	50
18	Crosby	83	0	10
19	*Aldridge No. 25*	50	46	00

EARLY VARIETIES.

By consulting Table VI, we find three varieties that bore a fifth or more of their crop before June 15 and so may be classed with the early berries.

Beder Wood has been mentioned on a previous page as a standard variety. *Feicht No. 2* has been moderately productive; the plants are strong and vigorous and the fruit is of good size and quality. *Aldridge No. 25* is worthless in this locality.

LATE VARIETIES.

Again turning to Table VI, four varieties are found that may be called late for this season.

TABLE VII. LATE VARIETIES RANKED ACCORDING TO YIELD AFTER JUNE 27.

NAME.	Date of last picking.	Yield after June 27, ounces.	Total yield, 1896.	Rank as to yield, 1896.
Feicht No. 3	July 9	89	286	5
Princeton Chief	July 9	57	145	14
Gandy	July 9	50	101	17
Townsend No. 2	July 9	49	110	16

Feicht No. 3 has been fairly productive, yielding nearly three times as much fruit this season as Gandy. Its season is somewhat longer than Gandy and it holds out to the end as well as does that variety. Princeton Chief is moderately productive. Gandy is one of the standard late berries. It has never been very productive on our soil. *Townsend No. 2* is no improvement on well known varieties.

SUMMARY.

While strawberries vary in their behavior in different localities, yet variety tests are not without value as the results obtained can usually be regarded as indications of what the varieties will do in other parts of the state.

Strawberries were fruited in one and two-year-old beds and contrary to the usual experience, some of the largest yields were obtained from beds that bore their second crop of fruit.

Of the varieties fruited for the first time this season the following are considered worthy of further testing: Bissel, Earliest, Enormous, Maple Bank, Omega, Robinson, *See No. 3*, *See No. 4*, *See No. 5*, Staples, *Thompson No. 101*, Tubbs and William Belt.

Among the varieties fruited in two-year-old beds and for the second time only, the following are considered to be worthy of further testing: Bostonian, Marshall, Marston and Tennessee.

Among the early berries the following may be mentioned as being worthy of testing: Earliest, Michel, Staples, Tubbs, Beder Wood and Marston.

Where very late berries are desired the varieties Hunn, Equinox, *Wilder No. 7*, *Feicht No. 3*, Princeton, Chief and Gandy are recommended for trial.

An attempt has been made to sum up the data that has accumulated at the Station concerning the varieties now in the Station collection that have fruited more than two years. More complete descriptions of these berries or of other kinds that are not now in the Station collection may be had by consulting former bulletins and reports of this Station.

List of strawberries growing on Station grounds in 1896:

Allen.
Allen No. 5.
Allen No. 14.
Allen No. 21.
America.
Annie Kennedy.
Annie Laurie.
Australian Everbearing.
Atlantic.
Beauty.
Beder Wood
Beecher, H. W.
Bissel.
Blonde.
Bostonian.
Brunette.
Bryant.
Bubach.
Canada Wilson.
Carrie.
Champion of England.
Charlie.
Columbian.
Crescent.
Dew Drop.
Earliest.
Edith.
Eicholtz Seedling.
Eleanor.
Enormous.
Equinox.
Fragaria Virginiana.
Ganargua.
Gandy.
Gardner.
Gertrude.
Giant.
Glen Mary.
Greenville.
Hadsell Seedling.
Haverland.
Hayes Prolific.
Haynes No. 31.
Henry.
Hersey.
Hull No. 3.
Ideal.
Iowa Beauty.
Ivins.
Jay Gould.
Johnson Late.
Lovett.
Maida.
Maple Bank.
Margaret.
Marshall.
Marston.
Mary.
Mexican Everbearing.
Michel.
Michigan.
Middlefield.
Murray.
Nan.
Omega.
Ona.
Orange County.
Oriole.

Oswego Queen.
Paris King.
Parker Earle
Plow City.
Premium.
Pride of Cumberland.
Princeton Chief.
Quality.
Robinson.
Scofield Seedling.
See No. 3.
See No. 4.
See No. 5
Sharpless.
Sherman.
Slaymaker No. 1.
Slaymaker No. 5.
Slaymaker No. 8.
Slaymaker No. 9.
Slaymaker No. 10.
Slaymaker No. 12
Slaymaker No. 25.
Sparta.
Staples.
Stayman No. 8.
Sunny Side.
Sunrise.
Tennessee Prolific.
Thompson.
Thompson No. 100.
Thompson No. 101.
Townsend No. 2.
Townsend No. 20.
Townsend No. 30.
Tubbs.
Vera.
Vicountess
Weston.
White Novelty.
Wilder No. 5.
Wilder No. 7.
William Belt.
Williams.
Wilson.
Young Seedling.

II. THINNING FRUIT.

S. A. BEACH.

Investigations begun in 1896 to determine the practical value of systematic thinning of fruit on orchard trees, and to illustrate principles pertaining to the production of fruit. Present extent of the practice in New York State. Thinning plums. Thinning apples.

A series of experiments in thinning fruit was undertaken by the Station Horticulturist in 1896 to get more definite information concerning the comparative merits of different ways of thinning fruit as shown by the size, appearance and quality of the fruit which is left to ripen and by the vigor and productiveness of the trees in succeeding years. It is expected that the work will be of value in setting forth more clearly some of the principles of fruit growing which may be applied in detail in various practical ways. An intelligent grasp of the principles which have something to do with the production of fruit is really worth more to the fruit grower than a mere knowledge of rules of practice and trade secrets, because when he understands the fundamental principles on which the secrets and rules of practice which are really worth anything depend, he can more intelligently vary practical operations to suit the different conditions which may arise.

In this state the practice of thinning fruit has not generally become established among fruit growers, with the exception that peaches are usually thinned by those who grow this fruit extensively. Thinning apricots is practiced by the most successful growers in this state. Plums, especially large and showy kinds or those which are liable to have the trees injured by overbearing, are sometimes thinned; the same may be said of grapes and pears. So far as I know, no one in this state makes a practice of thinning cherries, quinces or crab apples. Sometimes attempts are made to change the bearing yield of apples by close thinning or by taking off the entire crop. Mr. J. B. Collamer, Hilton, N. Y., has practiced thinning the Twenty Ounce for the past few years with good results; other instances are occasionally found where thinning apples is practiced, but they are not at all common.

It is to be expected that thinning fruit will give the best results where the trees are in good condition and well cared for. In seeking orchards where the proposed experiments in thinning fruit may be carried on the object has been to select trees in good bearing condition, well fed, well pruned and generally well cared for. The plan is to continue the experiments with the same trees year after year till satisfactory information is secured on the points which are under observation.

Thinning Plums.

A portion of an orchard at North Hector, belonging to Mr. Frank Smith, of Auburn, N. Y., was engaged for the experiment in thinning plums in 1896. The varieties selected were Lombard, Guii and Bavay's Green Gage. The trees were all thinned alike during the early part of the season, and July 3 and 4 a portion of the trees of each variety was further thinned, so that the fruits were at least three inches apart. The fruit at the time was half grown. The results showed that thinning so late in the season, in this case, had comparatively little effect on the size of the remaining fruit. It is proposed to continue the work with plums, and try various other methods of thinning.

Thinning Apples.

Experiments in thinning apples were begun in 1896 in an orchard of Thomas B. Wilson, Hall's Corners, Ontario county, N. Y. The sixteen trees which are under experiment are of three varieties, namely, Baldwin, Hubbardston and Rhode Island Greening. The two Hubbardston trees are about forty years old; the others are twenty-five. Trees of the same variety, as nearly alike in all respects as could be found, were paired for comparison, one of each pair being thinned, the other left unthinned. Three ways of thinning are being tried.

First. All wormy, knotty or otherwise inferior fruit is removed and all clusters thinned to one fruit.

Second. Same as first, and in addition, the rest of the fruit is thinned so that none of it is less than four inches apart.

Third. Same as first, and in addition the rest of the fruit is thinned so that none of it is less than six inches apart.

The thinning was done from June 25 to June 27, the largest apples at that time being about an inch and a half in diameter. The results of the first season's work are set forth below.

First Method. Two Baldwin trees, heavily loaded with fruit, were selected for this test. The fruit on one tree was thinned by taking off all knotty, wormy or otherwise inferior fruit, and all clusters were thinned to one fruit. It took four hours to do the thinning and four for picking, making altogether eight hours. It took five hours to pick the tree that was not thinned. The marketable fruit graded as follows:

FIRST METHOD—YIELD PER TREE.

	Per cent. No. 1.	Per cent. No. 2.	Total bushels marketable.
Thinned	70.3	29.7	27.75
Not thinned	60.5	39 5	32.25

From this we see that while the tree which had its fruit thinned gave 16 per cent. less fruit than the unthinned tree, 10 per cent. more of it ranked No. 1, so that it really yielded as many bushels of No. 1 fruit as did the unthinned tree, without carrying so heavy a burden of inferior fruit. There were about three times as many culls where the fruit was not thinned as there were where it was thinned. The thinned fruit was higher colored and more attractive in appearance than that from the trees which were not thinned.

Much better results followed the second method, as will now be shown.

Second Method. Six Baldwin and six Rhode Island Greening trees were selected for this experiment. Three of each kind were thinned, the others were not. All inferior fruit was taken out and the rest of the apples thinned to at least four inches apart. The following statement shows the average yield of marketable fruit per tree and the per cent. of it which graded No. 1 or No. 2, as the case may be.

SECOND METHOD—AVERAGE YIELD PER TREE.

	Per cent. No. 1.	Per cent. No. 2.	Bushels marketable.
Baldwin:			
Thinned	80.7	19.3	20.7
Not thinned	59.	41.	26.1
R. I. Greening:			
Thinned	88.	12.	16.7
Not thinned	78.5	21.5	15.8

With this method Baldwin thinned gave 26 per cent. less marketable fruit, but 22 per cent. more of it graded No. 1 than did the fruit from the unthinned Baldwin. The unthinned trees gave about three times as many culls as did the thinned trees. That is to say, although the unthinned trees carried over a fourth more fruit they actually yielded one and one-quarter bushels less No. 1 fruit per tree than did the thinned trees. With the thinned Greenings even a larger proportion of the marketable fruit graded No. 1, and they actually yielded two and one-third bushels more No. 1 fruit than did the unthinned Greenings. These results are interesting because they show that the total amount of marketable fruit per tree was larger where the Greenings were thinned than it was where they were not thinned. The Greenings were so heavily loaded with fruit the previous year that it was necessary to prop the branches so that in 1896 they set only a fairly good crop and did not need thinning nearly so much as did the Baldwins, which were overburdened with fruit. The consequence was that the Greening fruit was very fine and especially so where it had been thinned.

Third Method. Two Hubbardston trees were selected for the third test; one was thinned, the other was not. Besides removing all inferior fruit it was thinned so that the apples were at least six inches apart. The marketable fruit graded as follows:

THIRD METHOD—YIELD PER TREE.

	Per cent. No. 1.	Per cent. No. 2.	Bushels marketable.
Thinned	71.4	28.6	21.
Not thinned	54.3	45.7	26.3

The thinned tree gave 25 per cent. less marketable fruit, but about 17 per cent. more of it graded No. 1 than did the fruit from the unthinned tree. The unthinned tree gave about three times as many culls as did the thinned tree. The superior color of the thinned fruit was especially noticeable in this experiment. After the fruit had been picked and piled under the trees, the pile of thinned fruit could be distinguished from a distance by its higher color.

In all these tests the drops were fewer and considerably better where the fruit was thinned, and all grades of the fruit were higher colored and clearly superior to fruit of the same grade from the unthinned trees. The first grade included no apples less than two and a-half inches in diameter. The proportion of apples in the No. 2 grade, which measured almost two and a-half inches, was a great deal larger where the fruit was thinned, so that the No. 2 grade from trees which had been thinned was much superior to the No. 2 grade of the unthinned trees. Mr. Wilson estimates that the fruit from the trees which were thinned would generally bring 10 per cent. to 15 per cent. more in market than the same grade from the trees which were not thinned.

The thinning and picking of the fruit where the trees were thinned took about twice as much time as was required for picking the fruit where no thinning was done. Probably less time than this would usually be required, because the Baldwins had a very heavy crop and required a good deal of thinning, and for the sake of more accurate results in the experiments the thinning was done more thoroughly and more carefully than would be the case in ordinary practice.

According to these results the second method of thinning is enough superior to the first to more than pay for the extra work involved.

From the data now at hand the second and third methods cannot well be compared. It is also too early to say much about the effect which the thinning may have had on the development of fruit buds for next season's crop.

In view of the fact that the markets were so glutted with apples from the crop of 1896 that in many instances the prices which the growers realized did not cover the cost of packages and the labor of picking, packing and handling the fruit, the question arises whether it would not have been good economy to have decreased the total yield of marketable apples one-fourth by thinning the fruit in June. The experiments which have just been discussed show that this might have been done so as to decrease the yield of seconds and culls, yet increase the total amount of No. 1 fruit, making the fruit altogether of a better grade. With the markets relieved of a great amount of inferior fruit better prices could reasonably be expected and the remaining fruit superior in appearance would have strengthened the good reputation of New York apples in both home and foreign markets. The overburdened trees relieved of an excessive crop in such a favorable season as 1896 might be expected to provide the extra nourishment necessary to the production of fruit buds for the following season.

III. PLUM LEAF SPOT.

S. A. BEACH.

POPULAR ACCOUNT OF AN EFFORT TO CONTROL PLUM LEAF-SPOT.

May be controlled by spraying with Bordeaux Mixture.— Plan of investigations of 1895-6.— Course of treatment recommended.— Black knot and fruit rot checked somewhat by this treatment.

The leaves of plum trees are liable to injury from what is commonly known as the "leaf spot" or "shot hole" disease. It will be explained more fully later that this disease is caused by a fungus* which attacks all kinds of cultivated plums, including native and Japanese sorts, and also cherries and some other kinds of stone fruits. In years past it has caused considerable injury and sometimes serious loss in the plum and cherry orchards of this state. The disease as it appears on cherry leaves is illustrated in plate XXIX.

Investigations which have been made at experiment stations within recent years have shown that it may be prevented by thorough spraying with Bordeaux mixture,† and the results of these experiments are abundantly confirmed by the practical experience of many fruit growers.

Plan of Experiments in 1895.

In recent years, in one of the extensive plum orchards of T. C. Maxwell & Bros., of Geneva, eau celeste soap mixture has been used with very good results for checking the spread of the

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* *Cylindrosporium Padi*, Karsten.

† Thaxter, Rowland. Rep. Conn. Sta. 1889: 176, 1890: 102.

Green, W. J. The Shot-hole Fungus of the Plum. Bull. Ohio Exp. Sta 1891. II, 4: 216.

Fairchild, D. G. Plum Leaf Blight. Bull. U. S. Div. Veg. Path. 1894, 6: 39-40. Jour. Myc 7: 253-256 pl. 2., Rep. N. Y. State Exp. Sta. 1892, 11: 659-663. Treatment of Plum Leaf Blight in Nursery. Bull. U. S. Div. Veg. Path. 1892, 3: 63-64.

Beach, S. A. Preventing Leaf Blight of Plum and Cherry Nursery Stock. Rep. N. Y. State Exp. Sta. 1893: 688-693. Bull. N. Y. State Exp. Sta. 72.

leaf-spot late in summer.* For this reason it seemed desirable to compare the Bordeaux mixture with the eau celeste soap mixture as a remedy for this disease. Previous comparisons of these two fungicides have usually resulted in favor of the Bordeaux mixture when considered with reference either to its effectiveness against the spread of fungi or to its effect on the health of foliage. Were eau celeste as good a fungicide as Bordeaux mixture it would be more desirable because it contains no heavy sediment, does not need to be agitated and is easier to apply than is Bordeaux mixture.

In 1895 a comparison of these two mixtures was made by the Station Horticulturist to see which is preferable for fighting the leaf-spot. Two other questions pertaining to the treatment of the leaf-spot were also investigated, namely:

What is the least number of sprayings by which this disease may be kept under control?

At what time should these sprayings be made in order to do the most good?

An account of these investigations was published in Bulletin 98, a portion of which is included in this report.

PLAN OF EXPERIMENTS IN 1896.

In 1896 the investigations as to the least number of sprayings that are desirable and the best time for making them was con-

* The following is the history of the use of eau celeste in the plum orchard above referred to as given by the manager, Mr. C. K. Scoon:

In the summer of 1892 the foliage began dropping from a block of Bavay's Green Gage to an alarming extent. The trees had been sprayed twice in the spring with Bordeaux mixture although not so thoroughly as they should have been. At the suggestion of Mr. D. G. Fairchild an eau celeste soap mixture was tried to see if it would check the trouble. Three applications were made, at intervals of about ten days, beginning the last of July and extending into August. The immediate result was that the spread of the disease seemed to be checked. The most marked result was apparent in the fall, when the untreated trees dropped nearly all of their foliage before the fruit was picked while the sprayed trees retained their leaves till late in the season. The following winter was quite severe on plums and many trees were injured. Those trees which had been sprayed and held their leaves late in the fall were injured less than those trees which were not sprayed and which lost their leaves earlier

In 1893 the trees were sprayed in the spring with Bordeaux mixture more thoroughly than they had been in the previous year. Two applications of the eau celeste were made, one the latter part of July the other in August. The contrast between the treated and untreated trees was not so great as in the previous year, as the untreated trees held their foliage well, but in the fall it was noticed that the treated trees held their foliage longer than the untreated.

In 1894 a block of Italian Prune was given treatment similar to that which the Bavay's Green Gage received in 1893 and with similar results.

tinued, but the comparison of the Bordeaux mixture with the eau celeste soap mixture was dropped, for the results obtained in 1895 showed clearly that the eau celeste is inferior at least for treatments that are given before mid-summer. Neither in 1895 nor in 1896 did the leaf-spot show enough injury before the last of August to permit of a comparison of the Bordeaux mixture with the eau celeste for August treatment.

The courses of treatment with Bordeaux mixture before midsummer which were tried in 1896 resulted in marked benefit, especially to Italian Prune, and to a large extent confirmed the results of the work in 1895.

STRENGTH OF BORDEAUX MIXTURE USED.

In these experiments a comparatively weak Bordeaux mixture was used, namely, the 1 to 11 formula, for it had previously been shown that the plum leaf-spot may be controlled by using the mixture at this strength.* This formula again proved satisfactory, and it is confidently recommended for use in treating the leaf-spot. In view of these investigations the following line of treatment is advocated for bearing orchards:

COURSE OF TREATMENT RECOMMENDED FOR PLUM LEAF-SPOT.

Apply Bordeaux mixture, 1 to 11 formula, as follows:

1. About May 25 or within ten days after the blossoms have fallen.
2. About June 15 or three weeks after the first treatment.
3. About four weeks after the second treatment.

Spraying before the blossoms open to prevent leaf-spot has not proved superior to the course of treatment above given.

If only two treatments can be given let them be made about May 25 and June 17, but better results will usually follow the three treatments above recommended.

We have not yet seen the leaf-spot become serious in August after a course of treatment like that just recommended. Should

* Green, W. J. Bull. Ohio Exp. Sta. 1891: 216. Beach. S. A. Rep. N. Y. State Exp. Sta. 1893: 688–693.

it do so it would probably be best to apply eau celeste mixture, because it would be less apt to spot the fruit than would the Bordeaux mixture. This is suggested for trial but not positively recommended, as we have not yet had an opportunity to compare the two mixtures for August treatment.

Remember that thorough spraying is essential to success. This has been advocated over and over again in former bulletins and reports of this Station, and yet probably nine-tenths of the readers who have undertaken to spray their orchards fail to secure the best results because the work is not done thoroughly. It is not necessary to drench the trees, but the aim should be to completely cover every leaf with fine mist-like particles of the spray. To do this it is necessary to have a powerful pump and good nozzles. For a more complete discussion of spraying apparatus and methods of spraying, the reader is referred to Bulletin 74 or the 1894 annual report of this Station.

A remarkable instance of the practical benefits of protecting the foliage of bearing plum trees from the attacks of fungous diseases is seen in the case of the Italian Prune trees which were treated in 1896, as explained on subsequent pages. In this instance the treatment resulted in an average increase per tree of twenty-four and one-half pounds of marketable fruit at an estimated cost of less than one cent per pound.

BORDEAUX MIXTURE AS A PREVENTIVE OF BLACK KNOT AND FRUIT ROT.

The treatment of plum trees with Bordeaux mixture for leaf-spot appeared in Dr. Thaxter's experiments to check the plum black knot, as it did also in a later experiment by Lodeman.*

In treating peaches for the fungus which causes the ripe rot of the fruit and the blight of the blossoms, Chester† has found that four sprayings with Bordeaux mixture, 1 to 7½ formula, reduced the rot to about one-third of what it was on unsprayed trees. He found that with two sprayings there was about twice as much

* Lodeman, E. G. Spraying for black-knot upon cherries and plums. Garden and Forest, 7 508.

† Chester, F. D. Bull. Del. Station 29; 11.

rot as with four sprayings, and that four sprayings gave about as good results as did six sprayings. Two of the four sprayings were made before the blossoms opened; the third was made two weeks after the date of full bloom and the fourth was made twelve days after the third.

The same fungus which causes the fruit rot of peaches also causes the ripe rot of plums and in some instances attacks the blossoms, giving them a blighted appearance. Figure 7 illustrates the appearance of fruit attacked by the fruit rot fungus. It is gratifying to learn that Bordeaux mixture checks to some extent the spread of this disease, although as Dr. Thaxter has observed in the citation given above, it is not always effective in preventing its ravages.

From these observations we conclude that the treatment which has been advocated above as a preventive of plum leaf-spot may also be expected to show some beneficial results in lessening the prevalence of fruit rot and black knot in the treated orchards. Nevertheless, it is not expected that spraying will ever do away with the necessity of cutting off and burning the knots to prevent the spread of plum black knot, and it will still be advisable to remove and burn or bury the rotted and mummified fruit before the blossoms open the following spring for the purpose of checking the spread of the fruit rot fungus. In case there is reason to fear an attack of the fruit rot fungus on the blossoms spray thoroughly with Bordeaux mixture before the blossoms open, and follow with the line of treatment advocated above for leaf-spot.

NATURE OF THE PLUM LEAF-SPOT. EXPERIMENTS IN TREATING IT.

Appearance of the disease. Its destructive character. Details of experiments in controlling it. Work of 1895. Work of 1896. Course of treatment now recommended. Remarkable increase in yield of Italian Prune as a result of the spraying.

On the preceding pages are given the objects of the experiments in treating the plum leaf-spot disease which were tried in 1895 and 1896, and a line of treatment is recommended for orchards which is based on the results of those experiments. The reader who cares to follow the subject further will find on the following pages an account of the nature and appearance of the disease and a somewhat detailed statement of the plans of the experiments and the results which they brought forth.

It has already been stated that the plum leaf-spot is due to a fungus, *Cylindrosporium Padi*, Karsten, which attacks all kinds of cultivated plums, including the native and Japanese sorts; also cherries and some other kinds of stone fruits. It is quite widely distributed in Europe and America.

APPEARANCE.

In the plum orchard it makes its appearance soon after the first leaves are full grown. The leaves begin to show little discolored spots, at first about a sixteenth of an inch in diameter, with margins often tinged with purple or red. As the disease progresses the spots enlarge till they are an eighth of an inch or more across. Larger spots may be formed by the coalescing of several small ones. The spots soon become dark brown with a pale center. The tissues wither, and frequently breaking away from the healthy portion of the leaf which surrounds them, they drop out and leave circular holes in the leaf, as illustrated in plate XXIX, which is reproduced from a photograph of diseased leaves. The holes thus formed are often as clean cut and clearly defined as though they had been made with shot, and on account of this characteristic the disease is sometimes called the shot-hole disease. Inasmuch as another disease which attacks apricots, almonds and other stone fruits is popularly known, especially in California, as the shot-hole disease, it is better to designate the trouble which we are discussing as the leaf-spot disease of plum and cherry. The holes which are formed in the leaves by this disease are not always circular in form, but when several spots coalesce into one, or when the disease finds extremely favorable conditions for rapid development, large patches, irregular in shape, may drop from the leaf, giving the foliage a ragged or worm-eaten appearance.

INJURIOUS EFFECTS.

The infested leaves frequently turn yellow and drop prematurely, so that it is not uncommon in August to see a large proportion of the new growth leafless, or in case of very severe attacks the tree may lose nearly all of its foliage before September. Without the help of the foliage it is unable to properly ripen its wood, and in such instances, especially when it has borne a heavy crop of fruit, it goes into the winter in an enfeebled condition and is liable to be severely injured or even killed by the winter. The leaves may begin to drop to a considerable extent as early as July, but usually the loss from dropping is not serious before August or September.

The disease frequently checks the growth of plum and cherry nursery stock so much that it is difficult to bud them in August. It also interferes with the growth of the budded trees. See Annual Report of this Station, 1893, 688-693.

The nature of the leaf-spot is such that the disease may pass unnoticed or attract little attention unless it causes the leaves to drop badly. Should the loss of foliage not exceed five or ten per cent, a person unacquainted with the disease would be apt to think that the few leaves which dropped from time to time did so as a result of natural process of ripening rather than because they were attacked by the leaf-spot fungus, and failing to realize the danger of serious loss from this trouble he would take no precautions to prevent the progress of the disease.

Many fruit-growers do not realize as they should how essential healthy foliage is to the vigor, longevity and productiveness of trees. It is too often the case that a loss of five or ten per cent. of the foliage causes little anxiety, yet this means a loss of five or ten per cent. in the productive power of the tree. It is in the leaves, or other green portions of the plant, that the compounds are formed which are used to sustain life, to support new growth of wood, foliage or fruit, and to develop the fruit buds for another crop. The roots gather crude food materials from the soil, other material is supplied by air, and then with the help of sun-heat and sunlight, in the green portions of the plant, these are formed into starch, sugar or other compounds which the plant may either appropriate for immediate needs or store away for future use. The leaves may properly be called the food factory of the tree. Is it not wisdom to protect this factory, so far as practicable, from all attacks of insects or diseases, that it may do its work perfectly, and so enable the tree to yield an abundance of fruit of the highest possible excellence?

Experiments of 1895.

Objects.—The objects of the experiments of 1895 in preventing plum leaf-blight were to learn:

(1) The comparative value of Bordeaux mixture and eau celeste soap mixture for this purpose;

(2) What is the fewest number of treatments necessary for controlling this disease;

(3) When is the best time for making the treatments.

Messrs. T. C. Maxwell & Bros. kindly offered one of their plum orchards, near Geneva, N. Y., for the use of the Station in these experiments, and it is a pleasure to acknowledge their coöperation and uniform courtesy.

Plan of Experiments.—A block of 567 trees was selected for this purpose. The varieties included in this block were Italian Prune, Guii, Lombard, Purple Egg and Bavay's Green Gage, familiarly known here as *Reine Claude.* One-third of the trees of each variety were treated with Bordeaux mixture, as explained hereafter, one-third were similarly treated with eau celeste soap mixture and one-third were left untreated for comparison.

The experiments were planned so that with each of these varieties the trees that were sprayed with the Bordeaux mixture may be compared with others of the same variety that were sprayed with the eau celeste, and also with others of the same variety that were left unsprayed. The accompanying plan shows the location of the varieties with respect to each other and indicates the treatment of each section.

This plan included three series of treatments arranged so that early and later treatments might be compared with each other.

Series	Treatment.		Bavay Green Gage. 1 2 3	Purple Egg. 4 5 6 7	Lombard. 8 9 10 11	Guii. 12 13 14 15	Italian Prune. 16 17 18 19 20 21
SERIES I.	Section 1. Eau celeste soap mixture. May 1, May 17 and June 1.	1	. . .	. . . .	. . . .	. . . .	. . . . . .
		2	. . .	. . . .	. . . .	. . . .	. . . . . .
		3	. . .	. . . .	. . . .	. . . .	. . . . . .
	Section 2. Bordeaux mixture. May 1, May 17 and June 1.	4	. . .	. . . .	. . . .	. . . .	. . . . . .
			. . .	. . . .	. . . .	. . . .	. . . . . .
		6	. . .	. . . .	. . . .	. . . .	. . . . . .
	Section 3. No treatment.	7	. . .	. . . .	. . . .	. . . .	. . . . . .
			. . .	. . . .	. . . .	. . . .	. . . . . .
		9	. . .	. . . .	. . . .	. . . .	. . . . . .
SERIES II.	Section 4. Eau celeste soap mixture. May 17, June 1 and June 15.	10	. . .	. . . .	. . . .	. . . .	. . . . . .
		1	. . .	. . . .	. . . .	. . . .	. . . . . .
		12	. . .	. . . .	. . . .	. . . .	. . . . . .
	Section 5. Bordeaux mixture. May 17, June 1 and June 15.	13	. . .	. . . .	. . . .	. . . .	. . . . . .
		14	. . .	. . . .	. . . .	. . . .	. . . . . .
		15	. . .	. . . .	. . . .	. . . .	. . . . . .
	Section 6. No treatment.	16	. . .	. . . .	. . . .	. . . .	. . . .
		17	. . .	. . . .	. . . .	. . . .	. . . . . .
		18	. . .	. . . .	. . . .	. . . .	. . . . .
SERIES III.	Section 7. Eau celeste soap mixture. June 15 and to trees 19, 20 and 21 of row 1 only, July 16.	19	. . .	. . . .	. . . .	. . . .	.
		20	. . .	. . . .	. . . .	. . . .	. . . . . .
		21	. . .	. . . .	. . . .	. . . .	. . . . . .
	Section 8. Bordeaux mixture. June 15 and July 16.	22	. . .	. . . .	. . . .	. . . .	. . . . . .
		23	. . .	. . . .	. . . .	. . . .	. . . . . .
		24	. . .	. . . .	. . . .	. . . .	. . . . . .
	Section 9. No treatment.	25	. . .	. . . .	. . . .	. . . .	. . . . . .
		26	. . .	. . . .	. . . .	. . . .	. . . . . .
		27	. . .	. . . .	. . . .	. . . .	. . . . . .

PLATE XXV.

UNSPRAYED PLUM TREES DEFOLIATED BY LEAF-SPOT.

PLATE XXVI.

Italian Prune (unsprayed).

PLATE XXVII.

ITALIAN PRUNES TREATED WITH BORDEAUX MIXTURE.

PLATE XXVIII.

Italian Prune Sprayed with Eau Celeste.

Series 1 consisted of three sprayings. The first spraying was made May 1, when the buds were breaking; the second was made May 17, just after blossoming, and the third was made **June 1.**

Series 2, consisting also of three sprayings, was begun May 17, just after blossoming; the second spraying was made June 1, and the third, June 15.

Series 3. It was proposed to make three sprayings in the third series, one about June 15, the second about July 15 and the third about August 15. The first spraying was made June 15, using Bordeaux mixture and eau celeste according to the original plan. The second was made July 16 with the Bordeaux mixture, but on account of the injury which had followed the use of the eau celeste soap mixture it was applied at this time to three trees of the Bavay's Green Gage only. The proposed third spraying was not given either with Bordeaux mixture or with the eau celeste soap mixture, on account of the generally healthy condition of the foliage in mid-summer.

Formulæ.—The *eau celeste soap mixture* which was used in these experiments was made according to the formula followed by Mr. Scoon in previous years. One pound of copper sulphate was dissolved in water and diluted to about forty gallons. A quart of 26° ammonia was then added and a pound of whale-oil soap dissolved in water. The whole mixture was then diluted to fifty gallons. This formula calls for an excess of ammonia.

The *Bordeaux mixture* was made by dissolving one pound of copper sulphate in about eight gallons of water. Fresh slaked lime was then diluted with water and added in excess of the amount called for by the potassium ferro-cyanide test. The whole mixture was then diluted to eleven gallons.

Results.—The leaf-spot disease was not so abundant in this orchard in 1895 as it had been in some previous years, so that with some of the varieties the effects of the treatment were not so pronounced as they undoubtedly would have been had the disease been more prevalent. The Italian Prunes suffered most, and so the experiments with this variety are selected to show the comparative merits of the different treatments. Plate XXV, reproduced from a photograph made September 28, 1895, shows in the foreground an unsprayed Guii tree, still holding a considerable amount of its foliage. Immediately behind it, in the same row, are seen some unsprayed Italian Prune trees which are nearly leafless. This picture illustrates well the general difference between unsprayed trees of these two varieties on that date. The leafless condition of unsprayed Italian Prunes is still better shown in plate XXVI, which is also reproduced from a photograph taken September 28, 1895. These trees had gradually lost their foliage from the attacks of the leaf-spot disease. A very careful estimate of the injury or loss of foliage from all causes, which was made September 28, gave the following results:

Series 1. Treated May 1, May 17 and June 1	Bordeaux mixture	24 per cent. injury or loss
	Eau celeste soap mixture	66 per cent. injury or loss
	No treatment	95 per cent. injury or loss
Series 2. Treated May 17, June 1 and June 15.	Bordeaux mixture	10 per cent. injury or loss
	Eau celeste soap mixture	73 per cent. injury or loss
	No treatment	78 per cent. injury or loss

It appears from this table that much better results were secured with the Bordeaux mixture than with the eau celeste soap mixture. This is well illustrated by comparing plate XXVII with plates XXVI and XXVIII. Plate XXVII is from a photograph of Italian Prunes which were included in Series 2, and sprayed with Bordeaux mixture May 17, June 1 and June 15. Plate XXVIII is from a photograph of corresponding Italian Prunes which were sprayed on the same dates with the eau celeste soap mixture. Plate XXVI is from a photograph of corresponding Italian Prune trees which were not sprayed at all. All photographs were taken September 28, 1895.

BEST TIME FOR TREATMENT.

As before stated, one of the objects of the investigations in 1895 was to discover the fewest number of treatments that will be necessary for controlling the disease and the best time for making the applications. The results of the treatment with Bordeaux mixture, according to the plan previously explained, throw some light on these questions.

It will be remembered that three series of treatments were made. In Series 1 the first spraying was given May 17, when the buds were breaking; the second was given just after the trees had gone out of blossom; the third was given June 1. In Series 2 the first spraying was made May 17, the second was made June 1 and the third was made June 15. In Series 3 the first treatment was made June 15, the second was made July 16. The estimate of the amount of loss or injury to the foliage from all causes, which was made September 28, gave the following results:

Series 1. Treated May 1, May 17 and June 1.	Bordeaux mixture	24 per cent. injury or loss
	No treatment	95 per cent. injury or loss
Series 2. Treated May 17, June 1 and June 15.	Bordeaux mixture	10 per cent. injury or loss
	No treatment	78 per cent. injury or loss
Series 3. Treated June 15 and July 16.	Bordeaux mixture	41 per cent. injury or loss
	No treatment	96 per cent. injury or loss

Judging from these results it is not best to make the first treatment later than the first of June. Arthur* has shown that the leaf-spot fungus lives over winter in the infested leaves, and that the spores of the mature form of the fungus begin to ripen about the first of June. In the above experiments the best results were secured when the foliage was covered with Bordeaux mixture before the time when these spores are said to ripen, that is to say, before June 1. This confirms the results secured by Thaxter.†

* Arthur, J. C. Plum Leaf Fungus. Rep. N. Y. State Exp. Sta. 1887. 6: 347-350. f. 2.

† Thaxter, Roland. Rep. Conn. Sta. 1889: 176. 1890: 102.

Dr. Thaxter reports an experiment in 1889 in which two Lombard trees were sprayed with Bordeaux mixture, 1-3⅔ formula, May 22, June 14 and July 16. A third tree was left unsprayed for comparison. The two sprayed trees held their foliage intact up to severe frost in October, showed hardly any black-knot and matured a fair amount of fruit. The untreated tree was leafless in August, matured no fruit and was badly infested with black-knot "The mixture did not adhere to the fruit to any extent, which may account for the fact that the fruit rot was not more effectually controlled."

In 1890 similar application was made to several large plum trees, thereby preserving their foliage intact. In another place Bordeaux mixture was applied to plums and cherries with similar results while a few untreated trees lost their foliage in July.

EXPERIMENTS OF 1896.

Objects.—The experiments in 1896 were a continuation in part of the work of 1895; the objects were to learn:

(1) What is the fewest number of treatments necessary for controlling plum leaf-spot;

(2) When is the best time for making the treatment.

The comparison of Bordeaux mixture with eau celeste soap mixture was not continued in 1896 because the work of 1895 clearly showed the inferiority of the eau celeste, at least for treatments that are given before mid-summer. Neither in 1895 nor in 1896 did the leaf-spot do enough injury before the last of August to permit of a satisfactory test of August treatment.

Through the kindness of T. C. Maxwell & Bros., a block of trees adjacent to those which were used in the experiments of 1895 was used for these experiments. The block contained 168 trees, 72 Italian Prune, 48 Guii and 48 Lombard.

Plan of Experiments.—Four series of treatments were given in 1896.

Series 1. Sprayed Italian Prune, Guii and Lombard May 14, June 3 and June 17.

Series 2. Sprayed Italian Prune, Guii and Lombard May 25 and June 24.

Series 3. Sprayed Italian Prune and Lombard May 25, June 17 and July 14.

Series 4. Sprayed Guii May 25 and June 17.

In all cases Bordeaux mixture was used. It was made according to the 1 to 11 formula, as described on p. 393. The accompanying plan shows the relative position of sprayed and unsprayed trees of the different series. The numbers of the rows correspond to those of the block of trees which was used in the 1895 experiments, see page 392.

In the accompanying plan the letter "o" indicates the location of untreated trees and the letter "s" indicates the location of the sprayed trees.

		Lombard.				Guii.				Italian Prune.					
		8	9	10	11	12	13	14	15	16	17	18	19	20	21
Series 1	25	o	s	s	s	s	s	s	o	o	o	s	s	s	s
	26	o	s	s	s	s	s	s	o	o	o	s	s	s	s
	27	o	s	s	s	s	s	s	o	o	o	s	s	s	s
	28	o	s	s	s	s	s	s	o	o	o	s	s	s	s
Series 2	29	o	s	s	s	s	s	s	o	o	o	s	s	s	s
	30	o	s	s	s	s	s	s	o	o	o	s	s	s	s
	31	o	s	s	s	s	s	s	o	o	o	s	s	s	s
	32	o	s	s	s	s	s	s	o	o	o	s	s	s	s
Series 3	33	o	s	s	s	s	s	s	o	o	o	s	s	s	s
Italian Prune and Lombard.	34	o	s	s	s	s	s	s	o	o	o	s	s	s	s
Series 4	35	o	s	s	s	s	s	s	o	o	o	s	s	s	s
Guii.	36	o	s	s	s	s	s	s	o	o	o	s	s	s	s

The first treatment of the season was given to Series 1 May 14, soon after the blossoms had fallen.

In Series 3 Italian Prune and Lombard were sprayed as late as July 14. It was thought safe to do this for they are medium late varieties, but Guii, see Series 4, was not sprayed as late as this because it is an early variety and this treatment would come too near the time when it ripens its fruit.

Results.—Through the early part of the season the unsprayed trees showed but little of the leaf-spot, but as the season advanced the effects of the disease became more noticeable, especially on Italian Prune. The treated trees of this variety showed slightly more injury in Series 2 than in either Series 1 or 3, but in all three series they were far superior to the untreated trees. As early as August 12 the ground under many of the unsprayed Italian Prune trees was thickly strewn with fallen leaves, and in consequence of this loss of foliage the fruit was ripening prematurely and dropping. The unsprayed Guii trees at this time showed some loss of foliage, but the unsprayed Lombards were in nearly as good condition as the sprayed trees.

A careful estimate of the amount of loss or injury of foliage of the trees under experiment was made October 3, from which the following summary is derived:

	Amount of Injury.		
	Italian Prune.	Lombard.	Guii.
Series 1. Treated May 14, June 3 and June 17	1% to 5%. Average about 3% ...	About 10% ..	About 6%
Not treated.................	50% to 90%	About 10%..	About 15%
Series 2. Treated May 25 and June 24...............	Average about 6%.	About 3% ...	About 10%
Not treated.................	50% to 90%	About 25%..	About 15%
Series 3. Treated May 25, June 17 and July 14.......	Average about 2%.	About 5%...	....
Not treated.................	50% to 90%	About 10% ..	....
Series 4. Treated May 25, and June 17...............	....	....	About 3%
Not treated.................	....	....	About 15%

It was shown in the investigations of 1895 that the first treatment should be made before the first of June, see p. 395.

The effort to control the disease with two treatments would probably have been more successful in 1895 had the first treatment been given before June 1 instead of waiting until June 15.

In trying to control the disease by two treatments in 1896, see Series 2 and Series 4, it appears that on the whole this plan is not as effective as where three treatments were given, yet excellent results were secured. In seasons when the general condition of the foliage is as good as it was in 1895 and 1896 it would hardly pay to make three sprayings for the leaf-spot in commercial orchards, but till the plan of making but two treatments has stood the test of a season when the leaf-spot is unusually abundant, it is hardly safe to recommend it as sufficient for all seasons.

In view of the results of the investigations of 1895-6, the following line of treatment is confidently recommended instead of that which was suggested on page 14 of Bulletin 98.

Course of treatment recommended for plum leaf-spot.—When but two treatments are to be made during the season, let the first be given about May 25, or about ten days after the trees have gone out of bloom, and let the second be given about three weeks later. Better results may be expected from the following course of treatment, which is the one now recommended by this Station:

1. First treatment about May 25, or about ten days after the blossoms have fallen.

2. Second treatment about June 15, or three weeks after the first.

3. Third treatment about four weeks after the second.

A comparison of the different series of treatments which were made in 1895, see page 395, shows that when only three treatments are given it is better to make the first treatment after, rather than before, the blossoms open.

YIELD OF FRUIT INCREASED BY SPRAYING FOR THE PLUM LEAF-SPOT.

Aside from the results bearing directly on the questions under investigation in 1895 and 1896, the experiments in treating plums for the leaf-spot brought out some very important and definite information as to the influence of such treatment on the yield of trees which are subject to the attacks of this disease. It has already been said that the injury from the leaf-spot was especially severe on the Italian Prune, sometimes called Fellemburg, a variety which usually begins to ripen here the first week of September. Of the trees of Italian Prune which were under experiment in 1896, see page 397, 48 were sprayed and 24 were left unsprayed. As early as August 12 the ground under many of the unsprayed trees was thickly strewn with fallen leaves, and consequently the fruit was ripening and dropping prematurely, while under the sprayed trees but very little fallen leaves or fruit was to be seen. The amount of fallen leaves and fruit was so much greater under the unsprayed trees that by looking at the ground under them one could easily tell which trees had not been sprayed.

Because the treated trees held their foliage much better, their fruit ripened later, and on the whole averaged larger than the fruit on the unsprayed trees. Remembering that the later fruit as a rule brings better prices, it is at once apparent that the increased yield does not in this case fully represent the increase in receipts from sprayed as compared with unsprayed trees. The following is a statement of the picked fruit, drops and waste from these trees and the date of picking. The yield is measured both by 9-pound baskets and by pounds, except for the waste.

YIELD OF PLUMS FROM SPRAYED AND UNSPRAYED TREES.

48 *Sprayed Trees.*

DATE.	Grade.	Baskets.	Pounds.	Average pounds per basket.
September 1	Picked	369	3,374	9.14
September 24	Picked	48	436	9.08
	Drops	17	181	10.65
	Waste	......	110	......
24 *Unsprayed Trees.*				
August 25	Picked	104	897	8.63
September 12	Picked	36	427	11.86
	Drops	12	84	7.00
	Waste	......	290	......

The amount and character of the average yield per tree is as follows:

AVERAGE YIELD PER TREE.

	SPRAYED.			NOT SPRAYED.		
	Baskets	Pounds.	Per cent.	Baskets.	Pounds.	Per cent.
Picked fruit	8.69	79.38	93	5.83	55.17	78
Drops	0.35	3.77	4	0.50	3.50	5
Waste	....	2.29	3	....	12.08	17
Total marketable	9.04	83.15	97	6.33	58.67	83

From these records it appears that where the trees were sprayed, the average yield per tree of picked fruit was increased 44 per cent., the marketable drops increased 8 per cent. and the waste decreased 81 per cent. The total yield of marketable

PLATE XXIX.

CHERRY LEAF-SPOT. (*Cylindrosporium Padi*, KARSTEN).

fruit as recorded in pounds was 45 per cent. greater where the trees were sprayed than where they were not sprayed.

The extra cost of picking, packing and hauling to market would be, in this case, 13 cents. With the apparatus used by Messrs. Maxwell & Bros. the cost of spraying would be 8 cents per tree, counting the applications which were actually made, *i. e.*, two applications for sixteen trees and three applications for thirty-two trees. Thus the extra expense of securing and putting on the market an increased yield per tree of 24.48 pounds of fruit was only 21 cents. So it appears that spraying for leaf-spot in this instance secured an average increase of 24½ pounds of marketable fruit per tree at a cost of less than one cent per pound.

IV. PREVENTION OF FUNGOUS DISEASES IN CHERRY ORCHARDS.

S. A. BEACH.

Leaf-spot.— Fruit rot.— Object of spraying.— Tests of 1895.— Fruit rot checked.— Foliage injured.— Tests of 1896.— Foliage not injured.— Spray mixture shows on the ripened fruit.— No definite line of treatment as yet adopted.

Leaf-Spot.

The fungus which causes the leaf-spot on plum also does great damage to the foliage of cherry trees in nursery and in orchard. It frequently happens that cherry nursery stock loses so much of its foliage from the leaf-spot that the growth of the trees is checked and budding operations are seriously interfered with. In the orchard the loss of foliage, as has already been explained in speaking of the plum leaf-spot, lessens the power of producing good fruit, of forming fruit buds for the next season and of properly ripening the new growth before winter. The disease makes its first appearance and afterwards develops in a manner quite similar to that described for plums, see page 389. Plate XXIX, from a photograph, illustrates the appearance of this disease on cherry leaves.

Cherry nursery stock was treated for the leaf-spot at this Station in 1891 and 1892 by Fairchild. He concludes that* it may be stated conservatively that Bordeaux mixture, 1 to 10 formula, is a specific for this disease, and that it is undoubtedly superior to the ammonical solution of copper carbonate for this purpose.

The treatment of cherry trees of bearing age is reported in two or three instances, although in each case but few trees ap

* Fairchild, D. G. Cherry Leaf Blight, Bull. U. S. Div. Veg. Pathology 6: 38–39. Report of this Station, 1892, II: 654–659, pl. 2.

pear to have received treatment. Thaxter reports* that by the use of Bordeaux mixture, 1 to 32 formula, some cherry trees were protected from the leaf-spot in 1890, while corresponding trees which were not so treated lost their foliage in July. The time of the applications and their number is not definitely stated.

FRUIT ROT.

Craig † reports that in 1894 a much weaker Bordeaux mixture than that used by Thaxter, namely, a 1 to 12 formula, was used against the fruit rot with good results. A Yellow Spanish tree sprayed May 1 with Bordeaux mixture and three times afterwards with the same mixture, combined with Paris green, yielded 90 pounds of sound fruit, while a corresponding untreated tree yielded but 30 pounds. Also, in another orchard, a tree was sprayed May 10, May 26 and June 4 with Bordeaux mixture and Paris green, using one ounce of Paris green and one pound of copper sulphate for each twelve gallons of the mixture. July 4 it was sprayed with ammonical solution of copper carbonate. This tree yielded 130 pounds of fruit, while the corresponding unsprayed tree yielded but 17 pounds.

OBJECTS OF TREATMENT.

In spraying cherries it is desirable to prevent the leaf-spot, the fruit rot, the mildew of the leaves, and the attacks of the curculio, an insect which causes wormy cherries. Some experiments with cherries, similar to those with plums described on page 391, were planned in 1895, to determine if possible the comparative values of Bordeaux mixture and eau celeste soap mixture as preventives of the fungous troubles just named, but no attempt was made in these experiments to prevent the attacks of the curculio.

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* Thaxter, Roland. Rep. Conn. Sta. 1890: 102.

† Craig, John. Report Horticulturist, Canada Dept. Agr. 1894: 112.

EXPERIMENTS OF 1895.

Messrs. W. D. Barns & Son, Middle Hope, N. Y., kindly offered their orchard for the purpose of the experiments and cordially coöperated in the work. The details of the work were under the immediate supervision of Mr. Paddock, the Assistant Horticulturist of this Station.

One hundred and fourteen trees were set apart for the experiments. They include three varieties, namely: Reine Hortense, Early Richmond and Montmorency. Some of each variety were left untreated for the sake of comparing them with treated trees, some were sprayed with Bordeaux mixture and some with the eau celeste soap mixture.

Three series of treatments were planned. The treatments of the first series were made May 1, May 14 and May 29. The treatments of the second series were made May 14, May 29 and June 15. The first and only treatment of the third series was made June 15. The buds were well expanded May 1, when the first treatment was made, and the blossoms opened about four days later. May 10, just after the blossoms had fallen, the second spraying was made.

A careful examination of the trees June 15 showed that up to this time very little leaf-spot was present either on sprayed or on unsprayed trees. The foliage on trees which had received the eau celeste treatment was somewhat spotted, but this was probably largely due to the injurious effects of the spray. The untreated foliage and that treated with Bordeaux mixture appeared at this time to be perfectly healthy.

Two weeks later, June 28, Mr. Barns reported that the trees in series I, which had received the Bordeaux mixture treatment, showed a little injury to the leaves, while worse injury was seen on eau celeste treated trees of series II. The trees in series III, which had received but one treatment with eau celeste, already showed some injury to the leaves. On this account spraying was discontinued, so that series III did not receive treatment July 15 and August 15, as was first planned.

Fruit rot checked.—So far as the fruit rot is concerned rather encouraging results were obtained, although comparatively few of the trees fruited, and even on unsprayed trees the rot was not generally abundant. A careful estimate made when the fruit was picked showed some advantage from the treatment. Especially in one group of trees the amount of rotted fruit was slight while on unsprayed trees of the same variety which stood near, from one-twentieth to one-fifth of the fruit rotted. In preventing the rot, the eau celeste seemed to be as effective as the Bordeaux mixture, but generally it injured the foliage much more than Bordeaux mixture did.

Foliage injured by spraying.—The results of the treatment for the leaf-spot in 1895 were not very encouraging, because so much of the foliage was injured by the spray. The last spraying was made June 15, and from that time till the close of the season the unsprayed trees were, generally speaking, in better condition than were the trees which had been sprayed.

As a rule the leaves were hurt much less by the Bordeaux mixture than by the eau celeste. We were much surprised to find an exception to this in the Reine Hortense of series I, where the leaves were hurt much more by the Bordeaux mixture than they were by the eau celeste.

EXPERIMENTS OF 1896.

Because the experiments in 1895 did not give conclusive evidence on the points under investigation, the work was continued the following year. Mr. C. K. Scoon, of Geneva, N. Y., kindly offered his orchard for the use of the Station for this work. In view of the injury to the foliage which followed the use of the Bordeaux mixture in 1895 it was decided to compare heavy and light applications of this mixture in 1896 to see whether heavy applications were more apt to do injury than light applications of a mixture having the same strength. Further investigations as to the best time to do the spraying and the least number of treatments needed were also planned. One hundred and fifty-five trees were included in the experiments; part of them were English Morello and the rest were Montmorency Ordinaire. The only fungicide tried was the Bordeaux mixture of the 1 to 11 formula.

The season was not favorable for the development of the leaf-spot, so that the foliage generally kept in healthy condition throughout the season of 1896, and but little difference was seen between the foliage of the sprayed trees and that of trees which were not sprayed. In October a few of the sprayed trees showed more yellow and fallen leaves than did sprayed trees which stood near by, but the difference was not sufficient to support any conclusions as to the comparative merits of the different methods of treatment.

Foliage not injured by spraying.—Contrary to the experience of 1895, the sprayed foliage in 1896 showed no injury from spraying. The injury which followed the spraying with Bordeaux mixture in 1895 appears to be exceptional. It is difficult to find any theory which offers a satisfactory explanation for it. The tree which was literally drenched with the spray in 1896, to see whether heavy spraying would result in injury to the leaves, showed no bad results from the heavy spraying, but held its foliage in good condition throughout the season.

Fruit spotted by the spray.—In these experiments the first treatment was given May 14 soon after the blossoms had fallen. The following treatment was given May 25 in one trial, May 29 in another and June 3 in another. In all cases when the fruit ripened it showed spots of Bordeaux mixture as a result of the second spraying, although quite a good deal of rain fell during nearly two months which elapsed from May 25 till the fruit ripened.

SUMMARY.

The results of these attempts to control the leaf-spot and other fungous diseases on bearing cherry trees by spraying with Bordeaux mixture and eau celeste are summarized below.

(1) On orchard trees of Montmorency sprayed with Bordeaux mixture May 14, May 29 and June 15, 1895, only a slight amount

of rot was found, while on adjacent trees of the same variety which were not sprayed, from one-twentieth to one-fifth of the fruit rotted.

(2) On orchard trees of Montmorency sprayed June 15, 1895, with eau celeste soap mixture, only a slight amount of rot was found, while on adjacent unsprayed trees from one-twentieth to one-fifth of the fruit rotted.

(3) From the middle of June, 1895, till the close of the season, the unsprayed trees had much more and better foliage than did the trees which had been sprayed.

(4) Generally the injury to the leaves in 1895 was much greater on the trees which were sprayed with eau celeste than it was on the trees sprayed with Bordeaux mixture, but on one group of Reine Hortense the Bordeaux mixture caused the greater injury.

(5) No injury to the leaves resulted from spraying orchard trees with Bordeaux mixture in 1896, even when the trees were drenched with it.

(6) Bordeaux mixture applied as late as May 25 is liable to show on the fruit when it is ripe and injure its appearance.

(7) The results of these tests do not give conclusive evidence as to the best line of treatment for the leaf-spot on bearing cherry trees, so no definite line of treatment is as yet recommended.

V. REPORT ON INJURY TO FRUIT TREES DURING THE WINTER OF 1895–6.

S. A. BEACH AND C. P. CLOSE.

The winter of 1895-96 caused an unusual loss to New York fruit-growers by the winter-killing of fruit buds and fruit trees. It was especially destructive in those regions where the less hardy kinds of fruit, such as plums, quinces, sweet cherries, peaches and apricots are grown in commercial orchards. At the Geneva Experiment Station the fruit buds of apricots, peaches and some of the more tender plums were killed by the cold weather of January 6 and 7, 1896. The cold of February 17 and 18 was even more severe, the mercury falling as low as 21° below zero. This killed the fruit buds of sweet cherries, and, with rare exceptions, those of the European and Japanese plums which had escaped the previous cold snap uninjured. Pears were injured to some extent in wood as well as in fruit buds. Native plums and sour cherries were about the only stone fruits which carried fruit buds uninjured through the winter and bore a crop of fruit the following summer. Soon it became known that similar injury to fruit trees had been experienced generally throughout the state. As this condition appeared to afford an excellent opportunity for studying the comparative hardiness of the different varieties of fruit which are cultivated in New York State, the Station Horticulturist undertook to collect information in this line by instituting correspondence with local observers in every part of the state.

Letters were addressed to every supervisor in the state, except those in cities, asking each one to name some good observer for his town who would report to the Station the names of the varieties of fruit which were grown in the town either for home use or for market, and the amount of winter injury sustained by them. Circular letters were addressed to the names of correspondents which were thus obtained, one in April and another in June, asking for reports from their localities. The supervisors and the correspondents whom they named showed commendable interest in the work, and the Station is under special obligations to them for the information which they have kindly furnished. Nearly 700 names of correspondents were furnished to the Station, and 442, or nearly two-thirds of them responded to the inquiries, an exceptionally large number for correspondence of this kind. The following statement shows the localities from which replies were received:

Albany	5	Ontario	11
Allegany	19	Orange	10
Broome	8	Orleans	5
Cattaraugus	8	Oswego	11
Cayuga	15	Otsego	16
Chautauqua	21	Putnam	1
Chemung	8	Queens	2
Chenango	13	Rensselaer	9
Clinton	4	Rockland	2
Columbia	6	St. Lawrence	7
Cortland	6	Saratoga	9
Delaware	7	Schenectady	1
Dutchess	5	Schoharie	6
Erie	10	Schuyler	4
Essex	6	Seneca	9
Franklin	7	Steuben	16
Fulton	4	Suffolk	6
Genesee	9	Sullivan	3
Greene	5	Tioga	5
Hamilton	4	Tompkins	5
Herkimer	6	Ulster	6
Jefferson	9	Warren	4
Lewis	8	Washington	5
Livingston	6	Wayne	8
Madison	8	Westchester	6
Monroe	15	Wyoming	7
Montgomery	5	Yates	7
Niagara	7		
Oneida	15	Total	442
Onondaga	12		

It appears from this statement that the plan to secure correspondents from every portion of the state was in a large measure successful. As the publication of the entire correspondence would make this report too long, an attempt has been made to present in the following pages a summary of the information which was furnished by the Station's correspondents. We are glad to avail ourselves of this opportunity to thank these correspondents for their kind coöperation in carrying out the plan of the inquiry.

That different sections of the state may be more readily compared with reference to the reports which have come from them, several groups of counties will be considered separately.

These sections have been set apart with the idea of combining, so far as possible, the reports from regions which have a general similarity of fruit interests or which offer somewhat similar conditions for fruit culture. It is manifestly impossible to do this except in a general way, for each of the sections comprises a large territory, exhibiting great diversity of soil and considerable differences in the range of temperature and moisture in soil and air. On account of nearness to large bodies of water, or because they do not have a great elevation above the sea, many places furnish especially favorable conditions for fruit culture. Possibly other places but a few miles distant, at a greater elevation or further removed from the modifying influence of bodies of water, may be much less favorably located for fruit culture.

In the various localities of each section there are also found a great variety of soils and sub-soils, and a great diversity in the combinations of soil and climatic conditions exists, so that places which are but a few miles distant from each other may differ widely in their adaptability to fruit growing. These things should be kept in mind in considering the summarized reports which are given on the following pages.

DESCRIPTION OF SECTIONS.

The different sections may be described as follows:

Section I.—Northern New York.—The region north of Rensselaer county, the Mohawk river to Rome and a line passing from

SECTION I. Northern New York.
II. Eastern New York.
III. East Central New York.
IV. West Central New York.
V. Shore Counties of the Great Lakes.
VI. Southern New York.
VII. Southeastern New York.

Rome through Pulaski to Lake Ontario. This includes the western part of the Lake Champlain valley, the northern part of the Mohawk valley, the northeastern shore of Lake Ontario and the southern part of the valley of the St. Lawrence river so far as it is included in New York State. Portions of the Champlain and St. Lawrence valleys have gained a reputation for producing apples of high color and excellent flavor. Certain varieties, notably the Fameuse, seem to do better there than they do in most other sections of the state. It will be remembered that region contains the Adirondack wilderness, and it is not surprising that reports from many of its interior localities show that comparatively little attention is given to the cultivation of fruit. In such places wild small fruits and seedling apples or crab apples are depended on chiefly for home-grown fruit. One locality in Hamilton county reports that the thermometer dropped as low as 48° below zero. Seven other places reported lowest temperatures varying from 40° to 46° below zero, and the average of the forty-eight reports on lowest temperature which were received from the northern New York section is nearly 33° below zero (— 32.9°).

Section II.—Eastern New York.—The region extending southward from the Mohawk river, from Rome to the Hudson, and from the south line of Washington county to the Fishkill mountains, occupying the lower part of the Mohawk valley and the middle section of the Hudson valley. It extends eastward to Massachusetts and westward into the Catskills. It includes the counties of Schenectady, Albany, Rensselaer, Columbia, Greene and Ulster.

This section contains the famous plum-growing districts of the Hudson valley, and produces large quantities of fruit of various kinds. In the more favored portions of this territory pears, sweet cherries, peaches and plums are grown in perfection. The lowest temperature reported from this region is 32° below zero, which occurred in the northwestern part of Rensselaer county. The average of seventeen reports on lowest temperature is 21° below zero.

Section III.—East Central New York.—The country east of the central New York lake region and north of the southern tier of counties extending to the northern and eastern groups of counties as named under sections I and II. It includes the counties of Montgomery, Schoharie, Otsego, those portions of Herkimer and Oneida south of the Mohawk river, Madison, Chenango and Cortland. The reports indicate that no peaches are grown in this section, except where a few are grown for home use in some of the more favored localities. Fifty-five reports on lowest temperature give an average of 29¼° below zero. In three places the thermometer fell to 40° below zero.

Section IV.—West Central New York.—The region extending from the west line of Cortland and Madison counties westward to Erie county, and lying between the southern tier of counties and the counties which border Lake Ontario. It includes the central New York lake region, and is composed of the following counties: Onondaga, Cayuga south of the Seneca river, Tompkins, Schuyler, Seneca, Ontario, Yates, northern Steuben, Livingston, Wyoming and Genesee. In many parts of this section peaches are grown on a commercial scale; probably the largest apricot orchard east of the Rocky mountains is found in this section; some very large orchards of plums, cherries, quinces and other orchard fruits are found; grapes are grown extensively, as are also the small fruits. On the higher lands, remote from the modifying influences of the lakes, the climate is more severe, and the more tender fruits, such as peaches and apricots, are grown but little if at all. The lowest temperature reported from this region was 38° below zero. This occurred in Onondaga county. Fifty-five reports on lowest temperature gave an average of 23½° below zero.

Section V.—Counties Bordering Lakes Erie and Ontario.—This includes the following counties: Northern Chautauqua, Erie, Niagara, Orleans, Monroe, Wayne, Cayuga north of Seneca river, and Oswego south of the Salmon river. In this region are found the celebrated Chautauqua grape belt which borders the shore of Lake Erie, and the peach districts of Niagara and adjacent counties, the raspberry districts of Wayne county, and the strawberry districts of Oswego county. Apples and other orchard fruits are grown extensively, as are also various small fruits. The lowest temperature reported from this section was 32° below zero, which was recorded in two towns in Oswego county. The average of forty-one reports is 20 2-5° below zero.

Section VI.—Southern New York.—The southern tier of counties from the west line of the state eastward to and including Delaware and Sullivan counties. It contains the counties of Sullivan, Delaware, Broome, Tioga, Chemung, Steuben south of Bath and Hornellsville, Allegany, Cattaraugus and Chautauqua south of the lake shore towns. In this section fruit growing is not as important an industry as it is in the Hudson valley and the central lake and great lake regions, where the altitude above the sea is considerably less and where the climate is modified by adjacent bodies of water. According to the reports received, peaches are not grown to any extent either for market or for home use. Forty-two reports on lowest temperature give an average of $22\frac{1}{7}$° below zero. The lowest temperature reported is 36° below zero, which occurred at Andover, Allegany county.

Section VII.—Southeastern New York.—The region south of the Fishkill mountains, including Long Island and Staten Island and the counties of Orange, Rockland, Dutchess, Putnam and Westchester. Peaches are grown for market to a considerable extent in many localities of this section. Very fine apples and pears are produced, as well as grapes and small fruits. The lowest temperature reported is 24° below zero. This occurred in the town of Woodhull, on Long island. Twenty-four reports give an average lowest temperature of $13\frac{1}{8}$° below zero.

It is quite a difficult task to condense the information furnished in the reports of our many correspondents so as to give in a few words a satisfactory summary that may be used as a basis for estimating the adaptability of any particular variety to different sections of the state, or for comparing different varieties with each other. An attempt to do this has been made in the following pages, but it is not expected that strict comparisons can be safely made from the reports which are here presented.

Each kind of fruit will now be considered separately, and reports of the same kind of fruit from the various sections of the state, as already explained, will be set side by side for comparison.

APPLES.

Northern New York.—Of the fifty-eight kinds mentioned by correspondents from northern New York, the following were named most frequently:

VARIETY.	TIMES MENTIONED.			PER CENT. OF WINTER INJURY REPORTED.		
	Home use.	Market.	Total reports.	Least.	Greatest.	Average of all reports.
Baldwin	7	18	21	0	50	7
Ben Davis	5	21	24	0	75	13
Fameuse	10	17	23	0	20	2
Northern Spy	9	21	28	0	50	9
Oldenburg	13	16	26	0	100	14
Red Astrachan	11	15	23	0	75	11
Rhode Island Greening	16	21	31	0	75	13
Talman Sweet	15	11	25	0	100	15
Tompkins King	4	8	10	0	75	11
Wealthy	6	7	12	0	75	9
Yellow Transparent	8	3	10	0	50	9

Other varieties which are mentioned favorably for this section are McIntosh, St. Lawrence, Stone (sometimes erroneously called Bethel), and a new kind, a seedling of Stone, called Oel Austin.

Eastern New York.—Of the thirty-three kinds mentioned in the reports from this section, the following were named most frequently:

Variety.	Times Mentioned.			Per Cent. of Winter Injury.		
	Home.	Market.	Total.	Least.	Highest.	Average of all reports.
Baldwin	3	18	19	0	20	2
Ben Davis	1	7	7	....	....	....
Esopus Spitzenburg	0	7	7	....	....	....
Fall Pippin	2	3	5	....	....	....
Hubbardston	0	6	6	0	50	8
Northern Spy	3	15	16	....	....	....
Rhode Island Greening	3	16	17	0	35	3

Three reports mention injury to Baldwin; one 5 per cent and two 20 per cent. One report mentions an injury to Early Harvest of 35 per cent.; one speaks of Hubbardston as injured 50 per cent.; one of Lady Sweet as injured 20 per cent.; one of Vandervere as injured 30 per cent., and one of Winter Pippin as injured 25 per cent. No injury to other varieties was reported. In addition to the kinds already named, the following were mentioned: Alexander, Blush Pippin, Fameuse, Golden Russet, Gravenstein, Green Newtown Pippin, Grimes Golden, Jonathan, Maiden Blush, McIntosh, Oldenburg, Oat Harvest, Pomeroy, Porter, Red Canada, Swaar, Sweet Bough, Talman Sweet, Twenty Ounce, Wagener, Wealthy, Wilson Sweet, Yellow Bellflower and York Pippin.

East Central New York.—Fifty-nine varieties were reported on by correspondents from this section. Those which were most often mentioned are:

Variety.	Times Reported.			Per Cent. of Winter Injury Reported.		
	Home use.	Market.	Total.	Least.	Greatest.	Average of all reports.
Baldwin	9	32	33	0	90	14
Ben Davis	2	8	10	0	100	13
Esopus Spitzenburg	5	12	14	0	90	16
Fameuse	5	5	9	0	25	4
Northern Spy	11	34	35	0	80	13
Pound Sweet	8	7	11	0	90	31
Red Astrachan	11	9	17	0	90	11
R. I. Greening	8	32	35	0	90	16
Talman Sweet	6	7	12	0	40	10
Tompkins King	9	22	25	0	80	16
Twenty Ounce	4	6	9	0	90	23

The other varieties were reported on from once to six times, and but little idea of the comparative hardiness can be derived from so few reports.

West Central New York.—Forty-two varieties were reported on by correspondents from this section. Those most frequently mentioned were:

VARIETY.	TIMES MENTIONED.			PER CENT. OF WINTER INJURY.		
	Home.	Market.	Total.	Least.	Greatest.	Average of all reports.
Baldwin	10	44	47	0	20	0.4
Ben Davis	2	8	8	0	0	0
Esopus Spitzenburg	3	9	10	0	0	0
Northern Spy	5	29	29	0	0	0
Pound Sweet	3	6	8	0	0	0
Roxbury Russet	3	8	10	0	0	0
R. I. Greening	8	40	42	0	50	1.9
Sweet Bough	7	4	9	0	0	0
Talman Sweet	5	12	12	0	0	0
Tompkins King	7	23	26	0	0	0
Twenty Ounce	2	10	10	0	0	0

The other varieties were named from once to six times. From so few reports but little idea of their comparative hardiness can be formed. But three localities in this section report that apple trees were injured. The correspondent from Fleming, Cayuga county, estimates that Baldwins were injured 20 per cent there; from Covert, Seneca county, Rhode Island Greenings were reported as injured 25 per cent, and from Tyre, Seneca county, they were reported as injured 50 per cent.

Great Lake Region.—Reports from the country bordering on Lakes Erie and Ontario mention fifty kinds of apples grown for home use and market. Baldwin was reported as injured 5 per cent. at Cato and Ira, Cayuga county, and 25 per cent. at Schroeppel, Oswego county. Esopus Spitzenburg was reported as injured at Volney, Oswego county, 2 per cent., and at New Haven, Oswego county, 10 per cent. Hubbardstons, in the latter town, were injured 10 per cent. The only reports of injury in this region to Northern Spy came from Oswego county, where the injury was estimated at 4 per cent. in Volney and at 50 per cent. in Schroeppel and New Haven. Rhode Island Greening was reported as injured 10 per cent. in Cato and Ira, Cayuga county; and in Oswego county, 2 per cent. in Volney, from 10 to 50 per cent. in New Haven and 50 per cent. in Schroeppel. With these exceptions no injury to apples was reported from the Lake Shore region. The varieties named most frequently in the reports from this section are Baldwin, Ben Davis, Esopus Spitzenburg, Hubbardston, Northern Spy, Oldenburg, Red Astrachan, Roxbury Russet, Rhode Island Greening, Talman Sweet and Twenty Ounce.

Southern New York.—Of the fifty-two varieties named in the reports from this section, nearly half were credited by one or more towns with winter injury. The rest were mentioned by so few correspondents that but little idea can be formed of their comparative hardiness throughout this section. The following kinds were reported from seven or more towns:

VARIETY.	TIMES MENTIONED.			PER CENT. OF WINTER INJURY.		
	Home	arket.	Total.	Least.	Greatest.	Average.
Baldwin	15	31	37	0	25	3
Early Harvest	12	3	13	0	25	5
Esopus Spitzenburg	7	6	10	0	10	2
Fall Pippin	8	5	9	0	65	13
Golden Sweet	7	2	7	0	0	0
Maiden Blush	6	1	7	0	50	7.14
Northern Spy	17	27	33	0	25	3
Red Astrachan	8	9	14	0	10	0.71
Roxbury Russet	4	5	7	0	0	0
Rhode Island Greening	14	30	35	0	25	3
Seek-no-further	7	7	11	0	25	3
Sweet Bough	7	5	11	0	50	5
Talman Sweet	8	11	17	0	60	6
Tompkins King	12	17	24	0	75	12
Twenty Ounce	7	7	11	0	75	11
Wagener	3	7	8	0	20	5
Varieties in general	17	13	25	0	50	4

Southeastern New York.—Reports from this section mention fifty-seven varieties, and in but few localities was any winter injury to any of them noticed. The following is a list of those which were reported from five or more towns:

VARIETY.	TIMES MENTIONED.			PER CENT. OF WINTER INJURY.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Baldwin	5	21	23	0	10	1
Ben Davis	2	5	7	0	0	0
Fall Pippin	2	8	10	....	....	....
Gravenstein	4	4	6	....	....	....
Green Newtown Pippin	2	4	5	0	35	7
Hubbardston	3	4	6	0	75	15
Northern Spy	2	13	15	0	35	2
R. I. Greening	6	20	23	0	50	3
Roxbury Russet	3	4	6	....	....	....
Talman Sweet	2	5	7	....	....	....
Tompkins King	2	12	14	0	10	0.7

Westchester county reports 10 per cent. injury to Baldwin at South Salem and Yorktown; 50 per cent. to Golden Russet at Yorktown; 75 per cent. at New Castle to Hubbardston and 25 per cent. to Nyack Pippin; 25 per cent. to Rhode Island Greening at Yorktown. Orange county reports 35 per cent. injury to Green Newtown Pippin, at Hamptonberg, 35 per cent. to Northern Spy and 50 per cent. to Rhode Island Greening. No other injury to apples is reported in this part of the state.

PEARS.

Northern New York.—In many parts of northern New York pears do not succeed at all, or are grown only for home use. Of the fourteen kinds named by correspondents from this section of the state, the following were mentioned most frequently:

VARIETY.	TIMES MENTIONED.			PER CENT. OF WINTER INJURY.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Bartlett	8	8	12	0	100	56
Clapp Favorite	5	7	11	0	100	62
Flemish Beauty	12	8	15	0	100	46
Seckel	4	2	6	0	100	58
*Varieties in general	15	4	19	25	100	87

Eastern New York.—Of the fourteen kinds mentioned in the reports from this section these were named most frequently:

VARIETY.	TIMES MENTIONED.			PER CENT OF WINTER INJURY.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Anjou	1	8	8	0	90	54
Bartlett	5	14	18	0	90	63
Bosc	0	5	5	70	90	63
Seckel	4	11	12	0	90	69
Sheldon	2	6	8	0	100	61
Varieties in general	0	2	2	90	90	90

East Central New York.—Of the nineteen kinds of pears reported on by correspondents from this section, the following were mentioned most often:

VARIETY.	TIMES MENTIONED.			PER CENT. OF WINTER INJURY.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Anjou	6	4	9	0	100	53
Bartlett	14	7	20	0	100	35
Clapp Favorite	10	4	12	0	100	49
Flemish Beauty	11	6	16	0	100	59
Seckel	8	4	10	0	100	35½
Sheldon	5	3	8	0	100	50
Varieties in general	21	2	23	0	100	66

* In these tables where the expression "varieties in general" is used it means that some of the correspondents reported on that kind of fruit in a general way without specifying any particular varieties. For instance, one would report that peach buds were all killed without naming any particular variety or varieties of peaches which were grown in his vicinity.

West Central New York.—Of the thirty-one varieties mentioned, the following were named most frequently:

VARIETY.	TIMES MENTIONED.			PER CENT. OF WINTER INJURY.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Angouleme	7	14	16	0	100	75
Anjou	6	11	12	50	100	85
Bartlett	16	26	35	0	100	74
Clapp Favorite	6	6	11	0	100	79
Flemish Beauty	10	6	14	10	100	82
Kieffer	1	8	9	0	100	69
Louise Bon de Jersey	3	6	8	0	100	65
Seckel	12	20	25	0	100	76
Sheldon	4	8	11	50	100	86
Varieties in general	20	15	30	25	100	87

Great Lake Region.—Eighteen varieties were mentioned in the reports from the great lake region. The following were named most frequently:

VARIETY.	TIMES MENTIONED.			PER CENT. OF WINTER INJURY.		
	Home.	Market.	Total.	Least.	Greatest.	Average
Angouleme	9	20	24	0	100	83
Anjou	7	9	11	0	95	37
Bartlett	12	24	28	0	100	43
Flemish Beauty	9	8	12	0	100	47
Seckel	7	71	14	0	100	51
Varieties in general	13	10	22	20	100	80

Southern New York.—Of the nineteen varieties mentioned by correspondents from southern New York, the following were named most often:

VARIETY.	TIMES MENTIONED.			PER CENT. OF WINTER INJURY.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Angouleme	5	4	8	0	100	66
Bartlett	15	13	24	50	100	82½
Clapp Favorite	5	4	7	0	100	45
Flemish Beauty	6	5	8	0	90	52
Seckel	12	6	15	0	100	52
Sheldon	5	1	5	0	100	63
Varieties in general	33	7	35	0	100	43

Southeastern New York.—Seventeen varieties were named in the reports from this section. The following were mentioned most frequently:

VARIETY.	TIMES MENTIONED.			PER CENT. OF WINTER INJURY.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Anjou	1	4	4	0	50	17
Bartlett	5	15	17	0	95	42
Clapp Favorite	5	10	12	0	90	40
Kieffer	1	4	4	20	50	32
Lawrence	1	5	5	0	50	20
Seckel	5	12	14	0	95	28
Sheldon	1	5	5	0	50	25
Varieties in general	14	4	18	25	100	85

QUINCES.

This fruit appears to be but little grown in northern New York. Eight correspondents say it is grown for home use; one mentions it as being grown for market. In every instance it is reported as injured 100 per cent. No varieties were specified.

From *Eastern New York* reports the following table is compiled:

VARIETY.	TIMES MENTIONED.			PER CENT. OF WINTER INJURY		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Champion	1	2	2	0	20	15
Orange	4	2	5	10	90	40
Varieties in general	2	7	8	0	100	61

East Central New York reports mention Rea, Winter Sweet and Meech, in addition to those named above. Nine reports say quinces are grown for home use; five speak of them as grown for market. Two reports say Champion was injured from 90 per cent. to 100 per cent. Other reports say the injury to varieties in general varies from 75 per cent. to 100 per cent. In one instance each Meech, Orange, Rea and Winter Sweet are reported as uninjured.

One report from *West Central New York* says Champion was not injured; six reports on Orange give the injury as varying from 10 per cent. to 100 per cent.; and forty-four reports, without naming varieties, say quinces were injured from 25 per cent. to 100 per cent., averaging about 76 per cent.

In the *Great Lake Region* one report says Meech was not injured; nine reports say the injury to Orange varied from none to 100 per cent., averaging 38 per cent.; three reports say Rea was injured from none to 75 per cent., averaging 25 per cent.; and the average of thirty-four reports on varieties in general give the injury as 60 per cent.

The average of eleven reports from *Southern New York* gives the injury to varieties in general as 80 per cent. Two reports give Meech 80 to 100 per cent.; three reports give Orange an average injury of 60 per cent.

Seven reports from *Southeastern New York* give an average injury to varieties in general of 60 per cent. Three reports on Champion give an average injury of 87 per cent., and two on Orange give an average injury of 13 per cent.

PEACHES.

Northern New York.—But few peaches are grown in this region. Seven varieties were mentioned, but only two, Crawford Early and Crosby, are reported from more than one locality. The fruit buds of all varieties were injured 100 per cent., and in many instances the trees were entirely killed.

Eastern New York.—Several localities in eastern New York report that peaches are grown there for market as well as for home use, but in almost every instance all fruit buds were winter-killed. Three reports on Crosby give the injury as varying from 10 per cent. to 100 per cent.; two reports on Mountain Rose say the injury varied from 95 per cent. to 100 per cent., and one report on White Globe estimates the injury at 75 per cent. With all other varieties the fruit buds were said to be entirely destroyed. Among the kinds mentioned were Champion, Crawford Early, Crawford Late, Elberta, Foster, Morris White, Oldmixon Cling, Oldmixon Free, Stump and Wheatland.

East Central New York.—None of the reports from this section speak of peaches as being grown for market, and in but few cases as grown for home use. All but two of the reports on peaches say the fruit buds were all destroyed by the winter.

West Central New York.—Forty-five reports on varieties in general give an average injury of 96 per cent. The following varieties were mentioned most frequently in reports which named varieties:

VARIETY.	TIMES MENTIONED.			PER CENT. OF WINTER INJURY.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Alexander	4	1	5	50	100	84
Crawford Early	15	15	21	15	100	87
Early Rivers	3	3	5	75	100	95
Foster	3	3	5	75	100	95
Mountain Rose	3	4	5	80	100	96

Great Lake Region.—Thirty-seven reports from this section on varieties in general give the average injury to fruit buds of peaches as 99 per cent. In reports which name varieties the following kinds are mentioned most frequently:

VARIETY.	TIMES MENTIONED.			PER CENT. OF WINTER INJURY		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Alexander	3	2	5	90	100	96
Crosby	0	6	6	50	100	88
Crawford Early	2	8	10	99	100	99
Crawford Late	1	5	6	99	100	99
Elberta	0	6	6	90	100	99
Hill's Chili	1	4	5	50	100	87
Oldmixon	3	6	7	25	100	87

Southern New York.—Out of twenty-seven reports on varieties in general, but four speak of peaches as grown in this section for market. The least injury reported is 25 per cent., the greatest 100 per cent., and the average of all reports shows 99 per cent. of injury.

Southeastern New York.—Eleven reports from this section, in which no varieties are named, report injury from 10 per cent. to 100 per cent., averaging 83 per cent. In reports which name varieties, the following kinds are mentioned most frequently:

VARIETY.	TIMES MENTIONED.			PER CENT. OF WINTER INJURY.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Crawford Early	4	7	9	75	100	97
Crawford Late	4	5	7	60	100	94
Crosby	3	3	5	60	100	92
Elberta	1	4	5	60	100	92
Mountain Rose	2	6	6	75	100	96
Oldmixon Cling	2	6	6	75	100	96
Stump	3	5	6	75	100	96

PLUMS.

Northern New York.—The reports indicate that the plums which are grown in this section of the state are cultivated chiefly for home use. Twenty-five towns report the winter injury to plums in general as varying from nothing to 100 per cent., and the average of these reports is 90 per cent. One report speaks of the natives as uninjured. The average injury reported for the named varieties varies from 50 per cent. to 100 per cent. Lombard is mentioned fourteen times, and the injury reported for it varies from 30 per cent. to 100 per cent., averaging 87 per cent. The other varieties are mentioned from once to four times. They include two Japanese, two native and thirteen kinds of the *Prunus domestica* L., the species most commonly cultivated in this country.

Eastern New York.—In some portions of this territory plums were formerly grown very extensively for market, but the business has been very much demoralized by the ravages of the disease known as the black knot, which has ruined many orchards. Ten correspondents refer to cultivated kinds in general, without specifying any particular varieties. The injury which they report varied from 75 per cent. to 100 per cent., averaging 95 per cent. Other correspondents mention eleven kinds of the plum commonly cultivated, i. e., *Prunus domestica*, among them being five reports of injury to Bavay Green Gage, varying from 15 per cent. to 90 per cent., and averaging 51 per cent.; and six reports of injury to Lombard, varying from 10 per cent. to 100 per cent., averaging 40 per cent. Of the Japanese varieties Abundance is mentioned three times with an average of 64 per cent. injury, while Burbank is reported twice with an average injury of 45 per cent. No cultivated kinds of the native plums are mentioned.

East Central New York.—The reports from this part of the State mention neither native plums nor Japanese varieties but name twenty of the ordinary plums of the European class. Eighteen reports, speaking of the cultivated plums in general without naming any particular kinds, give the amount of injury as varying from nothing to 100 per cent., the average of all reports being 85 per cent. The following were named most frequently:

Variety.	Times Mentioned.			Per Cent. of Winter Injury.		
	Home.	Market.	Total.	Least.	Greatest.	Average
Bradshaw	7	3	10	25	100	90
Green Gage	5	3	6	10	100	70
Lombard	9	3	12	0	100	70
Yellow Egg	3	3	5	25	100	83

The reports indicate that plums are not grown extensively for market in this section.

West Central New York.—In some portions of west central New York plums are grown extensively for market. Fifty reports speak of cultivated kinds in general, without naming any varieties, and give the amount of injury as varying from nothing to 100 per cent., the average of all reports being 95 per cent. In other reports the following varieties of the European class were mentioned most frequently:

VARIETY.	TIMES MENTIONED.			PER CENT. OF WINTER INJURY.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Bavay	5	8	11	0	100	85
Bradshaw	3	6	8	0	100	84
German Prune	2	3	5	50	100	90
Guii	1	4	5	0	100	80
Lombard	8	11	15	0	100	87
Washington	2	3	5	90	100	95

Of the native varieties, Weaver is mentioned in one report as injured 50 per cent. and Wild Goose as injured 100 per cent. Three Japanese kinds are mentioned, namely, Abundance, Burbank and Ogon. Abundance is reported twice as injured 100 per cent., Burbank is reported once as injured 90 per cent., and Ogon once as injured 100 per cent.

Great Lake Region.—Fifteen plums of the European class were mentioned by correspondents in the region bordering the great lakes. Those named most frequently are given in the following table, together with the three Japanese varieties which were reported on. No report on native plums was received:

VARIETY.	TIMES MENTIONED.			PER CENT. OF WINTER INJURY.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
European class:						
Bavay	1	5	5	10	100	58
Bradshaw	2	5	6	0	100	61
German Prune	2	6	7	0	95	36
Italian Prune	2	3	5	0	10	2
Lombard	1	11	12	0	100	35
Varieties in general	24	15	35	25	100	92
Japanese class:						
Abundance	2	4	6	25	100	75
Burbank	0	3	3	90	100	97
Willard	0	1	1	....	100	100

Southern New York.—Only nine varieties of the European class are spoken of. Of these Bradshaw is given six times with injury varying from 75 per cent. to 100 per cent., average 92 per cent.; Green Gage four times, injury nothing to 100 per cent., average

63 per cent., and Lombard ten times, injury nothing to 100 per cent., average 79 per cent. Abundance, of the Japanese class, was injured 100 per cent. Of the natives Weaver was injured 65 per cent. and Wild Goose 60 per cent. Varieties in general are mentioned forty-four times, with an average injury of 88 per cent. The reports indicate that nearly all of the plums which are grown in this section are intended for home use.

Southeastern New York.—Only a few varieties are mentioned in the reports from this section, four of which are European, four Japanese and one native. Lombard is mentioned three times, injury nothing to 100 per cent., average 37 per cent.; Abundance five times, injury 70 per cent. to 100 per cent., average 92 per cent., and Burbank twice with 83 per cent. average injury. Cultivated kinds in general are reported fourteen times, and the average of all reports of injury is 73 per cent.

Cherries.

Northern New York.—Reports from twenty-two towns, speaking of cultivated kinds in general, without mentioning varieties, give the injury as varying from nothing to 100 per cent., the average of all reports being 87 per cent. But few varieties were mentioned in particular, and these were mostly sour kinds. Dyehouse was reported twice, with an average injury of 55 per cent.; Early Richmond five times, average injury 65 per cent.; Montmorency (Ordinaire) four times, average injury 53 per cent.

Eastern New York.—Seventeen named varieties are mentioned, but the most of them are mentioned only once. Black Eagle is reported four times, with injury from 90 per cent. to 100 per cent., averaging 97 per cent.; Black Tartarian four times, injury 25 per cent. to 100 per cent., averaging 81 per cent.; Early Richmond six times, injury 25 per cent. to 95 per cent., averaging 57 per cent.; Governor Wood three times, injury 10 per cent. to 100 per cent., averaging 63 per cent., and Yellow Spanish three times with an average injury of 100 per cent. There were twenty-three reports which spoke of varieties in general without naming any particular kinds. These reported from 10 per cent. to 100 per cent. of injury, with an average of 75 per cent. The reports indicate that cherries are grown in this section for market to a considerable extent.

East Central New York.—Only eleven varieties were named in the reports from this section. Those mentioned more than once are given below, with the average percentage of injury. Black Tartarian twice, 75 per cent.; English Morello three times, 50 per cent.; Early Richmond eleven times, 68 per cent.; Late Duke twice, 88 per cent.; May Duke three times, 84 per cent.; Montmorency five times, 51 per cent., and Ostheim twice, 63 per cent. Varieties in general, no names of varieties being given, are reported from twenty-eight localities, with injury ranging from 10 per cent. to 100 per cent., the average of all reports being 71 per cent. The reports indicate that cherries are not grown extensively for market in this section, although they are much grown for home use.

West Central New York.—Most of the reports from this section refer only to cultivated kinds in general, or make separate mention of the two classes of sweet and sour cherries without naming any particular varieties. These reports are summarized in the following table:

VARIETY.	TIMES REPORTED.			PER CENT. OF WINTER INJURY.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Varieties in general........	36	9	44	0	100	79
Sweet cherries in general...	15	3	18	90	100	99
Sour cherries in general....	17	5	20	0	100	45

Great Lake Region.—From this section, as from west central New York, the reports refer chiefly to cultivated kinds in general, or to the sweet or sour classes of cherries, without naming particular varieties. These reports are summarized in the following table:

Variety.	Times Mentioned.			Per Cent. of Winter Injury.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Black Tartarian	3	2	5	0	100	52
Early Richmond............	4	4	6	0	25	15
Montmorency (Ordinaire)..	3	5	5	0	50	24
Varieties in general	12	14	22	0	100	58
Sweet cherries in general ..	11	6	15	50	100	84
Sour cherries in general ...	10	7	14	0	100	55

Southern New York.—The following table contains a summary of all reports on cherries from southern New York. It indicates that but little of this fruit is grown in that section for market, and that sweet cherries suffered considerable more injury than sour cherries.

Variety.	Times Mentioned.			Per Cent. of Winter Injury		
	Home.	Market.	Total.	Least.	Greatest	Average.
Black Tartarian............	1	....	1	....	100	100
Dyehouse	1	....	1	....	50	50
Early Richmond............	4	1	4	20	100	61
English Morello............	4	0	4	25	100	56
Governor Wood	1	0	1	....	90	90
May Duke...................	4	0	4	40	100	78
Varieties in general........	34	7	38	0	100	62
Sweet cherries in general ..	5	0	5	90	100	98
Sour cherries in general....	7	0	7	0	75	29

Southeastern New York.—The few reports on cherries which came from southeastern New York are all summarized in the following table. They indicate that even in this section of the State cherries suffered considerable injury from the winter.

VARIETY.	Times Mentioned.			Per Cent. of Winter Injury.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Black Tartarian	2	3	4	0	90	54
Downer Late	....	1	1	....	50	50
Governor Wood	....	1	1	....	50	50
Empress Eugene	....	1	1	....	50	50
Early Purple	....	1	1	....	100	100
Elton	....	1	1	....	75	75
May Duke	1	1	2	50	90	70
Reine Hortense	....	1	1	....	75	75
Yellow Spanish	....	1	1	....	75	75
Varieties in general	9	4	11	50	100	82
Sweet cherries in general	2	....	2	....	90	90
Sour cherries in general	2	....	2	40	50	45

GRAPES.

In the following notes on grapes it is understood that the percentage of winter injury reported refers to vines which were not taken from the trellis and covered with earth, or given some other sort of winter protection. In several of the tables the native varieties, such as Concord, Clinton, etc., are separated from the hybrids between native and European kinds, such as Brighton, Niagara, etc., that the two classes may more readily be compared.

Northern New York.—Reports from twenty-nine towns speak of grapes in general without specifying varieties. The injury reported from them varies from nothing to 100 per cent., the average of all reports being 57 per cent. Reports from other towns mention altogether twenty-four kinds. The following were named most frequently:

VARIETY.	Times Mentioned.			Per Cent. of Winter Injury.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Concord	12	1	12	0	90	52
Delaware	6	1	6	25	70	49
Moore Early	7	....	7	0	80	45
Niagara	7	2	8	50	100	73
Worden	4	1	4	0	70	36
Varieties in general	26	4	29	0	100	57

With but few exceptions the reports speak of grapes as being grown only for home use. In many places it is necessary to take the vines from the trellis and cover them with earth or mulch for winter protection.

Eastern New York.—In this section there are some localities in which grapes are grown to some extent for market, but the area devoted to this fruit is not nearly so large as it is in some parts of the lower Hudson valley, the interior lake region of central and western New York and along the borders of the great lakes. The varieties mentioned most frequently in reports from eastern New York are as follows:

VARIETY.	TIMES MENTIONED.			PER CENT. OF WINTER INJURY.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Native varieties:						
Concord	9	10	16	0	95	30
Moore Early	3	1	4	15	80	48
Worden	3	3	6	0	95	43
Hybrids:						
Brighton	3	2	5	0	95	36
Delaware	6	4	9	0	100	40
Niagara	4	5	8	0	95	40

East Central New York.—The reports from this section indicate that grapes are not grown to any great extent except for home consumption. Twenty-three kinds are mentioned, of which the following are named most often:

VARIETY.	TIMES MENTIONED.			PER CENT. OF WINTER INJURY.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Native varieties:						
Concord	13	2	15	0	100	64
Moore Early	6	1	7	0	80	41
Worden	3	1	4	0	100	28
Hybrids:						
Brighton	4	1	5	60	100	81
Delaware	8	1	9	0	100	62
Niagara	5	3	8	25	100	74
Varieties in general	20	2	22	50	100	55

West Central New York.—This region contains many localities where grapes are grown extensively for market. The country bordering lakes Keuka, Seneca and Canandaigua is especially noted for its vineyards. The following table mentions the grapes named most frequently by correspondents from west central New York:

VARIETY.	TIMES MENTIONED.			PER CENT. OF WINTER INJURY.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Native varieties:						
Catawba	5	8	13	0	75	24
Concord	15	16	28	0	90	27
Diamond	4	5	9	10	90	64
Isabella	6	1	7	0	100	45
Moore Early	2	2	4	0	40	18
Pocklington	5	1	6	10	50	33
Worden	5	7	10	20	90	47
Hybrids:						
Agawam	2	2	4	10	40	29
Brighton	4	....	4	0	90	35
Delaware	11	11	21	0	100	40
Duchess	2	2	4	25	90	48
Niagara	13	20	32	0	100	49
Salem	5	1	6	0	85	39
Varieties in general	20	10	28	0	100	68

Great Lake Region.—Like the section last noticed, this region also contains many localities in which the vineyard interest is a very important one. Especially is this true of the belt along the south shore of Lake Erie, which is commonly known as the Chautauqua grape belt. In this belt Concord grapes are grown to perfection, and in greater quantities, probably, than in any other equal area in the world. Many of the correspondents reported only on grapes in general, without naming particular kinds. The kinds most often mentioned were as follows:

VARIETY.	TIMES MENTIONED.			PER CENT. OF WINTER INJURY.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Native varieties:						
Concord	13	13	23	0	100	34
Diamond	3	2	5	0	75	45
Isabella	4	1	5	0	100	40
Moore Early	2	4	6	0	80	34
Pocklington	1	3	14	40	65	54
Worden	7	9	15	0	100	43
Hybrids:						
Agawam	5	1	6	0	100	50
Brighton	5	2	7	0	95	51
Delaware	2	6	8	0	75	37
Moyer	2	3	4	25	100	68
Niagara	7	19	24	0	95	44
Varieties in general	14	7	19	0	100	58

Southern New York.—But few reports on grapes were received from southern New York, except those which referred to all kinds in general without mentioning particular varieties. These reports may be summarized as follows:

VARIETY.	TIMES MENTIONED.			PER CENT. OF WINTER INJURY.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Concord	5	....	5	....	50	25
Delaware	3	....	3	0	50	25
Niagara	3	1	4	0	90	35
Varieties in general	16	1	17	10	100	63

From these reports it appears that growing grapes for market receives little attention in the southern tier of counties.

Southeastern New York.—Although many commercial vineyards are found in this section, especially in the lower Hudson valley, but few reports on the condition of vineyards were received. Forty-five varieties were named as being grown either for home use or for market, but none of them were mentioned more than seven times. Six reports on cultivated kinds in general gave the amount of injury as varying from nothing to 50 per cent., the average of all reports being 28 per cent.

CURRANTS.

Northern New York.—Reports from thirty-one towns, speaking of cultivated kinds in general, give the amount of winter injury as varying from nothing to 50 per cent., the average of all reports being 17 per cent. In the reports from other towns the following kinds were named most frequently:

VARIETY.	TIMES MENTIONED.			PER CENT. OF WINTER INJURY.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Champion Black	3	1	4	0	30	8
Cherry	8	5	10	0	50	9
Fay	7	4	9	0	50	16
White Grape	9	4	11	0	50	13

Eastern New York.—The following is a summary of the reports on currants from eastern New York:

VARIETY.	TIMES MENTIONED.			PER CENT. OF WINTER INJURY.		
	Home.	Market.	Total.	Least.	Greatest.	Average
Cherry	4	5	8	0	30	7
Fay	2	3	5	0	0	0
Versaillaise	1	4	4	0	50	13
White Grape	3	1	4	0	25	6
Varieties in general	6	4	8	0	80	23

East Central New York.—The varieties named most often in the reports from this section are given in the following table:

VARIETY.	TIMES MENTIONED.			PER CENT. OF WINTER INJURY.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Cherry	8	3	10	0	100	22
Fay	10	4	14	0	100	16
White Grape	3	3	5	0	100	30
Varieties in general	23	2	24	0	90	25

West Central New York.—The varieties mentioned most often in the reports from this section are given in the following table:

VARIETY.	TIMES MENTIONED.			PER CENT. OF WINTER INJURY.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Cherry	7	7	11	0	75	19
Fay	5	7	11	0	50	20
Victoria	1	4	4	10	50	34
White Grape	4	1	5	0	50	24
Varieties in general	30	9	36	0	100	20

Great Lake Region.—Reports from this section mentioned the following kinds most frequently:

VARIETY.	TIMES MENTIONED.			PER CENT. OF WINTER INJURY.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Cherry	4	5	7	0	70	17
Fay	3	4	6	0	90	23
Varieties in general	18	16	31	0	50	8

Southern New York.—The kinds most often named in the reports from this section are as follows:

VARIETY.	Times Mentioned.			Per Cent. of Winter Injury.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Cherry	10	4	11	0	50	10
Fay	8	2	9	0	25	3
White Grape	7	3	8	0	50	10
Varieties in general	29	6	35	0	100	24

Southeastern New York.—The kinds named most often in reports from southeastern New York were as follows:

VARIETY.	Times Mentioned.			Per Cent. of Winter Injury.		
	Home use.	Market	Total.	Least.	Greatest.	Average.
Cherry	5	1	6	0	80	13
Fay	3	1	4	0	....	0
Varieties in general	6	3	9	0	50	6

GOOSEBERRIES.

It is commonly thought that currants and gooseberries are so hardy that they are almost proof against winter injury in this latitude, but the fact is that the crop of these fruits in 1896 was very much lessened in many localities in the state because the fruit buds were destroyed the previous winter. Many of the plants which were growing at this Station were injured in this way, and the result was that the fruit spurs, being relieved of the burden of producing fruit, grew into vigorous leafy shoots. The gooseberries of the European class suffered much more than those of the American class, such as Downing, Houghton, etc. In order that the two classes may the more readily be compared they are listed separately in the following tables:

Northern New York.

Variety.	Times Mentioned.			Per Cent.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Native class:						
Downing	2	....	2	0	....	0
Houghton	3	....	3	0	....	0
Smith	1	....	1	0	....	0
European class:						
Chautauqua	1	1	1	0	....	0
Industry	2	....	2	0	50	25
Lancaster Lad	1	....	1	....	5	5
Whitesmith	1	....	1	....	50	50
Varieties in general	21	3	23	0	100	17

Eastern New York.

Variety.	Times Mentioned.			Per Cent.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Native class:						
Downing	1	1	2	0	10	5
Houghton	....	1	1	....	10	10
European class:						
Industry	1	3	4	0	10	3
Whitesmith	....	1	1	0	....	0
Varieties in general	2	....	2	0	50	25

East Central New York.

Variety.	Times Mentioned.			Per Cent. of Winter Injury.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Native class:						
Downing	1	2	3	0	30	10
Houghton	....	1	1	0	0	0
Mountain	1	....	1	0	25	25
Smith	1	....	1	0	25	25
European class:						
Industry	5	0	5	0	50	15
Varieties in general	17	0	17	0	100	19

West Central New York.

VARIETY.	Times Mentioned.			Per Cent. of Winter Injury.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Native class:						
Downing	5	....	5	0	75	25
Houghton	3	....	3	0	75	25
Varieties in general	17	5	21	0	100	18

Great Lake Region.

VARIETY.	Times Mentioned.			Per Cent. of Winter Injury.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Native class:						
Downing	2	2	4	0	0	0
Houghton	2	2	3	0	0	0
European class:						
Industry	2	1	2	0	0	0
Varieties in general	11	6	16	0	25	12

Southern New York.

VARIETY.	Times Mentioned.			Per Cent. of Winter Injury.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Native class:						
Downing	5	1	6	0	50	15
Houghton	4	1	4	0	50	19
European class:						
Industry	3	....	3	0	25	8
Varieties in general	24	....	24	0	100	19

Southeastern New York.

VARIETY.	TIMES MENTIONED.			PER CENT. OF WINTER INJURY.		
	Home.	Market.	Total.	Least.	Greatest.	Average.
Native class:						
Downing	1	2	2	0	....	0
Houghton	1	2	3	0	....	0
European class:						
Industry	....	1	1	0	....	0
Varieties in general	2	....	5	0	25	9

VI. OBSERVATIONS ON COVER CROPS FOR ORCHARDS.

S. A. BEACH AND C. P. CLOSE.

It is the practice of many New York fruit-growers to give cherry, plum and peach orchards clean cultivation during the growing season. Less frequently quince and pear orchards, and rarely apple orchards, are cultivated in the same way. Those who follow this practice generally prefer to cease cultivating about August 1, so that growth may be checked and the wood and buds may become thoroughly ripened and prepared for the severities of winter. If the ground is left bare of all vegetation except the orchard trees till the following spring, when cultivation is again resumed, it appears that the year's cycle is completed without providing for the return of any vegetable material to the soil at any period of the year, except what may be furnished in stable manure or the slight amount which comes from the decay of the root fibers and the weed growth which may escape destruction by the harrow or plow.

It is well known that the humus, which is made up of the decaying animal and vegetable matter in the soil, is a very valuable and important part of the soil. It contains a great deal of plant food, which is constantly becoming available for the use of the plants; it increases the moisture-holding power of the soil; it renders the soil more friable and puts it in a better mechanical condition.

If with the last cultivation of the orchard in summer, some crop like clover, vetch or rye be sown, the ground will soon be covered with a vegetable growth which may be turned under by plowing late in the fall or in the spring, and thus material for keeping up the supply of humus may be added to the soil in a comparatively inexpensive way. Such a crop as this is called a cover crop. A cover crop is valuable not only because

PLATE XXX.

CANADA PEAS AND BUCKWHEAT.

FIGURE 1.—WINTER RYE AND WINTER-VETCH.

FIGURE 2.—MAMMOTH CLOVER.

it helps to keep the soil filled with humus, but because it seizes upon soluble plant food in the soil and makes use of valuable fertilizing material which might escape in the drainage waters were the ground not occupied. The nearer the ground is to being filled with the roots of orchard trees, the less is the liability to lose plant food through drainage waters.

Another advantage to be gained by the use of cover crops is that some kinds of plants may be used for this purpose by which the amount of nitrogen compounds in the soil may be increased. Since nitrogen is the most expensive element of plant food in commercial fertilizers, and because without a sufficient amount of it neither orchard trees nor farm crops can be brought to their highest productiveness, the use of cover crops has an important bearing on the problem of keeping orchards up to the highest productiveness in the most economical way.

The object of this article is not to set forth in detail the reasons for using cover crops, but to give a brief account of the growth of various plants which were tried for cover crops, the seeds of which were sown about August 1, 1896, in the orchards at this Station.

CANADA PEAS AND BUCKWHEAT.

Canada peas, at the rate of two bushels per acre, and buckwheat, one-half bushel per acre, were sown in a bearing apple orchard. The plants made an even, rapid, vigorous growth, so that by the latter part of September they averaged nearly two and one-half feet in height in their natural recumbent position, but when straightened up they were four feet high. The vines remained green and vigorous until late in the fall. (See plate XXX, taken October 19.) In this and the following plates the yard stick which appears in the foreground will help in forming an idea of the height of the cover crop. About half of the vines were still green December 1. Part of this crop was sown on heavy clay soil, where crimson clover was sown as a cover crop the year before, but did not prove a success. It is interesting to note that where crimson clover failed, Canada peas made an excellent growth. The buckwheat which was put in to support the pea vines did as well as usual, and was killed by frost October 9.

Such a rank growth as was made by the buckwheat and peas naturally interfered somewhat with the work of gathering the apple crop and was especially unpleasant after a rain or in the morning when the dew was on.

BLUE PEAS AND BUCKWHEAT.

Blue peas and buckwheat were sown in the same orchard and at the same rate per acre as the Canada peas. They did not stand quite so thick or even as did the Canada peas, but made fully as good growth. These vines, as well as those of the Canada peas, blossomed profusely, but set no fruit. By December 1 half of the vines were dead and the others were no longer erect, but spread out over the ground.

COWPEAS AND BUCKWHEAT.

Cowpeas and buckwheat were sown in the same proportion and in the same orchard as the crops just mentioned. From the start the plants were scattering, but they made a fair growth, being from eight inches to sixteen inches high by the latter part of September. The plants of this variety grow upright, have few branches and large broad leaves, like bean leaves, but do not have the twining habit of growth of the blue pea. The buckwheat made a good growth and formed the principal part of the cover crop. On October 9 both the cowpeas and buckwheat were killed by frost.

WINTER VETCH AND WINTER RYE.

In a young orchard winter vetch and winter rye were sown at the rate of forty pounds of the vetch and one-half bushel of the rye per acre. Both came up nicely, and in a couple of months formed a thick dark-green carpet of plants from six inches to twelve inches high. (See figure 1, plate XXXI, which also shows the Dwarf Essex rape in the distance, from a photograph taken October 19.) This makes an excellent cover crop, because it forms a perfect mat of vegetation over the ground and does not grow tall enough to interfere with the gathering of fruit which ripens as late as winter apples. These plants were still green and in good condition in December.

Sweet Clover.

An old apple orchard was sown to sweet clover (*Melilotus alba*) at the rate of thirteen pounds of the seed per acre. It made a fair catch, and away from the shade of the trees did fairly well, although it was rather too thin upon the ground. In the shade it did not do well. It attained a height of from four inches to one foot. In December the plants were drooping and some were turning black. This is a well-known roadside weed and is oftentimes difficult to eradicate.

Mammoth Clover.

Mammoth clover (*Trifolium medium*) was tried in a young orchard and gave excellent results. It is a rank growing clover much like the common red clover, but larger. This was given a heavy seeding, nearly one bushel per acre. The plants were very thick upon the ground and formed a close-fitting green covering. (See figure 2, plate XXXI, taken October 19.) They were from four to eight inches high when cold weather set in.

Sainfoin.

Sainfoin, or burr clover (*Onobrychis sativa*), at the rate of twenty-five pounds of seed per acre was sown next to the mammoth clover. The plants made a short spreading growth. They were still green in December.

Dwarf Essex Rape.

In an orchard set last spring the Dwarf Essex rape was tried. About seven pounds of seed were sown per acre. The plants grew rapidly, and in a few weeks formed a dense dark-green mass of foliage ranging from one foot to two and one-half feet in height. The rape is a rank grower. Its large leaves are upright or spreading, and while not resting on the ground, still form a complete covering a few inches above. Like the Canada and blue peas, if sown in a bearing apple orchard, it would impede the gathering of the crop. This rank growth seemed to invite the mice to an excellent hiding place, and early in the fall they gnawed the bark of several trees, in some cases completely girdling them. The mice caused no trouble in orchards where other field crops were used. Plate XXXI, figure 1, shows an orchard where winter rye and vetch were used for a cover crop, and in the background appears the ranker growing rape.

The results of the season's experience with cover crops, so far as they are now available, may be summarized as follows:

(1) *Sainfoin* does not make a good cover crop for the orchard because it takes the plant so long to get established that when it is sown the first of August it does not grow enough in the fall to compare favorably with other kinds of cover crops.

(2) *Sweet clover* was not given a satisfactory test because too little seed was used and because it was sown in an old orchard where the ground was very much shaded. It is an aggressive weed.

(3) *Canada peas,* or *blue peas,* with *buckwheat* gave very satisfactory results on hard clay soil where crimson clover had previously been tried with no success. The peas kept green till winter.

(4) *Cow peas,* like buckwheat, are killed with the first frost, and for this reason do not compare favorably with Canada peas for use in orchards in this latitude.

(5) *Winter vetch and winter rye* form a perfect mat of vegetation in a few weeks and remain alive through the winter. They do not grow high enough to interfere seriously with gathering winter fruit if sown by August first.

(6) *Mammoth clover* formed a dense cover, remained alive through the winter, and, on the whole, was one of the most desirable plants tested, comparing favorably with winter vetch and winter rye for orchard use.

(7) In some cases orchards are making so rank a growth that it is not desirable to add nitrogen compounds to the soil. The

leguminous plants such as the clovers, peas, vetches and sainfoin add nitrogen to the soil when they are used as cover crops. In such instances these should not be used for cover crops, but winter rye, rape or buckwheat may be used. Attention should be called to our experience in having trees girdled by mice early in the fall where rape was used in a newly-planted orchard.

(8) *Crimson clover* has been tried at this Station many times. The results show that in this location it is not reliable for a cover crop. It is often winter-killed, and on hard clay land, where it is most needed, it does not do well.,

FIGURE 7.—RIPE ROT OF PLUM FRUIT CAUSED BY THE FUNGUS *Monilia fructigena.*
[See Report of Horticulturist, p. 388.]

FIGURE 8.—WARD'S CARNATION SPRAY NOZZLE.
[See Report of Mycologist, p. 487.]

REPORT

OF THE

DEPARTMENT OF VEGETABLE PATHOLOGY.

F. C. STEWART, M. S., MYCOLOGIST.*

* At Branch Station in Second Judicial Department.

TABLE OF CONTENTS.

These bulletins are:

REPORT OF THE MYCOLOGIST.

F. C. STEWART.

I. PRELIMINARY STATEMENT.

During the past year the Mycologist has prepared three bulletins. Two of these present the results of experiments made in 1895, while in the third are reported some observations made in 1896.

These bulletins are:

(1) Bulletin No. 100. Combating Carnation Rust.

(2) Bulletin No. 101. Potato Diseases on Long Island in the Season of 1895.

(3) Bulletin No. 113. The Cucumber Flea-Beetle as the Cause of "Pimply" Potatoes.

They are republished with this report.

The work of 1896 has consisted chiefly of spraying experiments on carnations, potatoes and cucumbers, together with laboratory studies on the fungi causing diseases of these plants.

The carnation experiments were designed to duplicate the field spraying experiments made in 1895 and reported in Bulletin No. 100; but owing to the peculiar weather conditions which prevailed in 1896, the carnation rust* did not appear to any extent in the field, and, as a consequence, the spraying experiments were barren of results.

The spraying experiments with potatoes were designed to furnish data by means of which the expense of potato spraying might be determined and compared with the value of the increase in yield resulting from spraying. Neither of the two common potato blights appeared, making the results of the ex-

* *Uromyces caryophyllinus* (Schrank) Schroeter.

periments exceptionally valuable, because they show what spraying will accomplish when no disease is present. It appears that on Long Island it will pay to spray potatoes in any and every season. A bulletin on this subject will soon be ready for publication.

The spraying experiments with cucumbers were directed against the downy mildew,* a disease which has recently become so wide-spread and so destructive as to threaten the destruction of the pickle industry in southeastern New York. The results are very gratifying. A successful and practical remedy has been found. A bulletin, giving a full account of the disease and its treatment, will be ready for publication early in 1897.

A large quantity of herbarium material has been collected, and the study of miscellaneous economic fungi has occupied considerable time. Some of these miscellaneous studies are published with this report.

The correspondence of the Mycologist during the year has not been as large as it should have been, and it seems necessary to remind farmers again that they can materially aid this Department by reporting to the Station any outbreak of plant diseases which may come under their observation.

The Mycologist has delivered addresses before farmers' meetings at Riverhead, Southold, Southampton, Northville, Jamaica, Suffern and Goshen, and before the American Carnation Society at New York.

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* *Plasmopara Cubensis* (B. and C.) Humph.

II. NOTES ON MISCELLANEOUS PLANT DISEASES.

Macrosporium herculeum on Flat Turnips.

Fig. 6, plate XXXII, is taken from a photograph of a flat-turnip leaf affected with a spot of disease caused by the fungus *Macrosporium herculeum* E. & M. This disease of flat-turnips has been common on Long Island during the past two seasons. In some cases it has been so abundant as to seriously affect the growth of the plants.

Circular, dead, brittle spots appear on the leaf, which, if the spots are numerous, withers and falls off. If the upper surface of one of the diseased spots is carefully scraped with a scalpel and the scrapings examined with a compound microscope, numerous brown, club-shaped spores will be found. (Fig. 1, plate XXXII.) These are the spores of a species of *Macrosporium* which, upon comparison with authentic specimens, proves to be *M. herculeum* E. & M. The species was originally described* on horse-radish (*Nasturtium armoracia*), and so far as we know, has never been reported as occurring on any other host. On Long Island we have occasionally found it on cabbage leaves. On both cabbage and turnip the gross characters of the fungus are identical with those of *Macrosporium cheiranthi* Fr., var. *circinans* B. & C., on these hosts, but the spores of the two species are quite different.

In a thin cross-section, made through a diseased spot, the hyphae or feeding threads of the fungus may easily be seen traversing the tisues in every direction.

There are many species of *Macrosporium*, the majority of which are saprohytes. In damp weather they may be found on almost any decaying vegetable matter. Often they take possession of tissues which have been killed by other agencies, and so closely simulate parasites that they are often mistaken for such, even by expert mycologists; but there are a few species which are certainly parasitic on plants. *M. herculeum* is one of the undoubtedly parasitic species.

* American Naturalist for Dec., 1882, p. 1003.

Some species of *Macrosporium* are known to have a second kind of spores which are borne within sacs (asci) enclosed in an envelope called a perithecium. In other species this ascigerous form is unknown. It has never been observed in *M. herculeum.* Some of the turnip leaves affected with *M. herculeum* were put in cheese-cloth bags, which were then placed on the ground out of doors and left there during the winter. The following spring the leaves were carefully examined for perithecia, but none could be found.

During late summer of the past season the foliage of horse-radish on Long Island was quite generally affected with *Macrosporium* disease and was probably somewhat injured by it. However, it is not likely that either the flat turnip or the horse-radish is injured sufficiently to warrant the expense of spraying. Should treatment seem advisable, nothing is more likely to prove successful than Bordeaux mixture, applied before the disease makes its appearance.

BLIGHT OF CORN LEAVES.

The white blast or leaf-blight of corn has been so common this season as to attract the attention of farmers, who attributed the cause to a period of unusually hot weather which occurred in August. Both sweet corn and field corn suffered; in some cases so severely as to materially lessen their value for fodder and to prevent the ears from maturing properly. Diseased leaves have somewhat the appearance of having been frost bitten.

The primary cause of the disease is a parasitic fungus, *Helminthosporium inconspicuum* C. & Ell., which may be seen growing on the under surfaces of the diseased spots in the form of a delicate olive-green mould. The appearance of the fungus, when magnified, is shown at Fig. 2, plate XXXII. "Weather" can not be held responsible for the disease except that certain weather conditions (usually warm, wet weather) are more favorable than others for the development of the *Helminthosporium.*

There is another disease of sweet corn which may be mistaken for the *Helminthosporium* disease. This other disease is an undescribed bacterial disease which attacks sweet corn only, and principally the early dwarf varieties of sweet corn. It makes its appearance early in the season, stunting and often killing the plants while they are forming ears, whereas the *Helminthosporium* disease usually does not appear until the month of August.

The *Helminthosporium* disease has rarely been reported as being injuriously abundant, but on Long Island it must be regarded as an enemy of considerable importance. Dr. Thaxter* reported it abundant in Connecticut in 1889.

No practical remedy can be recommended.

NORWAY MAPLES INJURED BY DRY WINDS.†

About May 25, 1895, the Norway maples (*Acer platanoides*) on Long Island presented an appearance which puzzled observant persons. The entire foliage, even of large trees, looked as if it had been scorched by fire or killed by heavy frost. But since there had been no frost for at least three weeks, the phenomenon was at first thought inexplicable. However, the fact that the trouble was a general one, and appeared suddenly, suggested the idea that some unusual condition of the weather was responsible for it. Such was, in fact, the case. For a period of about a week previous to the appearance of the trouble the temperature had been unusually high for the time of year, and for at least three days very strong, dry winds had blown steadily from the west. The leaves of the Norway maples were about half grown at this time and very tender. The hot, dry wind caused the leaves to transpire water more rapidly than the roots could supply it, the consequence of which was the death of the leaves. It was observed that some trees suffered more than others, and trees recently transplanted were burned most severely of all. The explanation of this is, that trees in sheltered positions transpired less water, and, consequently, suffered less than trees exposed to the wind; and trees newly transplanted were not able to supply their leaves with water as rapidly as

* Thaxter, R. Ann. Rept. Conn. Exp. Sta. for 1889, p. 171.

† Since this article was written Dr. Stone has reported a similar injury to sugar maples (*Acer saccharinum*) in Massachusetts, in May, 1896. His theory as to the cause of the trouble is the same as the one here advanced. See Ninth Ann. Rept. of the Hatch Exp. Sta. of Mass. Agr'l Coll., pp. 81-82.

were trees with well-established root systems. The common practice of horticulturists in pruning away large portions of the tops of plants, especially conifers, at the time of transplantation, is based upon the same principle; the object being to reduce the transpiring surface to the mimimum until the plant can establish a root system.

The Norway maple is much planted as a shade tree on Long Island, and seems to be well adapted to both the soil and the climate; but it suffered more from the dry wind than did any other common tree. The white pine was somewhat affected, and Mr. Nicholas Hallock called our attention to pear and apple trees which were slightly injured from the same cause.

THE *Cercospora* LEAF-SPOT OF *Tilia*.

For two years past several species of *Tilia* (Linden) in the Long Island nurseries have been attacked by a leaf-spot disease which disfigures the foliage and causes the leaves to fall prematurely. It is caused by the fungus, *Cercospora microsora*, Sacc. In the Botanical Gazette for 1881, Prof. Peck* has described the same fungus under the name *Cercospora Tiliæ*.

The common fungicides should control the disease.

Phyllosticta limitata PK.

In our last Report† this fungus was reported as destructive in 1895. During the past season it has been more abundant than ever, and must be placed in the list of serious orchard pests. More or less of the disease may be found in almost any orchard on Long Island, and in some it has defoliated the trees. The generally unhealthy condition of Long Island apple orchards is probably largely due to the attacks of this fungus. Year after year the leaves fall prematurely, sometimes as early as the middle of July, and the trees become gradually weakened. In the report previously mentioned, it was stated that the three spray-

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* Peck, C. H. New species of Fungi, Botanical Gazette, Vol. vi, p. 277.

† Stewart, F. C. A New Leaf-spot Disease of Apples. Fourteenth Ann. Rept. New York Exp. Sta., p. 545.

ings recommended* for apple scab would probably control the *Phyllosticta* disease also. Observations made the past season indicate that this may not be true. At Cutchogue, an apple tree which had been sprayed with Bordeaux mixture three times; once before blossoming and twice after (April 27th, May 19th and June 3d), on June 10th was found to be badly spotted with *Phyllosticta*, many leaves having already fallen. It should be stated, however, that the Bordeaux mixture used for the last two applications was not freshly prepared. It seems scarcely possible that Bordeaux mixture, properly prepared and properly applied, can fail to prevent this disease.

Two Common Diseases of the Sunflower.

The common garden sunflower, *Helianthus annuus*, is not a plant of much importance here, but this note may be of interest to those who have observed the dying of the lower leaves of sunflowers and would like to know its cause. The sunflower is subject to several diseases, but the two under consideration are much more common than the others; in fact, they are almost universal. Every one familiar with these plants has observed that the lower leaves turn brown, shrivel and fall off, leaving only a few green leaves on the upper part of the stalk. This is so common that some probably think it the normal condition of the plant; but it is a disease, or rather two diseases, caused by two species of parasitic fungi. The first of these to appear is the disease caused by the fungus, *Septoria Helianthi* Ell. & Kell. In the early stages of this disease the lowest leaves turn brown along the margins and at the tips. Soon the entire leaf becomes brown, shrivels and falls off. The unaided eye can see nothing upon the leaf, but when a small portion of a diseased leaf is placed under a compound microscope, numerous small, dark-brown, hollow, spherical bodies (perithecia) are seen. If one of these spherical bodies is crushed it is found to contain several slender, colorless spores. (See Fig. 3, Plate XXXII.) A

* New York Exp. Sta., Bulletin No. 86, p. 70.

microscopic examination of the interior of the leaf reveals minute fungus threads (hyphæ) running through the cells. These fungus threads cause the cells to turn brown and die.

The second fungous disease makes its appearance a little later in the season. The leaves are affected in about the same manner as in the *Septoria* disease, but in this case the naked eye can see that the surface of the leaf (on both sides) is covered with small pustules (sori) containing a brown powder. Some of the pustules are considerably darker colored than others. Under the microscope the brown powder is found to be composed of the spores of the fungus, *Puccinia Helianthi* S. The light-brown pustules contain uredospores and the dark-brown pustules teleutospores. (Figs. 4 and 5, plate XXXII.) The uredospores are capable of germination as soon as they are mature, and are the means by which the disease spreads from leaf to leaf and plant to plant. The teleutospores require a period of rest before germination. Most of them probably do not germinate until the following spring. It is their office to carry the fungus over the winter. This fungus, like the *Septoria* fungus, has a mycelium which grows within the tissues of the leaf and derives its nourishment therefrom. The *Puccinia* is a true rust.

Both the *Septoria* and *Puccinia* inhabit other species of *Helianthus*. Particularly is this true of *Puccinia*, which has been found on almost every known species of *Helianthus*.

The *Septoria* disease can probably be prevented by the use of any of the ordinary fungicides, but the rusts are difficult to combat.

THE HORSE-CHESTNUT DISEASE.

The horse-chestnut, *Aesculus Hippocastanum*, is a common shade tree on Long Island. In July the leaves begin to show brown spots, which continue to enlarge and coalesce until finally the entire leaf is brown and dead. Long before frost the foliage is disfigured, the affected leaves begin to fall, and people wonder what is the matter.

There are several causes which may produce this condition, but the chief offender is a parasitic fungus, *Phyllosticta sphaerop-*

soidea E. & E., which is a near relative of the apple-leaf *Phyllosticta*, discussed on a previous page. One with good eyesight can readily see the perithecia, which appear like minute black dots thickly sprinkled over the brown leaf-spots.

The disease does not affect the health of the plant to any great extent, because the horse-chestnut makes the principal part of its growth early in the season before the leaves fall. But it disfigures the foliage and the falling leaves are a source of annoyance. A remedy is, therefore, desirable.

In some experiments made by Fairchild* on nursery trees at Geneva, N. Y., the disease was considerably checked by five applications of Bordeaux mixture, the first application being made before the appearance of the disease. But Prof. Galloway† states that he has not been successful in combating the disease by spraying. He thinks that frequently it may be caused by agencies not affected by fungicides; for example, red spiders may cause it. In such cases he thinks that much benefit might result from a judicious use of the hose. When red spiders become injuriously abundant in green-houses, they are managed by using the hose freely.

The Sycamore Disease.

The sycamore or plane tree, *Platanus occidentalis*, on Long Island, is subject to a disease which is perhaps less conspicuous, but is really more injurious, than the horse-chestnut disease. It is so common that scarcely a tree entirely free from it can be found on Long Island.

The affected trees put out their leaves tardily, and until quite late in the spring the foliage presents a scorched appearance. During the winter season affected trees may be detected by their stunted, scraggy appearance, due to the presence of numerous rosettes of small twigs on the smaller branches. (See plate XXXIII.)

* Fairchild, D. G. Horse-Chestnut Leaf-Blight. Journ. Myc., Vol. vii, pp, 352-3.

† Galloway, B. T. Horse-Chestnut Leaf Disease. Amer. Gardening, Vol. xvii, No. 95, p. 662.

All of this is the work of a parasitic fungus, *Glœosporium nervisequum*, which grows on the leaves and also on the young twigs. By its growth on the young twigs they are killed, and then the lateral buds develop into branches. The repetition of this process results in the formation of a rosette.

No practical remedy is known.

ASPARAGUS RUST.

Long Island market gardeners apply the name "rust" to an asparagus trouble in which the subterranean portion of the stem shows irregular rust-colored patches. It is frequently quite destructive. The cause is unknown.

Although the name "rust" is descriptive of this trouble, it should not be used, for the reason that it is already preëmpted as the proper name of an asparagus disease which is caused by the fungus, *Puccinia Asparagi* DC. The name "rust" is properly applied only to diseases caused by fungi belonging to the family of rusts, *Uredineæ*.

Puccinia Asparagi is a true rust. It has rarely been reported as destructive, but during the past year there has been a remarkable outbreak of it in New Jersey, Long Island and southern New England. Dr. Halsted, of New Brunswick, N. J., first directed my attention to it last September. Upon examination the Long Island asparagus fields were found to be badly affected. In fields of several acres extent it was impossible to find a single plant which was entirely free from the disease.

Healthy asparagus plants will remain green until heavy frosts occur, but plants affected with rust were dead and dry by September 1. The main stem and all of the branches were covered with pustules (sori) which contained a brown powder—the spores of the *Puccinia*.

Dr. Halsted recommends burning over the affected fields in autumn to destroy as many of the spores as possible, but it is our opinion that this treatment has little or no practical value.

Uromyces Trifolii (HEDW. F.) LEV.

This fungus is a true rust which is parasitic on various species of clover. It presents the same general appearance as the other rusts, such as asparagus rust, sunflower rust, carnation rust, etc., but is an entirely distinct species. On Long Island, the past season, it has been very abundant on the second growth, or rowen, of red clover. The damage must have been considerable. A full account of the fungus is given in Cornell Experiment Station Bulletin XXIV, issued in 1890.

No remedy is known.

Exoascus Cerasi (FCKL.) SADEBECK.

Several additional localities for this fungus on the cultivated cherry have been found on Long Island in 1896. It appears to be well established. Dr. Halsted* reports having observed it on a cultivated cherry tree at Newark, N. J., five years ago.

Exobasidium Peckii HALS.

This has again been abundant both on leaves and infloresences of *Andromeda Mariana*.

Ramularia cylindriopsis PK.

This, too, has been abundant in 1896.

* Halsted, B. D. Abnormal Growths Due to Fungi. Rept. of Bot. Dept. of the New Jersey Agr'l College Exp. Sta. for 1895, p. 355.

EXPLANATION OF PLATE XXXII.

Fig. 1. A spore of *Macrosporium herculeum.*

Fig. 2. A cluster of sporophores of *Helminthosporium inconspicuum*, with one spore attached.

Fig. 3. Spores of *Septoria Helianthi.*

Fig. 4. Three uredo-spores of *Puccinia Helianthi.*

Fig. 5. A teleuto-spore of *Puccinia Helianthi.*

Fig. 6. From a photograph of a flat-turnip leaf affected with *Macrosporium herculeum.*

Note.—Figures 1-5 were drawn with the aid of the camera lucida. Magnification, 345 diameters.

PLATE XXXIII.

A Diseased Sycamore Tree.

III. COMBATING CARNATION RUST.*

Summary.

(1) The majority of carnation growers still consider rust one of the most serious enemies to carnation culture, but it is not dreaded nearly so much as it was three years ago.

(2) Carnation rust is not localized at the point where the pustule appears, but may be found in all parts of the plant.

(3) Rust spores are not carried from one part of the plant to another by the circulation.

(4) Rust cannot rise spontaneously. The theory of spontaneous generation is exploded.

(5) The rusts found on various weeds are not the same as carnation rust.

(6) There have been made scarcely any properly conducted tests of fungicides for carnation rust.

(7) Some of the fungicides which have been most commonly recommended are: Bordeaux mixture, Fostite, potassium sulphide, carbolic acid, copper sulphate and copper sulphate in ammonia. The reports on these fungicides are conflicting.

(8) Tests of spore-germination in copper sulphate solutions indicate that 1-1000 solution is much too weak to prevent rust. Spores germinated readily in 1-500 solution, and there was some germination in 1-300 solution.

(9) One to forty-five appears to be the strongest salt solution in which rust spores can germinate.

(10) Spore-germination tests show that carnation rust spores are remarkably susceptible to the action of potassium sulphide. A 1-3000 solution entirely prevented germination

(11) Cuttings soaked in copper sulphate solutions were much injured. One-half hour in 1-2000 solution produced decided injury.

(12) Cuttings soaked in salt solution 1-20 were much injured; 1-40 solution apparently did no harm.

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* Published also as Bulletin No. 100.

(13) Cuttings soaked one-half hour in potassium sulphide solution, 1-134, rooted better and were more vigorous than untreated cuttings. Stronger solutions wrought injury.

(14) An attempt was made to cure rusty plants by weekly sprayings with potassium sulphide solution (1 oz. to 1 gal.), salt solution (8 lbs. to 45 gal.) and salt solution used alternately with copper sulphide solution (1 lb. to 45 gal.). All completely failed to cure rust.

(15) An attempt was made to prevent rust by weekly sprayings with potassium sulphide solution (1 oz. to 1 gal.), copper sulphate solution (2 lbs. to 45 gal.), salt solution (8 lbs. to 45 gal.) and Bordeaux mixture (1-to-7½ formula). At "lifting" time the percentage of rusty plants on potassium sulphide plot was 43½ per cent.; on copper sulphate plot 42 per cent.; on untreated cuttings, salt and Bordeaux mixture plots 100 per cent.

(16) We know of no fungicide which will cure rusty plants, nor of any method of wholly preventing infection in the field.

(17) Plants in the field are very liable to infection from neighboring fields.

(18) Plants grown all summer under glass are easier to manage as regards rust.

(19) Mr. Ward's device for spraying the lower leaves of large plants in the bench is an excellent one.

(20) Some knapsack sprayers are soon "eaten out" by potassium sulphide. Buy those which are made of copper.

(21) The greenhouse can be so managed that rust will give no trouble, even when susceptible varieties are grown.

(22) It has been proven by experiment that rust will spread among mature plants.

(23) Exposure to the fumes of burning sulphur for one hour killed rust spores.

(24) Varieties differ greatly in their susceptibility to rust. The reason for this is not known. The variety Wm. Scott is nearly, but not absolutely rust-proof. Uncle John is probably the most susceptible of all varieties.

(25) It is desirable that florists make experiments of their own.

(26) Throughout the entire life of the plants spray once per week with copper sulphate solution (2 lbs. to 45 gal.).

HISTORY AND DISTRIBUTION OF CARNATION RUST.

About five years ago it was announced* that a new fungous disease of the carnation had made its appearance in the United States. The new comer proved to be the carnation rust caused by the fungus, *Uromyces caryophyllinus* (Schrank) Schroeter, common in various parts of Europe, but hitherto unknown in America. By the time it began to attract the attention of florists it had already become widely disseminated through the sale of cuttings and rooted plants. We have no knowledge of the exact time of its importation into the United States, but there is good reason for believing that it had been here but a short time previous to its discovery by Prof. Taft, at Lansing, Mich., in 1890. Had it been long in this country it certainly would have come into prominence before it did, because florists are observant and ever watchful of the health of their plants, and mycologists, everywhere, are eager to find new fungi.

The fungus was first described in 1789 by Schrank,† a German botanist, who gave it the name of *Lycoperdon caryophyllinum.* At this time the knowledge of fungi was very limited and the classification much confused. The genus *Lycoperdon*, as now understood, includes the fungi which we call puff balls, a group of plants quite different from the rusts. Later, about 1805, it received from Persoon‡ the name of *Uredo Dianthi*, and finally in 1872 Schroeter§ gave it the name which it now bears, *Uromyces caryophyllinus.*

In the countries of Europe the disease is of long standing but does not seem to be particularly troublesome. It is occasionally

* Arthur, J. C., Botanical Gazette, November, 1891.

† Baiersche Flora II., p. 668.

‡ Synopsis Methodica Fungorum, p. 222.

§ Die Brand und Rostpilze Schlesiens, p. 10.

mentioned in works on plant diseases and in horticultural journals, but in no part of Europe has it been so destructive and so much feared as it has been in the United States during the few years of its presence here.

In the United States its distribution is as wide as that of the carnation itself. However, it is more common and more troublesome in the States lying east of the Alleghanies than in the interior of the continent. There are two reasons for this:—(1) the climate of the Eastern States is more moist; (2) carnation growers are more numerous and located closer together. It is not uncommon to find three or more carnationists in the same village. Such proximity makes it easy for spores to be carried by wind from one field to another.

A very few growers are entirely free from rust. I have personally visited a good many greenhouses on Long Island but I have been in only one which was wholly free from rust. That particular house was kept so dry and at such a low temperature that the plants themselves could barely exist. Some find rust exceedingly troublesome, being obliged to throw out entire houses of certain varieties; others, although never entirely exempt from rust, have no trouble with it and do not consider it as bad as the spot (*Septoria Dianthi*), bacteriosis or even stem-rot (*Volutella Dianthi?*). The majority still consider rust one of the most serious enemies to carnation culture, but it is not dreaded nearly so much as it was three years ago. During the winter of 1892-93 the rust scare amounted almost to a panic. As an indication of the interest taken in the matter at that time it is an interesting fact that three lengthy papers* on carnation diseases were presented to the American Carnation Society at its meeting held in Pittsburg, Pa., Feb. 21-22, 1893.

SOME POPULAR ERRORS REGARDING RUST.

The life history and microscopic characters have been so ably treated by Profs. Halsted, Arthur and Atkinson in the annual

* Halsted, B. D., Diseases of the Carnation other than Rust: Atkinson, Geo. F., Carnation Diseases; Ward, C. W., Carnation Enemies and Supposed Remedies.

reports of the American Carnation Society that it is unnecessary to discuss them in detail here. It is sufficient to call attention to a few erroneous ideas which are held by some florists.

Strange as it may seem there are still some who do not know carnation rust. In reply to a request for specimens of rust on the variety Wm. Scott I received from Kentucky leaves affected with bacteriosis. I have known of other cases in which these two diseases have been confused. The most reliable test for rust is the presence of the brown powder. The external manifestation of the presence of rust is in the production of chocolate-brown, elliptical, blister-like pustules (sori, sing. sorus) on the leaves and stem. If one of these pustules is rubbed with the slightly moistened finger tip a fine brown powder clings to the finger. This powder is composed of the spores or " seeds " of the rust fungus.

Some florists believe that rust is localized in those parts of the plant where the pustules make their appearance. Upon this theory as a basis they hope to eradicate the disease by the removal and destruction of the diseased leaves. While such practice is to be commended it can not, reasonably, be expected to effect a cure. The spread of the disease may be checked but that is all. By the time the pustule appears the mycelium has already spread to other parts of the plant.

This leads us to the consideration of another erroneous idea in regard to the circulation in plants. The circulation in plants is quite different from that in animals; that is to say, in plants the liquids do not follow definite channels in any sense homologous with the veins and arteries of animals, but instead, pass from cell to cell *directly through the cell-walls* according to the law of osmosis.* Consequently it is not possible (as some believe) for rust spores, although of microscopic size, to be carried from one part of the plant to another by means of the circulation. Rust spores are never found on the interior of carnation plants except in the immediate vicinity of the pustules.

* If two miscible liquids are separated by a membrane each liquid will pass through the membrane and become diffused throughout the other. This is known as the osmosis of liquids.

To prevent a possible misunderstanding which may arise from what has just been said it should be stated that the rust fungus consists of two portions: (1) a vegetative portion consisting of delicate colorless threads (mycelium) which are found only on the interior of the plant; and (2), a reproductive portion composed of the brown spores found in the pustules just beneath the epidermis of the leaf. The spores are the "*seeds*" of the fungus and not the fungus itself.

A few florists are not yet fully convinced that it is impossible for rust to arise spontaneously. There are a few diseases of plants which may be produced by unfavorable conditions of climate or soil or methods of culture. Such diseases are called physiological diseases and are never contagious. But no disease which is due to the destroying action of parasitic fungi or bacteria can ever be produced by any conditions of climate, soil or culture whatever unless the specific germ of the disease comes in contact with the plant; however, such conditions may accelerate the advance of the disease by being favorable to the development of the parasite or by reducing the vitality of the host-plant. Carnation rust is caused by the fungus, *Uromyces caryophyllinus*, which is a plant as truly as is the carnation itself. No carnation plant can become affected with rust unless it was propagated from a cutting containing the rust-mycelium or else comes in contact with rust spores. The theory of spontaneous generation, once vigorously advocated, has been, during the present century, so completely exploded that it is no longer upheld by any scientist in good standing.

Another popular error which should be corrected is the idea that the rust found on weeds is the same as carnation rust. In one case,* at least, this error has appeared in print. From conversation with florists I have learned that there are a good many who do not understand this matter. A Long Island florist once told me that he had discovered the source of the rust which was attacking his carnations. He conducted me to a patch of Canada thistles affected with the rust, *Puccinia suaveolens*, and point-

* Hatfield, T. D., Garden and Forest, 1894, Vol. VII., p. 17.

ing to them said, "*There* is where rust comes from." The family of rusts, *Uredineæ,* is a large one. A great many weeds are affected—some with two or more species of rust—but, so far as known, none of them harbor the carnation rust, *Uromyces caryophyllinus.* According to Dr. Winter* the host-plants of *U. caryophyllinus* are *Dianthus caryophyllus* L. (Carnation), *D. prolifer* L. *D. superbus* L. and *Gypsophila paniculata* L.

Fungicides Which Have Been Recommended for Rust.

A perusal of the floricultural literature reveals the fact that quite a variety of remedies have been recommended for carnation rust. One would naturally expect that these recommendations, coming as they do for the most part from practical florists, would point us at once to the proper method of combating rust. But it is to be observed that the evidence is frequently contradictory, some of it is pure theory and only in a few cases are the recommendations for treatment based upon the results of properly conducted experiments. Let us briefly review the literature of some of the fungicides recommended.

Bordeaux mixture.—This is the leading fungicide. It has been proven by experiment and in practice to be a specific for a long list of fungous diseases. It is in general use for spraying vineyards, orchards and potato fields. When the destructive character of carnation rust was brought to the attention of botanists they unhesitatingly recommended the use of Bordeaux mixture and gave the subject no further consideration. Florists who tried it in practice reported from time to time in the columns of the *American Florist* and *Florists' Exchange.* Most of these reports were favorable but some were unfavorable. It is not worth while to consider them in detail because, with one exception, the experiments were not made under test conditions. Those who tried the Bordeaux mixture were so anxious to entirely eradicate the disease from their premises that they did not take the precaution to leave a few untreated plants with which they might compare their treated plants in order to determine

* Winter, G., Rabh. Kryptogamen Flora I., Abtheil I., p. 149.

whether the treatment was beneficial or otherwise. (This applies not only to tests of Bordeaux mixture but to tests of all other fungicides as well.) Without such a check for comparison an experiment has but little value. If the disease disappears under treatment such disappearance may be due to the treatment or it may be due to something else. Carnation rust is very capricious in its behavior. I know of at least one case and have heard of several others where plants badly rusted completely recovered without any treatment whatever.

The exception above noted is an account of a spraying experiment made by W. R. Beattie* at Columbus, Ohio. A bench of badly rusted plants of the variety Tidal Wave was divided into plots and sprayed weekly with solutions prepared according to the following formulæ:

(1.) *Bordeaux mixture:—*

Copper sulphate, six pounds;
Quick lime, five pounds;
Water, twenty-two gallons.

(2.) *Sulphide of potassium:—*Two ounces to 22 gallons water.

(3.) *Chloride of copper:—*Three ounces to 22 gallons water.

"After three applications had been made a marked difference could be noticed between the sprayed and the unsprayed plants especially in favor of Bordeaux mixture." In all, five applications were made and the three sprays were found about equal in efficiency, "all showing a marked increase as compared with the unsprayed." The author concludes that it is impossible to exterminate the disease by any means whatever when it has once become established and efforts must therefore be directed to the prevention rather than the cure of it.

Carnation rust has received very little attention at the Experiment Stations. Lodeman † at the Cornell Experiment Station claims to have cured badly rusted carnations by two applications of Bordeaux mixture. As no untreated plants were left for a check his results cannot be taken as proof of the efficacy of Bordeaux mixture.

* Beattie, W. R., Carnation Rust. Florists' Exchange, Vol. VI., p. 492.
† Lodeman, E. G., Cornell Exp. Sta., Bull. No. 96, p. 333.

Fostite is a patented fungicide. Several have reported on it favorably, but as with Bordeaux mixture the reports were not based upon proper experiments. W. Davison* used copper sulphate solution on one-half of a lot of rusty plants and Fostite on the other half. The copper sulphate checked the rust but Fostite cured it completely.

Potassium sulphide:—Beattie† found that potassium sulphide checked rust and treated plants produced more flowers than did untreated. H. E. Chitty‡ got good results from the use of a spraying solution made by dissolving two pounds of potassium sulphide in forty-five gallons of water. In an address before the Massachusetts Horticultural Society January 26, 1895, Dr. Halsted said,§ "For carnation diseases potassium sulphide ½ oz. to 1 gal. has proved successful." Orpet|| reported it a failure.

Carbolic acid:—Tracht and Son¶ found three teaspoonfuls of carbolic acid to a bucket of water to be an effectual remedy. Beckert Bros.** cured badly infested stock by two applications of a 1 per cent. solution of carbolic acid and did no harm to the foliage.

Copper sulphate and ammonia:—This I believe has been used more generally than any other fungicide. In most cases the following formula has been followed:—

Dissolve one pound of copper sulphate in two quarts of ammonia in a two-gallon jar. When dissolved add another quart of ammonia and stir well. Add one pint of this solution to a barrel of water and spray every two weeks.

This formula appeared regularly at the head of the carnation columns of the *American Florist* from Aug. 9, 1894, to Nov. 17, 1894, and for several issues following that of Feb. 2, 1895. Very few have published reports on this fungicide, but from conversation and correspondence with florists I learn that it has sometimes appeared to be a success and sometimes a failure. Wm.

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* Davidson, W., Fostite for Carnation Rust. Florists' Exchange, Vol. VII., p. 148.
† Beattie, W. R., Carnation Rust. Florists' Exchange, Vol. VI., p. 492.
‡ Sulphide of Potassium for Carnation Rust. Florists' Exchange, Vol. VI., p. 1016.
§ Halsted, B. D., Fungous Diseases of Ornamental Plants. American Florist, Vol. X., p. 629; also Florists' Exchange, Vol. VII., p. 617.
|| Orpet, O. E., Carnation Rust. American Florist, Vol. IX., pp. 513–514.
¶ Tracht, J. A., and Son, Carbolic Acid for Carnation Rust. American Florist, Vol. IX., p. 681.
** Beckert Bros., Carbolic Acid for Carnation Rust. American Florist, Vol. IX., p. 880.

Stuart's* experiments on spore-germination show that it cannot possibly have any value as a preventive of rust. Some germination occurred in a solution *twenty-eight* times the strength of this formula.

Copper sulphate:—It has been found that plain copper sulphate solutions of considerable strength may be used on carnations without injury to the foliage. Mr. C. W. Ward has used as much as three pounds of copper sulphate to a barrel of water without any noticeable injury to the plants. Prof. Taft† found a 1-1000 solution of copper sulphate, applied once a week, entirely successful against carnation rust and recommended this treatment as being the most satisfactory.

Other fungicides which have occasionally been used and recommended are:—Ammoniacal copper carbonate solution, fir-tree oil, Littles' "Antipest," common salt, copper chloride, corrosive sublimate, sulphate of iron and arsenic.

SPORE-GERMINATION IN FUNGICIDES.

A fungicide protects a plant from the attacks of parasitic fungi by preventing the germination of fungus spores which happen to come in contact with the foliage of the plant. As a guide to the intelligent use of a fungicide against a particular fungus it is, therefore, important to know whether the fungicide is capable of preventing the germination of the fungus spores. Fungicides which prevent the germination of spores of some species of fungi may not be able to prevent the germination of spores of other species of fungi or else stronger solutions will be required. It is nearly always advisable to make laboratory tests of spore-germination in the fungicide to be tested before undertaking spraying experiments. Time is saved by so doing.

The germination tests of rust spores herein reported were made for the purpose of determining the best fungicide to use against carnation rust. In all cases the spores were germinated in hanging drops in Van Tieghem cells. In the check cells plain

*Stuart, Wm., Some Studies upon Carnation Rust. 8th Ann. Rept. Vermont Exp. Sta., 1894, p. 116. Also American Florist, Vol. IX., July 26, 1894, p. 1232.
† Taft L. R., Carnation Rust Combated. Florists' Exchange, Vol. VII., p. 123.

tap-water was used. In order to secure absolutely parallel conditions, except as to the liquid in which the spores were germinated, the treated cells and check were, in every case, taken from the same spore-pustule, or sorus, as it is technically called.

The results are presented in the following tables:

Copper Sulphate.

Strength of solution.	Number of cells.	Time.	Germination.
1–300	4 and check	22 hrs.	Check germinating freely. All treated cells showed considerable germination with vigorous germ-tubes.
1–400	4 and check	22 hrs.	Check germinating fairly well. All treated cells showed germination. Several long germ-tubes in each cell.
1–500	4		Some germination in all.
1–500	3 and check		Some germination in all. Check germinating most freely.
1–500	3 and check	15 hrs.	All germinated — treated cells more vigorously than check.
1–500	3 and check	6 hrs. 15 hrs.	Many spores in each of the four cells germinating. None of the treated as good as check, although two of the treated were germinating vigorously.
1–500	3 and check	20½ hrs.	Check and two treated germinating, treated doing well but not as good as check. No germination in one of the treated.
1–1000	4 and check	22 hrs.	Check germinating nicely. All of the treated showed germination but none as good as check. Germ-tubes vigorous.

COMMON SALT.

Strength of solution.	Number of cells.	Time.	Germination.
1–30	2 and check	22 hrs.	Check germinating vigorously. No germination in treated cells.
1–35	4 and 2 checks	22 hrs.	One check germinating fairly, the other not at all. No germination in treated cells.
1–40	4 and 2 checks	22 hrs.	Checks both germinating vigorously. No germination in treated cells.
1–45	4 and 2 checks	20 hrs.	Checks germinating very vigorously. Treated cells show from one to several germ-tubes barely started. At end of 25 hours no further development. Evidently this is the limit.
1–50	2 and check	19 hrs.	All germinating, but treated not as good as check.

POTASSIUM SULPHIDE.

Strength of solution.	Number of cells.	Time.	Germination.
1–100	3 and check	72 hrs.	Check dry, but had started to germinate; treated cells in good condition but showing no signs of germination.
1–135	5 and 2 checks	15 hrs.	One check germinating freely, the other only at edge of the drop; no germination in treated cells.
1–250	2 and check	22 hrs.	Check germinating freely; no signs of germination in treated cells.
1–250	2 and check	22 hrs.	Check germinating freely; no signs of germination in treated cells.
1–300	4 and 2 checks	19 hrs.	Almost every spore in checks germinating; treated cells show no signs of germination.

POTASSIUM SULPHIDE—*Continued.*

Strength of solution.	Number of cells.	Time.	Germination.
1–400	4 and 2 checks	19 hrs.	Checks germinating vigorously; treated cells show no signs of germination.
1–500	4 and 2 checks	18 hrs.	Checks germinating moderately; treated not at all.
1–625	4 and 2 checks	22 hrs.	One check germinating, the other not; no signs of germination in treated cells.
1–700	4 and 2 checks	21 hrs.	Checks germinating freely; no signs of germination in treated cells.
1-1000	4 and 2 checks	23 hrs.	Checks germinating vigorously; no signs of germination in treated cells.
1–1200	2 and check	41 hrs.	Checks germinating vigorously; no signs of germination in treated cells.
1–1200	7 and 2 checks	17 hrs.	Checks germinating weakly; treated not at all.
1–1200	4 and check	27 hrs.	Checks germinating vigorously; no signs of germination in treated cells.
1–1500	4 and 2 checks	17 hrs.	One check germinating freely, the other moderately; no germination in treated cells.
1–2500	3 and 2 checks	22 hrs.	One check germinating freely, the other not at all; no germination in treated cells.
1–3000	4 and 2 checks	18 hrs.	Checks germinating very vigorously; no signs of germination in treated cells.
1–3000	4 and check	17 hrs.	Check germinating freely around edge of drop; no signs of germination in treated cells.

The results of these tests are somewhat remarkable. Copper sulphate is considered an excellent fungicide, but as a preventive of the germination of carnation rust spores it is not nearly so efficient as potassium sulphide. Copper sulphate, 1-300, failed to wholly prevent germination, whereas potassium sulphide, 1-3000, completely prevented germination. These studies taken in connection with the results of our spraying experiments reported in a subsequent part of this bulletin lead me to believe that the beneficial results obtained by Prof. Taft* at the Michigan Agricultural College were accidental and not due, as he supposed, to the copper sulphate spray, 1-1000. No check is mentioned and I think there was none. In the germination test, copper sulphate, 1-500 (which is double the strength used by Prof. Taft) did not prevent germination. Generally the germination was less vigorous than in the treated cells, but the germ-tubes appeared healthy and capable of developing a mycelium if opportunity were offered.

It was frequently observed that spores lying at the edge of the hanging drop germinated sooner and more vigorously than spores nearer the center of the drop. This happened in pure water as well as in the fungicide solutions. The explanation of the phenomenon is as follows: spores, like seeds, require oxygen for their germination, and those spores lying near the edge of the drop have a more abundant supply of oxygen.

My results do not quite agree with those obtained by Wm. Stuart.† In copper sulphate, 1-500, he made two cultures neither of which showed any germination. I made sixteen cultures and fifteen of them showed more or less germination. In copper sulphate, 1-1000, he made seven cultures of which five did not germinate at all and two germinated nicely. I made four cultures all of which germinated. I am unable to account for these discrepancies except to suggest that in his tests of the 1-500 strength it may be possible that he accidentally used spores which were incapable of germination under *any* conditions. This sometime happens.

* Taft, L. R., Carnation Rust Combated. Florists' Exchange, Vol. VII., p. 123.
† Stuart, Wm., Some Studies upon Carnation Rust. 8th Ann. Rept. Vermont Exp. Sta., 1894, p. 116. Also American Florist, Vol. IX., July 26, 1894, p. 1232.

In potassium sulphide solution, 1-1000, he made eight cultures, three of which failed to germinate, four germinated poorly and one showed good germination. I made four cultures in this strength solution and obtained no signs of germination. In potassium sulphide, 1-2000, he made six cultures, two of which showed no germination, two poor germination and two medium germination. I made eleven cultures in this strength and obtained no germination at all; nor even in cultures made in solutions of 1-2500 and 1-3000. I used potassium sulphide from freshly opened packages. Upon exposure to the air it undergoes chemical change. This may account for the differences.

Mr. Stuart's experiments indicate that iron sulphate (copperas) may be a good fungicide against rust. A 1-2000 solution entirely prevented germination.

Soaking Cuttings in Fungicides.

Carnations are propagated chiefly by means of cuttings. If these cuttings are taken from plants affected with rust they are likely to contain portions of rust-mycelium which will develop as the carnation develops. The cure of affected plants by means of fungicides, if possible, must at least be a very difficult process for the reason that the mycelium or vegetative portion of the fungus is ensconced within the tissues of the plant where it is inaccessible to fungicides applied externally.

A plant may be affected with rust and yet not show it. Plants apparently in perfect health at the time the cuttings are taken may be affected with rust and transmit it to the cuttings. Hence it can rarely be determined with certainty whether a particular lot of cuttings is rust-free or not.

For the above-mentioned reasons it is very desirable that some process be devised whereby the rust-mycelium in cuttings may be killed so that the florist may be sure that he is starting with healthy stock. It occurred to me that possibly this end might be attained by soaking the cuttings in fungicides. If a freshly-cut stem is placed in a liquid, not too concentrated, the liquid will rise in the stem and penetrate to all parts. Anyone can demonstrate this to his satisfaction by placing the cut end of the stem of a white carnation in a bottle of thin red ink. In a short time the white petals will be streaked with red. This treatment brings the fungicide into direct contact with the rust-mycelium and we anticipated striking results.

The first step in the experiment was to determine what effect the treatment would have upon the cuttings themselves. The fungicides used were copper sulphate solution, potassium sulphide solution, and salt solution. In the tests of spore-germination these fungicides had been shown to be capable of preventing the germination of rust uredo-spores. While it does not necessarily follow that they would kill the rust-mycelium when brought into contact with it, it is reasonable to suppose that such might be the case.

In all of the soaking experiments each lot of cuttings was tied into a bunch by itself and the cut ends immersed in the fungicide.

The following is a record of the experiments made to determine the effect on cuttings of soaking them in fungicides:—

Copper sulphate.—January 23, 1895, ten lots of cuttings were prepared. Each lot contained 25 cuttings—12 of the variety Michigan and 13 of the variety Uncle John. Three lots were soaked in copper sulphate solution of the strength 1-2000, three lots in copper sulphate, 1-1000, three lots in copper sulphate, 1-500, and one lot, used a check, was not soaked at all. Of the three lots in each of three strengths of copper sulphate, one lot was soaked one-half hour, one lot one hour and the third lot two and one-quarter hours. After soaking, the cuttings were all "struck" January 23. The results are shown in the following table:

Strength of solution.	Time soaked.	Number of cuttings used.	Number of cuttings rooted Feb. 26.
Check.	Untreated.	25	19 rooted.
1-2000	½ hour 1 hour 2¼ hours	25 25 25	6 rooted. 1 rooted. 1 rooted.
1-1000	½ hour 1 hour 2¼ hours	25 25 25	None. None. None.
1-500	½ hour 1 hour 2¼ hours	25 25 25	None. None. None.

It appears that carnation cuttings soaked in copper sulphate even in as weak solutions as 1-2000 were very much injured.

Common salt.—April 25, 1895, cuttings were selected at random from rusty plants of the variety Uncle John, and divided into five lots, one of which was used as a check and the other four soaked in salt solutions with the following results:

Strength of solution.	Time soaked.	Number of cuttings used.	Condition June 12	
			Number rooted.	Number rusty.
1-40	½ hour 1 hour	25 24	22 24	18 22
1-20	½ hour 1 hour	25 53	12 6	12 6
Check*	Untreated	25	25	13

* This check was used also for the second experiment with potassium sulphide solution.

Salt, 1-20, wrought decided injury; but salt, 1-40, apparently did no harm.

Potassium sulphide.—February 26, 1895, nine lots of cuttings were prepared—four lots of the variety Lizzie McGowan, four lots of the variety Daybreak and one lot of the variety Uncle John. Three lots of McGowan and three lots of Daybreak were soaked for one-half hour in potassium sulphide solution of strength 1-134, 1-267 and 1-401 respectively. The remaining three lots were not soaked at all. All cuttings were "struck" February 26. Those which rooted were potted April 11 and (checks excepted) thereafter sprayed weekly with potassium sulphide, 1 oz. to 1 gal.

The results of the soaking experiment are shown in the following table. In the last column the results of spraying are given.

Variety.	Strength of solution.	Time soaked.	Number of cuttings.	Condition April 11.		July 15.
				Number rooted.	Remarks.	
Uncle John	Check	Untreated	13	9		9 rusty
McGowan	Check	Untreated	10	9		0 rusty
	1 oz. to 1 gal. (1–134)	½ hour	10	9	More vigorous than check	2 rusty
	1 oz. to 1 gal. (1–267)	½ hour	10	10	More vigorous than check	6 rusty
	1 oz. to 3 gal. (1–401)	½ hour	10	10		0 rusty
Daybreak	Check	Untreated	10	5		2 rusty
	1 oz. to 1 gal. (1–134)	½ hour	10	8		0 rusty
	1 oz. to 2 gal. (1–267)	½ hour	10	7		0 rusty
	1 oz. to 3 gal. (1–401)	½ hour	10	8		0 rusty

In this experiment, cuttings appear to have received a positive benefit from having been soaked in potassium sulphide solution. Desiring to ascertain the effect of soaking for a longer time and in stronger solutions, a second experiment was made as follows:

April 25, 1895, six lots of cuttings of the variety Uncle John were selected at random from rust-infested stock. All poor cuttings were discarded. Five lots were soaked in strong solutions of potassium sulphide, and one lot was left untreated for a check. The results are set forth in the following table:

Strength of solution.	Time soaked.	Number of cuttings.	Condition June 12.	
			Number rooted.	Condition as regards rust.
1 oz. to 1 gal. (1–134).	1 hr.	25	12	All show rust.
2 oz. to 1 gal. (1–67).	½ hr. 1 hr.	25 25	5 none.	All show rust.
3 oz. to 1 gal. (1–45.)	½ hr. 1 hr.	25 25	none. none.	
Check.	Untreated.	25	25	13 show rust.

It will be seen that strong solutions of potassium sulphide proved very injurious. Even of those soaked for one hour in strength 1 oz. to 1 gal. (1-134) less than 50 per cent. rooted, whereas, in the previous experiment this strength for one-half hour appeared to benefit the cuttings.

These experiments on the soaking of cuttings are so incomplete that we are not warranted in drawing conclusions from them, and, so far as I know, no other experiments of the kind have been reported. However, it seems to me not improbable that some treatment of this kind may yet be found advantageous.

The experiments indicate that copper sulphate cannot be used for this purpose. Of cuttings soaked one-half hour in a 1-2000 solution only 24 per cent. rooted, and of cuttings soaked the same length of time in a 1-1000 solution none rooted, while untreated cuttings under entirely parallel conditions, except that they had not been soaked, rooted 76 per cent. Copper sulphate solution as strong as 1-500 does not prevent the germination of rust spores.

Potassium sulphide is the most promising fungicide tried for soaking cuttings. As previously stated, cuttings soaked one-half hour in potassium sulphide solution, 1-134, rooted a larger percentage and appeared more vigorous than check. And yet 1-134 is more than twenty times the strength required to prevent germination of rust spores.

In the case of salt, a 1-20 solution was injurious, but a 1-40 solution for one hour did no harm. The strength required to prevent spore-germination is not less than 1-45.

For soaking cuttings it is best to discard all solutions which will not prevent germination of rust spores. Otherwise, the spores which cling to cuttings taken from infested houses might germinate and start the disease, thereby counteracting the good effect of soaking.

It will be seen that rust appeared on cuttings which had been soaked in potassium sulphide and also on those soaked in salt solution. But this fact should not be considered proof that the treatment had not killed the mycelium in the cuttings. In both cases, forty-eight days intervened between the date of soaking the cuttings and the date on which the plants were examined for rust. This gives ample time for rust pustules to result from inoculation occuring after the cuttings were soaked.

AN EXPERIMENT ON CURATIVE TREATMENT OF RUST.

In order to determine what can be accomplished by curative treatment of rust the following exepriment was made:

The plants used were, at the beginning, about three inches in height and potted in 2-inch pots. They were of three varieties; viz., Daybreak, Michigan and No. 54, and had been propagated from rusty stock in a house where rust was plentiful. They were divided into four lots and placed under treatment March 4.

Lot I consisted of 32 plants of Daybreak, 80 plants of Michigan and 10 plants of No. 54. They were sprayed once per week with salt solution, 8 pounds of salt to 45 gallons of water. While these plants were kept in the house (March 4 to May 27) they were never free from rust and by May 22 they showed considerable rust. May 27 all rusty leaves were removed and the plants set in the fields. In an examination made July 15, rust was found on 1 plant of Daybreak, 65 plants of Michigan and on none of No. 54.

Lot II consisted of 32 Daybreak, 80 Michigan and 10 No. 54. This lot was sprayed weekly—alternately with salt solution (8 lbs. to 45 gal.) and copper sulphate solution (1 lb. to 45 gal.). While indoors there was constantly a considerable quantity of rust. May 27 all rusty leaves were removed and plants set in the field. July 15 there was 1 rusty plant of Daybreak, 74 of Michigan but none of No. 54.

Lot III consisted of 32 Daybreak, 93 Michigan and 10 No. 54. This lot was sprayed weekly with potassium sulphide solution (1 oz. to 1 gal.). While indoors the plants showed considerable rust. May 27 all rusty leaves were removed and the plants set in the field. July 15 rust was found on 4 plants of Daybreak and on 79 of Michigan but on none of No. 54.

Lot IV consisted of 32 Daybreak, 80 Michigan and 14 No. 54. This lot was not sprayed at all. The plants showed considerable rust while indoors. May 27 all rusty leaves were removed and the plants set in the field. July 15 rust was found on 6 Daybreak, 68 Michigan and 1 No. 54.

It will be observed that there was no appreciable difference between the untreated and treated plots as regards the number of rusty plants, notwithstanding the fact that the treated plots had been sprayed once per week from March 4 to July 15. At the latter date we gave up all hopes of curing the plants and burned the entire four lots. Had the fungicides used possessed any value as curative agents, some benefit should have been manifest on the plants sprayed faithfully for eighteen weeks.

It may be asked what was the object of alternating salt solution with copper sulphate solution. It does not seem reasonable to suppose that the two fungicides used together in alternation could give better results than when used separately, but inasmuch as some carnation growers in the vicinity of Boston have advocated this treatment it was thought best to give it a trial.

From this experiment it appears that Michigan is more susceptible to rust than either Daybreak or No. 54. However, other observations show that Daybreak takes rust very easily.

AN EXPERIMENT ON PREVENTION OF RUST BY SPRAYING.

In March, 1895, we received from Fred Dorner & Son of Lafayette, Indiana, 3000 healthy* cuttings of the variety Uncle John. These were placed in a rust-free propagating house and while rooting they were sprayed weekly with potassium sulphide solution, strength 1 ounce to 1 gallon. Every precaution was used to keep them from rust infection. May 18 they were set in the field.

They were set in 11½ rows. A few days later the partial row was filled out with rooted plants received from Dorner & Son. There were then 12 rows containing about 3100 plants. Spraying was begun May 23 as follows: Two rows were sprayed with potassium sulphide solution, one ounce potassium sulphide to one gallon of water; three rows were sprayed with copper sulphate solution, two pounds of copper sulphate to forty-five gallons of water; two rows were sprayed with salt solution, eight pounds of salt to forty-five gallons of water; three rows were sprayed with Bordeaux mixture made of six pounds of copper sulphate, with sufficient lime to neutralize it, to forty-five gallons of water; the remaining row was left for a check and not sprayed at all. Subsequent sprayings were made at intervals of about one week on the following dates: June 1, 8, 14, 21 and 28, July 10, 16, 22 and 31, August 10, 16 and 24.

* I have inquired carefully into the condition of Mr. Dorner's place. I am assured by Mr. Dorner and also by Dr. J. C. Arthur, botanist of the Indiana Experiment Station, that Mr. Dorner has never had any rust on his premises. Dr. Arthur says that the nearest place where rust is found is at Indianapolis, 60 miles from Lafayette. The original healthy condition of the cuttings is beyond question.

On July 15, each and every plant was carefully examined and all which showed the least trace of rust were destroyed. This process was repeated July 27 and August 2. August 27, when the plants were "lifted," the check and plots sprayed with salt and with Bordeaux mixture were found to be so completely overrun with rust that it was thought best to destroy the entire stock in these three plots. There were just a few plants which did not show rust but they were so *very* few that no record of their number was kept. Practically all were rusty.

The results of the experiment may be tabulated as follows:

Fungicide used.	Number of plants treated.*	Number of Rusty Plants.				
		July 15.	July 27.	August 2.	August 27.	Total rusty plants.
Potassium sulphide (1 oz. to 1 gal.)	407	1	5	95	76	177 = 43½ %
Copper sulphate (2 lbs. to 45 gal.)	604	4	8	104	138	254 = 42 %
Salt (8 lbs. to 45 gal.)	397	23	4	75	remainder	397 = 100 %
Bordeaux mixture (1-7½ formula.)	890	30	9	69	"	890 = 100 %
Check (untreated.)	236	21	1	35	"	236 = 100 %

In this experiment, all of the fungicides used were prepared by myself and, with the exception of two sprayings were applied by myself. The two sprayings excepted were made by employees under my direction.

* In the course of the season nearly 500 of the plants were lost from various causes; some were killed by stem-rot, others were torn out or covered up in cultivation or met with some accident. The numbers given in the column under "Number of plants treated" represent the numbers of living plants on the several plots July 15.

In consideration of the fact that potassium sulphide undergoes a chemical change when exposed to the air for any considerable length of time, a fresh package of this chemical was opened for each application.

The Bordeaux mixture used was made according to the formula, six pounds of copper sulphate to forty-five gallons of water with sufficient lime to neutralize the copper sulphate, as shown by the potassium ferro-cyanide test.

At each spraying care was taken to wet every plant as thoroughly as possible. It is somewhat difficult to make spraying mixtures adhere to carnation foliage; particularly is this true of those varieties which possess a considerable quantity of the so-called " bloom." The variety Uncle John, however, has but little " bloom " and holds spraying mixtures fairly well.

The results of the spraying experiments are interesting and instructive. While summing up results and drawing conclusions we should constantly keep in mind the following and be governed accordingly:

First, This is but a single experiment, and a question of this kind should never be considered settled by one experiment, no matter how strong the evidence may appear. Next season's experiments may give different results.

Second, The test was a most severe one. Of all the varieties grown at the present time, Uncle John is probably the most susceptible to rust. Moreover, the season of 1895 on Long Island was an unusually favorable one for rust, and the experimental plants were constantly exposed to infection from rusty plants in a neighboring field.

None of the solutions appeared to injure the plants or retard their growth in the least. Both Bordeaux mixture and salt solution proved complete failures as preventives of rust, there being no noticeable difference between treated and untreated plants; all of the treated plants were rusty after twelve thorough applications. Copper sulphate solution and potassium sulphide solution were about equal in efficiency. Of plants sprayed with these solutions less than 44 per cent. in each case were rusty at lifting time as opposed to 100 per cent. of rusty plants in the check. Both of these solutions are readily washed off by rains which were very frequent during July. The adhesive character of Bordeaux mixture is well known. Notwithstanding this advantage possessed by Bordeaux mixture; both copper sulphate and potassium sulphide proved superior to it in a very rainy season under parallel conditions. It is probable that the latter two fungicides when used indoors, where they are not washed off by rains, will be still more efficient in preventing rust. It is impossible to say, without making further experiments, what degree of success may be expected from the faithful use of these solutions as a preventive indoors, but certainly the prospects are encouraging. The great obstacle to success in this direction is the difficulty of getting the plants through to lifting time without contracting rust. The most critical time in the life of the plant is the period of four months or thereabouts which it spends in the open air. So far as we at present know, there is no way of wholly preventing infection at this period and when plants are once infected we know of no treatment which will cure them. This last we learn from our experiments and from the experiments of Beattie* Plants in the field are constantly exposed to infection from rusty plants in neighboring fields. The vigilant, painstaking florist who takes all possible care, and at considerable expense perhaps, to prevent the rust from getting a foothold on his place, puts himself at the mercy of his more careless neighbors the day he sets his plants in the field. If there is a field of rusty plants anywhere within a radius of one mile his plants are almost sure to be exposed to infection. The rust spores, which are produced in immense numbers, are readily carried by the wind. How far spores may be carried in this way is not known, but probably for several miles. Dr. Thaxter† has placed on record some observations on a case of rust (*Roestelia botryapites*)

* Beattie, W. R., Carnation Rust. Florists' Exchange, Vol. VI., p. 492.

† Thaxter, R., On Certain Cultures of Gymnosporangia, with Notes on Their Rœsteliæ, Am. Acad. of Arts and Sciences, 1886, p 269. Dr. Thaxter informs me that on the Isle of Shoals, off the coast of New Hampshire, he found an abundance of *Rœstelia botryapites* on *Amelanchier* while there were no specimens of *Cupressus* (the host-plant of *Gymnosporangium biseptatum* which is genetically connected with *R. botryapites*) nearer than the mainland, eight miles distant. The sporidia of the *Gymnosporangium* must have been carried eight miles by the wind. The evidence here is more conclusive than in the instance above cited.

on leaves of shadbush (*Amelanchier*) in which the spores which brought about infection must have traveled eight miles. In the Mississippi Valley the wheat rust (*Puccinia graminis*) travels each season from south to north and it is believed to be spread chiefly through the agency of winds which carry uredo-spores from field to field.

As for carnation plants in the field, they cannot be counted entirely safe from infection unless they are several miles from any field of rusty plants. In regions like the vicinity of Philadelphia and Western Long Island where growers of carnations are numerous and located close together it is practically impossible to grow plants out-of-doors without exposing them to infection. There is one way of avoiding this trouble; namely, by growing the plants all summer under glass. Whether this method is practical or not I am unable to say. It is a point to be decided by carnationists rather than by botanists. But certain it is, that plants grown all the year under glass are entirely under the control of the owner. Messrs. Lonsdale,* Herr,† Dailledouze, Hill,‡ Dorner, Strollery, and, I believe, some others have tried it.

For spraying carnations, either indoors or out, copper sulphate solution is probably the best of all the fungicides tested in the experiments. There is no reason whatever for using the Bordeaux mixture. It is disagreeable to prepare and to apply, it spots the flowers and foliage, it is more expensive and not nearly as efficient as copper sulphate. Between potassium sulphide and copper sulphate there is not much choice except that the copper sulphate is somewhat cheaper. Copper sulphate can be purchased, in quantity, for about five cents per pound, making a barrel of the spraying mixture cost about ten cents.

When spraying large plants indoors it is sometimes difficult to reach the lower leaves and yet it is always desirable that all parts of the foliage be thoroughly wetted. Mr. C. W. Ward, of

* Lonsdale, E., Proc. 4th Ann. Meeting Am. Carnation Soc., 1895, pp. 44-45 and 53; also Am. Florist, Vol. VIII, p. 647.
† Herr, A. M., Am. Florist, Vol. X., pp. 194-195; also Am. Florist, Vol. XI., p. 673.
‡ Hill, E. G., Am. Florist, Vol. XI., p. 673; also the experiences of Dorner and Strollery are reported here.

Queens, N. Y., has devised an instrument by means of which this difficulty is overcome. It consists of a brass tube two feet long and bearing at its extremity a spray nozzle. This instrument is attached to the hose of the force pump and run between the rows of plants which are supported by the inverted V of wire netting illustrated on a subsequent page of this Report. One nozzle sprays the right-hand row and the other nozzle sprays the left-hand row. By this method it is possible to thoroughly spray all parts of the foliage. The instrument is shown in Fig. 8. It is not patented.

In this connection it may be well to call attention to the injurious effect which potassium sulphide has upon some knapsack spraying machines. The following case came under my observation the past season: In May, 1895, a " Gould Handy Knapsack Sprayer " was purchased and during the season it was used about two days out of each week for spraying carnations with potassium sulphide (1 oz. to 1 gal.) It is likely that a small quantity of the solution remained in the sprayer each time after it was used. The only other fungicides used in the sprayer were Bordeaux mixture, copper sulphate and salt, each of which was used a few times. About July 15, 1895, it was observed that the walls of the tank of the sprayer were almost as thin as paper. Holes could easily be punched through with the finger. The potassium sulphide had " eaten out " the sprayer in about seven weeks. The owner informed me that this was his second experience of the kind. In the spraying experiments reported in this bulletin a sprayer of another make was used and it was not injured in the least by the use of potassium sulphide. Knapsack sprayers made of copper (of which they should be made) will not be injured by potassium sulphide.

Controlling Rust without the Use of Fungicides.

There is much of importance which is, as yet, unknown concerning the physiology of carnation rust. Rust appears and disappears and we are unable to account for it; its capricious behavior has been observed by everyone who has given the subject any attention. Some time ago there appeared in the *American Florist** a brief article entitled, "A Carnation Puzzle." In substance it is as follows: The Heite Floral Co. have two places—one in Merriam, Kans., and one in Kansas City, Mo. At Merriam the houses are in terrible condition with rust although all remedies have been tried. In Kansas City the houses are in perfect health. The stock was all grown at Merriam. The question is asked, "Why is this?"

Some florists have no trouble with rust. They have a little here and there—a few plants affected—but it does not seem to spread and never gets the mastery. Daybreak is a very susceptible variety which some have been obliged to abandon on account of rust, yet have I seen this variety grown to perfection without the use of any fungicide whatever, notwithstanding the fact that rust was present in the house. Throughout the season traces of rust could be found but never in sufficient quantity to do harm. This is not an uncommon experience and it indicates that the disease may be controlled by greenhouse management.

In his account of the experiments previously mentioned Beattie says: "We have also found that careful managment of the greenhouse has more effect than anything else." In an article on ventilating, published in the *Florists' Exchange*, Lothrop Wight† says: "After cold weather has fairly set in we can have things just as we want them under glass and with proper management rust ought to disappear. If it does not, it will probably be due to neglect or oversight upon the part of the grower." I heartily endorse the views of these two gentlemen. I am confident that if we knew how to manage the greenhouse as regards temperature, watering, ventilation, etc., we need have no fear of carnation rust. It is easy to make such statements as the above and not difficult to demonstrate their truth, but to put the principles into practice and grow rust-free carnations is quite another matter. Exactly what are the conditions which are unfavorable to the growth of rust and yet not incompatible with the health of the plants themselves, we do not know and the

* S. M., American Florist, Vol. X., p. 512.
† Wight, Lothrop. Florists' Exchange, Vol. VII., p. 1146.

PLATE XXXIV.

Carnations Supported by Inverted V of Wire Netting.

knowledge is difficult to gain. The best thing we can do is to study carefully the methods of growers who are successful in combating rust and then experimentally duplicate these methods in our own greenhouses. To this end we are at the present time keeping careful records of the temperature, humidity, watering and ventilation in the greenhouse of a successful grower.

The method of watering is probably of considerable importance. Fungus spores require water for their germination, and hence the method of watering least favorable to the development of rust is the method in which the foliage is wetted the least. As far as the control of fungous disease is concerned, sub irrigation is the ideal system of watering carnations.

An interesting experiment* on the watering of carnations has been reported from Covington, Ky. Plants of Daybreak, McGowan, Portia and Hinze's White, which were kept wet all the time, developed rust in abundance, while other plants of the same varieties in the same house treated in the same way, except they were not allowed to become wet, showed no rust at all. Plants of Silver Spray within three feet of the rusty plants had not a trace of rust.

Mr. W. C. Ward,† of Queens, N. Y., considers that the first essential in fighting rust is to keep the "foliage free from heavy moisture." Anyone who wishes to do so can easily test this matter for himself.

As an additional precaution against the accumulation of moisture on the foliage, some means should be employed of raising the foliage off the soil, at the same time permitting the free circulation of air among the plants. The most perfect device for this purpose consists of an inverted V of wire netting (1-2-inch mesh) placed between the rows. The accompanying illustration (Plate XXXIV) explains how it is used.

An Experiment on the Inoculation of Mature Plants.

Dr. Bessey‡ attempted to inoculate mature carnation plants with germinating rust spores and failed. Basing his opinion

* "Backwoods." Carnation Rust: Cause and Prevention. Florists' Exchange, Vol. VI., p. 264.

† Ward, C. W., Carnation Enemies and Supposed Remedies. Ann. Report of the American Carnation Society for 1893, p. 77.

‡ Bessey, C. E., 7th Ann. Rept. Nebr. Exp. Sta., 1894, p. 10.

upon the results of this experiment and upon the common observation of florists that some plants refuse to take rust even when standing close to other plants badly infested, he stated it as his opinion that rust gains access to the carnation plant only when it is very young. Andrew Meyer* tried to infect some of the older varieties with rust and they failed to take it. Hinze's White flourished for two months among rusty Creightons and did not show rust. At the Boston meeting of the American Carnation Society Dr. Halsted† stated that he had produced rust by artificial inoculation of the leaves but he hesitated to say that Dr. Bessey was wrong. Wm. Stuart‡ inoculated healthy plants with rust spores. "Five weeks later microscopic examination of the tissues of the plants in the vicinity of the inoculations detected the presence of the mycelium in several cases. These were all cases in which the epidermis of the plant had been broken by needle puncture. In no case where this was not done was the mycelium found. No sori were found, the time being too short." The name of the variety upon which the tests were made is not given.

It will readily be seen that it is very important to know whether Dr. Bessey's idea is a correct one. If it is correct, all spraying and other application of fungicides to the foliage is useless expense and an entirely different line of treatment is necessary. In reply to a letter of inquiry, Dr. Bessey said that he did not know what was the variety he had tried to inoculate. The variety used in such a test is important because we now know that varieties differ greatly in their susceptibility to rust.

To test the matter for myself I made an experiment on two apparently healthy plants of Daybreak, a variety known to be very susceptible to rust. The plants, about six inches in height, were in 3-inch pots. May 6 they were thoroughly sprayed with water into which had been previously stirred a considerable quantity of fresh rust spores. The plants were then placed under a bell-jar and kept moist for 41 hours, the temperature of the room meanwhile being about 26° C. (79° Fahr.). When re-

* Meyer, Andrew, Am. Florist. Vol. VII., p. 807.

† Halsted, B. D., Proc., 4th Ann. Meeting Am. Carnation Soc., 1895, pp. 66 and 67; in the discussion following his paper, How to Distinguish Fungus Diseases of Carnations.

‡ 8th Ann. Rept. Vermont Exp. Sta., 1894, 117.

moved from under the bell-jar the plants were set in the garden. As late as July 1 (8 weeks from date of inoculation), no trace of rust could be found on the inoculated plants. The attempt at inoculation failed.

Such tests as these, however, are not sufficient to decide the matter. The proper test is to place healthy plants of a susceptible variety among rusty plants of the same variety. This kind of a test was made. On Nov. 6 five healthy plants of Uncle John, received from Dorner & Son, were set in a bench of very rusty Uncle John in the greenhouse of Mr. F. A. Storm. On Dec. 6 Mr. Storm, who had examined the plants daily, notified me that one plant showed a rust pustule first on Dec. 3. On Dec. 9 I examined the plants myself and found one undoubted rust pustule on each of two plants. The other three plants showed no rust. A few days later, and before any further observations were made, Mr. Storm destroyed the whole bench of Uncle John, which were so rusty as to be worthless, and replaced them with Easter lilies. The experiment was, therefore, unavoidably brought to a close before completed but not, however, before it was demonstrated that two of the plants had contracted the disease. There is no possibility that the plants were previously infected and hence it is proven that *carnation rust will spread among mature plants.* The time elapsing between the date of inoculation and the appearance of the first rust-sorus was twenty-eight days.

AN EXPERIMENT WITH SULPHUR FUMIGATION.

It is frequently recommended to fumigate greenhouses with sulphur in the fall before bringing in the plants. Painting the steam-pipes with a mixture of sulphur and lime is also recommended. The latter is done after the plants are brought in.

Wishing to know more definitely the effect which sulphur fumigation has on rust spores I made the following experiment:

A rusted carnation leaf was placed under a tall bell-jar having a capacity of twenty quarts. The bell-jar stood on a paper on the table, the edges of the bell-jar fitting closely all around. A dish containing five grams of burning sulphur was placed under the bell-jar and left undisturbed for one hour. At the end of the hour the carnation leaf was removed and four cultures made from one of the rust-sori. Before the leaf had been fumigated a check culture had been made from the same sorus from which the four cultures were afterward made. At the end of seventeen hours these four cultures and the check culture were examined under the microscope. The check culture was germinating freely but there were no signs of germination in any of the other four cultures. This showed that the sulphur fumigation had killed the rust spores.

During the process of fumigation the spores changed color, noticeably, from brown to light yellow.

The practice of fumigating greenhouses before bringing in the plants is undoubtedly a good one. If the work is thoroughly done spores of many kinds of fungi and also many insects will probably be killed; but I do not believe that the painting of steam-pipes with sulphur does any good—the fumes are not sufficiently strong.

RUST-RESISTANT VARIETIES.

It is an undeniable fact that some varieties of carnation are much less susceptible to the attacks of rust than are others, and this difference is sufficiently great to be of practical importance. Whether there is any variety absolutely rust-proof or not is uncertain. From observations which I have made in greenhouses in the vicinity of New York, I learn that the variety Wm. Scott is almost rust-proof. I have repeatedly seen it growing in the same house with other varieties which were rusting badly and not a trace of rust could be found on Wm. Scott. I have sought long and carefully for rust on Wm. Scott but have never been able to find it except in one case, viz.: in the greenhouse of Mr. Lee at Riverhead, N. Y., where it was not at all difficult to find specimens. In November, 1895, I published a note in the *American Florist* and also in the *Florists' Exchange* requesting those who have seen rust on Wm. Scott to communicate with me. Four florists responded—one from Texas, one from Kentucky, one from Ohio and one from Massachusetts. All claimed to have seen rust on Wm. Scott; but upon inquiry I learned that the gentleman in Texas and also the one in Kentucky did not know the rust. Their plants were affected with some other disease. The correspondents in Ohio and Massachusetts, however, still maintain that they know rust and are positive that they have seen it on Wm. Scott. But whatever the truth of this matter may be the fact remains that the variety Wm. Scott is remarkably resistant to rust. It is not uncommon for fungi to show a preference for certain varieties of their host-plant, but this character is rarely so strongly marked as in the present case.

Some of the varieties much subject to rust are Uncle John, Daybreak, Silver Spray and Jaqueminot. Of these, Uncle John is by far the worst. I predict a short life for this variety simply because of its extreme susceptibility to rust.

Wherein lies the reason for the difference in susceptibility of varieties is not at present clear. I suspect that there is considerable truth in Mr. Dorner's* theory that varieties possessing "bloom" on the foliage are more resistant to rust because the "bloom," being of an oily nature, prevents the accumulation of water on the foliage and hence favorable conditions for the germination of rust spores are not afforded. Comparative anatomical studies may throw some light upon the subject. I hope to be able in the near future to make such studies and also make further inquiry into the whole subject of rust-resistant varieties.

Making Experiments.

It is the business of the Experiment Stations to conduct experiments for the purpose of learning the nature and habits of fungi and of determining the value of fungicides, but there is no objection whatever to florists conducting experiments of their own. It is earnestly recommended that florists make experiments with different fungicides for carnation rust, and publish their results in the trade papers or elsewhere. But let the experiments be *experiments*, properly planned and faithfully carried out and the results accurately recorded and correctly reported. If all of those

* Dorner, Fred., Am. Florist, Vol. XI., p. 330

who have made the so-called tests of fungicides had made careful experiments such as they might have made with very little extra labor and expense we would be far in advance of our present position in this struggle with rust. In a properly planned experiment all conditions, save the one being tested, should be parallel; for example, if testing the value of any fungicide as a remedy for carnation rust there should be used at least two plots of plants. These two plots should be of the same variety, in the same house and treated in the same way as regards soil, watering, manuring, supporting, etc. They should be in all respects as nearly alike as possible save that one is sprayed regularly with the fungicide while the other is untreated. Should any difference appear between the two plots later they can then with good reason be attributed to the action of the fungicide.

RECOMMENDATIONS FOR TREATMENT.

As far as possible grow varieties which are least subject to rust.

Do not propagate from diseased stock and bear in mind that plants may be diseased and not show it. If there is any possibility of rust being present dip the cuttings in potassium sulphide solution* (1 oz. to 1 gal.) to kill such spores as may cling to the cuttings. "Strike" the cuttings in fresh sand.†

Throughout the entire life of the plants, from the time the cuttings are "struck" until the plants are exhausted the following spring, spray weekly with copper sulphate (2 lbs. to 45 gal.) or potassium sulphide‡ (1 oz. to 1 gal.). Copper sulphate is preferable because it is cheaper. It may be asked if it will pay to spray varieties which are not much subject to rust, such as Wm. Scott, Albertini, Portia, etc. Yes, it probably will pay because spraying will have a tendency to keep down spots,§ fairy ring, *Botrytis* and *Cladosporium*.

* It may be found best to soak cuttings one-half hour in this solution or a weaker one, but as yet we are not positive that such treatment will not injure the growth of the cuttings.

† Sand which has been used before is likely to contain spores of various fungi besides rust, particularly spores of the cutting-bed fungus *Volutella Dianthi*.

‡ This must be prepared fresh each time. Also the chemical must be excluded from the air. It is a good plan to buy it put up in 3 pound cans. One can of this size is the quantity required for a barrel of water.

§ There is scarcely any "direct" experimental evidence to show that either of the above fungicides will control the diseases mentioned. The statement is based on general principles. In Revue Horticole for 1894, p. 411, Prof. Magnin reports that copper sulphate, even in very dilute solutions, prevented the germination of the spores of fairy-ring fungus, *Heterosporium echinulatum*.

Before the plants are brought in in the fall the house should be thoroughly fumigated with sulphur.

Study carefully the greenhouse management of those growers who are able to control rust without the use of fungicides, and duplicate their methods as nearly as may be possible, giving special attention to the method of watering.

I wish here to thank those florists and others who have in various ways so kindly helped me in this work. In correspondence and conversation florists have at all times freely given me information. I am especially indebted to Fred Dorner & Son of Lafayette, Ind., who furnished the plants used in the experiments.

IV. POTATO DISEASES ON LONG ISLAND IN THE SEASON OF 1895.*

SUMMARY.

(1). The most serious disease affecting potatoes on Long Island are the early blight and late blight. These two diseases cause considerable loss which could be prevented by spraying with Bordeaux mixture. In an experiment at Floral Park five applications increased the yield 62 bushels per acre and three applications, 52 bushels per acre. Had late blight appeared the benefit from spraying would have been still greater.

(2). Paris green can be applied with Bordeaux mixture and is then more effective than when applied alone, either dry or in water. Plants sprayed with Bordeaux mixture and Paris green were less injured by flea-beetles and Colorado potato-beetles than were plants treated with Paris green only.

(3). The expense of spraying is small as compared with the increased value of the crop. With suitable apparatus it need not be more than about $1.00 per acre for each application.

(4). Beginning when the plants are from 6 to 8 inches high spray thoroughly at intervals of about two weeks until five or six applications have been made.

(5). The internal browning of potatoes was observed on Long Island in 1894. The cause of this trouble is not known. An experiment made at Cutchogue shows that potatoes so affected are considerably injured for seed purposes although the disease is not transmitted from seed to crop.

(6). A new stem-blight of potatoes has been observed on Long Island and in Dutchess county. Some fungus destroys the stem near the surface of the soil. It promises to become troublesome.

(7). "Pimply" potatoes are caused by some insect which punc-

*Published also as Bulletin No. 101.

tures the skin of the tubers while they are growing. This trouble was common in the eastern portion of Long Island in 1895.

(8) *Fusarium acuminatum* E. & E., a new species of fungus, has been found on potato stems at Canandaigua, N. Y. It is probably parasitic.

INTRODUCTION.

On Long Island potato growing is one of the leading industries and potato diseases consequently assume a proportional importance.

The season of 1895 on Long Island was probably about an average one for potato diseases. Some diseases were more destructive, while others were less destructive than usual.

The bacterial disease which causes a watery rot of the young tubers and suddenly wilts the tops by rotting the stem near the surface of the soil, has been rare. Upon good authority I am informed that in some seasons past, this disease has done much damage.

The potato scab, caused by the fungus *Oospora scabies*, which is so troublesome in many parts of the United States, is not at all common on Long Island. Its absence is to be attributed chiefly to the facts that the soil is sandy and devoid of lime and that very little barnyard manure is used. The fertility of the soil is maintained, for the most part, by the use of commercial fertilizers.

The greater part of the damage to potatoes here is caused by the two diseases known as early blight and late blight. Of these two, the *late blight* is much the better known. This disease appears in warm, moist weather in mid-summer. It first attacks the foliage. The leaves turn black and die. If the weather continues warm and rainy whole fields may go down in a few days. Later in the season the tubers become affected with a foul-smelling rot. The cause of the disease is a parasitic fungus, *Phytophthora infestans.* The *early blight* is not affected to any extent by weather conditions. It appears every year and continues its depredations throughout the entire life of the plants, whether the weather be wet or dry. It attacks the foliage only, producing brown, brittle, circular spots on the leaves. These spots usually have their origin in flea-beetle injuries. The disease works slowly. It never rots the tubers. The cause of the disease is a parasitic fungus, *Macrosporium Solani.*

In 1895 there was considerable loss from late blight in the eastern part of Long Island, but very little in the western part. The early blight did considerable damage in all parts of the island.

It is impossible to estimate, even approximately, the amount of damage done annually by these two blights, but the results of the spraying experiment reported in a subsequent portion of this Report go to show that the damage is considerable. I am confident that it is much greater than farmers generally realize.

SPRAYING POTATOES.

The object of spraying is to prevent the two diseases, early blight and late blight; and it has been proven by numerous experiments that spraying will prevent both of these diseases. Moreover, it has been shown that the yield can be increased enough to pay considerably more than the expense of spraying. It has been so thoroughly tested by experiment and in practice that we are warranted in making the statement that spraying should be made one of the regular operations in potato culture as much as the application of fertilizer or the cultivation. The question awaiting an answer is not, " Will it pay to spray? " but rather, " What is the most economical method of spraying? "

In order that farmers might see what can be accomplished by spraying potatoes on Long Island, the following experiment was made. It was also desired to compare five applications with three.

The experiment was made at Floral Park, N. Y., on a field of potatoes belonging to Mr. F. P. Baylis. Mr. Baylis kindly gave me permission to use four and one-half acres of the field for a spraying experiment. The experimental plot had been planted to potatoes for four consecutive seasons, during which time it had been fertilized practically alike all over. It was divided into three portions which we shall call Plots I, II, and III. The soil was uniform throughout. The three plots were planted on the same day, with the same variety of potato, Michigan Rose, treated with the same quantity of fertilizer, 1,825 lbs. per acre, and given the same cultivation.

Plan of Experimental Field.

Plot I	Plot II.	Plot III.
1½ acres.	1½ acres.	1½ acres.
Sprayed 5 times.	Check—not sprayed.	Sprayed 3 times.
Yield 270 bu	Yield 182 bu.	Yield 272 bu.

Spraying was begun June 4, when the plants were from 6 to 8 inches high, and repeated at intervals of about two weeks, until Plot I had received five applications and Plot III three applications. Plot II was not sprayed. The last application to Plot I was made Aug. 2.

The Bordeaux mixture used was made according to the 1 to 7½ formula, that is, six pounds of copper sulphate to forty-five gallons of water, with sufficient lime to neutralize the copper sulphate. When Paris green was used it was used at the rate of three-fourths of a pound to forty-five gallons of the mixture. The first application was made with a knapsack sprayer; all the others were with a horse machine.

The difference in the treatment of the three plots will be made clearer by the following table:

	Plot I.	Plot II.	Plot III.
1st spraying	Bordeaux mixture and Paris green.	Paris green in lime water.	Bordeaux mixture and Paris green.
2d spraying......	Bordeaux mixture and Paris green.	Paris green in lime water.	Bordeaux mixture and Paris green.
3d spraying......	Bordeaux mixture.	Not sprayed.	Bordeaux mixture.
4th spraying.....	Bordeaux mixture.	Not sprayed.	Not sprayed.
5th spraying.....	Bordeaux mixture.	Not sprayed.	Not sprayed.

On the unsprayed plot the early blight was plentiful by June 25, and continued its ravages throughout the season. This plot was less attacked than some other fields in the vicinity and more than others; on the whole it was about an average field for the season, as far as early blight is concerned. By August 2 Plot II was badly affected with early blight, and there was considerable on Plot III, but Plot I was almost perfect in foliage. On Aug. 15, not a single green leaf could be found on Plots II and III. All of the plants were dead, while on Plot I about two-thirds of the leaves were still green. The late blight did not appear at all.

Throughout the season it was noticeable that the flea-bettle injuries were much less numerous on the sprayed plots than on the unsprayed plot. That Bordeaux mixture will check flea-beetles is by no means a new idea. It has been repeatedly observed by Prof. Jones at the Vermont Station and by others.

Our experiment showed very strikingly, also, that Bordeaux mixture is exceedingly distasteful to Colorado potato-beetles.* At the time of the fifth spraying (Aug. 2) Colorado beetles were quite numerous on the unsprayed plot, and on other unsprayed portions of the field, while scarcely a beetle could be found on Plot I and only a few on Plot III. This could not have been the consequence of using Paris green in the Bordeaux mixture, because no Paris green had been used since June 24, and since that date several heavy rains had fallen, washing off all traces of the spray applied at that time. In the case of Plot III, twenty-four days had elapsed since it had been sprayed with anything. Only traces of the Bordeaux mixture could be seen and yet the Colorado beetles shunned the plants. Later in the season the same thing was observed on tomato plants. Colorado beetles were unusually abundant, and when the potato plants died the beetles migrated in swarms to egg-plants and tomatoes. Unsprayed tomato plants were almost completely stripped, while adjoining plants sprayed with Bordeaux mixture were scarcely touched.

At digging time the tubers on the three plots were sorted and measured, with the following results:

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* *Doryphora decemlineata* Say.

YIELD PER PLOT.

	Total.	Merchantable tubers.	Small tubers.
Plot I. Sprayed five times........	270 bu.	257 bu.	13 bu.
Plot II. Not sprayed..............	182 "	164 "	18 "
Plot III. Sprayed three times.....	272 "	242 "	30 "

YIELD PER ACRE.

	Total.	Merchantable tubers.	Small tubers.
Plot I...........................	180 bu.	171 bu.	9 bu.
Plot II..........................	121 "	109 "	12 "
Plot III.........................	181 "	161 "	20 "

Increase in yield due to spraying with Bordeaux mixture five times,—sixty-two bushels of merchantable tubers per acre.

Increase in yield due to spraying with Bordeaux mixture three times,—fifty-two bushels of merchantable tubers per acre.

Difference between three and five sprayings,—ten bushels of merchantable tubers per acre.

As previously stated, no late blight appeared. The increased yield on the sprayed plots is due to the fact that the Bordeaux mixture prevented the early blight* and gave more perfect protection against flea-beetles† and Colorado beetles.

I am convinced that many farmers who spray potatoes do not use enough Bordeaux mixture to get the best results. The object should be to keep the entire foliage at all times covered with the fungicide. A few drops of poison on the upper leaves may do for insects—they will eat of the poison and die; but against fungous diseases each leaf must be protected individually. When horse machines are used there should be at least *two* nozzles, and better yet, *three* nozzles for each row. If using a sprayer which has but a single nozzle to the row it is best to go over the ground twice. Vermorel nozzles are the best for spraying potatoes. The quantity of liquid required for an acre may be computed from the number of nozzles to the row. If one nozzle per row is used,

* *Macrosporium Solani* E. & M.
† *Crepidodera cucumeri* Harr.

about 30 gallons per acre will be required; two nozzles per row will use about 60 gallons per acre, and so on. When a knapsack sprayer is used the quantity of mixture required will vary from 60 to 100 gallons per acre, according to the size of the plants.

The kind of spraying machinery to be used depends upon the acreage to be sprayed. For small fields of three acres or less a knapsack sprayer is entirely sufficient and more economical than a power machine. However, if it is desired to use the same apparatus for spraying in the orchard it would be advisable to use the barrel pump outfit described below. The knapsack sprayer can also be used for applying fungicides and insecticides to small fruits and vegetables. The knapsack sprayer is rapidly taking its place as a part of the necessary farm machinery. There are several kinds varying in price from $10 to $15. One of the best can be purchased for $12.

For larger fields it will be found advantageous to use horse machines. Here again we have quite a variety, some better than others but none perfect. It is advisable to buy only on approval. If the dealer is not willing to have his machine tested it is a good indication that there is something wrong about it. For a discussion on spraying machinery see Bulletin No. 74 of this Station.

A cheap and very serviceable outfit for spraying potatoes may be made by mounting a force-pump in a barrel which is hauled through the field on a two-wheeled cart. The nozzles are fastened at the rear of the cart in such a position as to wet as much as possible of the foliage. One man can work the pump and do the driving, spraying two rows at a time. With slight changes in the hose, this outfit can be used for spraying in the orchard. Good brass-lined force-pumps for the purpose can be bought for $10.

Full directions for the preparation of Bordeaux mixture can be obtained from Bulletin No. 86 of this Station. Copper sulphate should not cost more than 5 cents per pound. In barrels of 350 lbs. it can be purchased for 4½ cents per pound f. o. b. New York. It can be kept indefinitely without losing its strength.

The treatment which has given the best results and which is consequently the one to be recommended is as follows: Make the first application when the plants are from 6 to 8 inches high and repeat at intervals of about two weeks until five or six applications have been made. In rainy seasons it is necessary to spray more frequently than in dry seasons. The Bordeaux mixture should be plainly visible on the foliage all the time. Spray *thoroughly.*

Since blight (late blight) appears on Long Island perhaps not oftener than one year in four on the average some have expressed the opinion that it will not pay to spray every year to prevent it. They who hold such opinions overlook the fact that spraying protects the plants not only against *the* blight (late blight) but also against the *early blight* which on Long Island is really the more destructive of the two. It will pay Long Island potato growers to spray if the late blight should *never* appear.

This leads us to the consideration of the expense of spraying. It is readily seen that the expense must vary with the price of labor and the kind of machinery used. Supposing that a knapsack sprayer is used, that a man can spray two acres per day, that the price of labor is $1.35 per day and that 90 gallons of mixture are used per acre, Mr. Hunn* places the cost of four sprayings at $6.50 per acre or $1.62 for each spraying. Prof. Galloway, Chief of the Division of Vegetable Physiology and Pathology, U. S. Department of Agriculture, makes a lower estimate. He says,† "With suitable apparatus and labor estimated at $1.50 per day, potatoes may be sprayed six times for about $6 per acre. This estimate is based upon experiments extending over several years and includes the cost of chemicals as well as of labor." The difference between these two estimates is due chiefly to a difference in the kind of apparatus used. The treatment with the knapsack sprayer involves a greater expense per acre. However, all agree that the expense is small as compared with the increased value of the crop.

* Hunn, C. E., Bordeaux Mixture Used to Prevent Potato Blight. Eleventh Ann. Rept., N. Y. Agrl. Exp. Sta., 1893, p. 698.
† Galloway, B. T., Some Destructive Potato Diseases: What They Are and How to Prevent Them. U. S. Dept. of Agriculture, Farmers' Bulletin No. 15. p. 7.

When considering the expense of spraying the fact should be taken into account that usually two, and sometimes more, applications of Paris green are required to control the Colorado potato beetles. When Bordeaux mixture is used the Paris green may be applied with the Bordeaux mixture and the only additional expense is the price of the Paris green itself. Paris green applied with Bordeaux mixture is more effective than when applied in any other way because it adheres to the foliage better.

INTERNAL BROWNING OF POTATOES.

Early in April, 1895, Mr. C. A. J. McCarthy of Cutchogue, N. Y., sent to the Experiment Station some potatoes affected with a peculiar disease. The tubers were outwardly perfect, but when cut open they showed numerous brown spots scattered irregularly through the white flesh. These spots varied in size and their outlines were very irregular and not definitely marked. As a rule, they were distributed throughout the tuber, but frequently they would be found aggregated at one end, in the center, or nearer one side. Mr. McCarthy, who made a large number of observations, says that such aggregations are more likely to occur at the seed end than in any other part of the tuber. There is no rot connected with the disease.

The same disease has been reported from Minnesota,* and Mr. A. F. Woods, of Washington, D. C., informs me that it has been reported to the U. S. Department of Agriculture from other States, and that it has also been observed in Europe. Prof. Green says that in Ramsey and Hennepin counties, Minnesota, probably one-half of the potatoes brought into market in 1894 were affected with the disease. Out of thirty-one varieties of potatoes grown on the University farm at St. Anthony Park, Minn., in 1894, twenty-eight showed the disease. In eleven of these varieties fifty per cent. or more of the tubers were affected. On Long Island, Mr. McCarthy's experience was different. In 1894, he grew thirteen varieties, but Green Mountain was the only one affected. This variety showed about sixty per cent. of

* Minn. Exp. Sta., Bull. No. 39, p. 212.

diseased tubers. So far as I can learn the disease appeared only to a slight extent on Long Island in 1894, and not at all in 1895. Prof. Green writes that he has heard of no case of the disease occurring in Minnesota in 1895, although diseased tubers were planted in various parts of the State. In Minnesota the disease is known as "rot" or "brown rot." Prof. Green calls it "Internal Brown Rot of Potatoes." Inasmuch as the disease is in no sense a rot, I prefer to use the name at the head of this article.

The cause is not clear. That it is *not* caused by insects, fungi or bacteria is quite certain for the following reasons:

(1) The brown spots are frequently *entirely surrounded* by healthy tissue and have no communication whatever with any portion of the surface.

(2) Agar-agar cultures made from diseased tissue produced no growth. Attempts to communicate the disease to healthy tubers failed, and diseased tissue placed in a sterilized moist chamber produced neither bacteria nor fungi.

(3) A careful microscopic examination of the spots shows no disorganization of the tissue, no diminution in the amount of starch, no fungi and no bacteria.

The cause is probably a physiological one. Certain conditions of growth, perhaps, bring about certain changes in the tuber. There are some reasons for believing that rapid growth favors the disease. One of these reasons is the fact that the small potatoes, or "seconds," are seldom affected. The small potatoes are produced late in the season, when growth is slow.

The disease materially injures tubers for cooking purposes, but the tubers appear healthy and are frequently disposed of before the disease is detected. Hence complaints usually come from consumers and dealers, rather than from producers. If the diseased tubers are fit for seed they should be put to that use? Here, two questions arise:

(1) Will the disease reproduce itself in the crop?

(2) Will plants from the diseased tubers be as vigorous and produce as large a crop as plants from healthy tubers?

In order to settle these questions I proposed to Mr. McCarthy to make an experiment. But before Mr. McCarthy received my letter he had already planted or disposed of his whole crop. He had, however, begun an experiment of his own planning, which is by his permission reported below. The experiment was planned and carried out wholly by Mr. McCarthy.

PLOT OF EXPERIMENTAL FIELD.

	100 feet.	88 feet.	50 feet.
1	*a* Yield 58 lbs.	*b* Yield 61 lbs.	
2	*c* Yield 167 lbs.		
3	*a* Yield 64 lbs.	*b* Yield 67 lbs.	*d* Yield 29 lbs.
4	*c* Yield 161 lbs.		*d* Yield 32 lbs.
5	*a* Yield 66 lbs.	*b* Yield 63 lbs.	
6	*c* Yield 161 lbs.		
7	*a* Yield 69 lbs.	*b* Yield 59 lbs.	
8	*c* Yield 159 lbs.		
9	*a* Yield 82 lbs.	*b* Yield 67 lbs.	
10	*c* Yield 142 lbs.		
11	*a* Yield 77 lbs.	*b* Yield 69 lbs.	
12	*c* Yield 166 lbs.		
13	*a* Yield 61 lbs.	*b* Yield 62 lbs.	
14	*c* Yield 171 lbs.		
15	*a* Yield 69 lbs.	*b* Yield 70 lbs.	
16	*c* Yield 164 lbs.		
17	*a* Yield 67 lbs.	*b* Yield 72 lbs.	
18	*c* Yield 157 lbs.		
19	*a* Yield 73 lbs.	*b* Yield 61 lbs.	
20	*c* Yield 151 lbs.		
21	*a* Yield 81 lbs.	*b* Yield 68 lbs.	
22	*c* Yield 167 lbs.		
22	*a* Yield 72 lbs.	*b* Yield 66 lbs.	
24	*c* Yield 149 lbs.		

Total length of Rows	*a* = 1200 ft.	Total yield	= 839 lbs.
Total length of Rows	*b* = 1056 ft.	Total yield	= 786 lbs.
Combined length of Rows *a* and	*b* = 2256 ft.	Combined yield	= 1624 lbs.
Total length of Rows	*c* = 2256 ft.	Total yield	= 1918 lbs.
Total length of Rows	*d* = 100 ft.	Total yield	= 61 lbs.

Rows *a* yielded at the rate of 169 bu. per acre.
Rows *b* yielded at the rate of 180 bu. per acre.
Rows *c* yielded at the rate of 206 bu. per acre.

Rows a were planted with badly diseased tubers.

Rows b were planted with healthy portions of diseased tubers; that is, the pieces planted showed no brown spots.

Rows c were planted with tubers which showed only a trace of the disease.

Rows d were planted with healthy tubers.

All conditions of soil, cultivation and amount of fertilizer were as nearly as possible the same. The same variety, Green Mountain, was planted throughout. The small yield is due, in part, at least, to attacks of blight, *Phytophthora infestans*, which killed the tops prematurely. This, however, does not affect the experiment, because none of the tubers rotted, and on account of the alternation of rows of badly diseased seed with rows of slightly diseased seed it is not likely that blight injured the one more than the other.

It is to be regretted that the check of perfectly healthy seed was not larger. Being so small it is of no value and will not be considered. The whole experiment is on too small a scale; but since it is so planned that all conditions (save the amount of disease in the seed) are parallel, and the results are so marked and so consistent with themselves, the experiment is worthy of consideration.

First, let us compare rows *a* and *b*. Rows *a* were planted with badly diseased tubers. Rows *b* were planted with healthy part of diseased tubers. With the exception of rows 7, 9, 19 and 21 the yield of *b* was larger, proportionately, than *a*. In five cases the eighty-eight feet of *b* yielded more than the one hundred feet of *a*.

Second, let us compare rows *a* and *b* with rows *c*. Rows *c* were planted with tubers showing only traces of the disease. Rows *a* yielded at the rate of one hundred sixty-nine bushels per acre; rows *b* yielded at the rate of one hundred eighty bushels per acre, while rows *c* yield at the rate of two hundred six bushels per acre.

It should be observed that in each couplet of rows the combined length of *a* and *b* is equal to the length of *c*; viz., 188 feet; but only in one case (rows 9 and 10) does the combined yield of *a* and *b* equal the yield of *c*. This is a very significant fact.

CONCLUSIONS.

Final conclusions cannot be drawn from a single experiment. All we can say is that this experiment teaches the following:

First: The disease of potatoes known as "internal brown rot" or "internal browning" is not transmitted from seed to product;

Second: The greater the amount of "interior browning" in the seed tubers the smaller the yield. It is therefore not advisable to plant tubers so affected.

ANOTHER STEM-BLIGHT OF POTATOES.

In July, 1895, I first noticed at Jamesport, N. Y., a peculiar appearance of potato foliage which was new to me. A few days later potato plants similarly affected were sent to me accompanied by the information that the disease was doing considerable damage in the vicinity of Farmingdale, N. Y. Pressure of other work prevented a thorough investigation of the trouble. In the later part of August a farmer in Dutchess county, N. Y., reported that the same disease was very destructive in that section. I visited Dutchess county September 4 and found that some fields had been wholly ruined by it. It has also been reported from Orange county, N. Y.

The disease is characterized as follows:

First, there is a cessation of growth. The topmost leaves take on a yellowish, or in some varieties a purple color, and roll inward from the edges and upwards, exposing the under surfaces. This condition is followed by wilting and complete drying up of the entire foliage, the process taking from one to three weeks. The tubers appear to be sound, but when cut at the stem end blackened fibers are seen penetrating the flesh to a considerable distance materially injuring it for cooking purposes. No rot develops in the tubers. The stem just beneath the surface of the soil first shows discolored spots and later becomes dry and shriveled.

In Dutchess county it was more prevalent on upland soil than on the moister lowlands. No variety appears to be exempt and the time of planting seems to make no difference. Neither is it to a great extent dependent upon weather conditions. It was plentiful in Dutchess county in 1894 which was there a very dry season; it was still more plentiful in 1895, a moderately wet season; and it also appeared on Long Island in very wet weather. Sometimes one or two stalks in a hill will be diseased while the remaining stalks continue healthy and mature their tubers. The yield is diminished and the tubers are poor in quality. Probably they are considerably injured for seed purposes.

There are several wilt diseases of the potato known and it is possible that this is one which has already been reported but I think not. I know of no description of a potato disease in which mention is made of a coloration of the young leaves correlated with a blackening of the fibro-vascular bundles at the stem end of the tubers; and a description of this disease which omits these characters is very incomplete because they are constant and the most striking characters of the disease.

The damage is not done by insects. It seems to be a clear case of strangulation caused by the attacks of some fungus just beneath the surface of the soil. The diseased stems contain an abundance of fungus mycelium but I have not been able to determine what particular fungus is the cause of the trouble. I strongly suspect that the damage is done by *Oospora rosea** (Preuss) Sacc. & Vogel, which may nearly always be found on the inside of diseased stems after the death of the plants. *Melanospora ornata** Zukal, supposed to be strictly saprophytic, is also frequently found on the inside of dead diseased stems; but I have been unable to find any specimen of the *Vermicularia* which Dr. Halsted† found in connection with his stem-blight of potatoes in New Jersey.

The disease will be a difficult one to treat. It cannot be controlled by spraying.

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* Determined by Dr. R. Thaxter.
† Halsted, B. D., New Jersey Agrl. Experiment Station. Report for 1891, p. 354.

"Pimply" Potatoes.

A peculiar trouble of potatoes has been brought to my attention by farmers in the eastern part of Long Island. The affected tubers are known as "pimply" potatoes. Several varieties have been affected but the Green Mountain has been more commonly affected than any other variety. A farmer near Cutchogue, who raised 180 bushels of "pimply" potatoes of this variety, was obliged to sell them at five cents per bushel below the market price because of their condition. Outwardly, the tubers are perfect, except for the so-called "pimples," which are low convex elevations, usually scurfy at the summit, from 3 to 5 millimeters in diameter, and distributed irregularly over the surface. Ninety-three such pimples were counted on a single medium-sized tuber. Upon removing a thin paring the flesh of the potato appears to be punctured here and there with short, brown, woody slivers, which give it an unsightly appearance when cooked. There is but a single "sliver" underneath each "pimple." Ten of the "slivers" which were measured, varied in length from 2 to 5 millimeters, the average length being 2.9 millimeters ($\frac{1}{9}$-inch). Microscopic examination shows that the "sliver" consists of a small tube surrounded by cork-cells. The surrounding cells within a radius of from one to two millimeters are markedly deficient in starch, while, curiously enough, the tube itself is filled with loose starch grains.

As to the cause of the "slivers," the most rational theory is that some insect punctured the skin of the tuber while it was growing and the plant, in its effort to heal the wound, produced cork-cells around the puncture. Almost any slight injury to the skin of a potato tuber will result in the formation of cork-cells. The absence both of insect eggs and of larval castings from the tubers indicates that the punctures were made for feeding purposes, rather than for the deposition of eggs.

A New Fusarium on Potato Stems.

In July of the past season a farmer in the vicinity of Canandaigua, N. Y., sent to the Station some potato stalks which were girdled in various places by a pink fungus, which Mr. J. B. Ellis pronounces a new species and names *Fusarium acuminatum* E. & E. Prof. Beach, the Station Horticulturist, informs me that complaints of a similar character have come to the Station in former years and he feels quite certain that specimens of the same fungus were sent him in 1893. As reported, the disease has usually appeared in the center of the field about mid-summer, spreading rapidly for a few days and then disappearing, so that when requests for specimens were sent the reply came that no more specimens could be found. Although not proven by inoculation of healthy plants, there is strong evidence that the *Fusarium* is parasitic. It has not been observed on Long Island.

The following technical description of the fungus by Ellis and Everhart, is copied from the Proceedings of the Academy of Natural Sciences of Philadelphia for 1895, page 441:

"*Fusarium acuminatum* E. & E. Sporodichia gregarious, minute, white at first, then flesh-colored, attenuate-acuminate at each end, 3 to 5, exceptionally 6 septate, not constricted, arising from slightly elongated cells of the proligerous layer, in which respect it differs from the usual type of *Fusarium*. Quite distinct from *F. diplosporum* C. & E., which occurs on the same host."

V. THE CUCUMBER FLEA-BEETLE AS THE CAUSE OF "PIMPLY" POTATOES.*

SUMMARY.

The cause of the trouble known as "pimply" potatoes has been definitely determined. Minute, slender, white grubs have been found boring into the tubers, roots and rootstocks of the potato during the growing season. The pupæ of these grubs have been found in connection with them. The grubs and pupæ have been proven to be the early stages of the common cucumber flea-beetle, a very injurious insect, the life history of which has heretofore been imperfectly known. The wound made by the boring of the grub results in the formation of a "sliver," but a "pimple" may or may not be produced, depending, probably, upon the stage of growth of the tuber at the time the wound is made.

The most practical method of preventing the "pimply" potato trouble is to protect the foliage against the attacks of flea-beetles by thorough spraying with Bordeaux mixture.

Seedling plants of various kinds suffer severely from the attacks of flea-beetles. Bordeaux mixture to which a small quantity of Paris green has been added is exceedingly efficient as a preventive of these attacks, provided that it is applied thoroughly and frequently.

RELATION OF THE CUCUMBER FLEA-BEETLE † TO "PIMPLY" POTATOES.

In a previous bulletin‡ of this Station there was given a brief account of a potato trouble in which small, scurfy, pimple-like elevations are scattered irregularly over the surface of the tuber. Underneath each of the elevations there is a brown, sliver-like body, composed of corky tissue and about one-ninth of an inch in length, penetrating into the white flesh of the tuber.

* Published also as Bulletin No. 113.
† *Crepidodera (Epitrix) cucumeris* Harr.
‡ New York Exp. Sta., Bulletin No. 101, pp. 84–85; also p. 511 of this Report.

In 1894 this trouble was sufficiently common on the eastern portion of Long Island to attract the attention of farmers. In 1895 it was so common in the same section that potato buyers were constantly on the lookout for potatoes so affected, and offered a reduced price for them. Frequently, the "pimply" potatoes, as they are called, sold for as much as five cents per bushel below the regular market price. In 1896 there has been little complaint from farmers and probably it is not as common as in the preceding two seasons.

When the pimply potatoes were first brought to our attention in 1894, we could find no published account of such a trouble—it appeared to be something new. After an examination of the "pimples" and their accompanying "slivers," the conclusion was reached that they probably result from punctures made by some insect while feeding on the growing tubers. This theory was advanced on page 85 of the previously mentioned bulletin.* For the purpose of learning what particular insect is the guilty one, we made, during the past season, an examination of the growing tubers of Green Mountain (the variety so generally affected in 1895), in a field where "pimply" potatoes had been abundant the previous season. Our search was immediately rewarded by the discovery of slender white grubs, which were feeding on the young tubers. A brief examination was sufficient to convince us that these little grubs were the cause of the "slivers," it being easy to find them inside of the tubes of the "slivers." The full-grown grubs were scarcely one-sixth of an inch (4mm.) long. When feeding they bore toward the center of the tuber, sometimes almost, if not completely, burying themselves in the tuber. They do not, however, penetrate to any great distance, since the "slivers" or canals which they make are rarely more than five millimeters in length, the average being about two and nine-tenths millimeters (one-ninth inch). The portion of the body which is outside of the tuber stands straight out at right angles to the surface of the tuber. Whether this is the customary position in feeding we do not know. Perhaps they take this position only when disturbed. Mr. F. A. Sirrine

* Page 511 of this Report.

has observed them boring into the potato roots and rootstocks in the same manner.

At the time of the discovery of the grubs the soil around the tubers was found to contain many white pupæ (the resting form of the grub). Some of the soil containing both grubs and pupæ was brought to the Station laboratory and turned over to Mr. Sirrine, who put some of the tubers containing grubs into dirt in a cage by themselves and some of the pupæ into dirt in another cage. The grubs, in fourteen days, and the pupæ, in eight days, changed to the adult form, which was in both cases the small black flea-beetle *Crepidodera* (*Epitrix*) *cucumeris* Harr. This proved that the grubs found boring into the potatoes are the same as the pupæ found in connection with them, and that both are the early stages of the common cucumber flea-beetle.

These observations are important because they add considerably to our knowledge of the habits and life history of the cucumber flea-beetle, one of the most troublesome insects with which Long Island farmers have to deal.

There are several species of small jumping beetles, which are known collectively as flea-beetles. The species which is the most numerous and most destructive to potatoes, tomatoes, egg-plants, etc., here, is a small beetle, about one-twelfth of an inch in length, with the body black and the legs and antennæ of a dull yellow color. It is called the cucumber flea-beetle (*Crepidodera* (*Epitrix*) *cucumeris*) because it was originally described as feeding on the cucumber; but this name is inappropriate, inasmuch as the insect feeds voraciously upon quite a variety of plants other than the cucumber. Although a common and injurious insect of many years' standing, its life history is very imperfectly known. Entomological writers have usually stated that the grubs (larvæ) are leaf-miners, feeding upon the interior of the leaves infested by the adult beetles. Whether this is true we cannot say. Mr. Sirrine doubts it. We are certain, however, that the grubs feed on the tubers, roots and rootstocks of the potato. They probably feed on the roots of other plants also, but as yet we have no proof of this.

When it was discovered that the "pimples" on potato tubers were caused by the attacks of flea-beetle grubs it naturally occurred to us as being strange that the "pimply" potato trouble should be confined to eastern Long Island. The flea-beetle is distributed over a large portion of the United States, and it is not easy to believe that only eastern Long Island flea-beetle grubs should feed upon potato tubers. Nevertheless, this habit of the insect does not appear to have been observed elsewhere.

The grubs were first observed feeding upon the potato tubers July 7, but the large number of pupæ found in the soil showed that they had commenced to feed somewhat earlier than this date—how much earlier it is impossible to state. The grubs were found in abundance in various places on Long Island until August, and Mr. Sirrine found some as late as August 15. Tubers showing the "slivers" have been received from Orange county also.*

Knowing that the grubs had everywhere been abundant on Long Island we expected to find the crop of 1896 very "pimply." Such, however, was not the case. The trouble was not at all common. As a possible explanation of this failure of the injured tuber to produce "pimples," the first idea to suggest itself was that certain varieties respond more readily than do others to injuries of the skin. This theory was soon exploded by the discovery that both "slivers" with "pimples" and "slivers" without "pimples" may be found on the same tuber. In order that the grub-puncture may be followed by the production of a "pimple" it is probably necessary that the tuber be at a certain stage of growth. Thus the formation of "pimples" is the exception instead of the rule, and unless "pimples" are formed the affection is not conspicuous, which probably accounts for its not having been previously discovered.

A knowledge of the cause enables us to prescribe a remedy. It seems probable that the grubs can best be controlled by pro-

* Since writing the above, Mr. C. W. Mally, at our request, has kindly examined potatoes grown on the Ohio Experiment Station farm at Wooster, Ohio. He found the "slivers" in abundance, but no "pimples." A potato received from Mr. A. L. Stewart, Greenfield, Iowa, showed one "sliver." But Mr. Hermann von Schrenk, St. Louis, Mo., in a thorough examination of potatoes in the St. Louis markets, failed to find either "pimples" or "slivers."

tecting the foliage against the attacks of the adult beetles. The most practical method of accomplishing the latter is to spray thoroughly with Bordeaux mixture as recommended for potato blight.*

Fig. 1, Plate XXXV, represents the adult flea-beetle; Fig. 4 represents the grub, and Fig. 5 shows its position while feeding. It is to be regretted that all of the specimens of pupæ preserved for study were accidentally destroyed, so that it is impossible to present a figure of the pupa at this time.

The Value of Bordeaux Mixture as a Preventive of Flea-Beetle Injuries.

Flea-beetles do a great amount of damage to the foliage of various cultivated plants by gnawing numerous small, round holes in the leaves. They are especially destructive to seedling plants. In potato fields they are sometimes so numerous as to greatly retard growth by keeping the young potato plants eaten off as fast as they show above ground. Tomato and egg-plant seedlings are frequently ruined by them.

The ordinary insecticides, such as London purple and Paris green, used so effectively against leaf-eating insects in general, seems to have but little effect on flea-beetles. Fairly good results have been obtained by frequently dusting the foliage, when the dew is on, with repellants such as tobacco dust and air-slacked lime. Recently it has been found that Bordeaux mixture is a very successful preventive of flea-beetle attacks. This remedy was brought into prominence by the potato spraying experiments of Prof. Jones at the Vermont Experiment Station in 1893 and 1894. It was there shown† that a single application of Bordeaux mixture reduced the amount of injury done by flea-beetles from twenty-five per cent. to as much as fifty-four per cent., according to the strength of the Bordeaux mixture, the stronger solutions being the more effective. Prof. Lodeman‡ found the benefit less marked. In his experiments the amount

* See New York Exp. Sta., Bulletin No. 101. p. 77; and p. 499 of this Report.
† See Seventh Ann. Rept. Vermont Exp. Sta., p. 50: and Eighth Ann. Rept. Vermont Exp. Sta., p. 95.
‡ Lodeman, E. G., Cornell Univ. Exp. Sta., Bull. No. 113, p. 276.

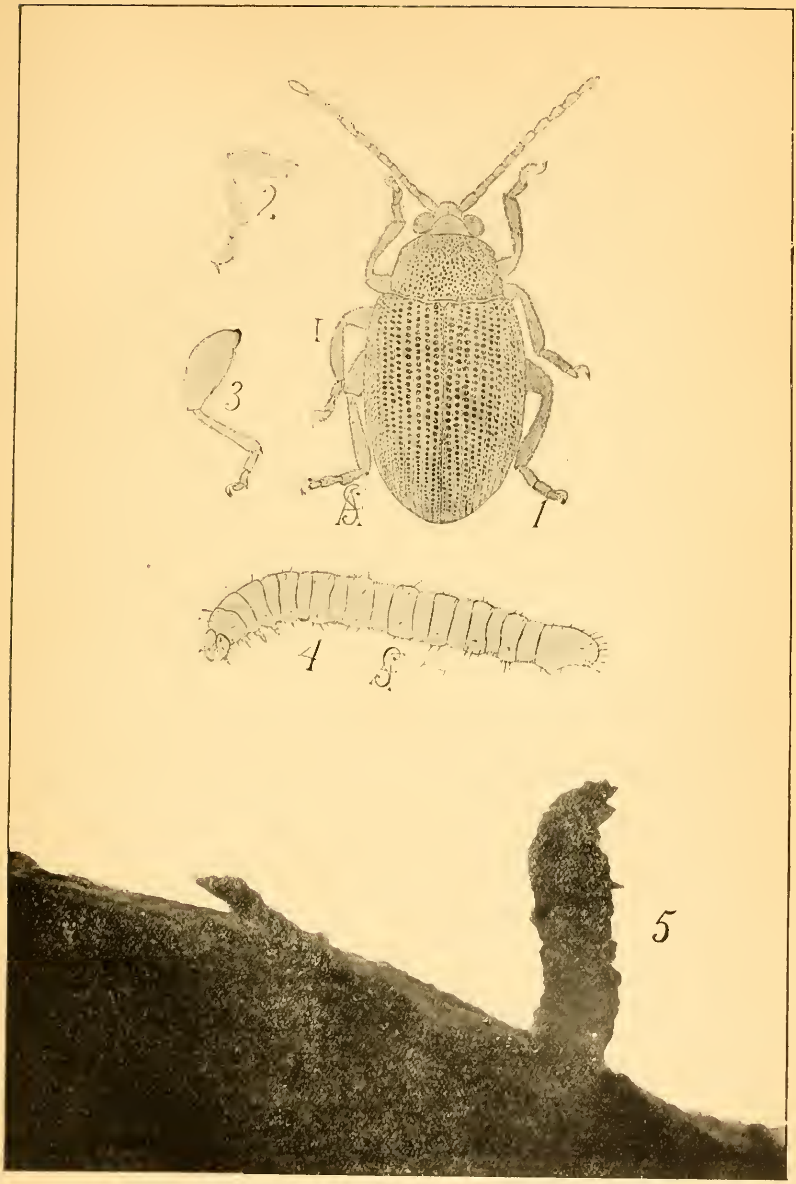
of injury on sprayed plants was from sixty to seventy per cent. as great as on unsprayed plants. Other experimenters report different degrees of success, but it is quite generally agreed that Bordeaux mixture is the best remedy now known for flea-beetles on potatoes.

Our own observations, made on extensive potato spraying experiments during the past two years, convince us that the degree of success attained is chiefly dependent upon the thoroughness with which the spraying is done. Where the spraying was done with a knapsack sprayer, and the plants kept well covered with Bordeaux mixture throughout the season, there was practically no injury from flea-beetles; while on plants which were sprayed every two weeks with a horse machine having two nozzles per row the injury was perhaps from fifty to seventy-five per cent. as great as on unsprayed plants. The latter is the customary method of spraying potatoes for blight, but it seems likely that it will be more profitable to use three instead of two nozzles per row for the last two applications.

Flea-beetles are much complained of by those who grow seedling egg plants, tomato plants, etc., for the market. They are also exceedingly destructive to these plants for a short time after they are transplanted. These crops being what we may call concentrated crops, that is, the plants on a small area have a considerable value, it is both practical and profitable to give them almost perfect protection by spraying with Bordeaux mixture. As soon as the first leaves appear spray thoroughly with Bordeaux mixture (the 1 to 7½ formula with a little Paris green added), and repeat the treatment at intervals of one week, or oftener if the mixture is washed off by heavy rains. Continue spraying until the plants are transplanted and growing vigorously. After this it will be sufficient to spray once in ten days. While the plants are young every leaf should be kept blue with Bordeaux mixture, which, if properly prepared, will not injure the plants in the least.

All seedling plants may be protected in the same manner, but it is difficult to make the Bordeaux mixture adhere to the foliage of plants of the cabbage family—cabbage, cauliflower, etc.

PLATE XXXV.



EXPLANATION OF PLATE XXXV.

Fig. 1. Adult flea-beetle, *Crepidodera (Epitrix) cucumeris* Harr.

Fig. 2. One of the front pair of legs of the same.

Fig. 3. One of the hind pair of legs, showing the powerful femur (thigh) which enables the beetle to execute its characteristic jumping movements.

Fig. 4. The larva (grub).

Fig. 5. A photomicrograph of a larva feeding on a potato root.

Note.—Figures 1 to 4 are drawn to the same scale by means of the camera lucida, the magnification being approximately nineteen diameters; but the larva from which the drawing was made was only about three-fourths grown. The full-grown larvæ measure about 4 millimeters.

The hair lines by figures 1 and 4 represent the actual size of the objects.

All figures were made by Mr. F. A. Sirrine.

REPORT

OF THE

DEPARTMENT OF ENTOMOLOGY.

Entomologists.

VICTOR H. LOWE, B. S.

F. A. SIRRINE, M. S.*

*At the Branch Station in Second Judicial Department.

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REPORT OF THE ENTOMOLOGISTS.

PART I.

VICTOR H. LOWE.

I. INTRODUCTION.

Toward the latter part of February of the past year, the writer was directed to leave the Long Island Branch Station for the purpose of taking charge of the entomological work at Geneva. As this is the first year that an entomologist has been employed here, the work of investigation and experiment was necessarily delayed until sufficient equipment could be secured to enable the work in the new field to be begun in a satisfactory manner. The report which follows is in no sense a continuation of work taken up on Long Island, but represents work done during the past year only.

Principal Lines of Work.

The work has been conducted along three principal lines as follows: First, the keeping of records which relate to the life history, habits, etc., of injurious and beneficial species of insects. Under this head comes the keeping of notes, the making of illustrations, etc. The notes are properly arranged and filed away for future use. The illustrations are either drawings or photographs as the occasion demands, the object being to picture the insect in all its stages of development, to show its methods of work and the injury done. In addition to these, maps showing the distribution in the state and in the United States are made as fast as the data can be obtained. The illustrations are also kept on file. Second, the building up of the Station collection of insects. This is being done by purchase, exchange and by collections made in the field. Third, investigations and experiments. These are necessarily carried on both in the laboratory and in the field. This part of the work has not been carried to the extent that it might have been owing to unavoidable delays in the early part of the season.

II. THE STATION COLLECTION OF INSECTS.

During the past year this collection has grown from a very small beginning, a collection of between 400 and 500 named species, to a collection of nearly 2,400 named species, including about 5,000 specimens and probably a third as many more which have not yet been properly classified and labeled.

The number of named species in the orders represented is as follows:

Hymenoptera	167
Coleoptera	1,900
Diptera	80
Lepidoptera	114
Hemiptera	111
Orthoptera	23
Total	2,393

Most of the additions to the collection were made by purchase. A collection of Coleoptera, including nearly 1,500 species, was purchased of Mr. Ph. Fischer, of Buffalo, N. Y. A collection of 335 species, including some of the less common species of the larger orders was purchased of the Michigan Agriculture College.

Objects of the Collection.

The collection is intended to serve two main purposes, first, as a reference collection for the Entomologist, and, second, to furnish object lessons to any who have an opportunity to see it. As a reference collection, the correctly named and arranged insects are invaluable to the Entomologist who must if possible identify all the species of insects which come under his observation. The biological material, also, which every collection of this kind should contain, furnishes an insight into the life history and habits of the species to which it refers. As a means of furnishing useful object lessons, the collection is already proving of much value. Farmers who visit the Station, and who are interested in some injurious species of insect, have the opportunity of seeing the insect itself in all stages of development. This opportunity may be extended by taking some of the insects to farmers' meetings.

III. SOME OF THE MORE IMPORTANT INJURIOUS INSECTS OF THE YEAR.

Locusts.

During the past season we have received letters from the vicinity of Rome, N. Y., to the effect that the "grasshoppers" were proving a serious pest again. We spent a day in August last driving through some of the infested sections near Rome. The locusts were very abundant at that time, although some of the farmers said that they were less numerous then than earlier in the season, and also that they were even more numerous the previous summer. But even last year these insects were sufficiently abundant in some districts to necessitate the cutting of oats, rye, etc., green in order to save the crop.

The following species were very common during August and probably throughout the season: *Melanoplus femoratus*, *Melanoplus femur-rubrum* De Geer, and *Melanoplus atlanis* Riley.

The Striped Cucumber-beetle.

An account of this insect as it occurs on Long Island was given in our report for last year. We find that this injurious insect is also of much importance in the western part of the state, especially since the growing of pumpkins, squashes and cucumbers has become a prominent industry among western New York farmers. During the early part of the season this pest threatened to ruin the young pumpkin and squash vines in many of the fields about Geneva. The authorities at the canning factories state that the "cucumber-beetle" is one of the most serious pests with which their growers have to deal.

Most of the injury is done just as the young vines are coming out of the ground. The beetles are usually present in great numbers at this time and will very quickly eat the young plants entirely off just at the surface of the ground, or cripple them to such an extent that they will be greatly delayed in growing or unable to survive the injury.

Although this insect is an old and well-known pest, its life history does not seem to be well understood. The grubs are supposed to feed on the roots of cucurbitaceous plants, but it has been frequently noticed that, when the beetles are very abundant, the grubs were not found and also that the roots did not appear to have been infested. This was observed last season, and indicates that the grubs may have other food plants.

Lime and Paris green are the insecticides frequently used against the cucumber-beetle. Last year this treatment proved a success with some growers and a partial failure with others. In one instance where this treatment proved a success, the lime was applied liberally just after a shower while the vines were yet wet. The next day Paris green was sprayed upon the vines, the poison being used at a strength of one pound to 150 gallons of water. The lime and Paris green were again applied a few days later. This treatment was kept up while the beetles were abundant and resulted in keeping the vines comparatively free from injury.

ASPARAGUS BEETLES.

Two species of asparagus beetles are common in western New York. One is commonly called the six-spotted beetle and the other the twelve-spotted beetle. The latter is also sometimes called the red beetle. The former is *Crioceris asparagi* Linn. and the latter *Crioceris 12-punctatus* Linn. In the vicinity of Geneva the former is the more common of the two.

During the past season the former species (*C. asparagi*) was first noticed at the Station on May 11. The eggs were then abundant on the young stalks of asparagus. The beetles themselves must have been present at this time but were not observed until May 14. May 22 a few of the eggs had hatched. At this time a number of the larvæ were transferred to the green-house, where they grew very rapidly, becoming nearly full size by the 26th. August 21 the beetles were found mating. Eggs and larvæ were also quite abundant on the brush.

The latter species (*C. 12-punctatus*) was first observed at the Station May 14. We did not succeed in getting either the eggs or the larvæ of this species early in the season, although the beetles were found during the summer and late in the fall. Later in the season, however, when the asparagus berries were ripening, many of them were found to be infested with this species in nearly all stages of development, including the larvæ, pupæ and mature insects.

The following extract from a letter to the writer from Mr. S. J. Robbins, of Brighton, N. Y., will give some idea of the importance of these insects to farmers interested in growing asparagus. Mr. Robbins says, in part: "We have two kinds of asparagus beetles here, the six-spotted or gray beetle and the twelve-spotted or red beetle. They are about the same size and must be related, for they are both hustlers. They live anywhere during the winter—under the bark of trees and vines or in the ground. I have found plenty of them under the bark on grape vine.

"During the first warm days of spring they come out and wait for the first shoots of asparagus to appear. When they are ready to make the attack they sweep everything before them. They like warm weather, and during a cool spell will go down into the ground, and, if hungry, gnaw the asparagus under the ground. As soon as vegetation starts, generally, they are not as troublesome on old beds, for they have more to eat in other places.

"For the past three years I have noticed only six-spotted beetles in the early spring, with rarely a red one among them. After two weeks' time the order seems reversed. Twelve-spotted or red ones are now present, with very few of the six-spotted.

"These insects are causing us much anxiety. Whether they will exterminate our asparagus or whether we will exterminate them is the question. Several about here have given up the fight and plowed up their asparagus beds. We might destroy the insects on our own premises, but the asparagus plants grow wild under the trees in all parts of the country, where the birds have carried the seed, thus making fine breeding places for the beetles, with none to molest."

With regard to remedial measures, Mr. Robbins says: "Many methods have been suggested as the most desirable ones for keeping these insects under control. The old hen with chickens is the best (dead sure) exterminator to date. The older fowls will do as good service, but they scratch over the ground and injure the young shoots of asparagus. It is almost impossible to keep the beetles from destroying the seedlings or young plants. Kerosene emulsion is probably the best preventive, but I believe it would be almost impossible to start a new bed of asparagus in this section of the country, for the beetles seem to be most hungry when they first wake up in the spring, and, as the grass is kept cut short on the old beds, they swarm on anything that is allowed to grow up. A method for controlling this insect recently recommended is as follows: 'Take an old woolen cloth and rub the eggs off the shoots of asparagus.' I think a bed 10 feet square would keep one busy, and for a bed of five acres it would be too expensive."

There are still other methods recommended for controlling this insect, one of which is the liberal use of lime, the lime being dusted on the infested brush. One grower on Long Island who was starting a new bed of asparagus of seven acres succeeded in keeping the beetles in check by knocking the larvæ off from the brush in the heat of the day. The ground between the rows was kept well cultivated so that when the larvæ fell upon it they were unable to crawl back to the asparagus and would soon perish in the hot sun. Two men were required for about two hours each day for three weeks, after which time there were but very few eggs, larvæ or beetles to be found on the bed. This grower planted the rows of his asparagus seven feet and a half apart. Thus the larvæ could be brushed off the asparagus so that they would fall about midway between the rows and yet be far enough away from the plants to prevent their returning. The soil in this bed is a very fine sand, which makes this method of combating the beetles more practical than it would be in many other cases. The larvæ are very clumsy when on the ground, and especially so when on loose soil. This ac-

FIGURE 1.—YOUNG CURRANT LEAVES, NATURAL SIZE, SHOWING EARLY STAGE OF INJURY CAUSED BY THE CURRANT-PLANT LOUSE (*Myzus ribis*). PHOTOGRAPHED MAY 3, 1896.

FIGURE 2.—LATER STAGES OF INJURY. PHOTOGRAPHED, NATURAL SIZE, APRIL 23, 1896.

counts for their not being able to return to the asparagus after having been brushed off. In the plot above mentioned the writer has watched this work being carried on successfully.

THE CURRANT APHIS.

This species of aphis (*Myzus ribis** Linn.), was quite abundant on currants at the Station throughout the season. Professor Beach first called my attention to it on May 1, at which time the work of the lice was indicated by the peculiar bladder-like deformities on the young leaves. The portions of the leaves thus affected were of a red color, which deepened a little later in the season to almost crimson. Upon examining the under surface of these leaves a small colony of lice could be found in the depression caused by the galls. Plate XXXVI, fig. 1, is from a photograph of some young currant leaves which show the early stages of the injury. Fig. 2 is from a photograph showing the injured leaves as they appear later in the season.

Of the many varieties of currants at the Station, the variety " Prince of Wales " was most seriously injured by the lice.

Although the infested currant bushes were thoroughly sprayed three different times during the summer, the aphis was not successfully held in check. Probably the most practical method of combating this insect is either to pick off and destroy the first leaves that are infested in the spring, or to dip them in kerosene emulsion using the emulsion at a strength of one part to from seven to ten parts of water. After the leaves have begun to curl, it is difficult to apply the spray so as to reach all of the lice.

Many of the lice were destroyed by parasites and spiders. Judging from our observations, over fifty per cent. were destroyed in this way.

THE RED SPIDER.

June 18th we received a letter from Messrs. C. G. Velie & Son, fruit-growers at Marlborough, Ulster county, N. Y., to the effect that great numbers of minute spider-like insects were seriously injuring their raspberry bushes. The letter says, in part, " They

* *Rhopalosiphum ribis* and an undetermined species were also abundant.

(the insects) seem to take all life out of the leaves, and bushes badly attacked have the appearance of having been singed by fire. We did not notice them until a week or so ago, but unless we can overcome them, it will be a serious matter, as we understand that this insect has appeared in all parts of this section. We enclose a leaf, but doubt if it reaches you in condition to judge from." The leaf referred to appeared to be infested with the red spider (*Tetranychus telarius* Linn.). This supposition was confirmed by specimens sent at a later date. We recommended spraying with kerosene emulsion at a strength of one part of the emulsion to seven parts of water, with the addition of sulphur, and also to clean up and burn all rubbish in and about the infested field at the close of the season. At a later date we received the following letter from Mr. Velie, which gives an idea of the importance of the outbreak to fruit-growers in the vicinity of Marlborough, and also shows that the kerosene emulsion did not have the desired effect. The letter says in part: "In reply to your letter of inquiry concerning the red spider would say, that we followed your directions as to spraying with kerosene emulsion, but could not discover any benefit therefrom, so discontinued it at the time of picking, with the intention of trying it again on young canes after we had cut out the bearing bushes. But by that time they had entirely disappeared, so we have done nothing but burn the old bushes and rubbish around the field of berries. The field of berries which was shaded by peach trees was injured the most. They also defoliated the currant bushes to quite an extent.

"As to how far this insect has spread, I do not positively know. To my knowledge, however, about all the plantations in this vicinity were affected more or less. I think the reason that the kerosene emulsion did not prove a success is that the insect seems to live under a web which is very hard to penetrate with a spray. If the pest continues to increase, it will certainly destroy the red raspberry industry in this section of the state."

Mr. Velie's experience with the kerosene emulsion only goes to show that if this insecticide is to be used against the red spider, the application must be made early in the season before the web which the mites spin has been made sufficiently thick to resist the spray.

The Chinch Bug.

This insect (*Blissus leucopterus* Say), has been reported to us from the eastern, central and western sections of the state. Judging from letters received, the damage done in the western section of the state was more serious than elsewhere. To furnish timely information concerning the pest, the following circular was sent to the newspapers of the state:

Notes on the Chinch Bug.

Among the multitude of injurious insects with which the farmer has to deal there is one which, as a destroyer of valuable farm crops, seems to have but few if any superiors. This is the chinch bug. Naturally, then, the appearance of this insect in seriously injurious numbers within the borders of our state causes some alarm among farmers and others interested in agricultural pursuits. Letters received at the State Experiment Station indicate that this insect has occurred in sufficient numbers during the past season to cause injury to the grass and grain crops in various sections of the state. A few remarks, therefore, concerning this pest will be of interest at this time.

Although apparently a Southern insect, the chinch bug has invaded many sections of the North. It is now well known in Maine, and is found in some parts of Canada. According to numerous accounts, it was first found in this country in North Carolina in 1783. After having become well established in some of the Eastern states it appeared in injurious numbers in 1839 in some of the then Western states, being reported from the northern part of Illinois and along the upper Mississippi. From this time on it became a much dreaded pest throughout this section, extending its ravages into Kansas, Nebraska, Indiana and Ohio. The first record which we have of its appearance in New York state is in Dr. Fitch's Second Report as State Entomologist, in which he states that he found three specimens in this state in 1848 and 1851. Fortunately for us it has not gained the strong hold in New York which characterizes its invasion into southern and more western states. It did, however, appear in injurious numbers in 1882, 1888, and again in 1894. During the past season, also, complaints of the injury caused by this insect have come to the Station from points within the state quite widely distant, some of the letters indicating that the bugs were very abundant.

In size the chinch bug is a dwarf compared to many of our injurious species of insects and a giant when compared with others. A mature bug measures a little more than one-eighth of one inch in length, is black in color, with white wings, each one of which is marked with a black spot.

The adults pass the winter hidden away close by the roots of certain grasses. They seem to prefer to seek shelter in stools of grass. The time of the appearance of the bugs in the spring undoubtedly varies with the season. The eggs, which are very small and of a whitish color, are laid in early spring at the base of grasses and grains. A single female will lay as many as 250 eggs. The eggs hatch in about two weeks. The young bugs, which are called nymphs, are at first yellow in color, but soon change to a bright red, with the exception of a portion of the anterior part of the body, which is darker. They moult four times before reaching maturity, and it is not until this time that their wings are fully developed. Five weeks is usually required for the change. Although the time varies in different seasons, it is probable that, in this state, the first brood matures in July or August. Eggs for a second brood are soon laid. The young of this brood are mature by the time winter sets in, when shelter is sought by the bugs as above stated. The common name chinch bug was given this insect because of the resemblance of the nymphs to the bed bug, which was known throughout the South by the Spanish name chincho.

The chief diet of the chinch bug consists of the juices of grains and grasses. Usually the crops which are most seriously injured are wheat, barley, Indian corn and timothy. The bugs do not devour the tissue, for, in common with other true bugs, their mouth parts are not fitted for biting, but are modified into a tube, by means of which the sap is sucked from the infested plants.

The presence of the chinch bug in a field of grass or grain may often be detected at some distance by the wilted and perhaps withered appearance of the infested plants. When occurring in large numbers, the bugs cluster around the stalk of the plants in great numbers, sucking the sap vigorously. The plants, thus deprived of much of their needed nourishment, soon show the effect of the attack.

During certain seasons, great numbers of the chinch bugs have been observed to succumb to a fungous disease. Several years ago experiments were begun to ascertain if this fungus could be used as a practical means of checking the bugs. Although in some instances very successful, it has been found that this method cannot always be depended upon, although in wet seasons it may aid materially in decreasing the numbers of the bugs. These experiments have been largely carried on at the agricultural experiment stations in states where the chinch bug was doing sufficient damage to warrant the expense of the undertaking. Chief among these are the Stations at St. Anthony Park, Minn.; Manhattan, Kans.; Lincoln, Neb.; Urbana, Ill., and Wooster, Ohio.

Undoubtedly one of the most satisfactory methods of combating the chinch bug in this state in localities where it occurs in sufficient numbers to do serious injury, is burning over the infested section, or deep plowing late in the fall. In case the burning is to be resorted to, the localities where the insects are hibernating should, if possible, be sought out and the infested locality burned over early in the winter if the season will permit. Where possible it is well to follow the burning by deep plowing and harrowing. Dr. S. A. Forbes, State Entomologist for Illinois, who for some years has given special attention to the chinch bug, states in his last report that the bugs may be trapped during the summer season when about to leave the fields of ripening grain. This is done by plowing a strip from four to six feet wide around the infested field. This strip should be thoroughly and deeply pulverized. A deep furrow should then be made lengthwise through the middle of the strip, much pains being taken to keep the sides pulverized as fine as dust. The furrow may be conveniently made by dragging a log endwise back and forth through the strip. Holes a foot deep should be made in the furrows at intervals of about twenty feet. The chinch bugs, leaving the fields in great numbers, will fall into this trap and may be killed, or if unable to get out, will finally die of exhaustion. Many of the bugs will fall into the holes and thus be securely caught. One of the most important points connected with this method is keeping the sides of the furrow thoroughly pulverized. Few of the bugs are able to fly at this time, else the furrow method would not be practical.

The Station will be glad to receive notice of the appearance of the chinch bug in any section of the state. When possible such letters should be accompanied with a number of specimens of the bugs.

Geneva, N. Y., September 14, 1896.

A Little-known Scale Insect.

This scale insect was first observed by us in December, 1894, on a young plum tree at Rochester. We sent specimens to Dr. L. O. Howard, entomologist of the United States Department of Agriculture, who identified the insect as *Aspidiotus ancylus* Putnam. Since that time we have observed this scale on young plum trees in the nursery and on bearing plum and apple trees.

The only references to this species which we have at command are found in "Insect Life" as follows: In Vol. VI, page 231, Dr. L. O. Howard records that a parasitic insect, *Coccophagus aurantii*, n. sp. was reared from *Aspidiotus ancylus* Put., found on linden, District of Columbia. In Vol. VII, page 210, Mr. T. D. A. Cockerell mentions this species in a list of New Mexico insect pests, including it in the list of imported species, and states that it infests the box-elder trees planted along the streets of Santa Fe.

THE OYSTER-SHELL BARK-LOUSE.

We have received many specimens of this insect (*Mytilaspis pomorum* Bouche) from our correspondents. In most cases the complaints were to the effect that the insect was doing serious damage to apple trees. When the scale attacks old trees the injury does not usually extend beyond a few of the limbs, but on young trees the injurious effects are much more noticeable. In one case reported to us, a young bearing apple tree was badly infested on the trunk as well as the main limbs and branches.

May 11 newly hatched lice appeared on an infested apple tree near the Station, and three days later moulted for the first time.

Plate XXXVII, fig. 1, is from a photograph of some infested apple twigs. Fig. 2 is from a drawing of a female scale showing the upper and under surfaces of the insect, the manner in which the eggs are protected and some of the eggs greatly enlarged.

Kerosene emulsion is the most satisfactory remedy. Where practical, the trunk or infested limbs should be scraped and the emulsion, full strength, applied with a stiff brush. This treatment should be made in the winter. The scraping loosens the scales and allows the emulsion to reach the eggs which they protect. Spraying with the emulsion, summer strength, as soon as the young lice hatch in June will also be found effectual.

CANKER WORMS.

An unusual outbreak of canker worms occurred during the past season. In the vicinity of Albion and all through Orleans, Genesee, and Niagara counties the insects were especially abundant. Early in June we visited some of the infested sections near Albion. Many fine large trees and, indeed, whole orchards were stripped of every leaf. Observations and inquiries there and elsewhere where the insects were abundant, indicate that both neglect and misdirected effort are the partial causes of such extended injury as was done by this insect last year. Old neglected orchards are too common, while scattered trees along the roadside which have never been sprayed, or received even ordinary attention, are more common. These trees furnish breeding

PLATE XXXVII.

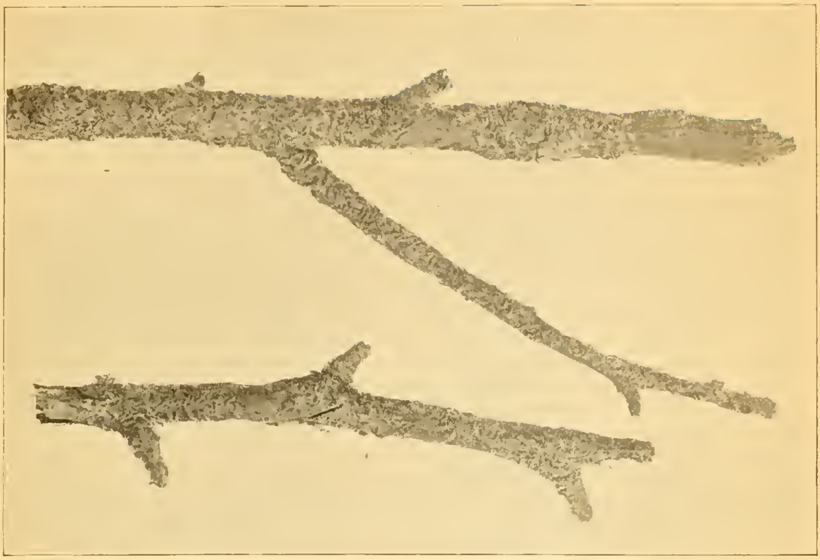

FIGURE 1.—OYSTER-SHELL BARK-LOUSE; MATURE SCALES OF FEMALE, NATURAL SIZE.
FIGURE 2.—FROM A DRAWING SHOWING UPPER AND UNDER VIEW OF FEMALE OYSTER-SHELL BARK-LOUSE WITH EGGS. ENLARGED (ORIGINAL).

PLATE XXXVIII.

View of Two Apple Orchards Infested with the Canker-worm. The one on the left had not been Sprayed and had but little Foliage. The one on the right had been Sprayed three times with Paris-green, and the Foliage was abundant. Photographed June 12, 1896.

PLATE XXXIX.

View of Apple Orchard near Albion, N. Y., showing work of Canker-worm.
Photographed June, 1896.

places from year to year for such insects as the canker worm, and hence are a source of danger to the fruit growing industries in the vicinity. In some instances, however, the orchards visited had been sprayed, but judging from their appearance and from some of the spraying done while the writer was present, the work was of little value.

Judging from our observations, there are three principal reasons why the canker worms were not held under better control in infested orchards in western New York last year. First, the application of Paris green was not begun early enough in the season. It is probably not unjust to say that in very many cases the spraying machine was not taken into the orchard until the canker worms were well established, while the work should have been begun as soon as the first young worms appeared. Second, the spraying was not done thoroughly enough, and third, there were not a sufficient number of applications of the poison made. In some instances, only one or two applications of the poison had been made where at least three or four would not have been too many. We may also add that in some cases an inferior quality of Paris green was used.

Among farmers it is a common statement that Paris green will not kill canker worms. We found it especially so with those whose orchards had suffered severely from this insect. The efficiency of Paris green as a remedy for canker worms we need not discuss in detail here. We did see some orchards, however, which had been carefully sprayed and which were in fine foliage when neighboring orchards were almost without a leaf. Plate XXXVIII is from a photograph of a portion of two orchards. The one on the right had been sprayed, while the one on the left had not been sprayed. An actual view of the orchards showed a much greater difference in the amount of foliage than is shown in the plate. Plate XXXIX is from another view in the orchard which had not been sprayed. Both of the photographs from which these plates were made were taken early in June.

IV. EXPERIMENTS WITH GREEN ARSENITE.*

During the latter part of May, 1896, the Adler Color and Chemical Works of New York sent to the Station one hundred pounds each of three arsenicals manufactured by them, and which they designated as follows: Green arsenite, compound arsenite, and pink arsenite. The superiority of these arsenicals over Paris green is supposed to lie in the fact that, instead of being chrystalline, they are very fine amorphous powders, also that they can be manufactured at a less cost than Paris green. The percentage of arsenic was not given, although they are supposed to be equal to Paris green in poisonous qualities. Only one of these poisons was used in these experiments, namely, the green arsenite.

The Objects of the Experiments

were as follows: First, to determine the length of time that the green arsenite will remain suspended in water; second, to determine its poisonous qualities as an insecticide; and third, to determine the relative danger of burning the foliage. It may be added here that it was the original intention to have a chemical analysis of the arsenical made before any of the experiments were commenced, but unfortunately the analysis was not forthcoming and is not yet completed.

Experiment No. 1.

To a two-quart jar of water enough green arsenite was added to make the poison and the water in the proportion of one pound to 150 gallons. The mixture was then stirred so that the green arsenite was well disseminated in the jar. It was then allowed to remain untouched, with the result that the green arsenite had not entirely settled to the bottom of the can until three hours after mixing.

* Sheele's green.

EXPERIMENT NO. 2.

Under this head may be grouped several experiments all of which had the same object in view, namely, to determine the efficiency of the green arsenite as a poison for some of the more common leaf-eating insect pests. The first experiment consisted of three applications to basket willows infested with the cotton-wood leaf beetle. These applications were made at Liverpool, N. Y., on May 18, June 5 and June 9. The plot sprayed consisted of about one-fourth of an acre, the green arsenite being used in each case at the ratio of one pound of the poison to 150 gallons of water. Sufficient lime was added to the mixture to make it slightly milky. The first two applications were made with a power sprayer, which, unfortunately, did not do satisfactory work, especially in the first instance. The third application was made with a knapsack sprayer. Considerable difficulty was experienced in making the mixture adhere to the leaves. Glucose was finally added at the rate of two quarts to 45 gallons, but it did not have the desired effect.

These applications can not be considered an entirely satisfactory test as to the efficiency of green arsenite when used against the cotton-wood leaf beetle, owing to the failure in making the first application thorough, and also the difficulty in making the mixture adhere to the leaves. However, the results were sufficient to show that, when properly applied, the green arsenite is an effectual poison for this insect. As a further test, Mr. Joseph Kennedy, of Liverpool, on whose farm the experiments were made, dipped some willow leaves in the poison and placed them in a breeding cage with a number of the beetles. It was observed that all the beetles, about thirty in number, which fed on the leaves, were dead very soon after.

The second experiment consisted of spraying two plots of nursery stock which was being attacked by a species of flea beetle. Plot 1 consisted of about three acres of one-year-old apple grafts. Plot 2 consisted of about three acres of two-year-old apple and pear stock. Both plots were very badly infested, many of the grafts having died, apparently from the effects of the injuries caused by the beetles. The poison was used at the same strength as for the cotton-wood leaf beetle, with the addition of lime, and applied in each case with a barrel pump outfit. Plot 1 was sprayed June 16th, June 18th and June 25th. Plot 2 was sprayed June 18th and June 25th. In both instances the poison had good effect. It was not possible to tell what percentage of the beetles had been killed by the poison. It did have a noticeable effect, however, in keeping them away, and undoubtedly saved the nursery stock from much more serious injury than had been caused when the spraying began.

The third experiment consisted in applying the green arsenite to potato vines infested with the potato beetle. The vines were badly infested and presented the appearance usual in such cases. Two small plots were sprayed, on two different occasions about a week apart, a knapsack sprayer being used in each instance. The usual amount of lime was added for each application. On plot 1 the poison was used at a strength of one pound to 150 gallons of water, on plot 2, one pound to 100 gallons of water. The effect of these applications was fully as beneficial as where Paris green had been applied under similar circumstances.

EXPERIMENT No. 3.

One small plot of potatoes was used in this experiment. The green arsenite was applied on two different occasions, about a week apart, and was used at a strength of one pound to 150 gallons of water. The lime was omitted. There was no noticeable injury to the foliage.

In addition to the above experiments, the green arsenite was used to a limited extent on apple and pear trees infested with fruit worms, and on apple trees infested with the pistol-case-bearer.

SUMMARY AND CONCLUSIONS.

As green arsenite will remain suspended in water a longer time than Paris green, it can be applied more evenly to the foliage and requires much less stirring in the tank.

The experiments have not yet been carried far enough to determine whether green arsenite is an equally effective insecticide with Paris green. From the experiments above mentioned, however, this poison seems to have considerable insecticidal value.

Green arsenite will not burn the foliage of potato vines when used without lime at a strength of one pound to 150 gallons of water.

V. EXPERIMENTS WITH DENDROLENE.

Early in April, 1896, the Bowker Fertilizer Company of Boston, Mass., sent a 20-pound pail of dendrolene to the Station for trial. Dendrolene, it is stated by the manufacturers, is "a new substance for tree protection" and is briefly described by them as follows: "It is a thick, plastic combination of about the constituency of printer's ink; but, unlike printer's ink, it will retain its 'stickiness' under almost all conditions of climate or temperature, and when spread with a trowel or stiff brush around the trunk of a tree in a thick band, forms a soft, sticky bed." This new insecticide was originated in New Jersey.

In addition to the twenty pounds sent, the Station bought fifty pounds more, a considerable portion of which was used in the experiments.

As above indicated, dendrolene is intended to be used chiefly on the trunks and branches of trees and thus to serve two principal purposes: First, to prevent such insects as the female canker worm moth from crawling up the trunks of trees. Second, to prevent borers from escaping from infested trees and the parent insects from depositing eggs on the trunk or at the crown of the root. When used for the first-named purpose, it should be put in a band around the trunk of the tree and when used for the latter, should cover the entire trunk.

Objects of the Experiments.

The experiments were made with the purpose of testing the dendrolene along the lines above mentioned, and also to ascertain if the trees were liable to injury from its use.

Experiment No. 1.

April 16, twelve large Baldwin apple trees were treated, the dendrolene being applied in rings about one and one-half feet wide about the trunk midway between the ground and the lower limbs. In this and the following experiment, the trunks were scraped before applying the dendrolene.

EXPERIMENT NO. 2.

Date the same as in Experiment No. 1. Six apple trees similar to those in the above experiment were treated, the dendrolene being applied on the trunks from the ground to the lower limbs.

These were all the experiments made in the apple orchard. In the first experiment the dendrolene was applied about one-fourth of an inch thick, while in the second it was put on in a very thin coating.

Examinations made April 20 and 28 and at intervals from a week to three weeks throughout the summer, showed that by April 28 a very slight crust had formed on the dendrolene. This was particularly noticeable where the dendrolene had been applied in a thick layer. A week later ants varying from a small red to a large black species were going back and forth over the dendrolene without the slightest difficulty. At this same time, however, large numbers of pistol-case-bearers which had been feeding on the leaves of suckers near the trees, and which were trying to crawl up the trunks of the trees, were found dead in the bands of dendrolene. No canker-worm moths were found and no large larvæ. Two noctuid moths, however, of average size were found dead in the dendrolene.

EXPERIMENT NO. 3.

In this experiment five eleven-year-old peach trees of the variety Early Rivers were treated. The application was made April 18, the dendrolene being applied about the lower part of the trunk and at the crown of the root only. The dendrolene was put on with a trowel and was about an inch thick at the base of the trunk. These trees were examined May 22. The dendrolene was covered with a crust which would probably support any insect of average size. Where the dendrolene had come in contact with the soil it had become granular losing its sticky character to a considerable extent.

EXPERIMENT NO. 4.

In this experiment, the trunks of the trees were covered from the ground to the lower limbs. The application was made on the same date as in Experiment No. 3. Nineteen trees were used, as follows: Five eleven-year-old peach trees, variety Early Rivers; four bearing plum trees, variety Reine Claude; two cherry trees, a variety of sour cherry just come into bearing; and eight dwarf Bartlett pear trees not yet of bearing age.

June 4, one of the peach trees had lost all of its foliage and was apparently dead. Both of the cherry trees looked sickly. The foliage was abnormally light in color and the young cherries were ripening prematurely. The foliage of the plum trees had also begun to turn a lighter shade. A few days later the dendrolene was scraped off from the cherry and plum trees to prevent further injury. The pear trees did not seem to suffer any injury. Before fall, however, four of the peach trees were dead.

SUMMARY AND CONCLUSIONS.

When exposed to the weather, a slight crust forms on the dendrolene, but it is not heavy enough to support insects as large as the female canker worm moth.

No injury is caused in one season to full-grown apple trees by the application of this insecticide, either in bands around the trunk or to the entire trunk. When applied during the growing season to the trunks of young bearing plum, cherry and peach trees in such a manner as to cover the entire trunk, there is much danger of serious injury to the trees.

VI. COMBATING THE COTTON-WOOD LEAF-BEETLE.

April 21st, Mr. Joseph Kennedy, a leading willow grower of Liverpool, N. Y., wrote to us that the Cotton-wood Leaf-beetle, or "Willow Beetle," as the insect is more frequently called in that vicinity, had again appeared in great numbers, threatening serious damage to the crop of willows.

For several years past this insect has been a very serious pest to growers of basket willows. It has also been complained of as attacking young poplar trees growing in the nursery.* We visited some of the leading growers in the vicinity of Liverpool and found, that although spraying with Paris green had been resorted to, it seemed to have but little effect upon the insects. In two instances we found that the Paris green which had been used was of an inferior quality, being adulterated with lime. In other instances, however, where the poison had been applied with considerable care, the effect had been scarcely more encouraging.

For the purpose of making a more thorough test than had yet come to our knowledge with green arsenite and arsenate of lead as remedies for this insect, a small field of about one acre of willows was secured. The field was divided into three plots. Plot 1 contained about three-fourths of an acre. Plots 2 and 3 were of equal size, and included the remainder, with the exception of a few rows which were left unsprayed. Plot 1 was made larger than the others as we wished to use a power sprayer. (A Peppler sprayer, owned by Mr. Kennedy upon whose farm the experiments were made, was used.) Plots 2 and 3 were sprayed with a knapsack sprayer.

Plot 1 was sprayed May 5 and June 19 with green arsenite, one pound of the poison to 150 gallons of water being used. In the first application sufficient lime was added to make the mixture of a slightly milky color; in the second glucose was added, together with the lime, at the rate of two quarts to 45 gallons, and in the third application the same amount of glue was added in the place of the glucose.

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* Fourteenth Annual Report New York Agricultural Experiment Station, page 558.

Only two applications were made on plots 2 and 3, the first on May 5th and the second on June 19th.

Plot 2 was sprayed with green arsenite mixed with water and lime in the same proportion as for plot 1. Plot 3 was sprayed with arsenate of lead at the rate of ten pounds to 150 gallons of water.

These experiments demonstrated that one of the most serious difficulties in applying the poisons for the "willow beetle" is the fact that the mixture does not spread well upon the willow leaf. The glazed surface of the leaf is evidently accountable for this. The arsenate of lead did not adhere well. The use of glucose did not prove a success. Glue, in the proportions used, proved more satisfactory than glucose. Although the insects were found in all stages of development on all of the plots, none of the spraying had any noticeable effect, except on plot 2, where green arsenite was mixed with glue and applied with a knapsack sprayer. The fact of the poison being more effectual in this case was undoubtedly due to the glue, which made it adhere to the leaves.

An important point in connection with spraying willows for this insect is that the larvæ and the beetles feed largely on the under side of the leaves and in protected places near the tips of the willows. This makes it a difficult matter to reach them even with a knapsack sprayer and practically impossible with the average power sprayer. The knapsack sprayer might be used in some cases, but many of the fields of willows are so large that it would be impractical to depend upon the knapsack alone.

These difficulties have caused most of the willow growers to give up spraying and to depend upon the machines for catching the larvæ and beetles. This method is described in the Fourteenth Annual Report of this Station, pages 557 and 558.

VII. THE PISTOL-CASE-BEARER.*

SUMMARY.

The pistol-case-bearer is one of the important injurious insects of the apple orchard. Last year it appeared in unusual numbers, doing serious injury, especially in the western part of the state.

This insect belongs to the same order as the moths and butterflies. It lives over winter in the half-grown larval condition, each larva or caterpillar being protected by a peculiar curved case which is firmly attached on end to the twig and which is just large enough to accommodate its occupant.

Early in the spring the case-bearers become active. They first attack the swelling buds and later the leaves, flower-buds and flowers as they appear. The fruit, also, is sometimes attacked.

The transformation to the pupa takes place within the case which each caterpillar carries, but which, as the time for pupation approaches, is attached firmly to the twig. This takes place during the latter part of May. The moths issue in from two to three weeks. The eggs are laid on the under surface of the leaves. The recently hatched caterpillars eat small holes into the interior of the leaves. Their cases, which are made of excrement and silk, are also very soon constructed. During September they migrate to the smaller branches and twigs to remain until spring.

Experiments at this Station show that this insect can be controlled by thoroughly spraying the infested trees with Paris green, using one pound to 150 gallons of water, with the addition of enough freshly-slaked lime to make the mixture milky. In the experiments the trees were sprayed three times; first, just before the buds began to swell; second, soon after the young leaves appeared, and third, just after the petals had fallen.

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* Published also as Bulletin No. 122.

THE PISTOL-CASE-BEARER.

Coleophora malivorella Riley.

HISTORY, NAME AND APPEARANCE.

Our attention was first called to this insect early last spring when a large apple orchard near the Station grounds was observed to be badly infested with it. Later in the season numerous complaints came to the Station, especially from fruit-growers residing in the western part of New York, stating that this insect was doing serious damage in their apple orchards.

As the outbreak appeared to be of sufficient extent to cause serious loss to the fruit-growing interests of the state, and as the insect is quite likely to become a well established pest of the apple orchard, we have, in addition to studying the life-history of the insect in the field as opportunity was afforded, conducted experiments with a view to determining upon a practical method of holding the insect in check. These observations and experiments are briefly reviewed in the following pages. Minute details of the life-history and structural characteristics of the insect are avoided herein as being of but little interest to the general reader.

Not a new offender.—Although this insect appeared in such unusual numbers in some sections of the state last year that it was thought by some to be a new pest to the apple, it proves to be one of the insects which have been known for a number of years, but which have not caused sufficient damage, excepting in certain localities, to occasion more than a passing notice among fruit growers. The earliest account of this insect which we have seen shows that it was a serious pest in Erie county, Pennsylvania, in 1878. Since that time the species has been quite frequently mentioned by writers on economic entomology.

The insect's name.—The scientific name of the insect, *Coleophora malivorella*, was proposed in 1878 by Dr. Riley, who published a technical description of the larva and the male and female moths in the Annual Report of the United States Department of Agriculture for that year. The popular name, Pistol-Case-Bearer, comes from the fact that the peculiar cases which the caterpillars construct for themselves slightly resemble a pistol in shape. Although we have not seen this name in print, it seems to have been in general use throughout the season among fruit growers who are familiar with the insect.*

When and where to look for them.—During the winter the case-bearers are not as readily detected, especially by those who are not familiar with them, as later in the season, when the caterpillars have enlarged their cases, making them very easy of detection, especially when occurring in large numbers. It is important, however, that the trees be carefully examined during the winter or early spring, so that, if the case-bearers are present, the remedy may be applied before it is too late. They will be found in greatest abundance upon the young twigs and usually close to the buds, or even upon them.

As will be shown later, each one of these little cases contains a living caterpillar, which, when warm weather comes, moves about freely, carrying its clumsy-looking case with apparent ease. Plate XL, fig. 1, is from a photograph of two infested apple twigs, natural size, cut from the tree in December. The caterpillars themselves are not seen, as they are hidden within their peculiar cases, which, it will be observed, are fastened on end to the bark. Each case is made largely of silk, which is spun and woven by its owner much as a caterpillar ordinarily spins and weaves its cocoon. The inner layer is comparatively smooth and closely woven, while the outer is loose and less substantial. In color they closely resemble the bark.

A closely allied species.—The cigar-case-bearer (*Coleophora fletcherella*) is sometimes confused, by the casual observer, with the species under discussion. The winter forms of the two species may at first appear somewhat alike, but a careful examination will show that the case of the cigar-case-bearer of average size is usually somewhat smaller and lighter in color than that of the

*Since this bulletin was written we have received Bulletin 124 of the Cornell Univ. Agl. Exp. Station, in which Mr. Slingerland suggests the name.

other species; also that it is more nearly flat, comparatively smooth, and curved in the shape of a half moon, while the case of the pistol-case-bearer, is more like a rough tube bent and shaped at the upper end so as to slightly resemble the handle of a miniature pistol. During the winter, also, the cigar-case-bearer is found more abundantly in the angles made by the branching twigs while the pistol-case-bearer passes the winter in more open situations on the twigs and buds. The two species have many similar habits. Both are found most abundantly upon the apple. The mature insects in both species are delicate moths which resemble each other in general appearance.

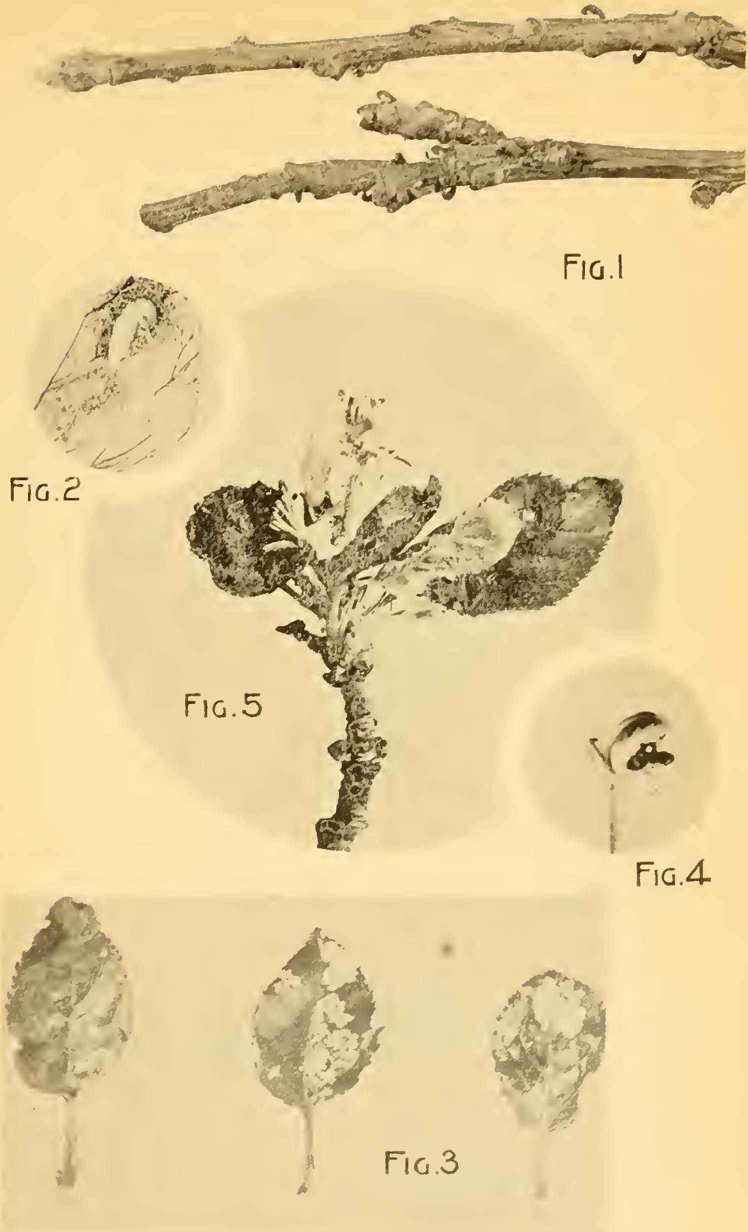
LIFE HISTORY, DISTRIBUTION AND NATURAL ENEMIES.

The story of this interesting insect's life is, briefly, as follows: The peculiar cases, which, as previously stated, may be found during the winter attached to the twigs, contain the hibernating caterpillars which are to develop into the parent moths before the summer is over. They remain inactive until about the time that the buds begin to swell. The warm days seem to bring renewed life, and if a careful watch is kept the observer may be rewarded by seeing some of the caterpillars unfasten their cases from the twigs, thrust their heads and part of their bodies out of the opening, which is in the anterior or lower end of each case, and move toward the nearest buds carrying their cases with them.

How the young case-bearers feed.—Having reached the buds they begin at once to bore into them. In doing this they do not leave their cases, but thrust their bodies out as they gnaw into the interior of the buds. Thus an opening bud may have several of these cases attached to it which give no signs of activity until removed, when a small round hole will be observed which the little caterpillars have made in searching for food. The injury thus done to the bud is very great, usually sufficient to destroy it. It often happens that nearly the whole inside of the bud will be eaten out.

As soon as the young leaves appear the case-bearers attack these, burrowing into them at first and feeding on the soft tissues

PLATE XL.



WINTER APPEARANCE AND EARLY WORK OF PISTOL-CASE-BEARER.

PLATE XLI.

FIG. 1

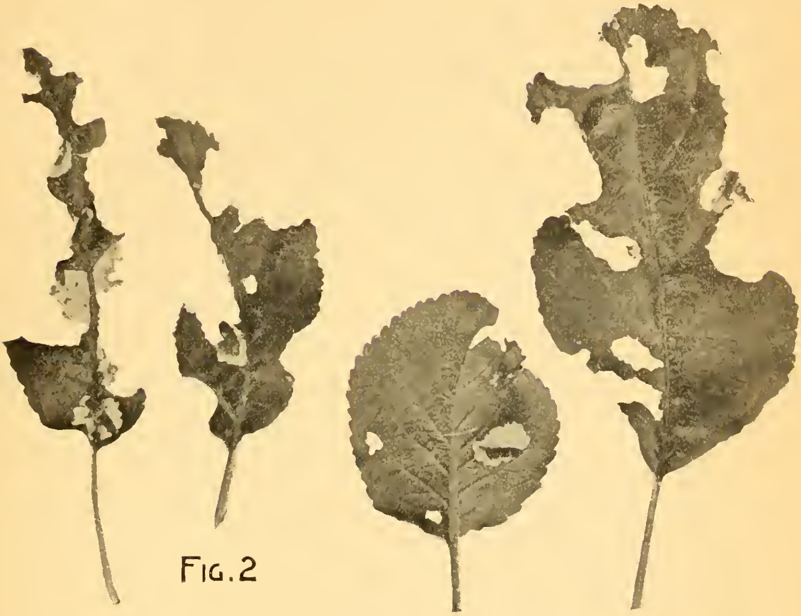


FIG. 2

FIG. 3

LATER WORK AND APPEARANCE OF PISTOL-CASE-BEARER.

between the two surfaces. Thus they are feeding at this time as leaf miners. Plate XL, fig. 2, is from a drawing, representing a case-bearer feeding between the two surfaces of an apple leaf. The case-bearers do not feed long as leaf miners, however, but soon begin to eat off the entire upper surface, leaving only the frame work, as shown in Plate XL, fig. 3. The caterpillars grow rapidly during this time and are soon strong enough to eat holes clear through the leaves, avoiding only the midribs and larger veins.

How the caterpillars enlarge their cases.—As stated on a previous page, the caterpillars make their cases largely of woven silk. The cases are just large enough during the winter to accommodate the young caterpillars, and thus it is necessary to enlarge them as the occupants increase in size. This is done by extending the case at the anterior end in the form of a tube of silk into which is woven the pubescence from the leaf—frequently giving it a pinkish color or making it nearly pure white. Very soon, however, probably from the effects of exposure to the weather, the entire case assumes a darker hue, resembling the bark in general color. By May 6th the new portions of the cases equaled the old in average length.

Habits of the caterpillars when attacking the flowers and full grown leaves.—As soon as the flower buds begin to swell, the case-bearers not infrequently attack these also, and the flowers themselves do not escape, as many were found last season with the petals nearly eaten away by these intruders. When attacking the flower buds, the caterpillars bore into them in much the same manner as when attacking the leaf buds, as shown in Plate XL, fig. 4, but when feeding in the full blown flower the petals may be entirely consumed and frequently a considerable portion of the pistil and stamens. Thus this insect not only injures the buds and leaves, but, indirectly, destroys the fruit. Plate XL, fig. 5, is from a photograph of two apple blossoms which have been injured by the pistol-case-bearer.

By the time the apple leaves are full grown the case-bearers have reached their full size. At this time their cases measure, on an average, a little more than one-fourth of an inch in length. The general shape of one of the full size cases is shown at Plate XLI, fig. 1. The full grown case-bearers feed readily on nearly all parts of the leaves, usually leaving only the midribs untouched. Plate XLI, fig. 2, is from a photograph of a few mature apple leaves partially devoured by the case-bearers. The fruit may also be injured by the caterpillars boring through the skin and feeding on the tissue just beneath. This causes the young apples to become more or less deformed, according to the extent of the injury.

The full grown caterpillars measure, on the average, a little more than one-fifth of an inch in length. The body is light-yellow, varying to deeper shades, with dark-brown markings on the thorax. The true legs are black. The head also is black with a more or less distinct yellow median line. Like other caterpillars, the pistol-case-bearers undoubtedly molt, probably several times during their development, but this interesting operation was not observed by us.

Pupation.—During the middle of May many of the case-bearers were observed migrating from the leaves to the twigs. Toward the latter part of the month a majority of them had pupated. Before pupating each caterpillar had fastened its case securely to the bark of the twig. A network of silk was woven over the anterior end of the case, so that if the case was forcibly removed the occupant would not be exposed. Plate XLI, fig. 3, is from a photograph of some of the cases as they appeared at this time. Thus made secure, the caterpillars managed to turn around in their cases so that their heads were in the opposite direction. The transformation from the caterpillar to the pupa then took place. The pupa is dark brown in color. Fig. 6 represents two cases cut open longitudinally, showing the caterpillar and pupa.

The pupa stage probaly lasts from ten days to two weeks. We observed the moths issuing June 22d and until June 26th. The moths escape by means of a slit-like opening at the posterior end of the case.

PLATE XLII.

FIG. 1

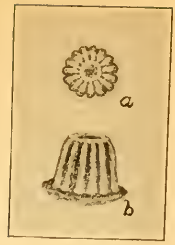


FIG. 2

FIG. 3

FIG. 4

THE PISTOL-CASE BEARER

FIGURE 1, THE MOTH, PARENT OF THE PISTOL-CASE BEARER; FIGURE 2, EGG, UPPER AND SIDE VIEW; FIGURE 3, YOUNG CASE-BEARERS ON THE UNDER SIDE OF AN APPLE LEAF; FIGURE 4, CASE OF A NEWLY-HATCHED CASE-BEARER. FIGURES 1, 2 AND 4 ARE FROM ORIGINAL DRAWINGS, ENLARGED; FIGURE 3 IS FROM A PHOTOGRAPH, NATURAL SIZE.

The adult insect is a beautiful steel-gray moth which measures nearly one-half of an inch from tip to tip when the wings are spread. The front wings are flecked with white scales on the basal half. Frequently these white scales are very numerous on the wings of the female and almost lacking on the wings of the male. Other striking characteristics are the rings of dark and white scales on the antennæ and legs and the tufts at the bases of the antennæ. The males are a little smaller on the average than the females and of a somewhat darker color. The moths fly at night and hence are not usually seen. Plate XLII, fig. 1, represents one of the moths enlarged.

The eggs.—We did not observe the exact time of egg-laying, but found eggs on the leaves late in June. These were on the under surface of the leaves. They were placed singly, most of them near the midribs and larger veins. Although they are very small, the eggs are plainly visible to the unaided eye if one knows what to look for. They are yellowish-green in color, nearly circular at the base, smaller, and with a slight depression at the upper end. Parallel depressions and ridges extend along the full length of the sides. Plate XLII, fig. 2, *a* and *b*, represent an upper view and a side view of an egg greatly enlarged. The eggs evidently hatch in about ten days or two weeks.

Habits of the young case-bearers.—We did not observe the exact limits between which egg hatching might occur. Early in August, however, the recently hatched case-bearers were found on the under surface of the leaves. The cases were made of excrement and silk presenting, when viewed under the microscope, the rough appearance represented in Plate XLII, fig. 4. The caterpillars were feeding on the soft tissues between the two surfaces of the leaves. When one of them was forcibly removed, the small round hole made through the skin of the leaf was plainly visible. September 5 the young case-bearers appeared, when feeding on a leaf, as shown in Plate XLII, fig. 3. At this time they measured, on an average, about one-eighth of an inch in length. From this time on they grew but little and soon migrated to the twigs to remain during the winter, attaching their cases to the bark as previously shown in Plate XL, fig. 1.

Brief summary.—From the above we may briefly summarize the life-history of this insect as follows:

The case-bearers, not yet half grown when winter overtakes them, hibernate on the twigs of the infested trees in silken cases curved at the upper ends, securely fastened to the bark in a nearly upright position, and usually near, but sometimes upon, the buds.

About the time that the leaf-buds begin to swell they become active again. They attack the growing buds, gnawing through the outer covering to feed on the tender tissues beneath. Later in the season they feed on the young leaves, boring into them and, for a short time, making mines similar to those made by true leaf miners. They may also eat away the entire soft part of the leaves, frequently making holes clear through them. In doing this the caterpillars do not leave their cases, but project their bodies apparently as far as they can without losing hold of these protective coverings. They also attack the opening flower buds, boring into them as when attacking the leaf buds; the full blown flower; the mature leaves, eating nearly the entire leaf with the exception of the midrib and larger veins; and the fruit, into which they mine to a short distance beneath the skin, causing the fruit to become deformed.

When ready to pupate the caterpillars migrate to the twigs and attach their cases firmly to the bark. Pupation takes place about the middle of May. Before this transformation is made, however, the caterpillars turn around in their cases so that their heads are toward the upper or curved end.

The moths come forth early in June. The eggs are deposited on the under sides of the leaves. They hatch in about ten days or two weeks. The young caterpillars make small holes into the leaves to enable them to feed on the tender pulp. Their cases are made out of excrement and silk. During September they migrate to the smaller branches and twigs to remain until spring. Thus there is but one annual generation.

Food plants.—The principal food plant of this insect is the apple. It is known, however, to attack the pear and it is said to attack the quince also.

Distribution.— The pistol-case-bearer is becoming well known throughout the apple-growing sections of the state. It has also been reported from the south, from the central states and from Canada. It is an American species.

Distribution by means of nursery stock.—We have occasionally found this insect on nursery stock. It is undoubtedly in this way that it is carried from one part of the country to another.

Natural enemies.—At least three species of parasitic insects prey upon the pistol-case-bearer. We bred this number from specimens kept in the laboratory. The number of parisitized case-bearers was sufficient to indicate that these little parasites may be an important check to the increase in numbers of this pest.

Remedial Measures.

As shown by the above account, the pistol-case-bearer belongs to that class of insects which in their larval state devour the tissue of the food plant instead of sucking the juices, as is the case with certain other insects, such as plant lice, scale lice, etc. It is therefore reasonable to expect that this insect can be controlled by spraying with an arsenical poison, provided the poison is applied at the right time. As we have already seen, the caterpillars do not feed openly on the leaves until quite late in the season, but feed for the most part on the interior of the buds and young leaves. The poison, then, should be applied before the winter buds begin to swell, so that the first meal of the young case-bearers as they begin to burrow into the buds may be a poisoned one. Another application made when the leaves are half grown, at which time the case-bearers begin eating holes clear through the leaves, should prove effectual.

With this in mind the following experiments were made. Full grown Baldwin apple trees were used in the experiments. All of them were badly infested with the pistol-case-bearer.

Experiment No. 1.—On April 20, May 1 and May 6, twelve trees were sprayed with Paris green used at the strength of one pound to 150 gallons of water. At the time of the first application the leaf buds had just begun to swell. But very few of the case-bearers were active. At the time of the second application the young leaves were well started, while at the time of the third application the young case-bearers were beginning to eat holes through the leaves.

From the first the effect of the treatment was plainly apparent. At the time of the last treatment the treated trees were comparatively free from the insect, although others in the same orchard, which had not been sprayed, plainly showed the effect of the injurious work of this pest.

Experiment No. 2.—On May 6, fifteen trees in the same orchard were sprayed with kerosene emulsion at a strength of one part of the emulsion to ten parts of water. The application was very thorough, the emulsion being applied until the trees were dripping wet. Although these trees were badly infested with both the pistol-case-bearer and the cigar-case-bearer, the emulsion seemed to have no effect upon either insect. Possibly a stronger emulsion would have penetrated the cases, but under the circumstances, it would undoubtedly have been endangering the trees to use a stronger emulsion, as the foliage was very tender and the flower buds were nearly ready to burst.

Experiment No. 3 consisted in trapping the moths with trap lanterns. These were kept all summer in the orchard of Mr. J. B. Collamer, of North Parma, to whom we are indebted for aid in this work. On the night of July 2, a large number of the moths were captured and a few on succeeding nights. Examinations in the laboratory showed that but few of the females contained eggs, which would indicate that the eggs are usually laid previous to this time, hence the trap lantern was of little value as a means of combating this insect.

Conclusions.— From the above experiments, we may conclude that the pistol-case-bearer can be controlled by the thorough application of Paris green at a strength of one pound to 150 gallons of water. The first application should be made just before the leaf buds begin to swell, the second about ten days later, and the third about a week or ten days from that time.

Kerosene emulsion, at summer strength, has no effect on either the pistol-case-bearer or the cigar-case-bearer. The use of the trap lantern does not seem to be a satisfactory method of combating this insect.

Additional notes.—When buying Paris green be sure that it is pure. A simple test for pure Paris green can be made with strong ammonia. Place a little of the Paris green in a test-tube and add enough ammonia to cover it well. Stir thoroughly with a glass stirring rod or other convenient instrument. If pure, all of the Paris green will dissolve readily, the solution turning at once to a deep blue color. If any sediment appears in the bottom of the test-tube, the Paris green may be considered adulterated. This is not necessarily an infallible test but may usually be considered of practical value. Another very good test is to place a little of the Paris green between two pieces of window glass and rub them together. If the Paris green is adulterated with lime or barium sulphate, which are quite frequently used for this purpose, the Paris green will appear to turn white in places. This appearance is caused by the small chunks of lime or barium sulphate which, when broken open, appear light colored.

As it is usually desirable to spray the orchard with Bordeaux mixture at the same time that the Paris green is applied for the pistol-case-bearer, the two may be combined as neither interferes with the beneficial action of the other. Add the Paris green to the diluted Bordeaux mixture in the same proportion as if it were being mixed with water. No additional lime need be added as the lime in the Bordeaux mixture will be sufficient.

Do not spray while the trees are in bloom.— There is nothing to be gained by so doing, and a good deal of injury may be done. The Bordeaux mixture and Paris green will be just as effectual if applied as indicated above, and then no injury will be done to the bees and other friendly insects which visit the blossoms and upon which largely rests the important responsibility of carrying the pollen from one flower to another.

PARTIAL BIBLIOGRAPHICAL LIST.

1878. RILEY, C. V. Ann. Rept. U. S. Dept. Agr., 1878, pp. 253-254. Brief account of outbreak in Erie Co., Pa., in 1877, with notes on the life-history of the insect. Original description of larva and imago.

CHAMBERS,* in Bull. U. S. G. G. Surv. Terr., IV, 1878, p. 93, (as *C. multipulvella*, auct. Walsingham).

1880. LINTNER, J. A. 39 Ann. Rept. of N. Y. Agrl. Soc., 1879, p. 52. Review and brief history. Ill. Dr. Riley's figure.

BARNARD,† in Proc. Amer. Assn. Adv. Sci., XXVII, 1880, p. 477. Pl. Insect Habits, figs. 8. (Case not identified.)

1882. LINTNER,‡ J. A., in Country Gentleman, July 6, 1882, XLVII, p. 533.

LINTNER, J. A. First Report, p. 329. Mentioned in list of insect depredators upon the apple-tree.

LINTNER, J. A. *Ibid*, pp. 163-167. General account, giving description and life-history; suggests London purple as remedy in preference to Paris green; Dr. Riley's figure of larvæ and cases, pupa and moth.

1883. SAUNDERS, WM. Insects injurious to fruit, p. 115. Brief general account.

1885. LINTNER, J. A. Second Report, p. 225. Brief review of article in Country Gentleman for July 6, 1882.

1890. LINTNER, J. A. Sixth Report, p. 178. Brief review of address before State Agrl. Soc. at its annual meeting Jan., 1880. *C. malivorella* mentioned.

1891. LINTNER, J. A. Eighth Report, p. 123. Specimens received from Oswego and Wayne counties; not yet abundant in New York. *Ibid*, p. 281. Mentioned in brief article in Country Gentleman, May 7.

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* From Dr. Lintner's First Report, p. 163.
† From Dr. Lintner's First Report, p. 163
‡ From Dr. Lintner's Second Report, p. 225.

1892. Moffat, J. A. Twenty-third Ann. Rept. Ent. Soc. of Ont., p. 47. Brief description of moth; life-history briefly stated.

1893. Lintner, J. A. Insect Life, Vol. VI, p. 184. Briefly mentioned.

1895. Fletcher, James. Ann. Rept. Canada Dept. Agr., p. 154. Briefly mentioned.

VIII. A BRIEF REPORT OF NURSERY STOCK INSPECTION IN WESTERN NEW YORK.

The inspection of nursery stock has recently become of much importance in this state. Such inspection serves two purposes: First, it enables the nurserymen to comply with the laws in other states, which require that a certificate showing that the stock has been inspected shall accompany all nursery stock sold within the state; and, second, it enables the officiating entomologist to keep a careful watch over the nursery stock grown in the state, and thus materially aids in enabling him to detect early the arrival of new pests in the nursery or the unusual increase of old offenders.

Early in the past season the writer was appointed by State Entomologist Dr. J. A. Lintner to act as his deputy for the purpose of inspecting nursery stock. Acting in this capacity, he has inspected stock from over twenty nursery firms. Most of the inspecting was done while the trees were in the packing yard. Between 15,000 and 20,000 trees were inspected in the packing yards. About 3,000 of these trees were infested with insects, most of which were either the peach tree borer or the wooly aphis. Over 1,000 of these infested trees were rejected as worthless. The remainder, which were not so badly infested, were freed from the insects by the application of insecticides.

In addition to the insects above named, the oyster-shell bark-louse, scurfy bark-louse, a scale insect scientifically known as *Asterodiaspis quercicola* Bouché, and the pear-tree Psylla, were occasionally found.

Method of inspecting the stock.—When circumstances would permit the stock was first inspected in the field and later in the packing yard. In the packing yard the trees requiring certificates were examined separately or in bundles, provided the bundles were not so large as to prevent the whole length of the tree being seen. Each tree was carefully examined from the roots to the top and only such trees as showed no evidence of the work of injurious insects or diseases were considered satisfactory. Where the stock can be first seen in the field, such close examination in the packing yard is, of course, unnecessary.

IX. THE PEACH-TREE BORER.

Sannina exitiosa Say.

Order, Lepidoptera. Family, Sesiidae.

Historical.

This insect is a native American species. It did not become generally known, however, until the introduction of the peach into this country from Europe. Prior to that time its natural food plants were undoubtedly the wild plum and cherry, as it is known to attack these fruit trees readily. The fact, however, that this species is now well known in every state where the peach crop is an important one, indicates that it must have taken readily to the new food plant early in the history of the fruit as an American product.

The original description of the Peach-tree Borer dates back to the time of one of America's earliest writers on entomology, namely, Thomas Say, who is known as the "Father of American Entomology." His description was published in 1823, in Vol. III of the Journal of the Philadelphia Academy of Natural Sciences, p. 216. He there describes the species under the name *Ægeria exitiosa.* Mr. Say also published one of the earliest general accounts which we have of this insect. This is found in his "American Entomology," published in 1824. A contemporary of Mr. Say, Dr. T. W. Harris, also published several articles concerning this insect. One of the chief of these is found in his "Insects Injurious to Vegetation," pp. 253-255, published in 1852. In this article he refers to the fifth volume of the New England Farmer, in which he published a review of the life-history and habits of this insect, together with a general history of the species, and also the names of the principal writers on the subject up to that time. Soon after the publications above referred to by Dr. Harris, Dr. Asa Fitch published his first annual report as State Entomologist of New York. Prominent among other articles in this report is found a comparatively long one on "The Peach-tree Borer, *Ægeria exitiosa* Say." This article occupies pages 108 to 121 of the report, and is illustrated by one wood cut representing a portion of a peach root injured by the borer.

From this time up to the present day, this troublesome insect has been repeatedly discussed in the reports of the various state and government entomologists, as well as in the agricultural press. Prominent among the earlier writers on this subject may be mentioned Dr. C. V. Riley, who published a comparatively long article on the Peach-tree Borer in 1868, in his First Missouri Report, as well as many of a similar nature at later dates; also Dr. Thomas and Dr. Forbes, in whose reports as State Entomologist for Illinois this insect is frequently mentioned. In 1879 Prof. Comstock referred at some length to this insect in his report as Entomologist of the United States Department of Agriculture. The reports of the State Entomologist of New York, by Dr. Lintner, and those of the Entomologist of the Dominion of Canada, Dr. James Fletcher, furnish a number of references to this insect, and accounts of its life-history and destructive habits. All of these writers speak of the serious injury to fruit trees caused by the borer, and in most, if not all, cases mention the need of great care by fruit-growers to prevent the increase of this pest.

DISTRIBUTION.

As previously stated, this insect is well known in every section of the United States where peaches are grown to any extent. In Circular No. 17, United States Department of Agriculture, Division of Entomology, Mr. Marlatt stated that the records of the division show that this insect is found from "Maine southward to the Gulf and westward to the Pacific slope."

Means of distribution.—The distribution within an orchard or from one orchard to another is easily effected by means of the female, as she can fly for some distance with comparative ease, even when heavy with eggs. But the carrying of the insect from one state to another or from one section of a state to another is undoubtedly most frequently effected by means of nursery stock. It is a too common occurrence in our own state to find many young peach trees in the packing shed, waiting to be shipped, which are infested with borers. Within the past few months hundreds of such trees have been found which were about to be

PLATE XLIII.

FIGURE 1.

FIGURE 2

FIGURES 1 AND 2. TWO PEACH-TREE ROOTS, SHOWING WORK OF PEACH-TREE BORER.

packed and shipped to some distant state. Such trees should be thrown out and destroyed or the borers should be cut out before the trees are packed.

Nature of the Injury.

The gummy exudations from the roots of the infested trees near the surface of the ground indicate the work of this insect. A close examination will show that the exudation comes from an opening in the bark which leads to one or more channels just underneath. These channels have been made by the borers and are not infrequently found to girdle the trees, thus causing an injury from which the tree is not likely to recover unless remedial measures are at once resorted to. Plate XLIII, figs. 1 and 2, are from photographs of plum roots (var. Myrobalan), which have been injured by the Peach-tree Borer. At Fig. 2 the borer itself is shown in the root which was cut open to expose the insect to view.

Description and Life History.

The peach-tree borer belongs to the same order of insects as the moths and butterflies, and to a family of moths, the members of which make a formidable array of injurious species. One of the characteristics of this family is that the mature insects, unlike most of our moths, have transparent posterior wings and slender bodies and that they are easily mistaken for wasps or bees by the casual observer. This is especially true of certain species. Although the borers themselves are very common, the parent insects are not generally known. The following careful descriptions, taken from Dr. Fitch's First New York Report, pp. 114-116, published in 1856, will enable the reader to identify the species. Dr. Fitch describes the male and female as follows: "The *male* is of a deep steel-blue color, with various sulphur yellow marks, and has a glossy lustre like that of satin. The antennæ are black, less than half as long as the body, abruptly curved outward at their tips and densely fringed along their inner sides with numerous fine short hairs, with a slight vacancy between them at each of the joints. The feelers are yellow on their lower sides; there is a paler yellow spot between the bases of the antennæ and a deeper yellow transverse stripe at the base of the head, both above and beneath. The thorax has a yellow stripe on each side of its middle, a transverse one at its base, which is slightly interrupted at the middle, and a short, broader one on each side under the wings; its base on the underside is white. The abdomen commonly has two slender yellow bands above, at the apex of the second and fourth segments, and a white line on each side of the tuft of hairs at its tip. The forward hips are yellow on their anterior face, the four others at their tips. The shanks are yellow at their tips, the hind ones have a yellow ring on their middle interrupted on the inner side, the other four have a large yellow spot on their anterior sides; their spines are white, their upper sides black, at least on the basal half. The fore feet have a white ring at the apex of each joint, and a broad white stripe upon the inner side; the middle and hind feet have a slender white line on their inner sides, which is often nearly obliterated, showing only a few white scales at the apex of each joint. The wings are transparent and glass like, with a slight tinge of smoky yellow; their veins, margins, and fringe is steel blue. The fore wings have a steel-blue band beyond the middle upon their transverse anastomosing veinlet, a slender yellow line upon their outer or anterior margin, both above and below, and a similar line on the inner edge of their inner margin; the hind wings also have a similar line on the inner edge of their outer margin." Dr. Fitch also describes seven varieties in this sex, which differ in the number and arrangement of some of the markings.

In describing the female moth Dr. Fitch says: "The *female* differs from the male so much that it would not be supposed to pertain to the same species. The abdomen is of a long oval form instead of being slender and cylindrical, and is twice as broad across the middle as that of the male. This sex is of a glassy steel blue color, with a purplish reflection in places, and blackish upon the face, and upon the middle of the abdomen is a broad band of a bright, glassy orange yellow color occupying the whole of the

PLATE XLIV.

FIGURE 1.—PEACH-TREE BORER; LARVA, UPPER AND SIDE VIEW; PUPA, AND MALE AND FEMALE MOTHS. FROM A PHOTOGRAPH (NATURAL SIZE), BY F. A. SIRRINE.
FIGURE 2.—ROOTS OF YOUNG APPLE-TREE INFESTED WITH WOOLLY APHIS; RECENTLY DUG.

fourth and fifth segments, except upon the middle of the under side, where, at least on the fourth segment, some orange scales often occur interspersed with the steel blue ones. The antennæ have no fringe along their inner sides. The fore wings are opaque and of the same steel-blue color as the body, their tips and fringes being of a purplish tint, both above and beneath. The hind wings are transparent, broadly margined upon both sides and marked at the base with steel blue, the glass-like portion being crossed by five robust veins, and commonly there are traces of a straw yellow stripe on the outer margin toward the tip." Brief descriptions of four varieties are also given, the chief differences being in the markings, as in the case of the male.

Plate XLIV, fig. 1, is from a photograph, by Mr. F. A. Sirrine, of the male and female moths together with the empty pupa case, shown above, and an upper and side view of the larva shown below.

In this climate the moths do not come forth, as a rule, before July 1, when egg-laying soon begins. The eggs are very small, about .02 of an inch in length and half as broad as long, and are oval in form. The surface of the shell is beautifully sculptured and the color is yellowish white. The eggs are deposited upon the surface of the bark during July and August and are said to be placed singly and to be attached with a gummy secretion. They are usually placed just above the surface of the ground, although they may be deposited as high up as some of the lower branches. In a short time the young borers come forth and begin at once to burrow through the bark or to seek an entrance by means of any convenient opening to the sapwood beneath. Here they remain during the summer and winter, feeding actively until late in the fall and making the channels previously alluded to. November 12 the writer found four borers in the root of a plum tree taken from a nursery near the Station. The smallest borer measured one-eighth of an inch in length, and the largest one inch. The borers remain dormant during the winter but resume feeding in the spring. As a rule they are fully grown by June, when they measure about an inch or a little more in length and may be briefly described as naked, robust larvæ, yellowish white in color and with the head and first segment dark brown.

When ready to transform to the pupa state, which is very soon after becoming full grown, the borers prepare elongate oval cells either under the bark of the injured root or in the gummy exudation at the entrance of the excavations. Some of the cells may also be found in the ground a short distance from the roots. These cells are just large enough to contain a single borer, and are constructed of pieces of bark, excrement and particles of the soil, held together by woven threads of silk. In these cells the transformation from the larva to the pupa takes place. The pupa state does not last more than a few days, when the mature insects emerge. Thus, in the climate of the northern states, the peach-tree borer is nearly a year in passing through its transformations from the egg to the mature insect.

PREVENTIVE AND REMEDIAL MEASURES.

Preventive.—Preventive measures consist largely in arranging some mechanical obstruction to prevent the depositing of the eggs on the tree, or the application of some poisonous substance to the bark that will be fatal to the young larvæ as they bore into the tree.

Mechanical obstructions.—These are usually formed by wrapping the trunk with paper, rye straw, etc., or mounding earth about the base of the trunk. The first was suggested by Dr. Harris in 1826. In his treatise on Insects Injurious to Vegetation, p. 254-255, Dr. Harris refers to this method as follows: "Remove the earth around the base of the tree, crush and destroy the cocoons and borers which may be found in it and under the bark, cover the wounded parts with common clay composition, and surround the trunk with a strip of sheathing paper eight or nine inches wide, which should extend two inches below the level of the soil, and be secured with strings of matting above. Fresh mortar should then be placed around the root, so as to confine the paper and prevent access beneath it, and the remaining cavity may be filled with new or unexhausted loam. This operation should be performed in the spring or during the month of June. In the winter the strings may be removed, and in the following spring the trees should again be examined for any borers that have escaped search before, and the protecting applications should be renewed." Dr. Lintner has suggested using fine wire netting as a sheathing for the trunk in place of the paper. *Dr. Lintner describes this protector as follows: "A cylinder made of fine wire netting, about fifteen inches high, mounted on a galvanized metal base, gathered in at the top so as to adjust itself closely to the tree, opens at one side for passing it around the trunk, and is then secured and fastened to the ground, and slightly into it, by a sliding pin. With this protection, the moth would be effectually prevented from depositing an egg upon or near the base of the tree. The cylinders could be quickly applied, and with proper care in housing them they would last for many years. It is thought that they can be offered for sale at about twelve dollars the hundred." Mounding up earth about the base of the tree is a preventive method which has been known for many years. Each year a few more inches of earth may be added. The mounds are for the purpose of preventing the moths from depositing the eggs near the roots.

Mixtures applied to the trunk which are repulsive to the moths.—The object of such applications as these is to keep a coating on the trunks of the trees which will be sufficiently repulsive to the female moth to prevent her depositing eggs there. A number of washes of this character are in use. The two following are probably among the best: Both formulas are given by Dr. Lintner in his Eighth Annual Report, pages 183-184. The first originated with Mr. Bateman, of Painesville, Ohio, who is quoted by Dr. Lintner as follows: "For our orchard of five hundred bearing trees we buy a pint of crude carbolic acid (or half as much of the refined), costing not over twenty-five cents; then take a gallon of good soft soap and thin it with a gallon of hot water, stir-

* Eighth Annual Report, pp. 185. 186.

ring in the acid, and letting it stand over night, or longer; then add eight gallons of cold soft water, and stir. We have then ten gallons of the liquid ready for use. The wash should be thoroughly applied with a swab or brush around the base of each tree, taking pains to have it enter all crevices." The formula for the wash recommended by Mr. J. H. Hale, the well-known Connecticut peach-grower, is given by Dr. Lintner as follows: "To a common bucket full of water take two quarts of strong soft soap, half a pint of crude carbolic acid, two ounces of Paris green, first reduced to a paste, with water and lime enough to form a thin paste that will adhere to the tree. A little clay may be added to assist in making it stick. Apply with a swab or brush before the first of June." A compound which is intended to serve the same purpose as the above is known as "Dendrolene," and is manufactured by the Bowker Fertilizer Company, of Boston, Mass. An account of the experiments with Dendrolene at this Station will be found in another part of this report.

Washes intended to poison the young borers have lately come into use. A simple and effective wash of this character consists of a heavy whitewash, to which is added a little glue or soft soap, together with two or three ounces of Paris green or London purple to a pailful of the whitewash.

Remedial measures.—The chief remedial measures consist of cutting out and killing the borers or inserting a probe into their burrows, which will accomplish the same end. Probably the former is more frequently resorted to. The principal objections to this method are the necessary injury to the tree and the time required to do the work. Bisulphide of carbon may be effectively used by pouring into the channels made by the borers. This compound evaporates very rapidly and the fumes, which are fatal to the insects, being heavier than air, will reach all parts of the infested portions of the tree. To apply the bisulphide of carbon, remove the sap and dirt from the opening into the root and inject a little of the bisulphide, covering the root again as soon as the application is made.

SUMMARY.

From the above we may briefly summarize as follows:

The peach-tree borer (*S. exitiosa*) is a native American species. It was originally described in 1823, at which time it was an important pest in many of the peach-growing sections of the country. It is now widely distributed throughout the United States.

The parent insects are beautiful moths. The eggs are laid on the trunk of the tree, usually near the crown of the root.

The injury is caused by the larvæ, which attack the roots, and occasionally the trunks of the tree. Their presence is indicated by the exudation of sap from the wound.

The pupæ may be found in the infested roots, in the sap about the roots, or in the ground a short distance from the roots. The moths usually appear in a week or ten days after pupation has taken place.

In this climate the insect passes the winter in the larval state. There is but one brood annually.

PARTIAL BIBLIOGRAPHICAL LIST.

* An asterisk denotes that the item was taken from the "Bibliography of the More Important Contributions to American Economic Entomology," by Samuel Henshaw; published by U. S. Dept. of Agr. Div. of Entomology.

1801. *ELLIS, JOHN. Account of a method of preventing the premature decay of peach trees. Papers on Agric., Mass. Agric. Soc., 1801, pp. 25, 26. Papers on Agric., Mass. Soc. for Promot. Agric., 1803, pp. 43-44.

Means against *Ægeria* [=*Sannina*] *exitiosa*.

1820. *COCKE, J. H. On peach trees. Amer. Farmer, 28 January, 1820, v. 1, pp. 350, 351.

Ægeria[=*Sannina*] *exitiosa* prevented from depositing eggs on peach trees by binding tobacco about base of trunk.

1826. *HARRIS, T. W. Peach-tree insect. N. Engl. Farmer, 25 August, 1826, v. 5, p. 34. See: Harris Ent. Corresp., p. 359.

Characters, habits and means against *Ægeria persicæ* [= *Sannina exitiosa*]

1843. GAYLORD, W. Trans. N. Y. State Agr'l Soc., 1843, v. 3. p. 161.

*HARRIS, T. W. Peach tree worms. Mass. Ploughman, 3 January, 1843, v. 2, No. 36, first page, figs.

Characters and figures of *Sanninaexitiosa;* its ravages and remedies.

1852. HARRIS, DR. T. W. Insects Injurious to Vegetation, pp. 253-255; brief general account, remedial measures.

1854. HARRIS, T. W. Proc. Amer. Pomol. Soc., 1854.

1859. FITCH, Dr. ASA. Trans. N. Y. State Agr'l Soc., 1859, v. 19, p. 595.

1867. *DODGE, JACOB RICHARDS. Insects. Mo. Rept. U. S. Dept. Agric. for 1866-1867. Statistical report on the ravages of *Ægeria* [=*Sannina*] *exitiosa.*

1869. *DEAN, A. Mounding peach trees again. Amer. Ent., July, 1869, v. 1, pp. 222-223.

Methods of mounding; effectiveness of the same; habits of *Sannina exitiosa.*

1870. RILEY, C. V. Second Mo. Report; mentioned.

1871. *LEBARON, W. The effects of clean culture in preventing the ravages of noxious insects—canker worms, codling moths, and apple and peach tree borers. Prairie Farmer, 27 May, 1871, v. 42.

*SAUNDERS, W. On the larva of the peach borer (*Ægeria exitiosa*). Can. Ent., June, 1871, v. 3, pp. 22-23, fig. 11.

Characters and ravages of *Ægeria* [=*Sannina*] *exitiosa;* preventives.

*[WILLIAMS, H. T.] Care for the peach borer. Horticulturist, May, 1871, v. 26, p. 154.

Advises the use of carbolic soap.

1871. RILEY. Third Mo. Report, pp. 76-77.

1872. *LEBARON, W. Prairie Farmer, 11 May, 1872, v. 43. Means against *Ægeria* [=*Sannina*] *exitiosa.*

1876. RILEY. Sixth Mo. Report, p. 108.

1879. *LINTNER, J. A. The peach-tree borer. Cultivator and Country Gentl., 27 March, 1879, v. 44, p. 199.

Means against *Sannina exitiosa.*

1880. *FULLER, A. S. Peach-tree borer infesting almonds. Amer. Ent., January, 1880 [v. 3], n. s., v. 1, pp. 11-12.

Ravages of *Ægeria* [=*Sannina*] *exitiosa;* notes on the early stages.

1881. KELLICOTT, D. S. Can. Ent., Jan., 1881.

1882. ZIMMERMAN, CHAS. D. Agr'l Review, II, 1, p. 56; brief mention.

1885. *DEVEREAUX, W. L. The early insect. N. Y. Tribune, 15 June, 1885.

Notes on *Haltica chalybea, Phyllotreta vittata,* Agrotidæ, and *Sannina exitiosa;* swine and sheep as destroyers of insects.

1887. *DORAN, E. W. Report on Economic Entomology of Tenn. Biennial Report Comm. Agr'l of Tenn., p. 218.

1888. *LINTNER, J. A. Egg laying of peach-borer moth. Cultivator and Country Gentl., 9 February, 1888, v. 53, p. 109.

The period of oviposition of *Sannina exitiosa* in New Jersey may extend from first week in June to the middle of September; preventives.

1890. PACKARD, DR. A. S. Forest Insects, pp. 521-522. Attacking wild cherry.

X. THE WOOLLY-LOUSE OF THE APPLE.

Schizoneura lanigera Hausm.

Order, HEMIPTERA-HOMOPTERA. Family, APHIDIDÆ.

WORK OF THE INSECT.

The injurious work of this insect is not confined to the roots, but it attacks the trunks and branches as well. The injury above ground is especially noticeable on young trees. The woolly aphis is chiefly an apple tree pest, although, as stated later on, it attacks other fruit trees as well.

The presence of the lice is plainly indicated by the woolly excretions. Unlike the peach-tree borer, the woolly aphis does not work its way into the tissue of the plant, but attacks it from the outside only, feeding on the sap which exudes from the punctures made by the minute setae* of the lice. The injurious work upon the roots is very evident soon after the attack is commenced, the infested roots soon becoming covered with galls, as shown a little later on in the illustrations. The injury to the bark and branches is also conspicous. The former frequently become pitted or scarred at the points of attack, while the latter wither and die.

HISTORICAL.

From the evidence at hand it appears that the woolly aphis is probably not a native American species. The earliest records which we have of it show that it was known in Europe in 1787. The species was not given a scientfic name, however, until 1801, when Hausmann described and named it. At this time it was well distributed in Europe, being especially abundant in the apple orchards of Germany. There seems to be no record of its being generally known in this country previous to 1800. The earliest record which we have seen is by Downing, who stated that in 1848 the woolly aphis was abundant and destructive to our fruit trees. Prominent among the early American writers on entomology who men-

* Part of the mouth parts.

tion this insect, are Dr. Asa Fitch, who published a general account of it in 1856, in his first report; Dr. Riley, who discusses it in his First Missouri Report, published in 1869, and Dr. Thomas, who published an exhaustive account in his Illinois Report for 1878. In addition to these are numerous shorter accounts, which have been published from time to time. Probably few of our injurious species of insects have been discussed in the press and in the various bulletins and reports of the experiment stations more than this one. In spite of this fact, however, the woolly aphis of the apple is still far from being controlled in our nurseries and orchards.

DISTRIBUTION.

In general it may be said that this species of woolly aphis is found wherever apples are grown. In the United States it is well known from Maine to California. In Canada it is also a serious pest.

Means of distribution.—Distribution may be accomplished in an orchard by means of the winged viviparous females which can fly from place to place. The distribution from one section of the country to another, however, is most frequently accomplished by means of nursery stock. It is surprising how many infested trees are shipped from our nurseries annually. Usually it is not difficult to detect the lice when on the roots or trunks of the trees, and hence there seems to be but little excuse for allowing the infested trees to go out of the packing yards without first being treated.

IMPORTANCE IN NEW YORK.

This insect is of especial importance in this state, as it is found in almost every section of the state where apple trees are grown. This is especially true with regard to the nurseries. As New York is one of the leading apple and nursery stock producing states, the importance of this insect as a pest in this state is at once apparent. On both light and heavy soils the insect seems to thrive and to increase with great rapidity. We have received letters from various sections of the state indicating that the woolly aphis is attracting a good deal of attention, especially among nurserymen and those who are planting young orchards, and that it is proving a difficult insect to control.

Appearance of Infested Trees.

It is usually a very easy matter to detect the presence of the woolly aphis, especially on young trees. They may live on the roots of old trees without causing any apparent injury or change in the general appearance of the trees. They also frequently escape detection on the rough bark of an old tree. On young trees, and especially trees yet in the nursery, the presence of this insect is more apparent. Usually the white cottony tufts hanging from the infested limbs readily attract the eye, but frequently the tree may be infested above ground when the limbs are free from the tufts of cotton. In such cases a few of the lice will be found in the wounds made by trimming the tree too close. This applies to nursery stock especially. We have frequently found infested trees in the packing yard which at first appeared to be free from the lice, but upon close examination a number of the hibernating insects could be found almost concealed in the wounds made by too close trimming of the tree. We have also found the roots of young apple trees badly infested when there were no traces of the lice on the other parts of the tree, and in many cases the trunk and limbs were infested, although the roots were entirely free. When the roots are badly infested, however, the whole tree is likely to present a sickly appearance.

Appearance of infested roots.—When first dug, young nursery trees whose roots are infested with the aphis will usually carry with them a good deal more of the soil than is usual with healthy roots. This is due to the fact that the roots, including many of the fibrous roots, are enlarged and deformed with galls. There also seems to be an unusual abundance of fibrous roots. These are often matted together and with the deformed and swollen roots form a support for the dirt. Plate XLIV, fig. 2, is from a photograph of the infested roots of a young apple tree as they appeared before the dirt was removed. It is evident that the amount of soil clinging to the roots would depend largely upon the nature of the soil and the extent to which the roots were infested, but even where the trees were grown in a very light sandy loam

PLATE XLV.

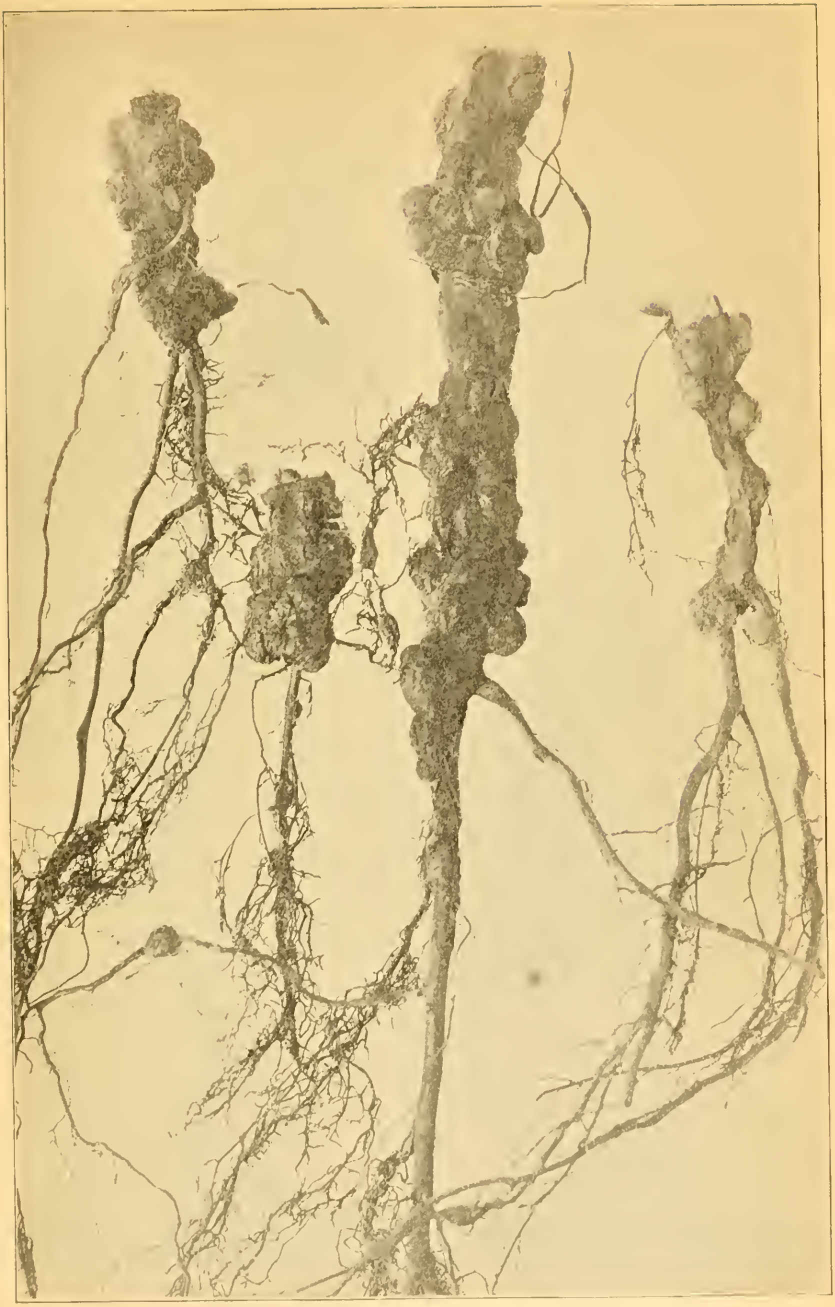
Fig. 3.

Fig. 1

Fig. 2.

THE WOOLLY APHIS OF THE APPLE. FIGURE 1.—HEALTHY ROOTS OF YOUNG APPLE TREES AS THEY APPEARED JUST AFTER THE TREES WERE DUG, SHOWING THE CONTRAST BETWEEN THESE AND THE INFESTED ROOTS (SEE PLATE XLIV., FIGURE 2). FIGURE 2 SAME AS FIGURE 2, PLATE XLIV., WITH DIRT REMOVED SHOWING GALLS. FIGURE 3.—APHIDS HIBERNATING IN SCAR ON TRUNK OF YOUNG APPLE TREE MADE BY TOO CLOSE TRIMMING.

PLATE XLVI.



GALLS ON ROOTS OF YOUNG APPLE-TREE CAUSED BY THE WOOLLY APHIS.
ENLARGED.

PLATE XLVII.

Woolly Aphis on Apple Twig.

we have observed that so much more dirt would cling to the infested roots than to roots which were not infested, that the trees with infested roots were readily distinguishable from the others. Plate XLV, fig. 1, is from a photograph of the roots of two healthy apple trees, freshly dug from soil which was exactly the same as that in which the others were grown. This figure is introduced here to show the contrast between the external appearance of freshly dug healthy and infested roots.

In order to make a closer examination of the galls and deformed roots the soil was removed from the roots shown in Plate XLIV, fig. 2. The result is shown in Plate XLV, fig. 2. From this figure it is evident that most of the galls occur on the larger roots. A closer examination, however, revealed the fact that many of the fibrous roots also were swollen in places, as if a gall had just started, and on others galls half as large as a pea were occasionally found. Plate XLVI shows a closer view of some of the infested roots. A few of the fibrous roots and some of the rootlets are shown to be slightly swollen or bearing small galls.

The trunk and branches.—Young nursery trees and those newly set out in the orchard show the injurious work of this insect more than older trees. In the summer the bark on the trunks of the young trees often becomes scarred and pitted, as a result of the work of the lice. The young branches, however, show the injury more plainly. Here the lice accumulate in great numbers, frequently almost covering the limbs. They seem to prefer to gather in the axils of the leaves, and also at the tips of the limbs. They are also often found on the leaves. Thus a badly infested branch is easily recognized by the large amount of the woolly-like substance which the lice secrete. Plate XLVII is from a photograph of an infested branch of a young apple tree as it appeared in the summer. But few of the lice themselves can be seen, as most of them are covered by the woolly secretion.

Although the usual method of carrying the species through the winter may be by the winter egg, yet in this climate many of the lice hibernate. They may be found in broken places in the bark of old trees, or in other protected places on the trunk or limbs. We have occasionally found them during the winter on the under sides of the limbs of nursery trees. Usually, however, they should be looked for in the scars made by trimming the tree too close, as shown in Plate XLV, fig. 3. Sometimes only two or three of the lice will be found, but they may be easily recognized by their white, woolly covering. During the past few months we have examined a large number of these winter colonies, and in every case have found the lice present in various sizes, from the very small larvæ to the nearly full grown insect. The winter eggs are also placed in sheltered places such as these.

IMPORTANCE AS A PEST TO NURSERY STOCK.

Although the woolly aphis does serious injury to the young trees in the orchard and sometimes to older ones as well, yet it is the nurseryman who suffers most from the depredations of the lice. When once well started in a nursery, this insect may make thousands of apple trees unsalable. When examining nursery stock last season, we found many thousands of trees which had become infested. In a majority of cases, apple trees only were found infested, but where pear or quince trees were grown next to blocks of infested apple trees, they, too, became infested with the lice. We have never found them occurring in such large numbers on either pear or quince trees, however, as on apple. Of the apple trees which we examined, the "Ben Davis" and "Yellow Transparent" varieties were found infested more frequently than any other, and when occurring on pears, the "Bartlett" variety.

This insect is also of especial importance as a pest to nursery stock, because it is by means of infested stock that it is distributed throughout the country. When only a very few of the insects occur on a tree, they are very easily overlooked, or, perhaps, are not recognized when found, as most growers and dealers seem to be familiar with the insect only as it appears when occurring in large numbers on the branches of the trees or when infesting the roots.

Life History and Habits.

Although this insect is being studied here at the Station, we have not observed, up to the time of writing this report, all of the transformations which take place during the life cycle. As usually given by entomologists, however, its life history is, briefly, as follows:

The winged viviparous females appear late in the summer or early in the fall. This female produces oviparous females. The males are present at this time and the oviparous females produce eggs, which will hatch the following season. These are called winter eggs. In addition to these eggs, propagation is provided for by hibernating larvæ. These live on the roots or above ground on the trunk or branches. This year, as previously stated, we found the lice hibernating in the very young larva stage and in all gradations to a nearly full grown louse.

The winter eggs hatch in the spring, producing agamic females. Each female starts a colony, from which other colonies originate.

Natural Enemies.

Several species of parasitic insects are known to prey upon the woolly aphis. Certain species of predaceous insect also prey upon this insect. One of the most important of these is the root louse syrphus fly, the larva of which was often found last season among the colonies of the lice.

Preventive and Remedial Measures.

Preventive measures.—At present the only preventive measure which we can suggest for both nurserymen and orchardists is to refuse to accept trees which are infested with this insect.

Growers of nursery stock will find it of advantage either to destroy old apple trees which may be in the vicinity of their blocks of apple trees, or to have these trees kept free from the woolly aphis. We have noticed several instances where the nursery stock had undoubtedly become infested with this insect from old infested apple trees near by.

Remedial measures.—There seems to be no satisfactory remedial measure which can be made practical in large nurseries. The colonies above ground are said to be easily destroyed by most of the standard insect washes. The root colonies do not thrive in heavy, damp ground. For this reason, Prof. Comstock states,* it has been suggested that "the earth around the crown be hollowed into a sort of basin in order that the water may collect there." Applying insecticides such as strong soap suds or kerosene emulsion is said to be an effective remedy. Hot water is also recommended for this purpose. Experiments conducted at this Station show that keeping the soil about infested roots constantly wet with cold water does not kill the lice or seriously delay their increase.

SUMMARY.

The most important points stated above may be briefly summarized as follows: The woolly aphis belongs to the well-known family of insects which includes the plant lice. It is easily distinguished because of the white woolly secretion. It has long been known as an injurious insect in both Europe and America.

This insect is well distributed throughout the apple-growing sections of the country.

It attacks the roots of the trees, forming galls on them; also the trunks and branches, causing pits and scars on the bark of the former, and withering and death of the latter. Lice may go from the roots to the trunks and branches. Most of the lice are wingless, although at certain times of the year winged individuals appear. Eggs are produced only once a year, and these remain on the trees over winter, hatching in the spring. Some of the lice also hibernate.

The woolly aphis is of especial importance to nurserymen, as it causes more injury to nursery stock and young trees newly planted in the orchard than to older trees. It is also largely by means of nursery stock that this insect is carried from one part of the country to another.

*Report United States Department of Agriculture, 1879, p. 260.

Preventive measures consist chiefly in refusing to handle infested stock and in keeping the nursery free from old infested apple trees.

Remedial measures consist in treating the infested tree with some insecticidal wash, such as strong soap suds or kerosene emulsion for the lice above ground, and applying these washes to the roots or keeping the soil around the crown of the roots wet with water until the lice have succumbed.

Partial Bibliographical List.*

* An asterisk denotes that the item was taken from the "Bibliography of the More Important Contributions to American Economic Entomology," by Samuel Henshaw; published by the U. S. Dept. Agr. Div. of Entomology.

1827. *Adams, John. Result of an experiment to destroy *Aphis lanigera*, or American blight on fruit trees. Loudon's Gard. Mag., 1827, vol. II, p. 49.

Spirits of turpentine effective against *Aphis* [=*Schizoneura*] *lanigera*.

*Dann, John. An effectual mode of destroying *Aphis lanigera*, or American blight, on fruit trees. Loudon's Gard. Mag., vol. II, p. 165.

Formula for the destruction of *Aphis* [=*Schizoneura*] *lanigera*.

1856. Fitch, Dr. Asa. First Report on the Noxious, Beneficial and Other Insects of the State of New York (in one volume with second report) pp. 5-11. Brief account of his discovery of this insect on some young apple trees, Oct. 29, 1849; also history of the insect up to that time, together with brief account of injuries to roots and detailed description of "young larvæ" and "matured winged individuals." Strong soap suds and ashes given as remedies. Popular name given as the apple-root blight, and the scientific name, *Pemphigus Pyri*, with *Erisoma Pyri* Fitch, and *Pemphigus Americanus* Walker, as synonyms

1865. *Verrill, Addison D. The woolly apple-tree blight—*Eriosoma lanigera* Harris. Prac. Ent., 25 December, 1865, vol. I, p. 21.

Occurrence of winged females of *E.* [=*Schizoneura*] *lanigera;* its power of enduring cold.

1866. WALSH, B. D. Practical Entomologist, vol. V, pt. 1, p. 34. Comparative character of *Eriosoma* (*Schizoneura*) *lanigera* and *Pemphigus pyri* [=*Schizoneura lanigera*].

1867. WALSH, B. D. Prairie Farmer, 1867, pp. 358-359. Ravages and means against *Pemphigus pyri* [=*Schizoneura lanigera*].

WALSH, B. D. First annual report on the noxious and beneficial insects of the State of Illinois.

RILEY, C. V. Prairie Farmer, 15th June, 1867, p. 397. Descriptions, life-history and means against.

RILEY, C. V. *Ibid*, December, 1867, p. 389. Means against root and stem forms.

1868. WALSH, B. D. Amer. Ent., vol. V, No. 1, pp. 54-55. Hot water as a means against; life history; nature of injuries to roots; natural enemies; remedies.

WALSH, B. D. and C. V. RILEY. Amer. Ent., vol. V, No. 1, p. 60. Means against.

*RILEY, C. V. Prairie Farmer, 22d Feb., 1868, p. 117. Answer to inquiry of C. S. J. *Schizoneura lanigera* not the cause of "rotten root."

1869. RILEY, C. V. First Missouri Report, pp. 118-123. Remarks on rot in roots infested with woolly aphis; life history and descriptions, together with technical description of winged form. Referred to genus *Eriosoma*. Natural and artificial remedies, the former including three predacious insects (one, a new species, *Pipiza radicum*, is described); and the latter hot water, and mulching to bring the lice to the surface of the ground.

WALSH, B. D. and C. V. RILEY. Amer. Ent., vol. V, No. 1, pp. 81-84. Life history and descriptions; natural enemies and means against; two forms described.

1870. *RILEY, C. V. Amer. Ent. and Bot., June, 1870, vol. II, p. 246. Answer to enquiry of B. M. McKinstry; ravages of and means against *Schizoneura lanigera* on roots of young apple-trees.

1870. *MERCHANT, J. W. Amer. Ent. and Bot., vol. V, No. 2, p. 303. Ravages and means against *Schizoneura lanigera.*

1871. RILEY, C. V. Third Missouri Report, p. 95. The apple-root louse identical with the woolly aphis.

BETHUNE, C. J. S. Report Fruit Growers' Assoc. of Ontario for the year 1870, 1871. Characters, habits, injuries, and means against.

1872. *D[IMMOCK], G. Insects infesting apple trees. New England Homestead, June 1, 1872, vol. V, No. 4, p. 25.

Treats of *Eriosoma pyri* [=*Schizoneura lanigera*].

1877. SAUNDERS, W. Ann. Report Ent. Soc. Ont., p. 390. Enemies and means against.

1878. GOTT, B. Ninth Ann. Rep. Ent. Soc. Ont., p. 57. Brief note; very abundant during the past season; oil or varnish given as remedies.

1879. COMSTOCK, J. H. Ann. Rept. U. S. Dept. Agr., 1879, p. 258. Notes supplementary to Dr. Cyrus Thomas' article in Trans. Dep. Agr., Ill., 1878, vol, XVI, p. 128. Including brief report of observations on life history. In Washington, both trunk and root form found to maintain themselves through winter without intervention of winter egg. Remedial measures also briefly stated.

OSBORN, H. Report on noxious insects. Trans. Iowa State Hort. Soc. for 1878-1879. Habits and natural history.

1881. COOKE, MATHEW. Treatise on Insects Injurious to Fruit and Fruit-Trees of the State of California, p. 51.

BETHUNE, REV. C. J. S. Twelfth Ann. Rept. Ent. Soc. Ont., pp. 74-76. General account of life history and habits; soap and tar given as remedies. 1 Fig.

1882. *GILLET, F. Sulpho-carbonate of potassium as a remedy against the apple-root louse [*Schizoneura lanigera*]. 1st Rept. Board State Hortic. Comm. Cal., 1882, pp. 33, 34.

Not effective.

1882. *DWINELLE, C. H. Later notes on the Woolly Aphis. 1st Rept. Board State Hortic. Comm. Cal., 1882, p. 89.
Lime and gas lime as means against *Schizoneura lanigera.*

*DWINELLE, C. H. Woolly Aphis on apple and pear trees. 1st Rept. Board State Hortic. Comm. Cal., 1882, pp. 18-19, fig.
Notes on *Schizoneura lanigera;* means against it.

1883. SAUNDERS, WM. Insects Injurious to Fruit, pp. 13-16. General description; life history; remedies. 1 Fig.

1884. OSBORN, H. Bul. No. 2, Iowa Agr'l College.

1886. WHITEHEAD, CHAS. Third report on injurious insects, London. Historical review; life history. Preventive and remedial measures; the latter include mixture of soft soap and quassia, paraffin oil and water, also vegetable and animal oils as linseed, whale and neat's-foot oil, and a wash of lime, made of very quick lime and water. Also refers to successful use of linseed oil and powdered sulphur in America.

1887. BETHUNE, C. J. S. Seventeenth Ann. Rep. Ent. Soc., Ont., p. 58. Life history briefly given. Describes an instrument devised by Dr. Barnard of Washington, D. C., for injecting coal oil or other liquids beneath surface of ground to kill woolly aphis and other root inhabiting insects.

*WEED, C. M. Insects of the orchard. Prairie Farmer, 8 January, 1887, vol. 59. Means against *Schizoneura lanigera* and *Aphis mali.*

1888. RILEY and HOWARD. Insect Life, vol. I, p. 156. Brief extract from correspondent in Pacific Rural Press, of September 8, 1888, who "records the destruction of the woolly aphis upon his apple trees by a large flock of young English sparrows."

RILEY and HOWARD. *Ibid*, p. 89. New remedy for woolly apple louse as given by Maurice Maindoon in Revue Horticole.

1890. RILEY and HOWARD. Insect Life, vol. II, p. 276. Records experiments with resin wash for woolly aphis as given in a letter by Mr. E. K. McLennon, Berkeley, Cal.

RILEY and HOWARD. *Ibid*, p. 290. Note on article in New Zealand Farmer for Dec., 1889, in which coal soot is referred to as a remedy for the "American blight" (*Schizoneura lanigera*).

RILEY and HOWARD. *Ibid*, p. 336. Mentioned in brief reviews of Bul. 21, U. S. Dept. Agr., Div. of Ent. Found in Australia by Mr. Albert Koebele.

COQUILLETT, D. W. Bul. 23. U. S. Dept. Agr., Div. Ent., p. 26. Found that hydrocyanic acid gas used strong enough to kill the red scale does not kill woolly aphis.

1891. RILEY and HOWARD. Insect Life, vol. III, p. 256. Mentioned in brief review of Bul. 5, Oregon Agricultural Experiment Station.

HOWARD and RILEY. *Ibid*, vol. IV, p. 2. Mentioned in brief review of Handbook of Australian Insects, by C. French. *Ibid*, p. 91. Mentioned in brief review of Bul. 3, N. M. Ag'rl Exp. Sta.

1892. LAKE, E. R. Bul. 6, Wash. Ag'rl Exp. Station, pp. 113-114. Brief general account; 2 cuts showing normal and affected roots of one-year apple seedlings.

1893. CHAMBLISS, C. E. Univ. Tenn. Ag'rl Exp. Sta., Bul. 1, vol. VI, pp. 4-6. Gives two forms, apple-root louse, attacking the roots, and woolly-louse of the apple, attacking the trunk and branches. Descriptions, life history and habits given; also natural enemies, including spiders. Soap, bisulphide of carbon and scalding water given as remedies.

RILEY and HOWARD. Insect Life, vol. VI, p. 2. Reference to short notice of woolly aphis in Bul. 6, Wash. Ag'rl Exp. Sta.

1894. SEMPERS, F. W. Injurious Insects, pp. 72-73. Brief popular account and remedies.

ALDRICH, J. M. Insect Life, vol. VII, p. 202. Brief note; in restricted areas in Idaho during 1893.

1895. PIPER, C. V. Bul. 17, Wash. Ag'rl Exp. Sta., pp. 45-46. Brief account of two forms; Kerosene emulsion, hot water (120°-140° Fahr.) and bisulphide of carbon given as remedies.

GILLETT and BAKER. Bul. 31, Technical series 1, Col. Ag'rl Exp. Sta., p. 116. Common on apple; also found on crab apple in Colorado.

HOWARD, L. O. (?) Year book of the U. S. Dept. Agr., 1895, p. 580. Remedies for.

COMSTOCK, J. H. Manual for the Study of Insects, p. 162. Brief account, with remedies. Resembles the grape phylloxera, in having a root-inhabiting form.

XI. NOTES ON THE RECENT ARMY-WORM OUTBREAK.*

SUMMARY.

Although it is not probable that another outbreak of the army worm will occur this year, it is advisable to clear up and, where possible, to burn over infested sections.

The caterpillars are now passing through the chrysalis stage and should be looked for under stones, bunches of field grass, bits of board, or any rubbish which may be found in the fields or along the fences.

During an outbreak, the advancing insects may be checked by plowing furrows, rolling, or by poisoning a portion of the crop attacked. Prompt action is always necessary to secure the best results.

INTRODUCTION.

The recent outbreak of the army worm has caused much alarm among farmers throughout the state, and also much apprehension as to the probability of another serious invasion this season. Judging from our correspondence, there is a general desire among farmers, especially among those who have suffered from the depredations of the caterpillars, to know something of the life-history and habits of the insect. Many are also inquiring if it is advisable to make further effort to prevent the increase of the worms during the remainder of the summer.

With this in mind, the following brief article has been written in which the life-history of the insect is given, together with a statement of such facts relating to the invasion as are judged to be of especial interest at this time. The short time necessarily allowed in the preparation of this article precludes anything more than a brief review of the subject.

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* Published in part as Bulletin No. 104.

THE EXPERIENCE OF THIS SEASON.

*Extent of the outbreak in the state.**— During the past three weeks, letters and telegrams have been received at the Station from various sections of the state giving accounts of the ravages of the army worm and asking advice as to the best known methods of checking the onward march of this destructive pest. Circular letters and telegrams were sent in reply giving instructions and suggestions. Up to date, letters have been received from twenty-eight counties representing the more important agricultural sections of the state.

Although the attack has been widespread, the damage done seems to have been most keenly felt in those sections of the state which are devoted largely to dairying and stock raising. In these sections oats, corn, rye, wheat and timothy are extensively grown while thousands of acres are reserved for pasture. Unfortunately the army worm feeds chiefly upon the crops above mentioned and has been especially destructive this year to both corn and oats. Add to this the fact that, owing to the comparatively dry weather during the past two years, the hay crop this season is unusually light, and it will be readily understood that this invasion of caterpillars has been an especially serious matter to many farmers.

The invasion an unusual one.—This invasion of the army worm is one of the worst in the history of the state. Old residents say they have never before experienced such destruction to their crops by caterpillars of this kind. The amount of damage done would be difficult to estimate. Farmers in various sections of the state report that the oat and corn crops were practically ruined. In many cases the oats were cut and hauled to the barn with the worms still clinging to them. This soon produced such an unwholesome condition in the stacks that removal of the grain to open air was made necessary. Where the caterpillars attacked corn, the crop was usually ruined very quickly unless vigorous efforts were at once made to check the advancing insects.

* Plate XLIX indicates the extent of the outbreak in this state. The dots indicate the counties from which the outbreak was reported. Four of these counties, which were not in our list, we found in a list by Dr. Lintner, published in the *Country Gentleman*,.

In other States, including Pennsylvania, Massachusetts, New Hampshire, and Michigan a similar invasion is reported. We have sent letters to the entomologists of the various stations to ascertain the extent of the outbreak.

ACTION THAT IS ADVISED NOW.

Treatment of previously infested fields.—As we shall see later on, the caterpillars are now passing through the pupa stage. They have previously sought shelter under stones, bunches of dried grass, under pieces of board, bits of wood, along the fences under various kinds of rubbish, or have burrowed into the ground to a depth of an inch or two. In each case they have made for themselves snug cells of earth, or bits of rubbish and earth combined, as the case may be. In these retreats the wonderful transformation from an active caterpillar to an apparently lifeless creature takes place.

It is evident that, by destroying these pupæ, the moths will not be allowed to develop. This also means the destruction of many eggs. When practicable, therefore, it is desirable to burn over grass land and stubble where the caterpillars have been. When it is not practical to burn the fields over, and where the surface of the ground is moderately even, a heavy roller may be used to advantage. In addition to this, it is well to clear up all rubbish in the infested fields; also along the fences and in the fence corners bordering such fields. From our observations in the field, it seems evident that, when about to pupate, the caterpillars not only retreat under stones and rubbish, but that many of them find refuge under the matted grass in the fence corners and around the borders of the fields. In districts where infested fields adjoined the roads and especially where the caterpillars were known to have crossed the road, a careful examination should be made along the fence and under stones, rubbish, etc., along the roadside. If any pupæ are found, the infested section should be burned over if it is practicable to do so. Many of the pupæ can be gathered by hand and killed by dipping in kerosene oil or by crushing. Where furrows were plowed to check the insects, and especially if the holes were omitted, the dead grass and rubbish along their borders should be carefully examined.

Crops attacked.—Although the army worm feeds on a variety of plants, the grasses and grains are its favorite diet. In most cases, corn and oats seem to have suffered most severely. We have observed the caterpillar this season feeding on timothy, corn, oats, rye, barley, wheat, and the report has come to us that in one section of the state, the bean crop was seriously attacked.

Crops to take the place of corn and oats destroyed by the army worm.—With many farmers the ravages of the army worm have doubtless caused a serious shortage of fodder crops for fall and winter feeding. There appears to be no way of entirely making good this deficiency from crops which may be produced this season.

In those cases where corn was intended to be used as a fall soiling crop, barley and peas may be grown as a partial substitute. The mixture may be sown as late as August 10, at the rate of two bushels each of barley and peas. The crop is not injured by the frost and will furnish green fodder during October.

If more is grown than can be fed green, the excess may be preserved in the silo with fair success, although the silage will be inferior in quality to corn silage.

Where crops are destroyed by the army worm as early as the first week in July, Hungarian grass, if sown at once, will produce an abundant crop, which may either be fed green or cured for hay.

LIFE-HISTORY.

Name and classification.—The popular name "army worm" comes from the abnormal habit of the caterpillars, or "worms," as they are incorrectly called, of moving in great armies in search of food. The scientific name of this species is probably *Leucania unipuncta,* although it has been suggested that this may be the species known as *Leucania albilinea* or, popularly, the wheat-head army worm as, when attacking wheat, barley, or rye, many of the heads are found cut off by the caterpillars. These army worms belong to a large family of insects known as the *Noctuidae,* which includes the night flying moths. It is also interesting to note that this insect is closely related to some of our most destructive cutworms.

Some habits of the army worm, Leucania unipuncta.—Although unsuspected by most of us, the army worm is present in some of our fields every year. The grass land is its natural home. The caterpillars are usually found in those places where the grass grows most luxuriantly. Here they may remain season after season, one brood following another, feeding unnoticed almost before our eyes. It is not until meteorological conditions are favorable for them, however, that the abnormal increase occurs. It is only at such times that the unusual habit of moving in vast armies is developed. As a rule also, it is said, the caterpillars are usually nearly half grown before the march in search of food begins. They seem to be especially ravenous at this time and the rapidity with which a field of grain may be ruined is truly surprising. An acre or more of corn may be destroyed in a single night. The caterpillars usually feed more rapidly at night than during the day, although they are very active on cloudy days or during the cool of a bright day.

Life-history and descriptions.—The life-history of the army worm, *Leucania unipuncta*, together with descriptions of the different changes which take place during the life cycle, may be briefly stated as follows: The mature insects are dull brown moths having a white spot in the center of each anterior wing. When the wings are spread a single female moth will measure over an inch and a half from tip to tip. The body is about three-fourths of an inch long.

The eggs are very small, globular in form and nearly white in color. They are usually laid in the leaf sheaths of grasses and grains, the terminal sheath being most frequently selected. According to Dr. Riley* the early brood of moths oviposit freely "in the cut straw of old stacks, in hay ricks and even in old fodder stocks of corn stalks." He also adds that "old bits of corn stalk upon the surface of the ground in pastures have been re-

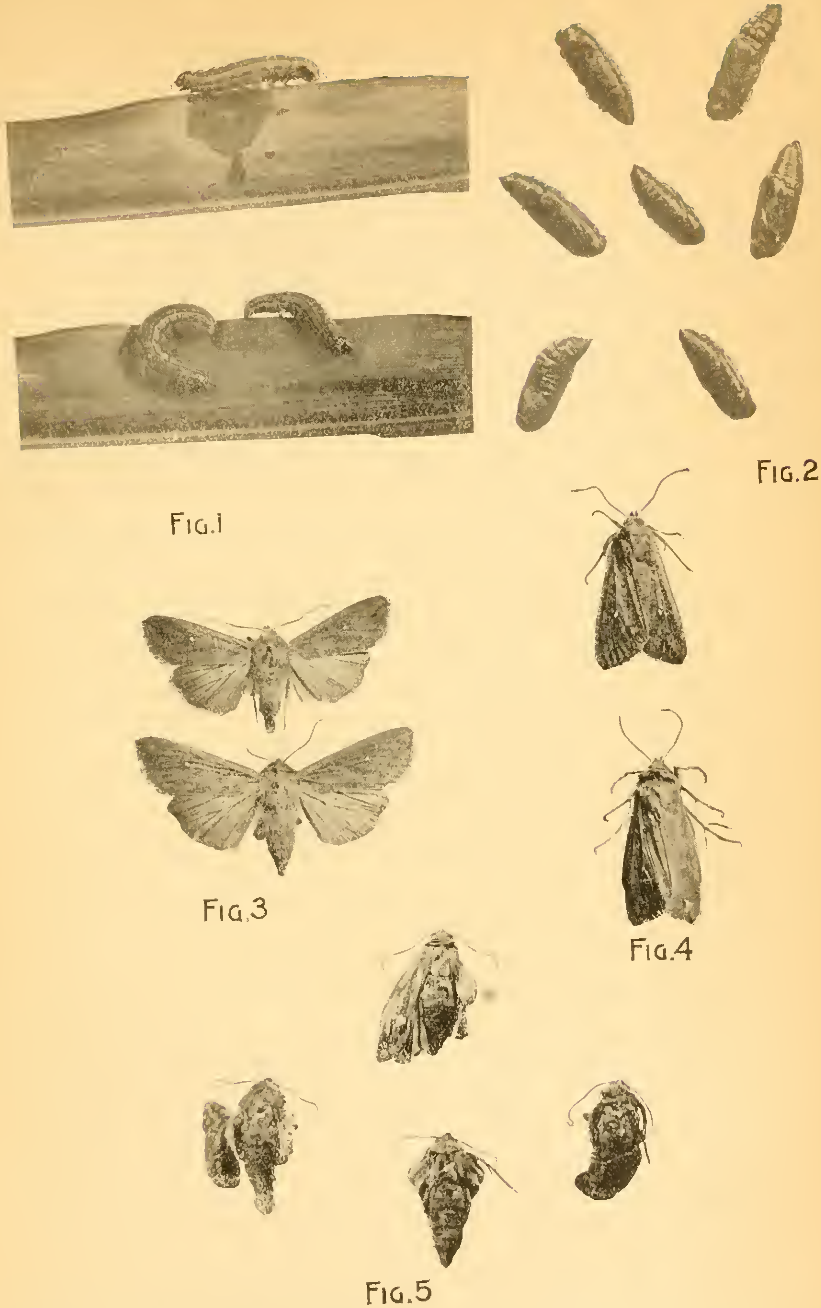
* U. S. Dept. Agr. Rep. 1881-2, pp. 90-91.

peatedly found . . . with hundreds of eggs thrust under the outer sheaths or epidermis, while the last year's stalks of grass in the fields around Washington have been found to contain these eggs in similar position." Dr. Riley also states that, lacking both stubble and fodder stalks, the moths will deposit their eggs in fields of winter grain. In this connection it may be stated that, in several cases with which we are familiar, the caterpillars evidently came from fields of winter rye to attack other crops, leaving the fields very soon after the rye was cut. Dr. Riley found that a single female moth is capable of depositing from five hundred to over seven hundred eggs. This wonderful prolificacy explains in part at least why, under certain meteorological conditions which favor the development of the eggs, the caterpillars appear in such vast numbers. In seasons when the army worms are not unusually abundant it is probable that only a small percentage of the eggs hatch.

The young caterpillars come forth in about ten days from the time the eggs are laid. In case the eggs were placed on fresh grass or grain, the young larvæ feed for a time in the sheath where the eggs were placed, but finally include the whole blade in the bill of fare. They are full grown in about four weeks. At this time a single larva measures about an inch and a half in length and a quarter of an inch in diameter. They may be briefly described as being smooth, naked caterpillars, moderately dark in color, with longitudinal stripes running the full length of the body. A broad, dark stripe is especially prominent along each side. Plate XLVIII, fig. 1, is from a photograph of some of these caterpillars. They are represented as somewhat reduced in size.

The third stage in the insects' life begins when the caterpillars go into the ground or under stones or rubbish to make the wonderful change from an active caterpillar to an apparently lifeless creature. This stage is called the pupa stage, or, in case of butterflies and moths, is more familiarly known as the chrysalis stage. A single chrysalis measures about three-fourths of an inch in length. They are at first light brown in color, but

PLATE XLVIII.



THE ARMY-WORM, *Leucania unipuncta*. FIGURE 1, LARVÆ; FIGURE 2, PUPÆ; FIGURES 3 AND 4, MOTHS; FIGURE 5, DEFORMED OR NOT FULLY-DEVELOPED MOTHS.

PLATE XLIX.

MAP INDICATING THE EXTENT OF THE OUTBREAK OF THE ARMY-WORM IN THIS STATE IN 1896.
THE BLACK DOTS MARK THE COUNTIES FROM WHICH REPORTS WERE RECEIVED.

soon change to a deep chestnut brown. Fig. 2 is from a photograph of several of these chrysalides. The moths come forth in about two weeks. Fig. 3 is from a photograph of two of the moths with their wings spread, and fig. 4 of two of the moths with their wings in the position which they assume when at rest. Fig. 5 is from a photograph of some deformed moths. They apparently lacked strength to develop properly and soon died. There are probably two or three broods every year in the more northern states.* It is usually only the first brood of the season, however, which occurs in such unusual numbers.

Hibernation.—The caterpillars of the last brood of the season are but half grown when winter overtakes them. For protection they hide away under any convenient shelter, where they become very sluggish, in which condition they remain until spring. The moths from this brood of caterpillars come forth quite early in the season. As above noted, it is this generation of moths which, under favorable circumstances, produces the vast armies of caterpillars such as we have witnessed this summer.

NATURAL ENEMIES.

Fortunately nature takes a hand in checking the onward march of such armies as these. Judging from our observations in the field, and from specimens sent us, the present generation of army worms is being seriously crippled by several species of parasites and predaceous insects. We have also found many of the caterpillars attacked by a fatal bacterial disease which seems to resemble the bacterial disease of cabbage worms. In one or two instances it was estimated that twenty-five per cent. were attacked by this disease. Of the parasites referred to, one of the most prominent is a species of Tachina fly. This active little insect resembles a house fly in general appearance. The Tachina fly lays its eggs on the backs of the ill-fated caterpillars just back of the head. Many caterpillars were found with three or four of

*NOTE.—Since the above was written the following notes were made at the Station; Larvæ of the army worm *Leucania unipuncta* were observed in the field from the latter part of June until August 7; July 7, full-grown and half-grown larvae were found; July 13, many of the larvæ were pupating; July 28, first moth emerged in breeding cage; August 3, moths abundant; September 24, army worms varying in size from one-half of an inch to full-grown worms were found under stones etc., in the field of peas on the Station grounds. During the middle of October worms were again found in the same field, but no pupæ.

these small white eggs attached. Few, if any, such caterpillars reach maturity, as the eggs soon hatch into minute white maggots, which burrow through the skin to feed on the fleshy tissues beneath. The maggots grow rapidly, and soon the unfortunate caterpillars succumb, although not until the maggots have had sufficient food to meet their wants. Among the most prominent predaceous insects which were found attacking the army worms were the fierce larvæ of some of our common ground beetles. Some of these larvæ grow to nearly the size of the cutworms themselves. They are very active and fight fiercely for the mastery over their prey, which they grasp in their strong jaws and endeavor to hold firmly while sucking the victim's juices. Several species of birds also feed upon the army worm.

METHODS RECOMMENDED FOR CHECKING THE ARMY WORM.

The methods which are usually recommended for checking the army worm are mainly these: Plowing deep furrows around infested fields or around an infested section of a field; also where possible in front of the army of advancing insects. It is better to make the sides of the furrows as near perpendicular as possible, and, where the soil will permit, to slant them back, especially the side opposite the infested section. Holes should be dug in the furrows at intervals of from ten to fifteen feet. The caterpillars which fall into the furrows, not being able to get out, will crawl along the sides, finally falling into the holes, where they may be easily killed by crushing or by the application of kerosene oil. The caterpillars in the furrows may also be killed by scattering straw over them and burning it, or they may be crushed by a log drawn back and forth through the furrow. Plate L is from a photograph of a field of corn in which the advancing army of caterpillars was successfully checked by furrows plowed between the rows of corn. In this case the soil was light and stony and it would have been a difficult matter to make the sides remain perpendicular. The soil being very loose, however, gave way with the weight of the caterpillars as they at-

PLATE L.

VIEW IN A CORN-FIELD WHERE THE ARMY-WORMS WERE SUCCESSFULLY CHECKED BY FURROWS BETWEEN THE ROWS OF CORN.

PLATE LI.

View in a Corn-field where a Strip about a rod wide was being Sprayed with Poison to check the Army-worms.

tempted to climb up the sides, and hence prevented their reaching the top. In this case the furrows were made promptly and hence nearly the entire crop was saved. The caterpillars were first seen in the field of rye shown on the left.

In pasture fields where the surface of the ground is comparatively even and the soil is firm, the caterpillars can be crushed by a heavy roller. Spraying of the infested crops with a strong mixture of Paris green and water may also be resorted to. It is usually unnecessary to spray more than a strip about a rod wide in advance of the caterpillars. Where possible the poisoned portion of the crop should be burned to prevent possible danger of injury to stock. Plate LI is from a photograph taken in an infested field of corn, showing the work of the poison in protecting the crop. A heavy roller was also used in this field, but the soil was too light for the best results by this method.

Additional Notes.

Since the above paper was written, we have received replies to a list of questions which we sent to numerous correspondents in the state. These replies indicate that in a large majority of cases the worms were most abundant in sections where grass lands are extensive; also that the worms were usually first observed in fields of winter rye, and that rye, oats and corn were the crops most seriously injured.

We also sent circular letters to the Entomologists of the various stations, including a short list of questions. These questions were asked for the purpose of ascertaining the extent of the outbreak and also to bring out any points which might be of value in the future. The questions were as follows:

(1) Is the army worm, *Leucania unipuncta*, known to occur in your state; if so, did it appear in injurious numbers during the past season? What crops were attacked?

(2) How many broods in your state? Was most of the injury done by the first brood?

(3) Were the worms checked by parasites, predaceous insects, disease and other natural agencies?

(4) If convenient will you kindly give the dates of previous outbreaks, if any?

Answers were received from forty-two states, and may be briefly summarized as follows:

From New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New Jersey, Delaware, North Carolina, New York, Pennsylvania, West Virginia, Ohio, Tennessee, Michigan, Indiana, Illinois, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska and New Mexico reports were received showing that the army worm, *L. unipuncta*, was present in injurious numbers last year, and that, in most cases, oats, rye and corn were severely attacked. Reports from Maine, Virginia, South Carolina, Georgia, Alabama, Mississippi, Arkansas, Texas, Colorado and Arizona state that this species is known to occur in these states, but was not present in noticeably injurious numbers last year. From Louisiana, Oklahoma, Wyoming, Montana, Idaho, Washington, Oregon, Nevada and California we received the report that this species of army worm was not known to occur within their borders. We did not hear from the remaining states.

As to the number of broods, Dr. Harvey, of the Maine State College says: "We generally take a few of the moths at sugar in June and more abundantly in September. This would indicate hibernating larvæ or two broods." Dr. Smith, of the New Jersey Agricultural College, says that "there seem to be four in the southern portion of the state, and probably three broods in the northern sections." In nearly every other instance the replies state that at least two broods are known to occur. Dr. Otto Lugger, of the University of Minnesota, says he now thinks that but one brood occurs in Minnesota. In nearly every instance the bulk of the injury was done by the first brood, and with but few exceptions the reports state that the worms were checked chiefly by a Tachina fly parasite.

As to the last question, in most cases the answers were not sufficiently definite to enable us to give dates of other outbreaks.

In conclusion it may be said that the outbreak of the army worm in 1896 was one of the most serious and extended which was ever known in this country. Probably the most serious injury was done in the eastern and central states.

Partial Bibliographical List.*

* An asterisk denotes that the item was taken from the "Bibliography of the More Important Contributions to American Economic Entomology," by Samuel Henshaw, published by the U. S. Dept. Agr., Div. of Entomology.

1835. *Bradshaw, Joseph. The army worm. Farmers' Reporter. Farmers' Register (Va.), 1835.

Account of *Leucania unipuncta* in Ohio in 1825 and 1835.

1837. *Porter, J. R. The army worm. Cultivator, September, 1837, vol. IV, No. 7, pp. 116-117.

Ravages of *Leucania unipuncta*.

1840. *Henderson, Stephen. The army worm. Farmers' Register [Va.], 1840, pp. 660-661.

Ravages of *Aletia xylina* in Louisiana in 1840.

1842. *Wait, William S. The army worm. Missouri Reporter, 1842.

History and habits of *Leucania unipuncta;* preventives.

*Bradshaw, Joseph. The army worm. Union Agric., 1842, vol. II, p. 4.

History, habits and means against *Leucania unipuncta*.

1847. *Morris, M. H. The army worm. Amer. Agric., February, 1847, vol. VI, p. 50. See: *Ibid*, July, 1847, vol. VI, p. 209.

Habits and metamorphoses of *Leucania unipuncta*.

1849. *Allen, A. B. & R. L. Ravages of the army worm. Amer. Agric., August, 1849, vol. VIII, p. 261.

Destructiveness of *Leucania unipuncta* in southern Illinois and in Missouri.

1861. *THOMAS, C. The army worm. Prairie Farmer, 1861, n. s., vol. VII, p. 363.

Description and figure, seasons, habits and means against the larva of *Leucania unipuncta;* figure and description of the pupa.

*THOMAS, C. The army worm. Prairie Farmer, 1861, n. s., vol. VII, p. 393. S.-b. No. 1, pp. 21-22.

*THOMAS, C. The army worm. Illinois Farmer, September, 1861.

Characters of larva, pupa and adult of *Leucania unipuncta;* preventives.

THOMAS, C. Further from the army worm. Prairie Farmer, 1861, n. s., vol. VIII, p. 100.

Notes concerning the habits of *Leucania unipuncta* in Jackson county Ill., in 1861.

*THOMAS, C. The army-worm question. Prairie Farmer, 1861, n. s., vol. VIII, p. 293.

Discusses the question of the hibernation of the eggs of *Leucania unipuncta;* considers the species single brooded.

*THOMAS, C. Army-worm question continued. Prairie Farmer, 1861, n. s., vol. VIII, pp. 306-307.

Argues against egg hibernation of *Leucania unipuncta* and in favor of pupa hibernation.

1861. FITCH, A. Insects of the past year (1860). Trans. N. Y. State Agric. Soc. for 1861-1862. Brief notice of *Leucania unipuncta.*

*FITCH, A. The Entomologist, No. 29 — The army-worm moth. The Country Gentleman, 25 July, 1861, vol. XVIII, p. 66. The Cultivator, September, 1861, s. 3, vol. IX, pp. 278-279.

History of the identification of the army-worm moth as *Leucania unipuncta;* description of the same.

*FITCH, A. The army worm and cutworm. The Country Gentleman, 4 July, 1861, vol. XVIII, p. 18.

Habits of cutworms (larvæ of Noctuidæ); the army worm probably a gregarious and migratory cutworm.

*FITCH, A. The army worm. The Country Gentleman, 26 September, 1861, vol. XVIII, p. 203.

Habits, seasons and ravages of *Leucania unipuncta;* remedies.

1861. *Fitch, A. The army worm's parasite. The Cultivator, August, 1861.

Describes *Ichneumon leucaniæ.*

*Packard, Alpheus Spring. Entomological report on the army worm and grain Aphis. 6th Ann. Rept. Maine Bd. Agric., 1861, pp. 130-145.

Scudder, S. H. Proc. Boston Soc. Nat. Hist., vol. VIII, p. 209. Abundance and ravages of *Leucania unipuncta.*

*Klippart, J. H. The army-worm question. Field Notes, 30 November, 1861.

Controversial reply to Walsh; asserts that the larvæ of *Leucania unipuncta* are viviparous.

*Klippart, J. H. The army-worm question again. Field Notes, 7 December, 1861.

Denies that *Leucania unipuncta* hibernates as an egg; also the existence of secondary parasites.

*Klippart, J. H. Army worm; Mr. Klippart's rejoinder. Field Notes, 21 December, 1861.

Controversial reply to Walsh in Field Notes, 14 December, 1861.

*Ferrill, George W. More about the army worm. Prairie Farmer, 1861, n. s., vol. VIII, p. 417.

Eggs of *Leucania unipuncta* laid in wheat in the fall or spring.

*Wiley, Benjamin F. The army worm. Prairie Farmer, 1861, n. s., vol. VIII, p. 37.

Notes on the infested fields, duration of life, and food habits o *Leucania unipuncta.*

*Allen, I. C. Further on the army worm. Prairie Farmer, 1861, n. s., vol. VIII, p. 386.

Notes on *Leucania unipuncta.*

*King, J. C. Army worm: Hungarian grass. Prairie Farmer, 1861.

Abundance of *Leucania unipuncta* in Warren county, Mo.; its ravages.

*Kirkpatrick, J. The army worm. 15th Ann. Rept. Ohio State Board Agric. for 1860, 1861, pp. 350-358.

Natural history, habits, ravages, parasites and enemies of *Leucania unipuncta.*

1862. *FITCH, A. The Entomologist. Entomological events of the past year. The Country Gentleman, February 20, 1862. Observations during 1861 on *Leucania unipuncta* and two other insects.

*SHURTLEFF, CARLTON A. The army worm. Proc. Essex Inst., 2 July, 1862, vol. III, pp. 193-200.

The occurrence of *Leucania unipuncta* in New England from 1743 to 1861; its characters, habits, ravages, early stages, enemies, and preventives.

*DORMAN, S. Army worm; new facts. Prairie Farmer, 1 February, 1862. S.-b. No. 2, p. 62.

Larvæ of *Leucania unipuncta* moving from southwest to northeast; they do not always start from cultivated meadows.

*FLINT, CHARLES L. [Army worm.] Harris's Insects injurious to vegetation, 1862, pp. 627-630, f. 274-278.

Descriptions and figures of *Leucania unipuncta;* habits, ravages, and means against them; enemies and parasites.

1863. *WISLIZENUS, A. The army worm. Trans. St. Louis Acad. Sci., 1863, vol. II, pp. 159-160.

Life history of *Bombyx draminis* [= *Leucania unipuncta*].

1865. *HOWARD, SANFORD. Injurious insects. Fourth Annual Rept. Secretary State Board Agric. of the State of Michigan for 1865, pp. 21-37.

Notes on *Anisopteryx* [= *Paleacrita*] *vernata* in Michigan; its habits distribution, seasons, ravages, enemies, remedies, and means against brief notes on *Doryphora 10 lineata* and *Leucania unipuncta.*

*EMERY, H. D. *Leucania unipuncta.* Prairie Farmer, 1865, vol. XVI, p. 3.

Abundance of *Leucania unipuncta* in Missouri; benefit derived from burning meadows.

1868. *TEELE, R. B. Destructiveness of the army worm. Country Gentleman, 20 February, 1868. S.-b. No. 2, p. 118.

Ravages and migrations of *Aletia argillacea* [=*xylina*].

1869. *TRABUE, A. E. Army worm. Amer. Ent., November, 1869, vol. II, p. 52.

Food habits of *Leucania unipuncta.*

*HYATT, A. A. Army worms. Amer. Ent., November, 1869, vol. II, p. 53.

Ravages of *Leucania unipuncta.*

1871. GLOVER. Report of Entomologist and Curator of Museum. Rep. [U. S.] Comm. Agr., 1870-1871. Estimates of damage done by insects; habits, characters, ravages and means against *Leucania unipuncta* and other insects.

1872. BETHUNE, REV. C. J. S. Insects affecting the wheat crop. Rept. Entomological Soc., Ont., for 1871-1872. Mentions *Leucania unipuncta.*

1872. *LEBARON, W. The army worm. Prairie Farmer, 29 June, 1872.

Life history of *Leucania unipuncta;* ravages and remedies; injuries of canker worms in Wisconsin.

*LEBARON, W. The Peshtigo army worm. Prairie Farmer, 5 October, 1872, vol. XLIII.

Abundance of *Leucania unipuncta* at Peshtigo, Wis.; remedies; notes on hibernation and parasites.

1873. GLOVER, T. Report of Entomologist and Curator of Museum. Rept. [U. S.] Comm. Agr., 1872-1873. Ravages and means against *Leucania unipuncta* and other insects.

1875. SCUDDER. 6th Ann. Rept. Ent. Soc. of Ont., p. 14. Mentioned as being abundant in portions of Mass.

1876. *FERNALD, CHAS. HENRY. Destructive insects, their habits and means of their depredations. Third Annual Report Maine State Pomological Society for 1875-1876. Mentions *Leucania unipuncta* in this connection.

1876. SAUNDERS, WM. 7th Ann. Rept. Ent. Soc., Ont., p. 39. Mentions appearance in Province of Ontario. Brief description of moth and larva.

*COOK, A. J. The three insect enemies most to be dreaded by the farmer. Delivered at Decatur, Adrian and Coldwater. 14th Ann. Rept. Secr. Board of Agriculture, Mich., for 1875-1876, pp. 276-282, figs. 1-5.

Life history of the army worm, *Leucania unipuncta;* note on the insect habits of birds, especially the robin and blackbird.

1876. *[GOULD, JOHN STANTON.] *Leucania unipuncta.* Trans. N. Y. State Agric. Soc., 1872-1876, pp. 47-50.

Brief compiled notice.

*TEMPLIN, L. J. The army worm. Ohio Farmer, 23 September, 1876.

1877. THOMAS, CYRUS. 6th Report of State Entomologist on the noxious and beneficial Insects of the State of Ill., p. 56.

*BREED, DANIEL. Recent inventions for insect destruction. Rept. [U. S.] Comm. of Agric. for 1876-1877. Describes and figures iron furnace for killing *Leucania unipuncta.*

1878. *FRENCH, G. H. Moths, *Lepidoptera.* VI. Ann. Rept. State Entomologist of Ill. for 1877-1878. Characters, habits, ravages and remedies of *Leucania unipuncta* and other insects.

1879. COMSTOCK, J. H. Report of the Entomologist. Ann. Rept. [U. S.] Comm. of Agric., for 1879, pp. 187-190. Descriptions, number of generations, hibernation, remedies, parasites.

1879. *HOWARD, LELAND O. The army worm. Moore's Rural Life, July, 1879, figs.

Figures larva, pupa, and adult of *Leucania unipuncta;* description; remedies; review of life history, with account of observations at Portsmouth, Va., in 1879.

*LINTNER, J. A. The army worm. *Leucania unipuncta* Haw. Cultivator and Country Gentl., 3 July, 1879, vol. XLIV, pp. 422-423.

Natural history; habits; characters and parasites.

1880. *THOMAS, C. Notes on the army worm. Moore's Rural New Yorker, 1880, November, December.

*LINTNER, J. A. Eggs of army worm. Cultivator and Country Gentl., 1 July, 1880, vol. XLV, p. 424.

Characters of the eggs of *Leucania unipuncta.*

*COMSTOCK, J. H. The army worm. Cincinnati Grange Bull., 15 July, 1880.

Report on the Delaware invasion of 1880 of *Leucania unipuncta.*

1880. *COMSTOCK, J. H. The army worm. New York Herald, 14 June, 1880.

Report on investigations concerning *Leucania unipuncta* in Kent County, Del., in June, 1880.

*HOWARD, L. O. The army worm. N. Y. Semiweekly Tribune, 5 August, 1880.

Injurious brood of *Leucania unipuncta* in Virginia the last week in July; the first brood not always the injurious one.

*RATHVON, S. S. Notes on the army worm. Lancaster Farmer, July, 1880.

Remedies for *Leucania unipuncta.*

*RATHVON, S. S. A supplement to the army worm. Lancaster Farmer, August, 1880, p. 114.

Variations, number of broods, and hibernation of *Leucania unipuncta.*

*HEATH, A. S. How to compensate for the ravages of the army worm. Amer. Rural Home, 10 July, 1880. Practical Farmer, 21 July, 1880.

Plowing and harrowing devastated fields; planting corn and potatoes afterwards.

*HICKS, JOHN S Army worm in Queens Co., N. Y. Amer. Ent., September, 1880 [vol. III], n. s., vol. I, p. 227.

Damage to corn, wheat, and timothy by *Leucania unipuncta*,

*BARNARD, W. S. The army worm. Ithaca (N. Y.) Journal, 8 July, 1880.

Relates to *Leucania unipuncta*; abundance of parasites.

*DODGE, ROBERT. The army worm. Amer. Rural Home, 19 June, 1880.

Life history (compiled) of *Leucania unipuncta.*

FLETCHER, JAMES. XI. Ann. Rept. Ent. Soc. Ont., p. 67. Mentions *Ichneumon suturalis* and *Ichneumon paratus* as parasitic upon the army worm (*Leucania unipuncta*).

1881. *THOMAS, C. Crop destroyers: The corn worm, chinch bug and army worm. Farmers' Review, 18 August, 1881.

THOMAS, CYRUS. 10th Report of the State Entomologist on the noxious and beneficial insects of the State of Illinois, p. 5.

1881. THOMAS, CYRUS. XII. Ann. Rep. Ent. Soc. Ont., p. 12. Mentions observations as to duration of life of army worm.

*LINTNER, J. A. The invasion of northern New York by this destructive pest. Albany Evening Jour., 23 May, 1881, p. 3. Cultivator and Country Gentl., 2 June, 1881, vol. XLVI, p. 359.

Ravages of and means against [*Crambus vulgivagellus*].

*LINTNER, J. A. The "army worm" invasion of northern New York. St. Lawrence Republican, 8 June, 1881, vol. LI.

Ravages of *Nephelodes violans;* habits and parasites of *Leucania unipuncta;* ravages and means against.

*FERNALD, C. H. Natural history of the army worm. Zion's Herald, 7 April, 1881.

Deals with *Leucania unipuncta.*

*FORBES, S. A. The army worm. Bloomington Pantagraph, 28 July, 1881.

Ravages of *Leucania unipuncta* in McLean and adjacent counties natural history, injuries, and remedies.

COOK, A. J. XII. Ann. Rept. Ent. Soc. Ont., p. 17. Mentions army worm as attacking corn in Mich.

SAUNDERS, WM. XII. Ann. Rept. Ent. Soc. Ont., p. 6. Mentions damage done by army worm in the west, together with brief account of life history and remedial measures.

*HICKS, EDWARD. The worm on Long Island in 1880. Cultivator and Country Gentleman, 9 June, 1881, vol. XLVI, p. 345.

Ravages of *Leucania unipuncta* on Long Island in 1880.

*MCBRYDE, J. M. The army worm. Exper. Work Agric. Dept. Univ. Tenn., 1881, pp. 200-203.

Account of an invasion of *Leucania unipuncta* in eastern Tennessee in 1881.

*MCBRYDE, JOHN M. The army worm. Exper. Work Agric. Dept. Univ. Tenn., 1879-1881, pp. 76-84.

Account of the invasion of *Leucania unipuncta* in eastern Tennessee in May and June, 1880.

1881. *PERIAM, JONATHAN. The army worm. Amer. Enc. Agric., 1881.

Natural history of *Leucania unipuncta.*

*GODING, F. W. "The army worm," *Leucania unipuncta* Haw. Blackberry [Ill.] Blade, 28 July, 1881, vol. II, p. 1.

Ravages and means against *Leucania unipuncta.*

*LOCKWOOD, S. Account of the invasion of 1880 in New Jersey. Rept. [U. S.] Commissioner Agriculture for 1881 and 1882, 1882 [January, 1883], pp. 101-106.

(Relates to the army worm.)

1882. THOMAS, CYRUS. 11th Report of the State Entomologist on the noxious and beneficial insects of the State of Ill., p. 49.

*FERNALD, C. H. More about the army worm. Maine Farmer, 17 August, 1882.

*WEBSTER, F. M. Observations on the army worm—*Leucania unipuncta.* Our Home and Science Gossip, 1882, January, February.

Character of infested fields in Illinois; number of broods; parasites.

*HOWARD, L. O. The army worm. Huntsville [Ala.] Democrat, 10 May, 1882.

Life history of *Leucania unipuncta;* notes on the appearance at Huntsville in 1882.

*HOWARD, L. O. The army worm. Chattanooga [Tenn.] Times, 12 May, 1882.

Corrects the local opinions in reference to *Leucania unipuncta.*

*HOWARD, L. O. Curious habits of *Metapodius femoratus.* Amer. Nat., July, 1882, vol. XVI, pp. 597-598.

Method of destroying larvæ of *Leucania unipuncta* and suspending their bodies.

*HOWARD, L. O. Report of observations upon the army worm, 1881. Ann. Rept. [U. S.] Commissioner Agric. for 1881 and 1882, 1882 [January, 1883], pp. 97-99. Reprint: 3d Rept. U. S. Ent. Commission, 1883, pp. 132-135.

1882. COQUILLETT, D. W. 4th Ann. Rept. State Entomologist, Ill. Gives characters, enemies, ravages and remedies of *Leucania unipuncta.*

BAYNES-REED, EDMUND. Ann. Rept. Ent. Soc., Ont., p. 50. Mentioned.

1883. RILEY, C. V. Report of Ent. Soc., Ont., p. 19. Note on time required for transformation of *Leucania unipuncta.*

FORBES, S. A. Trans. Miss. Valley Hort. Soc. for 1883. "Insects affecting the strawberry." Mentions *Leucania unipuncta.*

*GODING, F. W. Insects injurious to vegetation in Iowa. Rept. Iowa State Agric. Soc. for 1882, 1883, pp. 322-329. Reprint: Ancona, Ill., Advocate Publ. Co., 1883, 11 pp.

General account of *Anisopteryx* [=*Paleacrita*] *vernata, Clisiocampa americana, Selandria* [=*Monophadnus*] *rubi, Phyllophaga* [=*Lachnosterna*] *fusca, Leucania unipuncta, Blissus leucopterus, Doryphora* 10-*lineata, Pionea rimosalis,* and *Pieris rapæ;* means against them.

1885. RILEY, C. V. Proceedings Ent. Soc., Wash., II, p. 18. Mentioned.

1887. BETHUNE, REV. C. J. S. 17th Ann. Rept. Ent. Soc., Ont. Remedies for Noxious Insects. *Leucania unipuncta.*

BETHUNE, REV. C. J. S. VII Ann. Rept. Ent. Soc., Ont., p. 59. Brief account of remedial measures.

DANOBY, J. E. Correspondent in Insect Life I, 375. States that army worm was very abundant at Pensacola, Fla., March 1.

FLETCHER, JAMES. Experimental Farms Report, Canada, for 1887, pp. 16-17. Brief descriptions, injury done, remedies. Illustrated.

1888. FLETCHER, JAMES. Experimental Farms Report, Canada, pp. 50-51. Descriptions; life history; other army worms. Remedies. Illustrated.

RILEY, C. V. Insect Life, vol. I, p. 56. Mentioned.

1888. Bruner, Lawrence. Insect Life, vol. I, p. 67. Mentions army worm appearing in injurious numbers in oat field near Custer, N. D., and Ft. Robinson, Neb.

*Webster, F. M. The army worm. Indiana Farmer, 23 June, 1888.

Predicts ravages of *Leucania unipuncta* in Indiana; remedial measures.

Fletcher, James. 19th Ann. Rept. Ent. Soc., Ont., p. 9. Mentions appearance in injurious numbers in several localities in Canada. Brief mention of parasites.

Burnett Harvey S. Correspondent in Insect Life, vol. I, p. 287. Appeared in greater numbers than ever before near Kendal, Orleans Co., N. Y., season of 1888.

1889. Webster, F. M. Insect Life, vol. II, p. 258. Mentioned.

Webster. *Ibid*, p. 56. Appearance in Indiana, spring of 1889.

Townsend, Tyler. Insect Life, vol. II, p. 42. Records appearance of army worm in Mich., in 1881. Many fields of grain destroyed, especially oats.

Howard, L. O. Insect Life, vol. II, p. 222. Advantage of irrigation as a means against army worm.

Miller, I. M. Correspondent in Insect Life, vol. II, p. 77. Gives experience with army worm—first found in field of rye.

1890. Moffat, J. Alston. 21st Ann. Rept. Ent. Soc., Ont., pp. 51-54. Refers to and gives reprint of W. H. Ashmead's account of outbreak in Maryland. Mentions *Apanteles mutiloris* Walsh, as parasite upon (Ashm.).

Harrington, W. Hague. *Ibid*, p. 67. Mentions *Ophion purgatum* as parasite of army worm.

Webster, F. M. Insect Life, vol. III, p. 112. Notes on army worm in Indiana during season of 1890. Not unusually abundant, except in Southern part.

Ashmead, Wm. H. Insect Life, vol. III, pp. 53-54. Brief account of outbreak in Maryland.

1891. RILEY and HOWARD. Insect Life, vol. IX, p. 157. Army-worm moth sent from Jamaica by T. D. A. Cockerell.

RILEY, C. V. Insect Life, vol. III, p. 182. Mentioned.

RILEY. *Ibid.* p. 478. Mentioned.

1892. OSBORNE, HERBERT. Insect Life, vol. V, p. 112. Note on outbreak of army worm in Muscatine Co., Iowa, in 1892.

1893. RILEY and HOWARD. Insect Life, vol. VI, p. 41. Note from correspondent Dr. G. A. Hawkins, Toano, James Co., Virginia, reports that July 17 army worms were abundant in field of millet. *Ibid.* Note from Mr. T. D. A. Cockrell stating that Aug. 9, *Leucania unipuncta* was present near Las Cruces, N. M., in the larva state in millions.

RILEY and HOWARD. Insect Life, vol. VI, p. 37. Note from correspondent Edw. H. Thompson, Government Entomologist, Tasmania. Mentions army worm as one of the principal insect enemies in Tasmania.

WEBSTER, F. M. 24th Ann. Rept. Ent. Soc. Ont., p. 89. Briefly mentioned as being destructive in one brood only.

SMITH, J. B. Insect Life, vol. VI, p. 150. Mentioned as being destructive through one brood only.

1894. FLETCHER, JAMES. Experimental Farms Report, Canada, p. 192. Brief descriptions; life history; notes from correspondents relating to army worm remedies.

RILEY, C. V. Insect Life, vol. VI, p. 222. Mentions finding living specimens of army worm in some cereal from Mexico on exhibition at the World's Fair.

RILEY and HOWARD. Insect Life, vol. VI, p. 348. Notice of publication of circular on army worm by U. S. Dept. Agr., Div. Ent.

RILEY and HOWARD. *Ibid*, p. 374. Reports from correspondence show that army worm appeared in several localities in the eastern states.

HOWARD and MARLATT. (?) Insect Life, vol. VII, p. 269, General Notes. "The army worm in 1894." Gives brief review of the appearance of army worm in U. S. in 1894.

1894. Howard and Marlatt. (?) Insect Life, vol. VII, p. 279. Note from correspondent, Mr. Frank M. Jones, of Wilmington, Del., mentioning abundance of army worm moths taken while collecting at electric lights.

1895. Cockerell, T. D. A. Insect Life, vol. VII, p. 207. Brief note on army worm in New Mexico. "Did considerable damage last year" (1894).

1896. Slingerland, M. V. Rural New Yorker, vol. LV, p. 495. Brief general account of life history and habits; preventive and remedial measures. Illustrated.

Slingerland, M. V. *Ibid*, p. 846. "Next Season's Crop of Army Worms." Concludes that 1897 will not be an army-worm year. A tachina fly parasite. Illustrated.

Lintner, J. A. Country Gentleman, LXI, p. 552. "The Army Worm." Brief statement of extent of outbreak in New York State; preventive and remedial measures.

Lintner, J. A. *Ibid*, p. 574. Further notes on the ravages of the army worm in New York State, together with remedial measures.

Lintner, J. A. *Ibid*, p. 606. "More about the army worm." Letter from E. J. Preston, Orchard House, Amenia, Dutchess Co., N. Y., giving experience with ditching as preventive measure for army worms; also other preventive and remedial measures.

Lowe, V. H. Bul. ~~75~~ 104, New York Agrl. Exp. Station. Brief general account; preventive and remedial measures. Illustrated.

EXPLANATION OF PLATES.

Plate LII. Cabbage Looper:

Fig. 1. Photomicrograph of the egg. Magnified approximately 20 diameters.

Fig. 2. Female moth. Natural size.

Fig. 3. Male moth. Natural size.

Fig. 4. One of the worms feeding on a cabbage leaf. Natural size.

Fig. 5. Three of the worms, showing dorsal, ventral and side views. Twice natural size.

Plate LIII. View of field on Upper Chester meadows, showing how the poisoned bran bait was applied after the cutworms became scattered throughout the field. Next to the woodland the onions are eaten out by the cutworms until the ground is as clean as if recently plowed.

Plate LIV. View in same section as Plate II, showing how the onions are cut out by cutworms along the ditches. The onions to be seen in the field were saved by the use of the poisoned bran bait.

Plate LV. Birds-eye-view, showing how the fields are divided into various sizes by ditches.

Plate LVI. A perfect onion field on "Black Soil," with uncultivated swamp on right back-ground.

Plate LVII. View of the fields on the so-called "Gray Soils." In the ten or twelve fields shown here a few onions are left in the foreground, and also in the field where the two distant figures are standing. All the fields had been sown to onions.

Plate LVIII. The remains of an onion field on the "Semi-gray Soils." A few onions are to be seen at the farther end of the field.

Plate LIX. View showing the grass and weeds on fields after the onions have been gathered.

Plate LX. Onion Cutworms:

Fig. 1. Moth or miller of the "Dark-sided Cutworm," *Carneades messoria* — natural size.

Figs. 2 and 3. Dorsal and side views of full grown worms. Twice natural size. The dark band on side of body is not distinct, as the figures were photographed from alcoholic material.

Fig. 4. Female and male, one not expanded, of *Carneades illata?* Natural size.

Plates LIII and LIV. Views of the Upper Chester meadows, taken May 27, 1896.

The remaining plates are views from Florida and Big Island meadows, taken June 12, 1896.

REPORT OF THE ENTOMOLOGISTS.

PART II.

F. A. SIRRINE.

I. MISCELLANEOUS NOTES OF THE SEASON.

Summary.

(1) The results indicate that cucumber vines can not be protected from the attacks of the striped cucumber-beetle by using poisoned Bordeaux mixture or even poisoned resin-lime mixture.

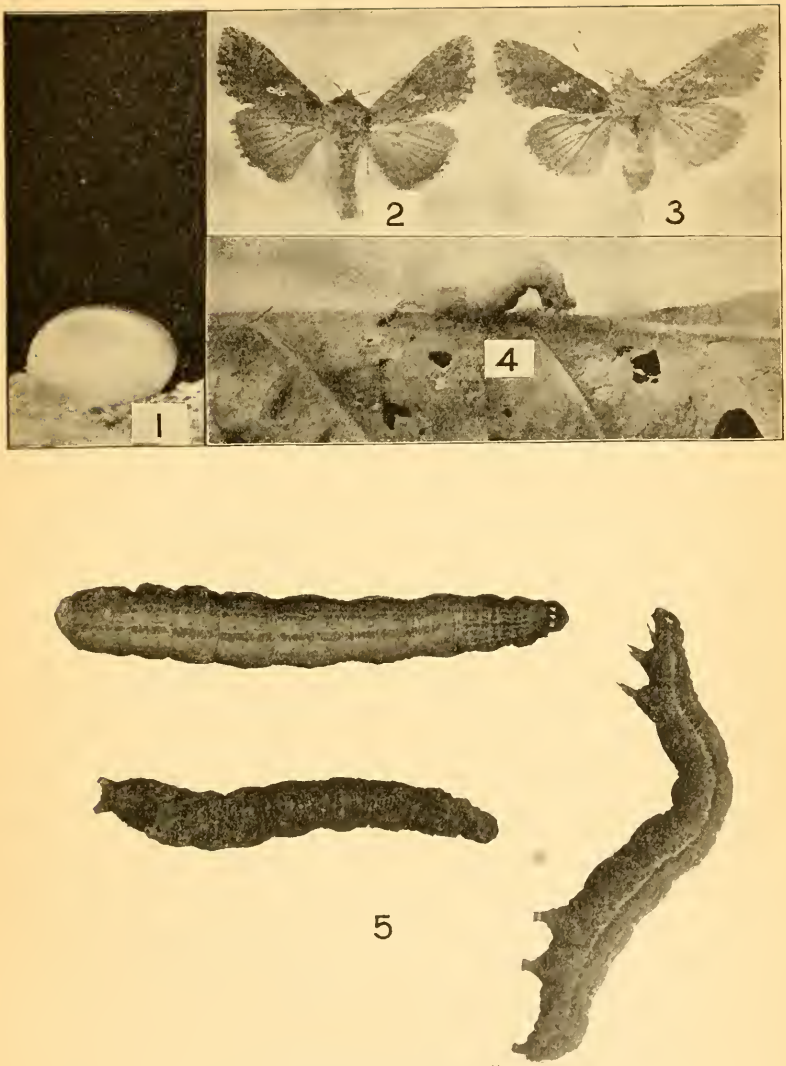
(2) The Colorado potato-beetle will not feed on potato vines that have been thoroughly sprayed with Bordeaux mixture. Probably potato vines which have been thoroughly sprayed with Bordeaux mixture are free from the attacks of the flea-beetle because the mixture is just as distasteful to them as to the Colorado potato-beetle.

(3) The indications are that the squash borer can be controlled entirely by cultural methods. The methods recommended are as follows: Harrow in the fall, but do not plow, the fields on which the squashes have been raised. When ready to use the ground in the spring plow at a uniform depth of six or eight inches, turning the soil as completely as possible. Do not re-plow until the following fall. As far as possible throughout the summer give shallow cultivation to the old squash field.

(4) In sections where the onion thrips is destructive to onions it is recommended that a few rows of set-onions be planted on the margins of the fields, and that these be sprayed every week or ten days with kerosene emulsion, whether the work of the thrips is to be seen or not.

(5) Where the red spider has occurred on raspberries in injurious numbers, it is recommended that the leaves be raked and burned in the fall, and, as an extra precaution, that the canes be sprayed about April 20 with a solution of whale oil soap or with kerosene emulsion.

PLATE LII.



"CABBAGE LOOPER."

PLATE LIII.

METHOD OF TREATING INFESTED FIELDS WITH "POISONED-BAIT."

PLATE LIV.

Field Showing Marching of Cut-worms from Ditch Banks.

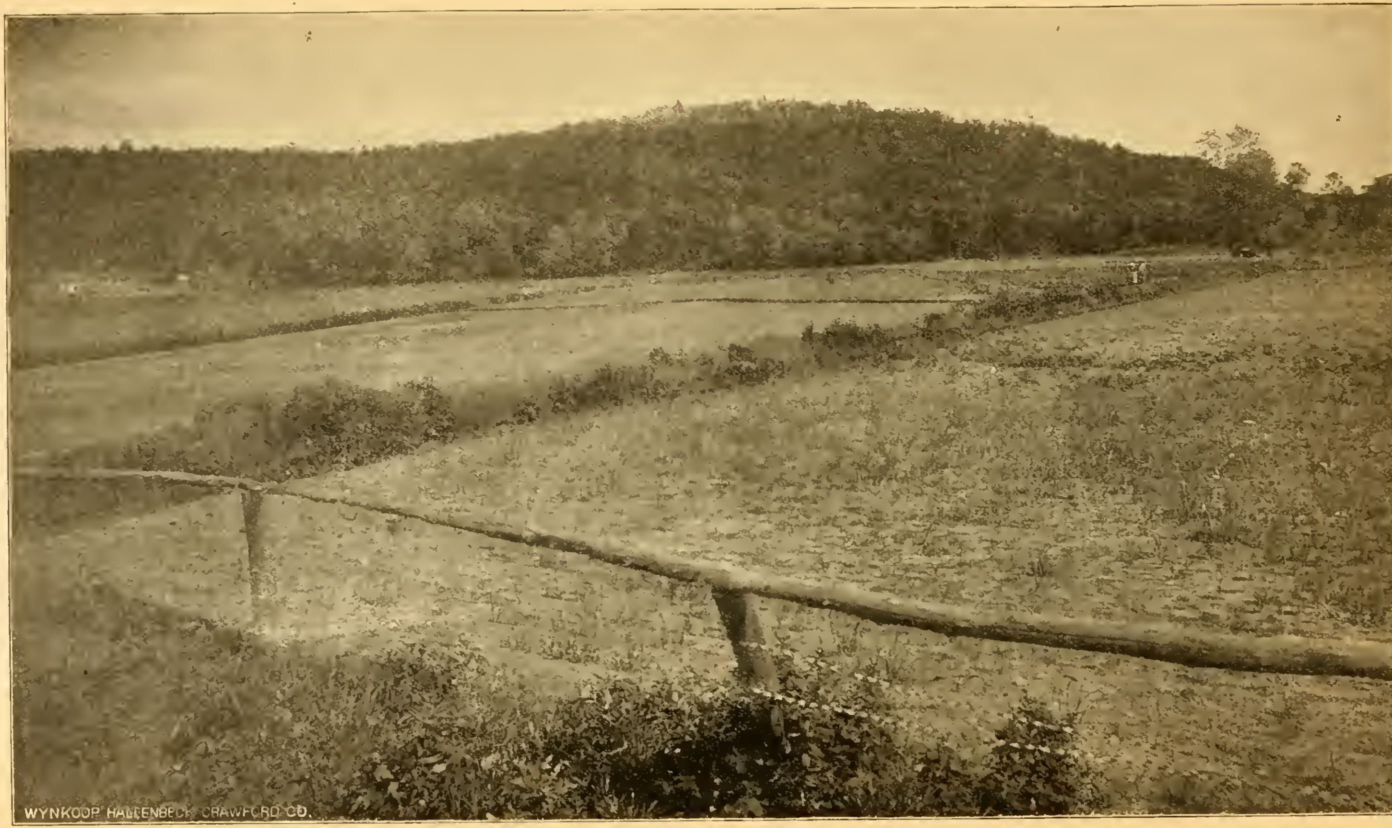
PLATE LV.

Bird's-eye-view of Onion-fields.

PLATE LVI.

A Perfect Onion-field on "Black Soil."

PLATE LVII.



WORK OF CUT-WORMS ON "GRAY SOILS."

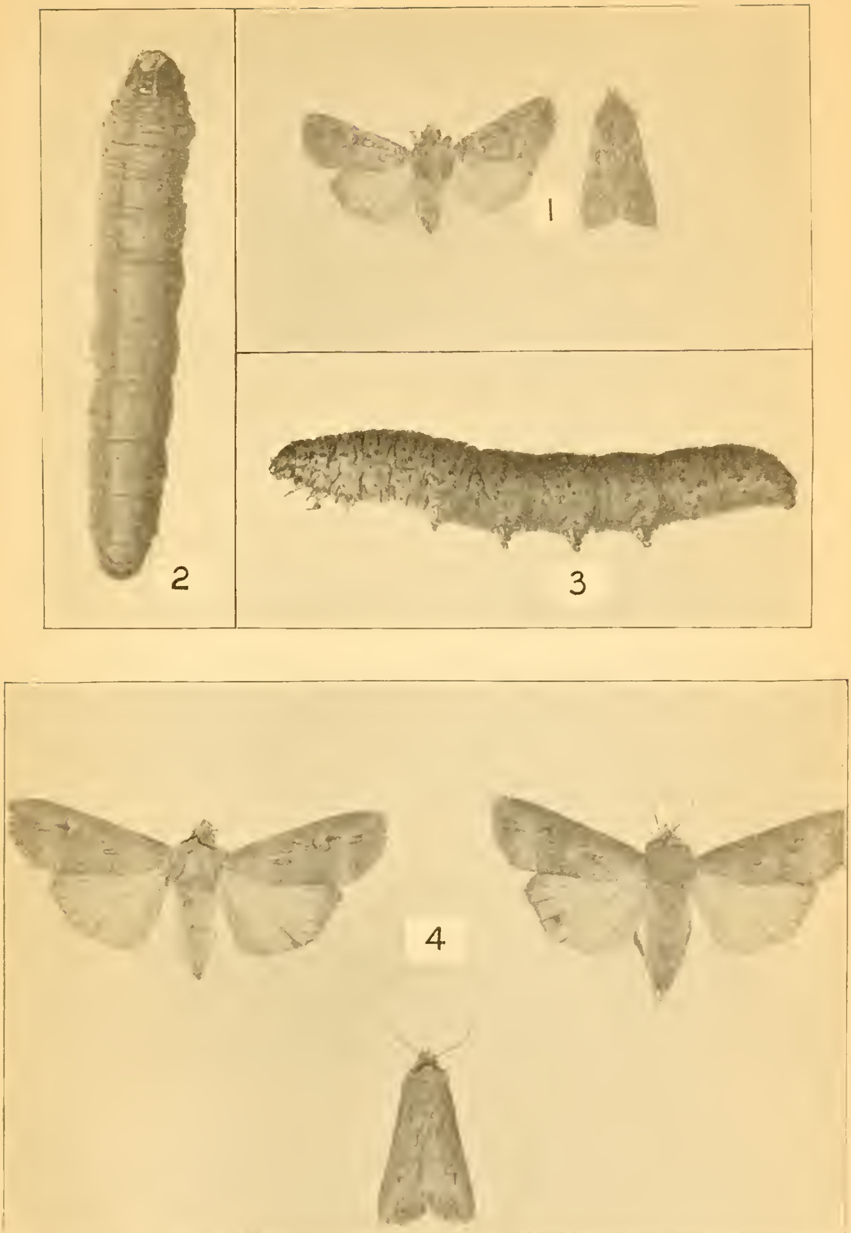
PLATE LVIII

FIELD SHOWING WORK OF CUT-WORMS.

PLATE LIX.

Grass and Weeds on Onion-fields at Time of Harvesting.

PLATE LX.



"ONION CUT-WORMS."

TEST OF SPRAYING MIXTURES FOR THE STRIPED CUCUMBER-BEETLE.

June 12. Several rows of cucumber vines, which had only one leaf besides the seed leaves, were sprayed with poisoned Bordeaux mixture. A number of rows which were nearly ready to run were also sprayed with the same mixture. Only the tops of the leaves were reached, hence the work was poorly done.

June 13. No dead beetles to be found; no apparent injury to the plants.

June 14. Heavy rains. Bordeaux mixture all washed off.

June 16. Resprayed the above vines, spraying once from each side and once on top of the row, with same mixture as used on the 12th inst.

June 17. Heavy rain.

June 18. No dead beetles to be found, but apparently the live beetles are not as numerous around the sprayed as they are around the unsprayed vines.

June 20. Still no dead beetles to be found around sprayed vines.

June 20. Sprayed with a poisoned resin-lime mixture a number of vines, both small and large, which had not been previously sprayed.

June 22. No dead beetles to be found around the vines sprayed June 20, but they avoid these about the same as they did those that were treated with Bordeaux mixture. Although the beetles appeared to avoid the leaves to which the above mixtures were applied, they were not prevented from working in the loose earth at the base of the plants. Hence these tests indicate that the above mixtures will not kill cucumber-beetles or even prevent them from depositing their eggs on the vines.

TEST OF SPRAYING MIXTURES FOR COLORADO POTATO-BEETLE.

July 2. Sprayed some rank growing potato vines with Bordeaux mixture. Placed the vines in cage and put about fifty young Colorado potato-beetles on the vines.

July 6. These beetles all starved to death. None of the vines were eaten. In fact, the beetles would not stay on the vines.

July 7. Repeated the above experiment with fresh vines and a new supply of beetles.

July 12. Beetles all dead. Plants not eaten. Beetles left the plants and starved to death.

This test was repeated the third time with the same results.

These tests indicate that the virtue of Bordeaux mixture as an insecticide lies principally in the fact that it is obnoxious to some insects and not necessarily poisonous to them. The tests on cucumber vines indicate the same thing. Also the tests of Bordeaux mixture against the potato flea-beetle indicate the same. No one who has tested this remedy has ever reported seeing one of the potato flea-beetles dead.

The tests of Bordeaux mixture on cabbage against the cabbage worms also indicate that this mixture is obnoxious to them and not necessarily poisonous.

TEST OF CULTURAL MEASURES FOR THE SQUASH BORER.

A description of this pest (*Melittia ceto* Westw.), its habits and life history, together with remedies, were given by Mr. Lowe in Bulletin No. 75 and in the Thirteenth Annual Report of the New York Agricultural Experiment Station.

During the past two years a few facts in regard to the use of cultural measures against the squash-borer have been obtained.

During November, 1894, a number of cocoons (winter stage) of the squash-borer were gathered. Thirty-six of the cocoons were placed in the bottom of a six-inch pot. The pot was then filled with dirt and buried so that the top was level with the surface of the ground. Twenty-four cocoons were placed on top of a pot which had been previously filled with dirt and plunged full depth into the ground. Both pots were fitted with lantern globes the tops of which were closed with cheese cloth. They were placed in the open field. From the cocoons placed on the surface of the ground the moths or millers commenced to issue July 22, 1895. Eight of these cocoons gave out good, active moths; sixteen never issued. Of those buried six inches deep thirty moths issued from the cocoons; six did not issue. Not one of these thirty moths succeeded in reaching the surface of the ground.

The above tests were repeated again in November, 1895, with slight variations, as follows:

Pot 1. Twenty-four cocoons buried four inches deep in sand.

Pot 2. Twenty-four cocoons buried four inches deep in black dirt.

Pot 3. Twenty-four cocoons buried six inches deep in sand.

Pot 4. Twenty-four cocoons buried six inches deep in black dirt.

Pot 5. Twenty-four cocoons buried eight inches deep in sand.

Pot 6. Twenty-four cocoons buried eight inches deep in black dirt.

All pots were covered with lantern globes and buried so that the tops were level with the surface of the ground. All were buried in the open field.

On July 20, 1896, pot No. 3 was taken up and the contents emptied out. It was found that none of the moths had issued from the cocoons. The soil and cocoons were replaced without reference to depth. By October 10th seventeen moths of pot 3 had issued and reached the surface in good condition. In pot No. 2 two moths had issued and reached the surface of the soil. It was found that the black dirt had shrunk away from the sides of pot No. 2. None of the moths in any of the other pots, whether in sand or black dirt, ever reached the surface of the ground, although numbers of them issued from the cocoons.

These tests tend to prove that if old squash fields are plowed at a uniform depth of six inches in the spring or even in the fall, and not replowed when planted, the number of squash-borers will be greatly reduced. The squash-borer is widely distributed to all parts of the United States, but we rarely hear of it occurring in any injurious numbers except in gardening districts.

Usually in gardening sections the land is plowed in the fall, then replowed in the spring. This method furnishes the best possible protection to the winter form of the squash-borers, burying them deep enough so that freezing and thawing does not injure them, then turning them up to the warm sun in the spring. As a result, they issue earlier than they would if left buried even four inches deep. Where they issue early they attack the squash vines before the latter commence to run.

ONION THRIPS.

This pest (*Thrips tabici* Lindemann) was described and figured in Bulletin No. 83, also in the Thirteenth Annual Report of the New York Agricultural Experiment Station, as being destructive to cabbage plants on Long Island.

During the past year it has done some damage to cabbage and cauliflower in seed beds, but it has been most destructive to the onion crop on Long Island.

On July 15th, Mr. Geo. W. Hallock, of Orient, N. Y., wrote that some insect was ruining the onion crop. The fields were inspected on the following day. It was evident that some of the fields were entirely ruined by this pest. The thrips were scattered over the remaining fields to such an extent that in order to make any headway against them it would be necessary to spray all of the fields. As the majority of the onions were nearly mature, such a procedure was not warranted. It was found that the thrips had first attacked the set-onions. After the latter were mature, they had migrated to the seed-onions.

The latter fact should be taken advantage of in fighting this pest. By planting a few rows of early set-onions around the margins of each field and keeping them thoroughly sprayed throughout the onion season this pest can be kept within bounds. The trap onions should be sprayed at least once each week with kerosene emulsion. The stock emulsion of kerosene diluted with nine parts of water will be strong enough to use on onions. This onion-thrips feeds on a great variety of plants and is constantly migrating into the onion fields from adjoining fields and weed patches. If they were confined to onions and cabbages as food plants, it would not be necessary to spray so often, in fact, it would be cheaper to spray the whole field once or twice; but, as they are not, the method of using set-onions will prove to be the cheaper.

This pest did not occur in destructive numbers on the Orange county onion fields.

RED SPIDER.

Early in June, 1896, I received a letter from Mr. W. D. Barns, of Middle Hope, N. Y., stating that the young upper shoots of the raspberries were being destroyed by an aphis, or by a spider. Later in the season he sent us some of the infested leaves. The trouble proved to be the work of the grayish-green form of the "Red Spider" (*Tetranychus telarius*, var.).

This pest has surely been on the increase on out-of-door plants for the past three or four years. Whether a series of comparatively dry seasons has favored their increase or whether some other conditions foster them, is a question.

Spraying with kerosene emulsion was recommended by some of the fruit-growers in the vicinity of Middle Hope. The emulsion would undoubtedly work well on some plants, but with this substance it would be a hard matter to reach the spiders on the leaves of raspberries, for the simple reason that the spiders are too well protected by the rough, hairy surface of the raspberry leaves. The kerosene emulsion was undoubtedly the best remedy that could have been applied at the time the trouble was first discovered, June 10.

From what has been seen of the habits of this pest, it is believed that the majority of their winter eggs are deposited on the leaves instead of on the stems, as is the habit of the true "Red Spider." Careful examination of raspberry canes from infested fields, kindly furnished in December, 1896, by Mr. C. G. Velie and Son, of Marlborough, N. Y., showed no trace of the eggs on the canes. They have been observed the latter part of April under oak and chestnut trees, swarming over the grass and ascending the trunks of the trees.

Hence, we would recommend the raking and burning of the leaves, in the infested raspberry fields, in the fall or early in April. As an extra precaution the canes should be sprayed about April 20 with a solution of whale-oil soap, or with kerosene emulsion.

II. THE PEAR MIDGE.

Diplosis pyrivora Riley.

No evidence of the spread of the pear-midge to new localities in this section (Second Judicial Department) was obtained the past year. The midges were plentiful enough in some localities to prevent the setting of any fruit on the Lawrence pears, and the yield was small on the Bartletts.

Results obtained from methods of treatment tested, make it necessary to repeat part of the results given in the report for 1895. The tests have been carried on in three separate localities.

During the spring of 1894 Mr. J. R. Cornell commenced the work at Newburgh, N. Y., as did also Mr. S. B. Heusted at Blauvelt, N. Y.

EXPERIMENTS AT NEWBURGH.

Mr. Cornell has two orchards, which consist principally of Lawrence pears. About April 10, 1894, Mr. Cornell sowed kainit (a German potash salt, sold by the German Kali Company) in one of his orchards at the rate of 2,000 pounds per acre. He also cultivated this orchard. The older of the two orchards was not cultivated or treated with kainit.

At Newburgh, on April 19, 1895, traps made of cheese cloth were placed under Lawrence trees which were known to have been infested with the midge the previous year. One trap was placed in the orchard which had been cultivated and fertilized with kainit at the rate of 1,500 to 2,000 pounds per acre about April 10, 1894. Another trap was placed under a tree around which kainit had been sown at a rate of over 2,000 pounds per acre a few days (April 15) before the trap was set. A third trap was set in the old uncultivated orchard where no kainit had been applied.

These traps covered about 4 square feet of surface. They were made by inserting two barrel hoops into the ground in such a way that the hoops met at the centre and formed an arch like the centre-arch of a croquet set. The cheese cloth was placed over these and fastened to the ground at the edges by covering with dirt.

Some of the midges were noticed flying to the flower buds the day (April 19) the traps were set.

These traps were examined by Mr. Cornell on April 27. The midges were so numerous under each of the traps that no estimate of the difference, if any, could be made.

When the infested fruit was examined, May 9, 1895, there was a slight difference in favor of the treated orchard in the amount of damage done by the midges. In fact, there was no fruit to speak of on the Lawrence trees in the old untreated orchard, while in the young orchard, which had been treated with kainit, there was about one-fourth of a crop.

During June, 1895, Mr. Cornell made a second application of kainit to the young orchard, using about the same amount as on the previous year. The main difference in the treatment this year was that the kainit was sown at the time the young pears were dropping to the ground.

At Newburgh, April 18, 1896, five traps were set in Mr. Cornell's orchards. Two were placed in the young orchard which had received applications of kainit two years in succession; one was placed under the tree which was treated with kainit, April 15, 1895, and two were placed in the old untreated orchard. Under one of the latter traps, the sod was spaded over to a uniform depth of four inches before setting. Some of the midges were noticed issuing about noon on the same day the traps were set. The traps were examined on April 21. We found that where kainit had been applied, even where it had only been applied once, there was only one midge under these traps to where there were five hundred under the traps over untreated ground. In the case where kainit was only applied one year the tree was somewhat isolated, so that too much dependence cannot be placed on this. In the old orchard where the ground was spaded deep, to test the effect of burying the cocoons or resting stage of the midge, the difference in the number of midges under the traps was so slight no estimate could be made.

These orchards were examined again June 4, 1896. Only about one-tenth of the fruit on the young orchard was found to be injured by the midge maggot. But the same conditions were found in another young orchard which had been cultivated in 1895, but had received no dressing of kainit. In the old orchard, possibly one-tenth of the pears were not injured.

In the young orchard which had received constant and clean cultivation, but where no kainit had been applied, there were a few large Lawrence trees. These all yielded a fair crop the past year. From one of the trees Mr. Cornell picked six barrels of fine pears.

EXPERIMENTS AT BLAUVELT.

As already stated a parallel test of remedies was conducted at Blauvelt, N. Y. During the spring of 1894 Mr. S. B. Heusted sowed muriate of potash at the rate of 1,500 pounds per acre around a Tyson pear tree that had been badly infested with pear midge. On April 19, 1895, a cheese cloth trap was placed under this tree. At the same time we thoroughly drenched with kerosene emulsion the ground under some Bartlett trees that had been infested the previous year. A trap was placed over the drenched ground and another trap was placed under a Bartlett tree that had not been treated with any substance. All the orchard had been cultivated the previous year and sown to rye. So few midges appeared under any of these traps that no conclusions could be drawn.

EXPERIMENTS AT QUEENS.

On June 20, 1895, a test of salt was started at Queens, N. Y., on the orchard of Mr. N. Hallock. Both table-salt and cracked rock-salt were sown under infested trees at the rate of one bushel per square rod of surface.

April 15, 1896, four cheese cloth traps were set in Mr. Hallock's orchard. Two were set where salt had been applied, June 20, 1895; one was placed over ground that had not been treated in any way; and the fourth was placed over ground which was spaded at a uniform depth of four inches.

These traps were examined on April 18, 1896, by Mr. Hallock. He found the midges were more numerous under traps on untreated ground than under those on the treated ground.

Personal examination of the traps at Queens, April 28, showed very slight difference in the number of live midges under traps or treated and untreated ground. All were females.

NOTES.

As already stated the midges were found flying April 19, 1895, at Newburgh, N. Y., and again in 1896, at the same place they were noticed to be rising from the ground, collecting on the bodies of the trees and pairing April 18, 1896.

Early in April, 1896, soil was taken from beneath trees which were infested the previous year, and taken into the laboratory. No midges issued from this soil until the 18th of April. They were found under the traps at Queens, N. Y., April 19, 1896. This indicates that forwardness of the trees and the difference in locality makes but little difference in the time of the issuing of the midges. It was a marked fact that Lawrence pears on Long Island were from a week to ten days later in starting and flowering than those at Newburgh, N. Y. Ever since the "Midge" was first discovered in this country it has shown a decided preference for the Lawrence pear. This preference has been supposed to be due principally to the difference in the flowering periods of the different varieties. However, at Newburgh, N. Y., the past season the difference in the flowering periods of the Lawrence, Bartlett and Kieffer was so slight as to be indistinguishable. The most marked character in the Lawrence was that the floral envelopes did not cover the stamens and stigmas, as in the other varieties, before it was time for them to open naturally.

This condition was most noticeable in the old uncultivated orchard. Another noticeable fact was that in most cases in the cultivated orchards, it was the central flower of each spur that was most apt to be affected.

During the spring of 1896 crude petroleum, crude carbolic acid and chloride of lime were tested to determine their value as repellants for the pear-midge. These substances were placed in phials, a dozen phials of each substance being used. Each substance was placed in a separate tree, the phials being distributed to different parts of the tree. These substances failed to give the desired results, but, possibly, the failure was due to the fact that the midges had commenced to issue a few days before the substances were placed in the trees.

While working with the pear-midge at Meriden, Conn., in 1884 and 1885, Dr. Riley bred a species of *Platygaster* from the midge-infested pears. These were apparently parasites of the midges. What was probably the same species of *Platygaster* was observed the past season, April 21, 1896, industriously depositing their eggs in the unopened pear flowers, but we did not succeed in breeding them from infested pears collected the latter part of May.

CONCLUSIONS.

The tests made show that there is a decided gain in the use of kainit. The question to be solved is, How long will an orchard stand the application of a potash salt at the rate of from 1,500 to 2,000 pounds per acre, especially an orchard on a tenacious clay soil? Another question is, Will not the plowing of the orchard in midsummer be just as discouraging to the midge as the application of the potash salt? The indications thus far are that thorough cultivation is far preferable to the application of salts. There is a certain amount of danger in using the potash salts, what their effect on the trees will be being an open question. In Mr. Cornell's orchard where kainit was applied blight was very bad, but blight has been quite marked in most places in this section the past two years — a thing which has been unknown heretofore. The application of common salt must be tested more thoroughly, as must also muriate of potash before any conclusions can be drawn as to their use.

Our observations indicate that the midges issue in this locality from April 15 to April 30. They pair as soon as they rise from the ground, deposit their eggs and perish within twenty-four hours.

III. NOTES ON CABBAGE PLUSIA AND REMEDIES FOR THE SAME.

Plusia Brassicæ.

SUMMARY.

The cabbage plusia, better known as the cabbage-looper, is the worst pest known on lettuce in forcing-houses. The most practical means of preventing its work on lettuce is to keep the ventilators closed with mosquito netting. We succeeded in killing this pest on cabbage in the open field by the use of a poisoned resin-lime mixture, also with a poisoned Bordeaux mixture to which the resin mixture had been added. The resin-lime mixture not only proved a success for making Paris green or London purple adhere to cabbage and related plants, but it was found that by its use the poison could be made to adhere to the under surface of the leaves where it was impossible for it to be washed off by rains.

INTRODUCTION.

This pest is better known in this section as the "Cabbage Looper" and the adult form as the "Cabbage Moth" or "Miller."

The history, habits, food plants, etc., of this pest have been given in Bulletin No. 83 and in the Thirteenth Annual Report of the New York Agricultural Experiment Station.

As the amount of damage done by this pest is increasing each year in this section we are warranted in calling attention to its work again. Furthermore, a certain amount of success has been obtained in the remedies tested, hence part of the facts already given will bear repeating.

INJURIES AND REMEDIES IN THE GREENHOUSE.

This "Cabbage Looper" is a marked greenhouse pest. The "moths" or "millers" lay their eggs on many of the plants before the latter are taken into the houses, but they usually prove more troublesome by getting into the houses through the ventilators. They fly into the houses on cloudy days and late in the afternoon or early evening. They are very destructive to chrysanthemums, cutting off the flower buds, also to smilax, but they usually do the largest amount of damage in lettuce houses and especially to lettuce in cold frames.

The most practical remedy thus far found for use in forcing-houses and cold-frames is the keeping of all ventilators closed with mosquito netting. In cases where the eggs and caterpillars are carried in on the plants when transplanted, the most practical means is hand-picking. A sharp lookout should be maintained for the castings on the leaves and for eaten leaves. When the latter are found a careful search will generally result in finding the caterpillar trying to mimic a leaf petiole.

IN THE FIELD.

It is when this pest occurs in destructive numbers in the field that it passes beyond all control by methods of cultivation and preventive measures. In the open field they are more destructive to cabbage and related plants, such as cauliflower, Brussels sprouts and rutabagas, which have a smooth leaf surface, than to any other crop. The caterpillars usually feed on the under surface of the leaves. They can travel quite rapidly, and if they find any foreign substance on the leaves, especially the upper leaves of the cabbage, they travel to other parts of the plant, and even to other plants. They are far more particular about what they eat than is the "Imported Cabbage-worm."

The "moths" or "millers" are swift flyers. As already stated, they fly principally on cloudy days and early in the evening, hence can not be captured as easily as can the "Imported Cabbage-butterfly."

From their peculiar habits of feeding, it is impracticable to use Paris green in the dry form, the same as used on potatoes for the "Colorado potato-beetle." Beside, if rain follows the application of dry poison to cabbage and its related smooth-leaved plants, the time and material are practically thrown away.

During the past two years an effort has been made to find some substance that would aid in making poisons adhere to the leaves of cabbages and rutabagas. It is known that Bordeaux mixture does fairly well, provided it can be made to adhere uniformly to the surface of the leaves when applied. It is also known that soap suds forms a film on the leaves which adheres well until a rain occurs.

RESIN-LIME MIXTURE.

The best substance tried is a resin mixture which has been used on the Pacific coast, and to some extent in other parts of the country, against scale insects. This resin mixture is in reality a liquid resin soap. It is made by dissolving a definite quantity of resin in oil and water, and then saponifying it with potash.

The formula as usually given is:

Pulverized resin, 20 pounds.
Fish oil, 3 pints.
Caustic soda or potash, 5 pounds.
Water, 100 gallons.

A mixture as strong as this is not needed, and, as a large quantity of the mixture is rarely needed, the following formula is a more convenient one:

Pulverized resin, 5 pounds.
Fish oil, or any cheap animal oil, 1 pint.
Concentrated lye, 1 pound.
Water, 5 gallons.

It takes about two hours to make this mixture. The oil and resin should be placed in a kettle and heated slowly until the resin is softened, then add one gallon of hot water, after which the solution of potash or concentrated lye should be carefully added. The mixture should be stirred while adding the lye. The concentrated lye should first be dissolved, according to directions given on the can for making hard soap. After the lye has been added, add four more gallons of hot water and allow to boil until the mixture will mix with cold water, making a clear amber-colored liquid.

To prepare for use: To every gallon of this resin mixture, made according to the second formula, add four gallons milk of lime, sixteen gallons of water and four ounces of Paris green. To distinguish this mixture from the resin mixture we will call it resin-lime mixture.

The milk of lime is made by slaking a quantity of stone lime and adding enough water to make a thin whitewash. About one-half pound of stone lime will make four gallons of whitewash, depending on quality of stone lime used. When the lime is added to the resin mixture the latter flocculates, or forms a suspended form of hard soap in the water. The Paris green, or London purple, whichever is used, adheres to the flocculated mixture and does not settle to the bottom. If an excess of lime is added to the mixture it will settle and will also clog the nozzles of the spraying apparatus. It is always best to have a slight excess of the resin mixture, as it aids in forming a soapy film on the surface of the leaves, which holds the particles of lime and poison until the lime dries.

This poisoned resin-lime mixture will stick to the under as well as to the upper surface of the leaves. Two or three heavy rains are often required to remove all of it, even on the upper, exposed portions of the leaves. The main disadvantage in using this mixture is that at times it gums up the valves, especially rubber ball valves, and the packing of the plunger of the spraying outfit so that they have to be renewed or cleaned frequently. Apparently this trouble is more likely to occur if the resin is not thoroughly saponified.

An excess of Paris green is recommended for two reasons. First, it is thought that the lime counteracts the action of the poison. Second, cabbage and related plants can not be drenched without wasting the material, and as only a slight film of the mixture adheres, it is necessary to have it carry all the Paris green it possibly will.

If the first formula given is preferred, enough water should be added to make 400 gallons; then all that is necessary is to add lime and Paris green in the right proportions to the amount of resin mixture used.

The best time to apply the resin-lime mixture is when the plants have only five or six leaves; then, if necessary, follow with two more applications to the top leaves before the heads are one-half formed. *This mixture should not be used on cabbage after the heads are two-thirds formed.*

EXPERIMENTS.

The following tests of the poisoned resin-lime mixture have been made. The tests were made on two separate farms, one-half acre of cabbage being used on each farm.

The first test was made on medium late cabbage, a mixture of Savoy, Red Dutch and Flat Dutch, part of which had commenced to head.

August 26—1. Sprayed six rows with the poisoned resin-lime mixture.

2. Sprayed six rows with Bordeaux mixture.
3. Sprayed six rows with poisoned Bordeaux mixture.
4. Sprayed two rows with poisoned resin mixture.
5. Sprayed two rows with a poisoned Bordeaux mixture plus resin mixture.

NOTE—The Bordeaux mixture used alone adhered only in the folds of the Savoy cabbage. Where the resin mixture was combined with the Bordeaux mixture it adhered as well as the resin-lime mixture.

September 4. Resprayed the above field, applying the same substances and in the same manner.

NOTE.—The cabbage on Nos. 1 and 5, have nearly perfect foliage. Only a few cabbage loopers to be found and practically none of the imported cabbage-worms. No distinguishable difference between cabbage on No. 2 and on check. All badly eaten and both kinds of caterpillars numerous. Condition of test No. 3 little if any better than No. 2.

On August 31 the owner of the above field treated an adjoining field with salt. When examined September 4 not a dead worm could be found on the whole field, nor did this salted cabbage ever look any better than did the check to our tests.

The second test was made on very late cabbage, the majority of which had only five or six leaves thrown out.

August 29—1. Sprayed two rows each of Savoy and Flat Dutch cabbage with the poisoned resin-lime mixture.

2. Sprayed two rows each of Savoy and Flat Dutch cabbage with Bordeaux mixture.

3. Sprayed five rows each of Savoy and Flat Dutch cabbage with a combined mixture of resin and poisoned Bordeaux mixtures.

NOTE.—Examined tests on August 31. Where No. 2 was used alone found no dead worms of either cabbage-moth or of the imported cabbage-butterfly. Very few live worms were found on either variety of cabbage where Nos. 1 and 3 were used. Examined again September 4, after a heavy rain. To all appearances there is very little difference between the adhering qualities of Bordeaux mixture and the resin-lime mixture.

There were about five acres of cabbage in the field used. On September 1 the owner of the field treated all but the one-half acre on which we were testing mixtures with Paris green mixed with flour. When examined September 4th no dead cabbage loopers could be found where he had applied the dry powder. He had, however, succeeded in killing a large number of the imported cabbage-worms. On September 17 the field which was sprayed August 29 was resprayed, the same substances being applied to the same number of rows of each variety of cabbage. When this second spraying was given no attempt was made to spray the lower outside leaves, as they were still protected by the first spraying, at least where the resin mixtures were used.

September 29. Although after two rains there is little difference to be seen between the amount of Bordeaux mixture (No. 2) and resin-lime mixture still adhering to the leaves, there is a marked difference to be seen in the leaves themselves. The leaves of the plants where the poisoned resin-lime mixture was used were nearly perfect, while where the Bordeaux mixture was used the leaf surface had been about one-half eaten away. Where the poisoned resin and Bordeaux mixture combined was applied the leaves were as perfect as where the poisoned resin-lime mixture was used. This indicates one of two conditions: First, there must be enough of the resin-lime mixture adhering to the under surface of the leaves and not visible to kill the worms, or there is an invisible film on the upper surface holding poison enough to do the work.

A final comparison of the tests was made October 19. Where the poisoned resin-lime mixture and poisoned Bordeaux mixture plus resin mixture were used, the cabbage has formed heads that are worth saving.

The difference between the sprayed portion of the field and the portion that was treated with dry Paris green and flour was not marked until after the second spraying, September 17. This would indicate that the second spraying was made at the proper time to kill the last brood of the imported cabbage-worms.

At this time (October 19) the difference noted September 29 is still noticeable. The leaves of the cabbage sprayed with the poisoned resin-lime mixture are nearly perfect, while those of the cabbage sprayed with Bordeaux mixture are about one-half devoured. The difference was so marked that it could be seen the whole length of the field.

It was estimated that one man could prepare the poisoned resin-lime mixture and spray about two acres a day with a knapsack sprayer. Hence the principal expense would be the time and Paris green. The results showed that, to be complete, at least two applications of the poisoned resin-lime mixture must be made to control the cabbage-looper. The first application should be made while the plants are small; best while the outer leaves are in such position that both sides can be reached by the spray. A second spraying should be given about the time the heads begin to form. Where all the damage is being done by the imported cabbage-worm alone, one spraying with this mixture during the fall will answer. Possibly the use of the dry Paris green and flour would answer fairly well provided it could be applied at the right time. With the poisoned resin mixture it is not necessary to wait and watch for the right time. This can be applied as soon as the plants are large enough and be there ready for the first "worm" that tries to make a meal of the plant. The poisoned Bordeaux mixture can be used with the resin mixture in place of using lime.

Miscellaneous tests.—During June, 1895, we sprayed a number of elm trees in nursery row with the poisoned resin-lime mixture. Both sides of the leaves were thoroughly wetted with the mixture. This test was made against the "Elm Leaf Beetle." No other spraying was given throughout the season, but the foliage remained nearly perfect while that on adjoining unsprayed trees was ruined by August 1.

On September 13, 1895, a small patch of rutabagas which were being devoured by the imported cabbage-worm was sprayed with the poisoned resin-lime mixture. The patch was examined September 6 and no live worms could be found. No evidence of their getting a foothold in this patch was seen again during the fall.

III. NOTES ON REMEDIES FOR CUTWORMS.

Summary.

The most destructive pests of the onion crop are cutworms. The " Dark-sided Cutworm " has caused the most damage to the onion crops of Orange county during the past two years. This same species of cutworm destroyed a large percentage of the onion crops in 1885 and 1886. It is estimated that at least 46 per cent. of the crop was ruined the past year. It was found that dry bran or middlings mixed with Paris green at the rate of one pound of Paris green to fifty of bran, or thirty of middlings, was the cheapest and most practical thorough means of killing the cutworms.

Introduction.

The principal cutworm which injures onions is one species of what are known as the " Climbing Cutworms." This particular cutworm has been given the common name of " Dark-sided Cutworm " (*Carneades messoria*) and by some of the old writers was called " Climbing Rustic " and " Reaping Rustic." It was first known as a climbing cutworm in peach orchards.

The dark-sided cutworm made itself felt in the onion districts of Orange county in 1885 and 1886. It was known prior to this date in many places as a " general garden and orchard cutworm." In most parts of the United States and Canada it is known principally as a grass feeder. In the spring the blue grass on the margins of the ditches and driveways of the onion fields is often eaten off by the young cutworms as close as though cropped by sheep. Early in June, 1895, they were found cutting off potato tops. This habit is very marked, even on onions, until the worms are nearly two-thirds grown. After this period they cut the plants off at the surface of the ground. This cutworm may have been known to have a special preference for an onion diet previous to 1885, but no reference to such a tendency has been found until the above date. At this time it was so destructive that the Department of Agriculture at Washington sent two experts to investigate the trouble and see what could be done. As usual in such cases the damage was not reported to them until about time for the cutworms to stop feeding, hence practically nothing was accomplished.

OUTBREAK OF CUTWORMS IN 1895.

Nothing further was heard of this pest on onions until June, 1895. At which time Mr. M. H. Vernon, of Florida, Orange county, wrote to the Station asking for help to combat them. The writer was sent to investigate the trouble. He found that in most cases the worms had done all the damage they could do, or else the growers had them under partial control by ditching and by picking. No further attempt at controlling them was made until the spring of 1896. Arrangements were made for Mr. M. H. Vernon to notify us as soon as the cutworms commenced their depredations. The onion fields were visited April 24, 1896, but no cutworms could be found. On May 11 word was received from Mr. Vernon that they were at work. The fields were reached May 12 and preparations made to carry on a series of tests of the different remedies that had been suggested and tried on other crops in various sections of the country.

PREVENTIVE MEASURES.

The object of these tests was to determine: First, which would be the most practical means of preventing the migration of the cutworms from the margins of the ditches and driveways to the onions. Second, to determine if the onions could be poisoned, or other means used to destroy the cutworms after they had migrated over the fields. Poisoning was tried as follows: First, about ten rods on one end of 150 rows of small onions was sprayed, liquid resin mixture of lime and Paris green being used.* Second, on another field fifty bunches of poisoned grass were put out. Paris green was used at the rate of one pound to eighty gallons of water to poison the grass. Third, fifty piles of poisoned bran

* A complete description of this mixture is given in the article, "Notes on Cabbage Plusia and Remedies for the Same." For the above tests sixteen quarts of milk of lime, about two pounds of dry lime, one pound of Paris green and four gallons of the resin mixture was used and enough water added to make 160 gallons in all.

were placed on still another field. The bran was first moistened and then Paris green added at the rate of one pound of Paris green to fifty pounds of bran. Fourth, about nine o'clock in the evening of May 12 a number of rows which ran parallel with a ditch were sprayed with kerosene emulsion, a stock solution of kerosene emulsion diluted with eight parts of water being used. At the time the spraying was done the little cutworms had climbed to the tops of the onions and were busy feeding. Examination with a lantern while spraying showed that the worms fell to the ground as soon as struck with a particle of spray and to all appearances were injured to such an extent that they would soon die. Early the next morning the surface of the ground where the spray was applied was carefully examined. No dead cutworms could be found on the surface, nor were any dead ones to be found buried in the loose surface soil. Cutworms taken from the surface of the ground immediately after spraying and confined became active and, apparently, were not permanently injured.

RESULTS.

The results of the tests as a whole were as follows: Where the onions were sprayed with Paris green added to the resin-lime mixture no dead cutworms were to be found. A few sickly specimens were found hidden in the loose soil. The onions were so small that only a very small portion of the spray could be made to adhere to them. No dead cutworms could be found around or under the poisoned grass baits. The grass remained fresh only one night. A large number of dead cutworms were found around the poisoned bran baits, not only under but hidden in the loose soil around the baits and on the surface.

All these remedies were known and had been tested, but it was deemed advisable to test them on the onion fields where the owners of the fields could see the practical results, as they were the most practical remedies that had been recommended, except hand picking, which was well practiced. No further tests were made at the time.

Dry Poisoned Bait.

One farmer, Mr. T. M. Vail, of Florida, tried the poisoned bran bait remedy and found by actual tests that the cutworms would feed on the dry bran just as well as on wet bran. In fact, the wet bran bait caked and hardened after the first night, so that the cutworms did not feed upon it as well as they did on the dry bait. It was also found that by using middlings, instead of bran, the bait could be applied with the seed drill alongside the onion rows. (See Plate LIII.) In most cases one application of the dry poison bait was enough, unless a rain followed within a day or two after it was sown. When the fields were visited on May 27 it was found that the cutworms not only fed on the bran bait as they were migrating from the margins of the field, but that in many cases they left the onions to feed on the bran. This habit was especially marked when the onions were quite large. Ninety per cent. of the half-grown cutworms found near the bait were dead. In fact, about the only specimens found alive were those still small enough to climb and feed on the tender portion of the onions.

For use on the fields this dry poisoned bait has the following advantages: First, it can be applied in drills around the margins of the fields and thus serve as a barrier against the migration of the cutworms from the margins of the ditches and driveways. Second, it is easily applied at a uniform rate with the onion-seed drills. Third, if the worms become scattered over the fields it can be applied in drills alongside the onion rows. (Plate LIII shows a field treated with the poisoned bait, over which the cutworms had scattered.) Fourth, the trouble of mixing with water and ladling out in piles, together with the addition of molasses or sugar, which some have recommended, is avoided. As a whole the tests made with the dry bran show that it is as effective as hand picking; that it is less expensive, and, in the case of onions, as near a perfect remedy as we can hope to obtain under the present methods of cultivation and care of the crop. If this bran bait had been used by every grower of onions in Orange county on May 10, 1896, not over one-tenth of the crop would have been lost: as it was, nearly one-half of the crop was destroyed. It is our opinion that if the bran bait were applied around the margins of the fields and sown in the grass on these margins each year, before the onions came through the ground, the growers would rarely find a full-grown cutworm on their fields, except in cases where they are carried onto the fields by high water. If middlings are used, 25 or 30 pounds should be mixed with one pound of Paris green; of the coarse bran, 50 pounds should be used with one pound of Paris green.

The above species of cutworm has been very destructive to garden crops on Long Island during 1895 and 1896. The dipping and spraying of cabbage plant with the resin-lime and Paris green mixture were tested, as were also the wet and dry bran baits. In addition, about 150 plants were smeared with "Raupenleim" or "Caterpillar-lime," a patent insecticide. This substance was put on the stem of the plant.

The dipping and spraying of the plants with the resin-lime and Paris green mixture killed some of the cutworms, but usually the plants were ruined, because this cutworm always climbs the plants and eats out the hearts before feeding on the sprayed leaves.

The bran baits were placed around the stems of the plants. Both the wet and the dry baits were successful, but preference must be given the dry bait, as it would remain in shape so the cutworms would feed on it for a longer period than they would on the wet bait. As already stated, the wet bait would dry and cake on the surface and mildew next to the ground.

All the plants treated with the "Raupenleim" were killed outright.

The above tests on cabbage plants were carried out at Bayside, Long Island, one-half acre of cabbage being used.

AMOUNT OF DAMAGE DONE.

As already stated, this cutworm was very destructive to the onion crop in Orange county in 1885 and 1886. Dr. Lintner states, in Country Gentleman for October, 1886, page 750, that the loss to the onion crop in this section in 1886 was one-half. During the last two years the cutworms have been most destructive on the margins of the so-called "drowned" lands, or what is known as the "gray soils." These "gray soils" have been under cultivation the longer, and have received a larger amount of loam than have the more recently developed lands known as the "black soils." It was an easy matter to select sections where 99 per cent. of the crop on all fields was destroyed. On June 12, 1896, the estimated acreage of onions destroyed in the vicinity of Florida and Big Island, Orange county, was as follows: Estimating 2,000 acres as the total acreage sown in this valley, 200 acres on the margins of the valley next to the bluffs could be selected, on which 99 per cent. of the onions were destroyed by the cutworms; 600 acres could be selected on which 75 per cent. were destroyed; on a belt of "semi-gray and black" soils 400 acres could be selected, of which 50 per cent. were destroyed; while the remaining 800 acres on "black soil" had 10 per cent. destroyed. This gives a total average of 46 per cent. destroyed, or nearly one-half. One gentleman estimated that 75 per cent. of the whole crop was destroyed, but this estimate was made from the poorer portions of the fields. By going directly across the valley in any one direction the amount of damage would not appear so great as by following around and viewing the fields from the uplands.

Causes which Aid in the Increase of the Worms.

The growers of onions have a theory that the cutworms prefer the so-called "gray soils." From observations made during 1895 and 1896 it is thought that there are other reasons why the cutworms occur on the "gray soils," which also account to a certain extent for their occurrence on the onion fields in such countless numbers, even though they are hand picked each year. The hills surrounding the swamp lands are usually pasture lands, many of which have not been under cultivation for the past decade. Here this species of cut worms breeds unmolested, except by its natural enemies, year after year. Dry seasons like 1894, 1895 and 1896 are favorable to their increasing in large numbers.

There is a natural migration of the cutworm moths from the high to the low ground and vice versa. This migration is probably fostered by the dry seasons. The pastures are cropped close by the stock, and hence furnish poor hiding places for the moths. If we take for granted that this species deposits its eggs early in August, and that the cutworms make part of their growth during the fall, as some other species of cutworms are known to do, then the rank growth of barnyard grass and numerous weeds around the margins of the onion plots furnish excellent breeding places for the moths. (See Plate LIX.) This is also a good theory for their being so much more numerous on the "gray soils." These gray soils are, as a rule, more foul with weeds and grasses than the new lands.

LIFE HISTORY AND HABITS.

Dr. Riley* states in his first report that this species of cutworm is single brooded. In his Government report for 1885† he says that the evidence points toward their hibernation in the larval stage, and, as the larval hibernation is by far the most common among the cutworms, is of the opinion that the species so hibernates as a rule. He also says: "This does not, however, preclude the hibernation of some of the later-developed moths, and the fact that neither moths, eggs nor young larvæ were found in October, must, we think, be explained on two grounds. First, either limited or insufficient search or, second, their occurrence in adjacent localities or on other plants."

Gillette‡ says: "The moths of this species have been most abundant about lights and sugar baits from the 20th to 30th of July. From dissections made it seems that the eggs are laid in the latter part of July and August."

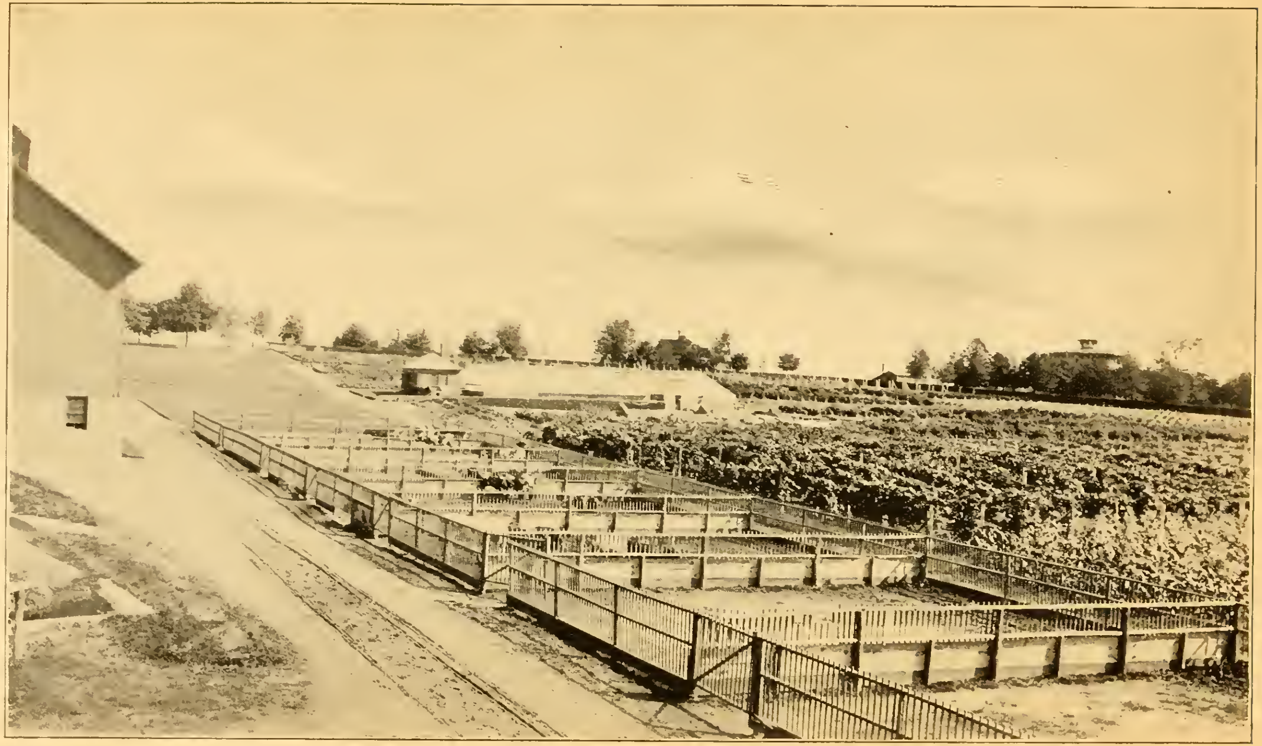
Dr. Smith§ says: "The eggs are laid by the moths toward the end of summer and hatch soon afterward. The larvæ or young cutworms develop slowly and become little more than half-grown in fall."

* First Report on noxious, beneficial and other insects of Mo., p. 74.
† U. S. Dept. Agr. Rept., 1885, p. 271.
‡ Bulletin 12, Iowa Agricultural Experiment Station, p. 538.
§ Ann. Rept. N. J. Agrl. Exp. Station, 1892, p. 470.

It can be seen from the above references that the exact time at which the moth of this species of cutworm deposits its eggs is not known. For reasons which follow it is believed that the eggs are deposited later in the fall than generally supposed and do not hatch until the following spring. First, when the cutworms commenced their work in the spring of 1896 (about May 1), it was found that they were not only migrating from the margins of the fields, but there were spots within the fields where they were numerous and doing a large amount of damage. Examination of these spots showed that the spots were covered with debris, weeds, etc., left by the high water. At just what time during the winter or spring the lands had been overflowed from the ditches could not be determined. It is barely possible that the worms were drowned out along the ditches by a spring freshet, and, clinging to the bits of weeds and other rubbish, were carried to the higher grounds at the center of the fields, but it seems more probable that they reached these spots in the egg stage; that the eggs being deposited on the weeds the previous fall were carried to the high grounds by the freshets. Second, at the time (May 12) that the worms were first discovered feeding, none were over half an inch long, and more were only one-eighth to one-quarter of an inch in length. It is possible that some of the moths hibernate and deposit their eggs in these dry rubbish heaps in the spring. We do not know over how long a period the egg laying of this species may be extended, nor do we know how long the young worms will live in dry rubbish heaps, without food, where they may have been lodged by high water. I did not succeed in capturing any adult moths at light traps until July 30, 1896.

One other species of cutworm, *Hadena illata?*, usually not common, was, also, quite destructive to onions at Florida, Orange county, during 1895 and 1896. When full grown this cutworm is from one and one-half to two inches long, of a greasy, dark color and covered with scattering hairs. These cutworms feed a little later into the summer than do the "Dark-sided Cutworm." As far as observed they cut the onions at the surface of the ground, and never climb them.

PLATE LXI.



CATTLE YARDS.

REPORT

FROM THE

Department of

ANIMAL HUSBANDRY

WILLIAM P. WHEELER, First Assistant.

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REPORT OF THE FIRST ASSISTANT.

WILLIAM P. WHEELER.

The work for 1896 has been a continuation of that for the preceding year. Experiments with poultry and swine have been continued and the feeding of the dairy cattle planned and superintended. Work connected with the cattle feeding has occupied the greater share of the time for the year. A portion of the Station correspondence has been attended to and occasional drawings have been made when necessary for illustration of reports or bulletins.

I. GENERAL SYSTEM OF FEEDING THE DAIRY HERD.

The coarse fodders used in feeding the dairy cows during the year were clover hay, mixed hay, corn stover, oat-and-pea hay, corn silage, alfalfa forage, corn forage, oat-and-pea forage and sugar beets. The grain foods have been wheat bran, corn meal, wheat middlings, ground oats, linseed meal and cottonseed meal.

During January corn silage was fed morning and noon and clover hay at night. With these there was fed a grain mixture containing, by weight, six parts wheat bran, four parts cottonseed meal and one part ground oats.

For the first half of February the same grain mixture was fed with corn silage in the morning and clover hay at night. Corn stover was fed at noon. For the latter half of the month the same coarse fodders were fed, and there was a change of the grain mixture to one containing six parts wheat bran, four parts old process linseed meal and one part ground oats.

From March 1st to 15th corn silage was fed morning and noon and clover hay at night. From the 16th to the 31st corn silage was fed morning and night and corn stover at noon. The same grain mixture was fed during the month as during the latter part of February.

During April a grain mixture consisting of five parts wheat bran, three parts old process linseed meal, two parts cottonseed meal and two parts ground oats was fed. Corn silage was fed morning and night and corn stover at noon until the 15th. For the remainder of the month corn silage was fed morning and noon and clover hay at night.

For the first twelve days in May corn silage was fed morning and noon and clover hay at night. For the rest of the month alfalfa forage was substituted for the silage. The grain mixture fed during the month consisted of six parts wheat bran, three parts corn meal, and one part each of wheat middlings, ground oats and old process linseed meal.

The ration for the first thirteen days in June, and for the last five days, was the same as for the latter part of May. From the 14th to the 25th clover hay was substituted for the morning feed of alfalfa forage.

For the first half of July the grain mixture was composed of six parts wheat bran, three parts corn meal and one part wheat middlings. Alfalfa forage was fed in the morning and oat-and-pea forage at noon and night. For the latter half of the month corn silage took the place of oat-and-pea forage, and the grain mixture was changed to one of five parts wheat bran and one part each of corn meal, wheat middlings and old process linseed meal. The ration for August was the same as that fed during the latter half of July.

During September corn forage was fed at noon and night, alfalfa forage was fed in the morning. The grain mixture fed contained four parts wheat bran, three parts corn meal and one part old process linseed meal. This same grain mixture was fed during the first fifteen days of October, when clover hay was fed morning and night and alfalfa forage at noon. From the 16th to the 31st corn silage was fed morning and night and oat-and-pea hay at noon. With these a grain mixture containing six parts wheat bran, two parts old process linseed meal, one part corn meal and one part ground oats was fed.

During the month of November the ration was the same as that fed during the latter half of October.

In December there was fed a grain mixture containing two parts of wheat bran, and one part each of ground oats, corn meal, and old process linseed meal. Clover hay was fed at night, sugar beets in the morning and corn silage at noon for the first half of the month. During the latter half of the month corn silage took the place of the beets.

As supplementary to a bulletin containing the results of some feeding trials with corn silage, the data from which have been given in the preceding annual report, a bulletin of general information upon silos and silage was prepared.

II. SILAGE AND SILOS.*

SUMMARY.

The silo affords a most economical means of assuring succulent food in winter and efficient and palatable food to supplement or supplant the dry pastures of summer.

Maize, or Indian corn, is probably the most valuable plant for ensiling.

As a succulent food for milch cows corn silage is cheaper and generally more efficient than roots.

Corn silage has proved equal in feeding value to the best dried corn fodder.

The largest growing variety of corn that is reasonably sure to ripen before frost is the best one to grow for silage.

Corn should be put in the silo after the grain is glazed, before there is much drying of the leaves or stalk. Clover should be cut when in bloom.

The essential points in building a silo are:

To have the walls tight enough to exclude air from the contents.

To have the walls not only strong, but rigid.

To have sufficient depth — thirty feet or more, if possible.

*Published also as Bulletin No. 102.

There should be not more than about five square feet of feeding surface in the silo for each cow.

The larger the silo the cheaper the storage for each ton of silage. The larger the herd the more cheaply can silage be supplied to each animal.

INTRODUCTION.

The importance of the silo, especially for the dairyman, is becoming every year more generally appreciated. The many inquiries received at this Station indicate a growing interest in this method of preserving fodder. In response to many of these inquiries, especially those called out by the publication of Bulletin No. 97, the following observations on silage and silos are published.

A number of fodders can be successfully preserved in the silo. but Indian corn has been so generally the crop depended upon that when silage is mentioned without qualification corn silage is commonly understood. Maize, our greatest arable crop, when at its highest value for feeding seems especially suited for preservation in this manner. The decided palatability of the fresh fodder is not diminished and as large a proportion of the digestible matter is preserved as by other methods. To fail to take advantage of the great possibilities of this magnificent crop, scarcely equalled by any other, for furnishing succulent food in winter and during time of dry pasture in summer, would appear at least very unprofitable conservatism.

At its best stage for feeding, when just mature, it is available as fresh fodder for only a few weeks in the fall. In storing and keeping the crop in any manner it is subject to some loss. The average determined loss of dry matter in the crop, when cut and shocked in the field until dry and stored in the barn, has been about equal to the average loss reported from the silo. The dry fodders, however, from which losses were estimated were, it appears, handled with more care and generally under much more favorable conditions of weather and shelter than those under which the corn crop can generally be handled, while the silos in which losses were estimated were not all of them suited to produce the best possible results. It is probable that experience will enable us to considerably reduce the amount of loss in the silo, but it is not so likely that the necessary loss in keeping the dried fodder can be materially diminished. The cost of good barn shelter for hay or dried fodder containing an amount of nutriment equal to the silage is as great as that of the silo. The same amount of dry matter in food can be stored in the form of silage that would occupy about three times the space in the form of dried fodder.

When fed in quite large quantities corn silage is usually eaten without waste, but when feeding the dried fodder there is as a rule considerable refused by the cattle, especially if the fodder is not finely cut or shredded. For feeding in summer to cows that have some pasturage, the dry fodder will not do, for not enough will be eaten to sustain the milk flow; while silage is readily eaten and in time of dry pastures during the latter part of summer will help greatly to keep up the flow of milk.

The loss of protein in corn kept in the form of silage is proportionally somewhat greater than that in the dry fodder. Even without this loss, and also when feeding the fresh plant, corn requires an accompaniment in the ration for milch cows of some more nitrogenous food. Usually such highly nitrogenous grain foods as linseed meal, cottonseed meal and the gluten meals are fed to good purpose with corn silage. The possibility of feeding liberal quantities of these products when their market prices are lower than their fertilizing values may be considerable advantage on farms where commercial fertilizers are regularly purchased. Wherever it is desirable for any reason to feed but little grain it is well to have clover hay for winter feeding and clover or some mixed pea silage with that of corn for summer feeding. When several silos are used, or a large partitioned silo, the different kinds of silage stored separately can be fed together.

Clover makes silage of excellent quality and has been used for this purpose in many silos through the country. Several mixed crops have been tried at various times but not extensively. A favorable result from the trial of silage made from equal parts of green corn fodder and green soja bean fodder was reported from the Massachusetts Experiment Station, summarized as follows: "Corn and soja bean silage has proved itself fully equal if not superior to hay in producing a yield of milk, without affecting the quality, and at the same time decreasing the absolute cost." At the Vermont Experiment Station the results of a short feeding trial were thought to promise as good returns from oat-and-vetch and oat-and-pea silage as from corn silage.

SILAGE AND ROOTS.

The advantage of having some of the food for milch cows during the winter in a succulent form is very generally appreciated, and the results derived from the addition of roots to the ration have often been out of proportion to the actual amount of food constituents supplied by them. For feeding cows for a while before calving, roots are better than silage, and silage could not economically supplant roots where too few animals are kept to warrant the expense of building a silo, or to empty a silo fast enough to prevent the loss from decay at the surface. Where many cows are kept, however, corn silage is a much cheaper food for milk production than roots. Some of the results obtained at this Station from rations containing roots compared with those from rations containing silage have been noticed in Bulletin No. 97.

At the Ohio Experiment Station the same amount of dry matter of the food was found to produce on the average about six per cent. more milk from corn silage than beets. At the average yield, the cost of dry matter in beets was more than double that of the corn.

In a feeding trial at the Pennsylvania Experiment Station more butter was produced when cows were fed silage than when fed beets. The cost of growing an acre of beets was found to be about twice as much as an acre of corn, and about twice as much dry matter was obtained from an acre of corn as from the same area of mangels or sugar beets.

In some feeding experiments with lambs at the Michigan Experiment Station, rations containing silage were found more profitable than others containing beets.

Losses in the Silo.

Even with an unusually large loss from keeping corn in the silo the silage would be a cheaper food than roots. The loss however, in the silo is not greater than with the dried fodder. The average loss in many instances where observations were made was, for dry fodder and silage, about 20 per cent. of the dry matter in the fresh crop. The loss in the silo, aside from that by decay at the surface and exposed corners, was found on the average of several determinations made at this Station to be about 12.6 per cent. There was a loss of about 18.5 per cent. of the albuminoids and 26.6 per cent. of the sugar and starch.

At the Wisconsin Experiment Station under favorable conditions a loss of dry matter of the crop of not much more than 8 per cent. was found, including all loss. It was estimated that the necessary loss could be made much smaller.

Ensilage and Field Curing.

Experiments made at the Pennsylvania Station on the influence of ensiling and field curing on the digestibility of forage corn led to the following conclusion: "When the processes are successfully conducted and the losses small, ensilage and field curing both decrease the digestibility of the fresh material somewhat, and to about the same extent."

While it has been estimated by some who have investigated the subject that dried fodder and silage when properly prepared have very nearly equal value for milk and butter production, a majority of feeding trials have shown advantages in favor of corn silage, and it is generally concluded that the silo furnishes the most economical means of feeding the corn crop entire.

In some feeding trials with steers at the Utah Station the animals having dry fodder gained in weight while those having silage lost in weight. The conclusion was that for such a climate where easy curing of fodder could be expected the silo was undesirable.

The results of a number of experiments with silage at the Kansas Station were summarized as follows: "If we estimate that 77.2 per cent. of the amount put in can be taken out sound and available for feeding, or about 1,544 lbs. for every ton put in the silo, we find that, at the average feed of 32 pounds per day, one ton will last one animal 48.2 days, or 100 tons will last a herd of 25 head 192 days; and in a reasonably favorable season, with good soil and good culture, this 100 tons may be grown on about 10 acres. What other method of handling corn fodder will maintain an average farm herd during the long winter season from grass until grass comes again, on so small an area?"

MATURITY AND VARIETY.

Corn when just mature, at the time it would be cut for husking, when the grain is glazed and just before much drying of the leaves occurs, is at its best for ensiling. In a deep silo corn can be put in when glazed and nearly ripe, when the best quality of silage can be made; but in shallow silos the more mature corn will not pack sufficiently to exclude air and greener and heavier corn has to be used, making poorer silage.

A variety of corn that is reasonably sure to mature before frost is best to grow for silage even with the expectation of a lighter acreage yield than could be obtained from some of the large, late maturing varieties.

The result of some investigations made at the Pennsylvania Experiment Station was that "As the corn crop approaches maturity there is a very rapid increase in the yield of dry matter per acre, while the digestibility of this dry matter appears to increase slightly, rather than to decrease as in the case of other crops. The yield of total digestible food by the fully mature crop was from two to three times as great as that by the same variety in the silking stage, and 36 per cent. greater than at the time the ears were glazing."

At the Minnesota Station in a trial of varieties of corn for silage is was found that "A hundred pounds of dry matter in either dent, sweet or southern ensilage corn proved very nearly of equal value for producing milk and butter in these trials, though the advantage in all cases was slightly in favor of the silage from the dent corn.

In experiments made at the Maine Station it was found that the smaller varieties of native corn which ripened in Maine were more digestible than southern field corn; 65 per cent. of the dry matter in the southern corn being digestible and 73 per cent. of the dry matter in the Maine field corn. "Pound for pound the Maine field corn silage was worth more than southern corn silage." Experiments at that station for five years showed that the average yield per acre of southern corn was 17 tons and of Maine field corn something over 11 tons. The average dry matter per 100 lbs. was nearly one-third more in the Maine field corn. The results of comparison were summarized by Prof. Jordan in part as follows: "The yield of digestible dry matter has averaged 175 lbs. more with the southern corn. To offset this it has been necessary to handle annually five and three-fourths tons more in weight."

Silage for Different Stock.

While silage has been used almost entirely for cows it can be fed with good results to some other animals, but it should not be expected that any should subsist wholly upon silage. For feeding steers corn silage has been successfully used in many trials, and rations containing silage have quite often given more profit than other rations fed in comparison. While corn silage was found at the Kansas Experiment Station most satisfactory for cattle generally, it was considered an unsuitable food for breeding bulls.

Many reports favor the use of silage for sheep, and a number of feeding experiments indicate its profitable use. It is recommended by several experienced men, with the caution to feed but little of that containing much grain to breeding ewes.

Silage has been fed to horses without trouble; but it should not be fed in large quantities, especially in cold weather, and silage containing much acid should not be fed at all. Some experienced feeders have successfully used it for horses and mules; others, after unsatisfactory experience, have considered it an unsafe food.

Silage is a desirable and well received addition to poultry rations in winter. Compared to the amount consumed by other stock it is a trifling total that would be eaten by an ordinary flock during the season.

Silage is eaten in moderation by pigs. In feeding trials made at this Station, corn silage could not be fed to pigs profitably in quantities large enough to warrant our calling silage a suitable food for them. Only very insignificant amounts of silage could be fed with profit.

SILAGE AND MILK.

In winter, for milch cows it has generally been customary with us to feed once a day some dry fodder, preferably clover hay, and silage twice with grain. A number of rations that have been fed, containing silage, were mentioned in full in Bulletin No. 97. Feeding of corn silage did not produce any inferior quality of milk so far as chemical composition would indicate and no objectionable flavor was noticed. If radical changes in the ration were made gradually and not suddenly and no spoiled or moldy silage allowed to reach the cow, it is probable there would be little complaint of any unpleasant flavor from silage. Of course, milk should not be exposed long in a stable filled with odors of silage or any others objectionable. At the Kansas Experiment Station the occasional taint noticed in the milk when silage was fed was entirely avoided by feeding the silage immediately after milking instead of before.

SILO CONSTRUCTION.

In building a silo the essential idea is to have a structure that will effectually exclude air from the mass of fermenting fodder. The first fermentation will not then be followed by souring and decay.

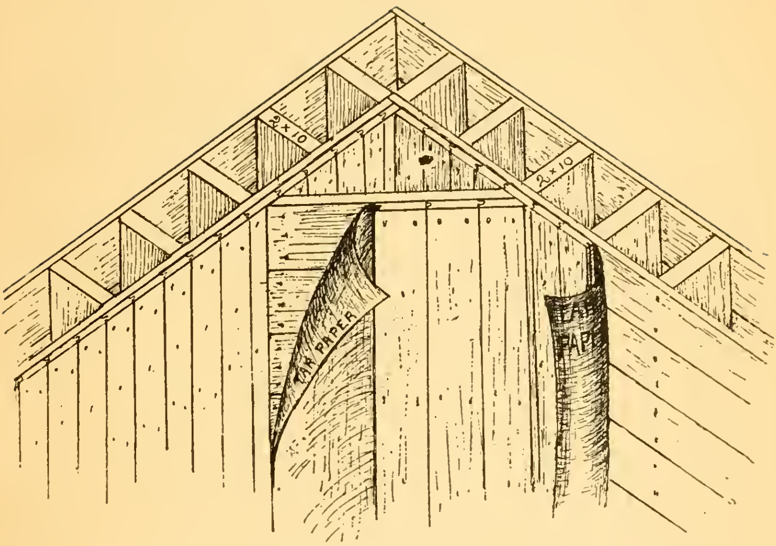

FIGURE 1

Corner of rectangular silo

The earlier silos were mostly pits in the ground, often too shallow for good results, afterward carried up above ground with stone or brick. They were inconvenient of use and the more effective ones were costly. First-class silos can be made of stone or brick if the inner walls are made smooth and vertical and well plastered with the best cement. Cemented or plastered walls will need a thin coating of cement each year to prevent action of the acid and absorption of so much moisture that the walls will crumble from effect of frost.

The less costly wooden silos are now most generally used. If built inside the barn a "square" silo or other rectangular one, often with partitions, is the common form, and if built outside the barn the round or cylindrical form of silo is preferably adopted.

Rectangular Silos.

A "square silo" built in the corner of the cattle barn at this Station eight years ago, 14 ft. x 15 ft. inside and 20 ft. deep, was constructed like many others in use at that time. The only change of any consequence made since has been that of boarding across the corners where air leaked in and most of the spoiled silage was found. This has been an improvement. The bottom of the silo is two and one-half feet lower than the basement floor. A stone wall extends around the bottom of the silo from below the frost line two and one-half feet high on the inner sides and eleven and one-half feet high on the exterior sides, these latter being formed by the main wall of the barn. Underneath the silo are six inches of stone from which a tile drain runs. On the stones a three-inch layer made of two parts cement and three parts gravel forms the floor. The stone sides are smoothly plastered up to the wooden wall. The upright timbers are 28 feet long by 5 by 10 inches, set three feet and eight inches apart with 2 x 10-inch studs set between. The bottom ends of the timbers are backed by nine inches of stone and cement of the basement floor. These uprights are also held by the second floor at the top and the main floor in the middle. Above the main wall on the two outer sides 2 x 10-inch studs only are used. The inside is boarded horizontally with matched hemlock, and again with matched pine, tarred building paper being between the two coverings of boards. The outside is covered with good quality of hemlock flooring. In the basement there is a door near the corner of the silo through which the silage is taken when low enough. A trap is over this in the main floor of the barn and two doors in the silo above in line make convenient the removal of silage and the filling in the fall. In this silo about 120 tons can be put and a first-class product obtained. The walls are not quite firm enough, however, and the springing caused by the pressure when filling is enough to admit some air as the mass of silage settles and causes considerable loss from decay that would not occur if the walls were more rigid.

The accompanying illustration, Fig. 1, shows the common method of boarding up a rectangular wooden silo, a sheathing of paper going between the two courses of boards. The partitions at the corners can be put across after the first course of boards instead of after the vertical second lining is in place, as shown in the illustration.

There are other styles of rectangular silos having rigid framework of strong horizontal girders, sometimes formed of three 2 x 10-inch planks spiked together. These have certain advantages. With any form of construction, however, especial attention should be given to securing a strong and inflexible framework. This should be stronger below the middle of the silo where the greatest pressure is found. The sills should be fastened to the foundation walls by heavy bolts imbedded firmly in the walls. The joints of the frame can be strengthened and horizontal girders held firmly together at the corners by short cross braces which will serve as backing to the boarding across the corners.

LOCATION.

The silo should stand where the ground is dry and well underdrained, naturally or artificially, and protected from all exposure to water from the outside. In a favorable location the silo can with advantage run several feet below the surface of the ground. This is especially desirable as increasing the depth of indoor silos where the height of the walls above ground is restricted.

The Round Silo.

The round or cylindrical wooden silo is now in quite general estimation. While about the least expensive in construction it is not surpassed in efficiency. This form of silo is recommended in preference to others by Prof. King, of Wisconsin, who has given especial attention to the subject for several years and studied the results obtained with many silos. Most of the following recommendations in regard to the construction of round silos are taken from the publications of the Wisconsin Experiment Station, and the illustrations are reproduced from similar ones in reports of that station.

Foundation and Floor.

The foundation wall should extend below the reach of frost and be about 18 inches thick. The top of the wall should be beveled on the inside. The wall should be thoroughly plastered with a mixture of two parts of good cement and three of sand, plastering carefully about the sill and bottom of lining so as to exclude all air. The bottom of the silo should be grouted and cemented to exclude rats, which, by burrowing under, admit air and cause considerable loss. Otherwise a good dry clay floor might suffice. At the Kansas Experiment Station two silo floors consisted simply of tamped clay and a third had a cement floor. The clay floors were thought to answer every purpose.

Framework and Walls.

The sill is made from pieces of 2 x 4-inch scantling. The pieces are cut into about two feet length on the slant of two radii of the circle of the silo, are toe-nailed together on the wall, bedded in mortar and leveled. By some it is recommended to lay a double course of 2 x 4 scantling for the sill, breaking joints with the pieces. The pieces for the plate, also of 2 x 4, are spiked on the tops of the studding. It is unnecessary to cut the pieces to a circle. Studding long enough is made by lapping. The studding need not be larger than 2 x 4 inches, except for silos of very large diameter. The studs are set a little nearer than 12 inches from center to center, and are toe-nailed to the sill. Every alternate stud is set first and stayed by a board to a temporary post in the center of silo. These studs are made plumb and stayed by a few strips of the outside sheeting tacked to each. The intermediate studs are then set in and nailed to the strips. The outside sheeting and siding are started at the bottom and carried up together. The lining is then put on. The lining of the round silo is made of fencing lumber split in two, making a little less than half-inch lumber. The fencing should first be sized to be of unvarying width. Three layers are put on the inside with good quality tar paper between, as shown in Fig. 2. For the last layer 10 d. nails are used and 8 ds. for the first two. The sheeting outside is of the same lumber except for very large silos. The ordinary siding for small silos is rabbeted on the thick edge. The doors are usually cut in after the lining is on, except one at the bottom. These are about two feet wide by three or four feet high. The studs at each side of where the door openings are to come are made double. Different kinds of doors, boarded both sides of cleats made of scantling, are recommended to swing on hinges. It would perhaps be better to have an outer door to swing on hinges, and have a double set of short one-inch boards cut to fit, in length equal to the width of the opening, held in place by cleats nailed on the studs. The inner surface of the boards may be flush with the inner lining of the silo and a layer of tarred paper should be between the boards. Where the filling is done through the one door at the top of the silo it is made about 3 feet wide and high enough to readily admit a man at the side of the carrier. The location of such a door is shown in Figure 4.

ROOF.

The roof can be made in any convenient style but is usually conical or two-sided, as shown in the illustration. A conical roof on one of the smaller sized silos can be made without rafters, a

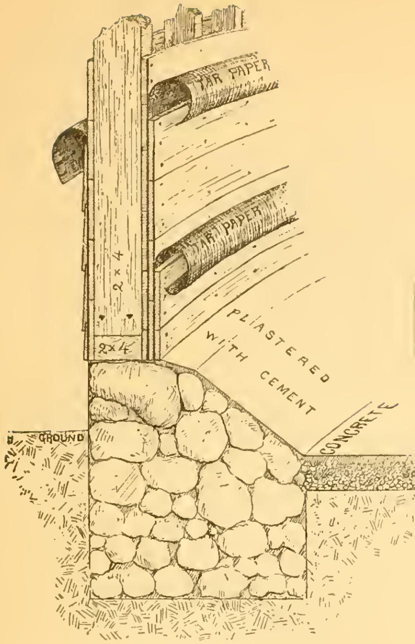

FIG. 2

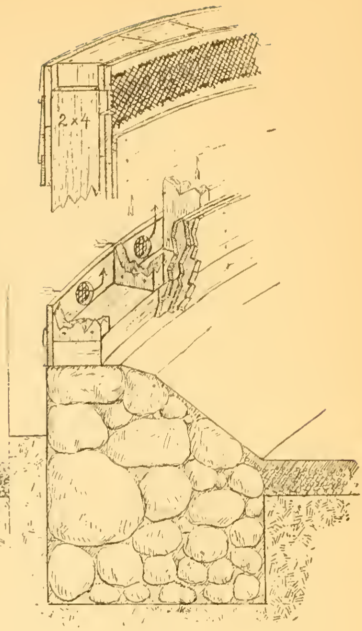

FIG. 3

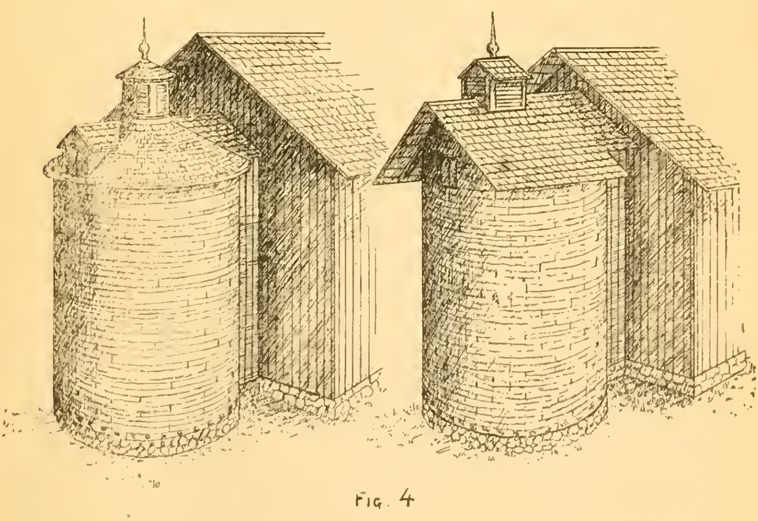

FIG. 4

circular frame about 6 feet in diameter being sawed out of pieces of 2 x 8-inch plank and the roof boards nailed to this and to the plate. A cupola of some sort is considered essential to good ventilation.

Freezing and Ventilation.

As a protection against freezing the outer covering of the silo is necessary. In exposed locations this covering should be thick, for frozen silage cannot be safely fed in any large amount. Silage of the better quality made from the drier and riper corn seems less liable to freeze than that of poorer quality made from more immature corn. For securing ventilation behind the inner lining, to prevent its rapid decay, holes are bored through the outer siding between the studs, just above the sill, as shown in Figure 3. These holes are covered with coarse wire cloth to keep out rats and mice. The inner lining is not carried quite to the plate, the opening at the top being also covered with the wire cloth or screen to keep silage from falling in.

An efficient round silo could probably be constructed of staves — one, at least, successful silo of this style has been reported — but first-class sound lumber, not less than two inches thick, would have to be used, and there would be difficulty in having suitable openings. Emptying all from the top would be decidedly inconvenient.

Cost of Silos.

The cost of the silo would be affected by many varying local conditions, and prices for labor and material. The estimates for rectangular silos can be readily made by different builders. Square silos, built in the barn, without roofs, holding 100 tons, have been estimated to cost less than $160. Some other estimates have placed the cost considerably higher. A round silo, about 20 feet in diameter and 30 feet deep, holding about 180 tons, will probably cost in this state from $300 to $350. King estimated the cost of a rectangular silo, holding 200 tons, at about $425, and of a round silo, holding the same amount, at about $247. A stone one of this capcity costs about $500.

The average loss of silage that has been heretofore reported is so much greater than is necessary, under favorable conditions in well-constructed silos, that it is poor economy to build any other than a first-class silo.

PRESERVATION OF THE SILO.

The deterioration of most silo linings was formerly very rapid from decay or crumbling, but recently it has been less noticeable since the silos have been better made and filled with riper material. Yearly plastering or covering cement linings with a light coat of cement whitewash prevents largely the injurious action of the silage juices. Metal linings have not been found satisfactory. The cheaper metals corrode rapidly, and paint has not seemed to adhere well. Ventilation of the double walls of the wooden silo and an occasional coating of preservative on the inner surface retards decay. Coal tar or gas tar is highly recommended by some authorities. This is thoroughly applied, while hot, to the inner surface.

Each year for several years past the inner surface of the wooden lining of the silo at this Station has been painted with a mixture of two parts, by weight, of paraffin, two parts rosin, and one part boiled linseed oil. These substances are melted together and the mixture applied, while *hot*, with a brush. The proportions of these constituents have been varied somewhat without apparent change in the result. This mixture is inflammable and should be carefully handled about the fire. The wooden lining, thus treated, after several years' service has a hard surface and there is no decay noticeable. A wood surface not treated would hardly have endured for this time without some decay.

FILLING THE SILO.

When the fodder has reached proper maturity it is put into the silo directly from the field, simply being evenly distributed over the interior and well trodden about the corners and sides. It is possible to preserve most fodders, including even corn, by ensiling whole as the plant comes from the field, provided the silo is deep enough, but it is not a satisfactory way. It has been customary at this station to cut the corn for silage into three-fourths-inch pieces—the ears cut along with the stalks.

Corn is best for silage in the stage of maturity when it would generally be cut and shocked in the field. In a shallow silo greener corn must be used, for the drier corn will not pack closely enough to keep. If filled rapidly enough to insure against decay at the exposed surface, there is no need of haste in filling. When the silo is full the top can be covered with grass or any finely cut cheap material that may be available. If not moist or juicy the top few inches of material can be moistened thoroughly by pouring water over it. The few inches at the top should be wet and compact to prevent the surface decay extending too deeply. When nothing more convenient than corn is available for covering, the ears can be picked from several loads before running through the cutter enough for the top few inches of material. When silage is fed the year around or feeding begins immediately after filling, the loss from decay at the surface is avoided and no especial effort is necessary to preserve the surface.

HARVESTING.

It is customary to cut the corn in the field by hand, and this has been the practice at this Station. A form of cutter devised for attachment to a low wagon to be drawn by horses was found unsatisfactory. A machine used at the Kansas Experiment Station with better satisfaction than any other of those tried is of a simple pattern similar to a cutter recommended by others. It consists of a V shaped sled frame drawn by one horse. There are two knives, one on each wing, set to cut two rows at a time. The wings are hinged to fold up toward the center when not in use. The frame is mounted on four low, broad, iron wheels. Two men stand on the cutter and gather the corn in bundles as cut.

For convenience in handling the heavy material, a low wagon having wheels with broad felloes and tires 5 or 6 inches wide and having a nearly level tight rack of boards is best. By the Wisconsin Station is recommended a wagon on high wheels having a level rack, narrow at the front and somewhat longer than usual hung under the axles, enabling a man to load readily from the ground. The fodder cutter is set so that the carrier delivers the material near the center of the silo.

Clover is often put into the silo whole but it is better to run it through the cutter. It is not so easy to pack clover closely as it is the heavier corn and in a shallow silo it often fails to keep well. During the process of filling it should be well trodden down at the edges and corners. Clover should be cut for silage when in bloom and if at the right stage of maturity, should not be ensiled when very wet with dew or rain. On the other hand the clover should not be too dry for there is much heat from fermentation. Sometimes clover is moistened two or three times in the silo during the process of filling. About two days after the silo is full the surface should be well trodden and saturated with water and again after several days. The matted moist layer at the surface will better exclude air and protect the silage from decay.

Silage from sorghum is made the same as that from corn but it is more acid, and inferior to corn silage.

In emptying the silo it is important to begin at the top and remove from the entire exposed surface daily, otherwise there will be great and unnecessary loss from rapid molding and souring. It is advisable to have the capacity of the silo suited to the size of the herd so that an average of about two inches or more in depth of silage will be fed daily. The depth of silage removed daily will be greater than this near the top of the silo and less near the bottom. About five square feet of feeding surface per cow is a fair estimate. For a herd of 30 cows a cylindrical silo of about 14 feet inside diameter would be satisfactory. A herd of 50 cows would take the silage from one 18 feet in diameter.

The weight per cubic foot of corn silage at the bottom of a silo 30 feet deep is about 60 pounds, towards the top it is about 30 pounds. The average weight per cubic foot of silage in a deep silo can be taken as something over 40 pounds.

Silage is not a food suited to all conditions and all times and should not be fed to the exclusion of other foods essential to a good ration, but there is no longer question as to its efficiency and the economy of its use.

III. FEEDING TRIALS WITH CROSS-BRED SWINE.

At all times during the year enough growing pigs, or older animals for breeding, have been kept to consume the skim milk from the dairy. Five lots of cross-bred pigs have been grown together in a feeding trial. This trial was continued from birth of the pigs until time of marketing, when about seven months old. The several lots were treated alike and had rations similar to those fed in some feeding trials of preceding years when pigs of other breeds and crosses were used. Those used this year were mostly of the Tamworth cross. The sow was fed with each lot until the pigs were eight weeks old.

For the first four weeks, wheat bran was fed with the skim milk which latter always constituted a part of the ration. A mixture of equal parts by weight of wheat bran and wheat middlings was fed for the second period. Other grain mixtures, containing corn meal in increasing proportions, followed. The mixture numbered 2, in the accompanying tables, contained equal parts of corn meal, wheat bran and wheat middlings. Mixture No. 3 contained four parts corn meal and one part each of wheat bran and wheat middlings. Mixture No. 4 contained ten parts corn meal and one part each of bran and middlings. Mixture No. 5 contained twenty parts of corn meal, two parts of bran and one part of middlings. A small quantity of charcoal was fed once a week. The food was weighed for each feeding and the pigs were weighed once a week. The average results of feeding are shown in the accompanying tables, arranged in periods of four weeks according to the different rations.

In estimating the cost of food, wheat bran rated at $18 per ton; corn meal and wheat middlings at $20 per ton, and skim milk at 25 cents per 100 pounds. These prices, much higher than those of the market during the past season, were assumed to allow more direct comparison of the results with those of former feeding trials given in preceding reports.

The cost of all food eaten during the twenty-eight weeks made the cost of all gain in weight during that period by pigs of the Tamworth-Yorkshire cross 3.8 cents per pound. For the Tamworth-Duroc cross the cost was 3.83 cents; for the Yorkshire-Tamworth 3.25 cents; for the Tamworth-Poland China 3.44 cents, and for the Ohio Improved Chester-Poland China 3.61 cents.

Estimating the cost of food at more recent wholesale prices: Wheat bran, at $10.60; wheat middlings, at $12.40, and corn meal at $12 per ton, and skim milk at 20 cents per 100 pounds, would more nearly show the actual cost of the gain made. This would give 2.54 cents as the cost per pound for the Tamworth-Yorkshire, 2.68 cents for the Tamworth-Duroc, 2.16 cents for the Yorkshire-Tamworth, 2.28 cents for the Tamworth-Poland China, and 2.44 cents for the Ohio Improved Chester-Poland China pigs.

The food cost of all gain made by the pigs after they were removed from the sow was 2.48 cents per pound for the Tamworth-Yorkshire, 2.41 cents per pound for the Tamworth-Duroc, 2.17 cents for the Yorkshire-Tamworth, 2.33 cents for the Tamworth-Poland China, and 2.37 cents for Ohio Improved Chester-Poland China pigs. It will be seen from these figures that there was little difference in the efficiency with which each lot utilized the food, although the pigs of the Yorkshire-Tamworth cross made somewhat the better showing.

Taking the cost of the growth made throughout the trial, different lots rank in profit in the following order: Yorkshire-Tamworth, Tamworth-Poland China, Ohio Improved Chester-Poland China, Tamworth-Yorkshire and Tamworth-Duroc. In rapidity of growth made by the different lots of pigs there were greater differences. At the same age the pigs of Tamworth-Poland China cross were much the largest, averaging at the end of the feeding trial about 11 per cent. heavier than those of the Yorkshire-Tamworth cross, the lot nearest them in size. They were over 36 per cent heavier than the pigs of Ohio Improved Chester-Poland China cross. Although both Poland China sows were mature and vigorous, the one used in the latter-named cross was of the smaller frame. The Tamworth-Poland China cross has also in former years produced pigs of large size. In both the Tamworth-Yorkshire and the Yorkshire-Tamworth cross the pigs were white but inclined in type to that of the dam, more noticeably in the latter cross.

During the twenty-eight weeks of the feeding trial the total average gain made per pig was for the Ohio Improved Chester-Poland China, 193 pounds; for the Tamworth-Yorkshire, 207 pounds; for the Tamworth-Duroc, 213 pounds; for the Yorkshire-Tamworth, 236 pounds, and for the Tamworth-Poland China, 262 pounds.

TAMWORTH–YORKSHIRE CROSS.

Number of pigs.	Average live weight per pig at beginning of period.	PERIOD.	Average per day for each 100 pounds live weight fed.										Pounds of water-free food consumed for each pound gain in total live weight.	Cost of food for each pound gain in weight of pigs.
			Gain in weight of pigs.	Loss or gain in weight of sow.	Wheat bran.	Mixed grain No. 1.	Mixed grain No. 2.	Skim milk.	Total food.	Nutritive ratio.	Total water-free food.	Total cost of food.		
	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Lbs.	Cts.	Lbs.	Cts.
5	2.6	April 2 to April 30	.78	+.08	1.87	......	......	8.07	9.94	1:2.9	2.43	3.72	2.82	4.77
5	14.6	April 30 to May 28	1.17	+.04	......	2.30	......	7.59	9.89	1:3.2	2.74	4.09	2.26	3.49
....	38.4	May 28 to June 25	1.62	......	......	......	2.49	12.14	14.63	1:3.5	3.32	5.44	2.05	3.37
4	61.8	June 25 to July 23	1.47	......	......	No. 3 3.57	......	7.37	10.94	1:5.5	3.77	5.35	2.56	3.64
4	94.3	July 23 to August 20	1.01	......	......	2.89	......	5.52	8.41	1:5.3	3.01	4.22	2.98	4.19
4	125.5	August 20 to September 17	.89	......	......	......	No. 4 2.52	3.59	6.11	1:6.3	2.52	3.39	2.83	3.75
4	161.5	September 17 to October 15	.94	......	......	No. 5 2.87	......	2.55	5.42	1:7.1	2.75	3.49	2.93	3 71

TAMWORTH-DUROC CROSS.

Number of pigs.	Average live weight per pig at beginning of period.	PERIOD.	Average Per Day for Each 100 Pounds Live Weight Fed.										Pounds of water-free food consumed for each pound gain in total live weight.	Cost of food for each pound gain in weight of pigs.
			Gain in weight of pigs.	Loss or gain in weight of sow.	Wheat bran.	Mixed grain No. 1.	Mixed grain No. 2.	Skim milk.	Total food.	Nutritive ratio.	Total water-free food.	Total cost of food.		
	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Lbs.	Cts.	Lbs.	Cts.
....	1.8	April 11 to May 9	.34	+.08	1.54	......	......	6.82	8.36	1:2.9	2.01	3.10	4.78	9.05
4	12.5	May 9 to June 6	.62	0	......	1.57	......	5.42	6.99	1:3.4	1.89	2.85	3.05	4.57
4	34.8	June 6 to July 4	2.17	......	......	......	2.51	11.55	14.06	1:3.6	3.28	5.30	1.51	2.44
4	63.8	July 4 to August 1	1.24	......	......	No. 3 2.92	......	7.51	10.43	1:4.9	3.22	4.78	2.60	3.83
4	90.5	August 1 to August 29	.97	......	......	2.42	......	5.76	8.18	1:4.9	2.63	3.82	2.71	3.93
4	119.3	August 29 to September 26	1.07	......	......	......	No. 4 2.64	3.58	6.22	1:6.4	2.64	3.51	2.47	3.29
4	162.0	September 26 to October 24	1.00	......	......	No. 5 3.16	......	2.21	5.37	1:7.3	2.97	3.68	2.94	3.66

Yorkshire-Tamworth Cross.

Number of pigs.	Average live weight per pig at beginning of period.	PERIOD.	Average Per Day for Each 100 Pounds Live Weight Fed.										Pounds of water-free food consumed for each pound gain in total live weight.	Cost of food for each pound gain in weight of pigs.	Cost per pound gain in weight of pigs considering the cost of any loss in weight of sow.
			Gain in weight of pigs.	Loss or gain in weight of sow.	Wheat bran.	Mixed grain No. 1.	Mixed grain No. 2.	Skim milk.	Total food.	Nutritive ratio.	Total water-free food.	Total cost of food.			
	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Lbs.	Cts.	Lbs.	Cts.	Cts.
11	2.6	April 21 to May 19	.94	—.27	1.56	......	......	6.72	8.28	1:3.0	2.01	3.00	3.00	3.28	5.07
....	12.5	May 19 to June 16	1.31	—.04	......	2.50	......	6.18	8.68	1:3.4	2.79	3.92	2.15	2.93	3.10
4	36.5	June 16 to July 14	2.16	......	......	......	3.02	11.50	14.52	1:3.7	3.72	5.80	1.26	2.68	....
4	67.5	July 14 to August 11	1.38	......	......	No. 3 2.72	......	7.10	9.82	1:4.8	3.01	4.45	2.18	3.24	....
4	99.3	August 11 to September 8	1.02	......	......	2.48	......	5.15	7.63	1:5.1	2.62	3.73	2.57	3.64	....
4	131.9	September 8 to October 6	1.06	......	......	......	No. 4 2.67	3.29	5.96	1:6.6	2.63	3.46	2.48	3.26	....
4	177.0	October 6 to November 3	1.07	......	......	No. 5 3.25	......	2.18	5.43	1:7.5	3.06	3.77	2.86	3.52	....

TAMWORTH–POLAND CHINA CROSS.

Number of pigs.	Average live weight per pig at beginning of period.	PERIOD.	Average Per Day for Each 100 Pounds Live Weight Fed.										Pounds of water-free food consumed for each pound gain in total live weight.	Cost of food for each pound gain in weight of pigs.	Cost per pound gain in weight of pigs considering the cost of any loss in weight of sow.
			Gain in weight of pigs.	Loss or gain in weight of sow.	Wheat bran.	Mixed grain No. ..	Mixed grain No. 2.	Skim milk.	Total food.	Nutritive ratio.	Total water-free food.	Total cost of food.			
	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Lbs.	Cts.	Lbs.	Cts.	Cts.
6	3.7	May 2 to May 30..........	.80	—.23	1.08	......	......	5.61	6.69	1:2.9	1.48	2.37	2.60	2.92	5.22
....	21.7	May 30 to June 27..........	1.06	—.15	......	2.09	......	5.27	7.36	1:3.0	2.34	3.30	2.57	3.13	4.24
4	57.3	June 27 to July 25.........	1.34	......	......	......	2.37	7.89	10.26	1:3.8	2.81	4.26	2.10	3.18	......
4	84.0	July 25 to August 22.......	1.04	......	......	No. 3. 2.15	......	6.20	8.35	1:4.9	2.44	3.66	2.35	3.53	......
4	112.8	August 22 to September 19.	1.06	......	......	2.50	......	4.03	6.53	1:5.5	2.53	3.46	2.39	3.26	......
4	152.0	September 19 to October 17.	1.09	......	......	......	No. 4. 2.96	2.54	5.50	1:6.9	2.82	3.57	2.59	3.28	......
4	206.3	October 17 to November 14.	.90	......	......	No. 5. 3.07	......	3.07	6.14	1:6.8	2.98	3.81	3.31	4.23	......

OHIO IMPROVED CHESTER – POLAND CHINA CROSS.

Number of pigs.	Average live weight per pig at beginning of period.	PERIOD.	AVERAGE PER DAY FOR EACH 100 POUNDS LIVE WEIGHT FED. Gain in weight of pigs.	Loss or gain in weight of sow.	Wheat bran.	Mixed grain No. 1.	Mixed grain No. 2.	Skim milk.	Total food.	Nutritive ratio.	Total water-free food.	Total cost of food.	Pounds of water-free food consumed for each pound gain in total live weight.	Cost of food for each pound gain in weight of pigs.	Cost per pound gain in weight of pigs, considering the cost of any loss in weight of sow.
	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Lbs.	Cts.	Lbs.	Cts.	Cts.
8	2.4	May 9 to June 6	.73	—.06	1.52	......	......	9.18	10.70	1:2.8	2.21	3.67	3.30	4.99	5.42
7	10.1	June 6 to July 4	1.22	—.05	......	2.37	......	6.87	9.24	1:3.3	2.74	3.97	2.34	3.24	3.46
4	29.3	July 4 to August 1	1.61	......	......	......	1.91	11.92	13.83	1:3.3	2.79	4.82	1.73	2.98	....
4	46.0	August 1 to August 29	1.45	......	......	No. 3 2.09	......	9.85	11.94	1:4.0	2.74	4.51	1.89	3.12	....
4	69.5	August 29 to September 26,	1.11	......	......	2.40	......	6.03	8.43	1:6.7	2.63	3.87	2.37	3.48	....
4	95.5	September 26 to October 24,	1.43	......	......	......	No. 4 3.47	3.52	6.99	1:6.7	3.35	4.32	2.34	3.03	....
4	143.0	October 24 to November 21,	1.09	......	......	No. 5 3.52	......	5.36	8.88	1:6.3	3.59	4.83	3.29	4.43	....

IV. FEEDING EXPERIMENTS WITH LAYING HENS.*

During the summer chicks were hatched and young fowls grown for use in a breeding experiment, which is being conducted with laying stock.

The results obtained in a feeding experiment with laying hens have been published in a bulletin. The substance of this publication, with addition of some data omitted from the condensed bulletin, which gave only the general result, follows:

Summary.

(1) Two pens of laying hens, one of a large and the other of a small breed, having a ration the grain of which was whole, ate during their second year somewhat more food at a little greater cost than two similar pens having a ration in which half the grain was ground and moistened.

(2) Cochin hens, having the whole grain ration laid much better than those having the ground grain, although neither lot laid at a profitable rate during the second year.

(3) Leghorn hens having a ration in which the grain was whole consumed on the average for two years over twenty per cent more food for the same egg production than did similar hens having half the grain in their ration ground and moistened. The hens having whole grain had on the average for two years 6.4 pounds of water-free food for every pound of eggs produced. Those having ground grain had on the average for the two years 5.3 pounds of water-free food for every pound of eggs produced.

Introduction.

For most poultry as commonly kept, grain constitutes the larger part of the food. The manner of feeding varies with the individual and opinions differ considerably as to the form in which the grain should be fed for most profitable results. The most general practice of experienced poultrymen is that of feed-

* Published in part in Bulletin No. 106.

ing part of the grain whole and part ground and moistened. By feeding the ground grain they are able to use by-products cheaper and, if desired, more highly nitrogenous than whole grains and they can conveniently feed in a mixture coarser vegetable foods and various animal foods. By feeding the whole grain scattered in straw or some substitute they are able to induce exercise among laying hens not easily assured by other means. So far as at present known this seems the best plan to follow. A few, however, feed mostly ground grain and some, especially on the farm, feed only whole grain.

With any whole grain that can ordinarily be obtained it is not possible to feed a ration composed largely of grain, which shall have so narrow a nutritive ratio as is by many considered essential for laying hens. In order to feed a very narrow ration it becomes necessary to substitute some highly nitrogenous by-product for part of the whole grain or use an excessive amount of meat. The economical necessity of a ration so much more nitrogenous than can be had established although it is probable that a narrower ration than can be had from mostly whole grain is best. A ration as wide, and possibly one as narrow, as may be found desirable can be made by using mostly ground grain and various by-products, and we can expect that the approximate composition of the most efficient ration may be ascertained. However, before experimenting with rations of various compostions it has seemed desirable to learn whether a ration mostly of whole grain, for the efficient utilizing of which the common hen is so admirably equipped by nature, may not under some circumstances prove more profitable than the ground mixtures.

FEEDING DRY WHOLE GRAIN VS. PART MOISTENED GROUND GRAIN.

PLAN OF THE EXPERIMENT.

Among several feeding experiments made at this Station to supply information concerning the economy of feeding ground grain, and the relative amounts of ground and whole grain that can be fed to best advantage was one with laying hens, the results of which are briefly summarized in this bulletin. In this feeding trial comparison was made of a ration in which all the grain was whole with another, similar in composition, but having about half the grain ground and moistened. Four lots of hens were used, two of White Leghorns and two of Buff Cochins. For convenience they are briefly referred to as pens 1, 2, 3 and 4. Pens 1 and 2 were Leghorns and pens 3 and 4 Cochins.

The two lots of Leghorns were alike, and the two lots of Cochins, so far as breeding, food and general circumstances of rearing to maturity were concerned. Each lot, however, had for the first year after approaching laying maturity been fed a ration similar to the one for the second year. The results mentioned in this bulletin are therefore those for the second of two consecutive years on the same ration. About the same number of hens were kept at all times in contrasted pens, equal numbers of the few hens taken out for other uses being removed from each pen. During the first year no male bird was at any time in any of the pens nor for the first half of the second year. It became necessary during the second year, however, owing to lack of room, to keep male birds with the hens and in April a cock was added to each pen, at the same time that two hens were taken from each Leghorn pen. On this account and also because fewer hens were kept the results for the second year cannot be so satisfactorily compared with those for the first year, although the contrasted pens were at all times comparable with each other. Any estimates are calculated from the average consumption per fowl and the average production per hen. The pens were all in one house, separated by partitions, each pen having floor space of 10 x 12 feet. The small open yards attached to Nos. 1 and 2 included about 240 square feet each, and those for Nos. 3 and 4 about 160 square feet each. These yards were deeply covered with coal ashes. No other yards were available, although somewhat larger ones than those used would be desirable. When it is wished to account for all food it is not possible to allow extended range although for other considerations larger runs are best in summer. With more liberty better laying might be expected than that recorded, but under the conditions of continuous confinement necessary the egg yields were not too low.

The Foods.

Pens No. 1 and No. 3 were given for the morning feed each day a mixture of ground grain moistened. Of this mixed grain, which was moistened with hot water and fed warm during cold weather and moistened with water at ordinary temperature during hot weather, the hens had all they would readily eat. Later in the day some kind of whole grain was fed, scattered in clean straw.

Pens 2 and 4 were fed whole grain of different kinds—with the single exception that corn was cracked. This was scattered in straw on tight wooden floors and none was left uneaten.

All the hens were fed twice each week all the cut fresh bones they would eat. During three periods skim-milk was fed to each pen. Either green alfalfa, cabbage, corn silage or soaked chopped hay was fed at noon, the moistened hay being fed warm to pens 1 and 3. Plenty of stone grit and oyster shells was kept always in each pen. As it was not possible to give the benefit of grass runs, all green food was fed cut in troughs. Although necessarily fed in this way to make accounting for all food possible, it was at some disadvantage, for, except at the risk of much waste, the green food could not be fed as liberally as desired at some times on account of rapid wilting and drying.

The nutritive ratio of the ration for pens 1 and 3 was kept at about that of the ration for pens 2 and 4, although it did usually run somewhat narrower. The mixed grain fed to pens 1 and 3 was made to correspond closely to the combination of whole grain which was fed at the same time to pens 2 and 4. With the exception of using wheat bran and middlings instead of ground wheat, the same grains were fed ground in the mixture that were fed whole in the contrasted ration. The grain mixture numbered 3 in the following table and fed from November 14 to December 12, consisted of three parts by weight of ground flaxseed and one part each of wheat bran, wheat middlings, corn meal, ground oats, ground barley and ground buckwheat. The grain mixture No. 4, fed from December 12 to July 24, contained two parts of wheat bran, two parts of corn meal and one part each of wheat middlings, ground oats, ground barley and ground buckwheat. The mixture, No. 5, fed during the remainder of the year, consisted of three parts ground flaxseed, two parts wheat bran and one part each of wheat middlings, corn meal, ground oats, ground barley and ground buckwheat.

The mixed ground grain constituted on the average for the year 48. 3 per cent. of the grain fed to the Leghorns in pen No. 1 and 47.4 per cent. of the grain fed to Cochins in pen No. 3. The accompanying table shows the average composition of each food.

COMPOSITION OF THE FOODS.

	Per cent. of moisture.	Per cent. of ash.	Per cent. of protein.	Per cent. of crude fibre.	Per cent. of N-free extract.	Per cent. of crude fats.
Grain mixture No. 3	11.8	3.1	13.8	5.6	59.0	6.7
Grain mixture No. 4	13.7	3.5	11.9	5.4	62.4	3.1
Grain mixture No. 5	10.9	3.1	15.0	5.3	58.9	6.8
Wheat	12.8	1.7	11.1	2.2	70.2	1.9
Cracked corn..............	13.2	1.1	8.2	1.4	72.9	3.2
Oats	12.6	3.4	13.8	8.0	56.6	5.6
Barley	13.4	2.5	11.9	3.5	66.6	2.0
Buckwheat.................	15 8	2.3	9.2	10.4	60.3	2.0
Flaxseed	7.9	3.6	22.4	4.9	32.6	28.6
Cabbage	89.3	1.2	2.5	1.1	5.5	.4
Corn silage...............	76.6	.9	2.2	4.9	14.4	1.0
Alfalfa, green	76 2	2.1	4.3	6.1	10.1	1.2
Alfalfa hay...............	16.0	9.8	21.5	19.2	31.3	2.2
Skim milk.................	90.5	.7	3.2	....	5.1	.5
Fresh bone................	34.2	22.8	20.6	....	1.9	20.5

COST OF THE FOOD.

In determining the cost of food, wheat was rated at the average of 57.6 cents per bushel, corn at 50.1 cents, oats at 37.9 cents, barley at 61.4 cents, buckwheat at 56.1 cents, wheat bran at $16 per ton, wheat middlings at $17, corn at $19.20, ground oats at $24, ground barley at $25.60, ground buckwheat at $23.60, alfalfa hay at $9.60, alfalfa forage at $2, cabbage and corn silage at $3 per ton. Skim-milk was rated at 24 cents per 100 pounds, cut bone at 80 cents, oyster shells at $1, and stone grit at $1 per 100 pounds; flaxseed, ground or whole, two and one-half cents per pound.

The Results of the Experiment.

The records of feeding and the results derived are given in full in the following tables. They are calculated to the average per fowl for each period of feeding. The valuations given to the foods were very much higher than the market prices holding at the present time. The older prices were used, however, to allow of convenient comparison of results with those of former feeding. At recent prices the food cost of egg production would be much lower than the data show. In determining the value of the eggs they were rated at the average wholesale market price for the period during which they were laid. Enough data are given to permit any recalculation desired.

For the pen of Leghorns, No. 1, having the ground grain the amount of water-free substance in the food taken per day per fowl on the average for the whole year was 2.83 ounces. For pen No. 2, having whole grain, the average was 2.94 ounces—an excess in consumption of about 4 per cent.

For pen No. 1 the cost of food per hen for the whole year was 84.27 cents. The average number of eggs was 92.94, weighing 194.15 ounces; 5.3 pounds of water-free food were consumed at a cost of 6.95 cents for every pound of eggs produced. The food cost for every dozen eggs 10.88 cents. The market value of eggs laid per hen was 133.86 cents, exceeding the cost of food by 58.8 per cent.

For pen No. 2 the cost of food per hen for the whole year was 85.56 cents. The average number of eggs was 77.03, weighing 165.81 ounces; 6.47 pounds of water-free food were consumed at a cost of 8.44 cents for every pound of eggs produced. The food cost for every dozen eggs 13.33 cents. The market value of eggs laid per hen was 111.51 cents, exceeding the cost of food by 30.3 per cent.

PEN NO. 1 — HALF OF GRAIN GROUND AND MOISTENED — AVERAGE PER DAY PER FOWL.

PERIOD.	Mixed grain.	Wheat.	Cracked corn.	Oats.	Barley.	Buck-wheat.	Alfalfa (green)	Alfalfa hay.	Cabbage.	Skim milk.	Fresh bone.	Oyster shells.	Stone grit.
	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.
	No. 3.												
November 14 to December 12	1.17	.23	.27	.27	.23	.26	.21	....	.29	....	.33	.02	.01
	No. 4.								Corn silage.				
December 12 to January 9	1.59	.39	.36	.20	.31	.15	....	....	.29	....	.33	.06	.01
January 9 to February 6	1.25	.36	.34	.39	.45	.35	....	.14	......	....	.33	.19	.02
February 6 to March 6	1.20	.23	.29	.32	.24	.31	....	.14	......	1.94	.33	.10	01
March 6 to April 3	1.07	.24	.23	.26	.23	.25	....	.15	......	1.15	.35	.20	.01
April 3 to May 1	1.50	.30	.34	.36	.35	.39	....	.17	......	....	.38	.08	.01
May 1 to May 29	1.48	.34	.29	.28	.33	.26	.67	....	......	....	.38	.14	.01
May 29 to June 26	1.29	.23	.21	.24	.16	.21	.67	....	......	....	.38	.10	.03
June 26 to July 24	1.16	.29	.11	.06	.28	.26	.73	....	......	....	.42	.25	.02
	No. 5.												
July 24 to August 21	1.47	.16	.43	.43	.20	.31	.80	....	......	2.07	.46	.08	.01
August 21 to September 25	1.45	.27	.33	.37	.37	.32	.80	....	......	....	.46	.04	.01
September 25 to October 23	1.36	.13	.33	.25	.27	.25	.80	....	......	....	.46	.04	.01
October 23 to November 13	1.24	.30	.43	.26	.17	.37	.53	.07	......	....	.46	.07	.02

Pen No. 1 — Half of Grain Ground and Moistened.

Number of fowls in pen.	Number days in period.	PERIOD.	Average live weight per fowl at beginning of period.	Average gain or loss in weight per fowl during period.	Average per Day per Fowl.					Approximate nutritive ratio.
					Ash in food.	Protein in food.	Crude fibre in food.	N.-free extract in food.	Crude fats in food.	
			Lbs.	Lbs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	
14	28	November 14 to December 12	3.21	+.28	.15	.38	.15	1.56	.19	1:5.6
14	28	December 12 to January 9	3.49	+.34	.16	.41	.16	1.98	.16	1:6.0
14	28	January 9 to February 6	3.83	+.18	.18	.45	.19	2.06	.17	1:5.8
14	28	February 6 to March 6	4.01	+.09	.18	.45	.17	1.80	.16	1:5.1
13	28	March 6 to April 3	4.15	—.49	.17	.40	.15	1.56	.15	1:5.1
12	28	April 3 to May 1	3.74	—.27	.19	.48	.21	2.13	.18	1:5.7
12	28	May 1 to May 29	3.47	—.12	.19	.45	.19	1.98	.26	1:6.2
12	28	May 29 to June 26	3.35	—.35	.17	.37	.17	1.56	.24	1:6.1
11	28	June 26 to July 24	3.00	+.22	.17	.36	.16	1.47	.15	1:5.5
10	28	July 24 to August 21	3.22	+.33	.22	.58	.21	2.05	.26	1:4.9
10	35	August 21 to September 25	3.55	+.19	.20	.53	.21	2.02	.25	1:5.3
10	28	September 25 to October 23	3.74	—.22	.19	.46	.18	1.70	.23	1:5.2
10	21	October 23 to November 13	3.52	—.01	.19	.48	.19	1.82	.23	1:5.3

PEN NO. 1 — HALF OF GRAIN GROUND AND MOISTENED.

PERIOD.	Average Per Fowl.			Pounds of water free food per day for each 100 pounds live weight fed.	Cost of food per day for each 100 pounds live weight fed.	Eggs Produced During Period. Average Per Hen.		Pounds of water-free food consumed for each pound of eggs produced.	Cost of food for each pound of eggs produced.
	Total food per day.	Total water-free food per day.	Total cost of food per day.			Number.	Weight.		
	Ozs.	Ozs.	Cts.	Lbs.	Cts.		Ozs.	Lbs.	Cts.
November 14 to December 12	3.26	2.42	.22	4.51	6.55	.14	.30	......	....
December 12 to January 9	3.62	2.86	.21	4.90	5.74	2.57	5.95	13.48	16.16
January 9 to February 6	3.61	3.05	.24	4.86	6.12	3.79	8.83	9.66	12.16
February 6 to March 6	5.00	2.75	.23	4.24	5.68	4.50	10.29	7.48	9.76
March 6 to April 3	3.93	2.44	.20	3.91	5.13	6.69	13.69	4.99	6.56
April 3 to May 1	3.79	3.19	.24	5.54	6.67	15.09	31.97	2.79	3.36
May 1 to May 29	4.03	2.98	.23	5.46	6.75	12.91	25.78	3.24	3.84
May 29 to June 26	3.39	2.44	.18	4.76	5.66	11.64	22.70	3.01	3.52
June 26 to July 24	3.31	2.31	.18	4.64	5.79	7.50	15.16	4.26	5.28
July 24 to August 21	6.32	3.32	.30	6.14	8.87	14.57	30.55	3.04	4.32
August 21 to September 25	4.37	3.21	.28	5.51	7.69	10.22	21.81	5.17	7.04
September 25 to October 23	3.85	2.76	.24	4.75	6.61	3.22	7.12	10.86	14.88
October 23 to November 13	3.83	2.95	.25	5.25	7.12	......	......	......	....

Pen No. 2 — Grain Dry and Whole — Average Per Day Per Fowl.

PERIOD.	Wheat.	Cracked corn.	Oats.	Buck-wheat.	Barley.	Flax seed.	Alfalfa (green).	Alfalfa hay.	Cabbage.	Skim milk.	Fresh bone.	Oyster shells.	Stone grit.
	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.
November 14 to December 12	.43	.49	.51	.52	.51	.13	.23	....	.31	......	.35	.01	.01
									Corn silage.				
December 12 to January 9	.59	.59	.37	.63	.65	......	....	....	.31	......	.35	.08	......
January 9 to February 6	.72	.74	.69	.66	.67	......	....	.15	....	......	.35	.08	.01
February 6 to March 6	.30	.34	32	.13	.11	......	....	.15	....	2.06	.35	.11	.01
March 6 to April 3	.50	.51	.50	.49	.51	......	....	.15	....	1.14	.35	.08	.01
April 3 to May 1	.65	.64	.63	.66	.64	......	....	.17	....	......	.38	.08	.01
May 1 to May 29	.40	.56	.59	.57	59	......	.73	....	....	......	.42	.06	.01
May 29 to June 26	.54	.56	.55	.47	.54	......	.77	....	....	......	.44	.08	.03
June 26 to July 24	.45	.48	.49	.57	.48	......	.84	....	....	......	.48	.03	.02
July 24 to August 21	.63	.56	.59	.61	.57	.19	.89	....	....	2.25	.51	.07	.02
August 21 to September 25	.71	.70	.66	.69	.69	.13	.89	....	....	......	.51	.03	02
September 25 to October 23	.59	.58	.60	.58	.62	.16	.89	....	....	......	.51	.02	.01
October 23 to November 13	.66	.68	.68	.70	.63	.03	.59	.07	....	......	.51	.02	.02

PEN NO. 2—GRAIN DRY AND WHOLE.

Number fowls in pen.	Number days in period.	PERIOD.	Average live weight per fowl at beginning of period.	Average gain or loss in weight per fowl during period.	Average Per Day Per Fowl.					Approximate nutritive ratio.
					Ash in food.	Protein in food.	Crude fibre in food.	N.-free extract in food.	Crude fats in food.	
			Lbs.	Lbs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	
13	28	November 14 to December 12	3.45	+.41	.15	.39	.15	1.69	.19	1:5.9
13	28	December 12 to January 9	3.86	+.16	.14	.39	.15	1.92	.15	1:6.2
13	28	January 9 to February 6	4.02	+.09	.17	.48	.20	2.33	.18	1:6.1
13	28	February 6 to March 6	4.11	+.13	.13	.30	.08	.95	.12	1:4.4
13	28	March 6 to April 3	4.24	—.29	.16	.41	.16	1.75	.15	1:5.5
12	28	April 3 to May 1	4.03	—.49	.17	.46	.20	2.16	.17	1:5.9
11	28	May 1 to May 29	3.54	—.04	.17	.41	.19	1.84	.18	1:5.9
11	28	May 29 to June 26	3.50	—.01	.17	.41	.18	1.93	.18	1:6.1
10	28	June 26 to July 24	3.46	—.31	.18	.40	.18	1.70	.18	1:5.7
9	28	July 24 to August 21	3.77	+.12	.22	.58	.21	2.21	.27	1:5.2
9	35	August 21 to September 25	3.89	+.04	.21	.54	.23	2.40	.25	1:5.9
9	28	September 25 to October 23	3.93	—.07	.21	.50	.21	2.09	.25	1:5.7
9	21	October 23 to November 13	3.86	+.16	.21	.51	.22	2.29	.22	1:5.9

PEN NO. 2—GRAIN DRY AND WHOLE.

PERIOD.	Average per Fowl.			Pounds of water-free food per day for each 100 lbs. live weight fed.	Cost of food per day for each 100 lbs. live weight fed.	Eggs produced during period. Average per hen		Pounds of water-free food consumed for each pound of eggs produced.	Cost of food for each pound of eggs produced.
	Total food per day.	Total water-free food per day.	Total cost of food per day.			Number.	Weight.		
	Ozs.	Ozs.	Cts.	Lbs.	Cts.		Ozs.	Lbs.	Cts.
November 14 to December 12	3.48	2.56	.21	4.38	5.75	0	......	......	......
December 12 to January 9	3.49	2.75	.22	4.36	5.58	3.85	8.50	9.05	11.36
January 9 to February 6	3.98	3.37	.26	5.19	6.40	3.46	7.94	11.90	14.80
February 6 to March 6	3.76	1.60	.14	2.40	3.36	3.62	8.15	5.50	7.78
March 6 to April 3	4.15	2.64	.22	4.03	5.37	3.54	7.63	9.67	11.64
April 3 to May 1	3.77	3.18	.25	5.26	6.61	11.65	25.27	3.52	4.42
May 1 to May 29	3.86	2.79	.22	4.33	6.25	13.10	28.16	3.77	3.42
May 29 to June 26	3.87	2.77	.21	4.98	6.03	9.26	19.04	4.07	5.02
June 26 to July 24	3.79	2.66	.20	4.61	5.54	6.47	13.38	5.56	6.72
July 24 to August 21	6.80	3.48	.30	5.61	7.83	11.75	25.98	3.76	5.12
August 21 to September 25	4.98	3.65	.29	5.21	7.42	9.00	18.84	6.79	8.61
September 25 to October 23	4.53	3.26	.26	5.22	6.67	1.33	2.92	......	......
October 23 to November 13	4.55	3.46	.27	5.49	6.85	0	0	......	......

PEN NO. 3 — HALF OF GRAIN GROUND AND MOISTENED — AVERAGE PER DAY PER FOWL.

PERIOD.	Mixed grain.	Wheat.	Cracked corn.	Oats.	Barley.	Buck-wheat.	Alfalfa (green).	Alfalfa hay.	Cabbage.	Skim milk.	Fresh bone.	Oyster shells.	Stone grit.
	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.
November 14 to December 12	No. 3. 3.14	.29	.37	.43	.27	.29	.25	......	.37	......	.43	.03	.03
December 12 to January 9	No. 4. 1.28	.56	.52	.34	.69	.31	......	.13	Corn silage. .25	......	.43	.01	.01
January 9 to February 6	2.07	.51	.61	.61	.54	.53	......	.13	......	......	.43	.16	.01
February 6 to March 6	1.68	.75	.74	.88	.68	.56	......	.13	......	2.84	.43	.20	.02
March 6 to April 3	1 31	.29	.29	.25	.20	.31	......	.13	......	1.78	.43	.30	.02
April 3 to May 1	1.55	.33	.37	.37	.45	.31	......	.13	......	......	.43	.05	.01
May 1 to May 29	1.38	.31	.29	.31	.31	.25	.62	......	......	......	.43	.01	......
May 29 to June 26	1.41	.24	.19	.22	.11	.23	.62	......	......	......	.43	.04	.02
June 26 to July 24	1.17	.21	.10	.16	.25	.34	.62	......	......	......	.43	.01	......
July 24 to August 21	No. 5. 1.37	.20	.29	.27	.26	.37	.62	......	......	2.17	.43	.02	.01
August 21 to September 25	1.44	.38	.42	.32	.25	.22	.50	......	......	......	.43	.02	.01
September 25 to October 23	1.29	.31	.24	.23	.46	.41	.62	......	......	......	.43	.04	.02
October 23 to November 13	1.88	.19	.30	.29	.24	.33	.42	.04	......	......	.43	.02	......

Pen No. 3 — Half of Grain Ground and Moistened.

Number of fowls in pen.	Number days in period.	Period.	Average live weight per fowl at beginning of period.	Average gain or loss in weight per fowl during period.	Average Per Day Per Fowl.					Approximate nutritive ratio.
					Ash in food.	Protein in food.	Crude fibre in food.	N-free extract in food.	Crude fats in food.	
			Lbs.	Lbs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	
8	28	November 14 to December 12	6.16	+.75	.24	.72	.28	2.98	.35	1:5.6
8	28	December 12 to January 9	6.91	+.76	.21	.54	.21	2.49	.20	1:5.9
8	28	January 9 to February 6	7.67	+.47	.24	.67	.28	3.17	.24	1:6.0
8	28	February 6 to March 6	8.14	+.24	.27	.81	.29	3.60	.27	1:5.6
8	28	March 6 to April 3	8.38	+.21	.20	.47	.16	1.83	.18	1:5.1
8	28	April 3 to May 1	7.50	—.48	.21	.50	.20	2.21	.19	1:5.7
8	28	May 1 to May 29	7.02	0	.19	.44	.19	1.89	.18	1:5.6
8	28	May 29 to June 26	7.02	—.73	.18	.39	.17	1.59	.17	1:5.5
8	28	June 26 to July 24	6.29	—.10	.18	.37	.16	1.48	.16	1:5.4
8	28	July 24 to August 21	6.19	—.43	.20	.54	.19	1.89	.24	1:4.9
8	35	August 21 to September 25	6.62	+.14	.19	.50	.18	1.96	.24	1:5.4
8	28	September 25 to October 23	6.76	—.12	.19	.49	.19	1.91	.23	1:5.3
8	21	October 23 to November 13	6.64	+.14	.20	.52	.21	2.04	.26	1:5.4

PEN NO. 3 — HALF OF GRAIN GROUND AND MOISTENED.

PERIOD.	Average per Fowl.			Pounds of water-free food per day for each 100 pounds live weight fed.	Cost of food per day for each 100 pounds live weight fed.	Eggs Produced During Period. Average per Hen.		Pounds of water-free food consumed for each pound of eggs produced.	Cost of food for each pound of eggs produced.
	Total food per day.	Total water-free food per day.	Total cost of food per day.			Number.	Weight.		
	Ozs.	Ozs.	Cts.	Lbs.	Cts.		Ozs.	Lbs.	Cts.
November 14 to December 12	5.84	4.57	.44	4.38	6.74	.87	1.80	....	......
December 12 to January 9	4.51	3.65	.27	3.13	3.70	0	0	....	......
January 9 to February 6	5.43	4.59	.35	3.63	4.43	5.12	10.30	12.48	15.36
February 6 to March 6	8.69	5.24	.43	3.96	5.21	5.00	9.87	14.86	19.52
March 6 to April 3	4.99	2.88	.25	2.12	2.95	4.53	8.96	9.00	12.26
April 3 to May 1	3.94	3.32	.25	2.86	3.44	7.71	15.38	6.05	7.33
May 1 to May 29	3.90	2.89	.21	2.57	2.99	3.14	6.37	12.71	14.88
May 29 to June 26	3.45	2.51	.18	2.36	2.70	5.14	10.61	6.62	7.68
June 26 to July 24	3.28	2.35	.17	2.36	2.72	3.43	6.54	10.06	11.84
July 24 to August 21	5.98	3.05	.28	2.98	4.22	5.00	10.11	8.45	12.32
August 21 to September 25	3.96	3.07	.26	2.87	3.89	6.00	12.24	8.77	12.00
September 25 to October 23	3.99	3.00	.26	2.80	3.88	.57	1.14	....	......
October 23 to November 13	4.12	3.26	.29	3.04	4.32	1.00	2.07	....	......

PEN NO. 4 — GRAIN DRY AND WHOLE — AVERAGE PER DAY PER FOWL.

PERIOD.	Wheat.	Cracked corn.	Oats.	Buck-wheat.	Barley.	Flax seed.	Alfalfa (green)	Alfalfa hay.	Cabbage.	Skim milk.	Fresh bone.	Oyster shells.	Stone grit.
	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.
November 14 to December 12	.90	.89	.90	.92	.95	.11	.03	....	.43	....	.49	.02	.04
									Corn silage.				
December 12 to January 9	.94	.84	.88	1.10	1.43	....	....	....	.03	....	.49	.10	.02
January 9 to February 6	1.18	1.32	1.24	.92	1.08	....	....	.14	......	....	.49	.19	.02
February 6 to March 6	.86	.85	.86	.91	.78	....	....	.14	......	2.89	.49	.14	.03
March 6 to April 3	.46	.52	.53	.50	.49	....	....	.14	......	1.59	.49	.11	.01
April 3 to May 1	.63	.62	.65	.61	.61	....	....	.12	......	....	.43	.18	.01
May 1 to May 29	.50	.49	.50	.57	.56	....	.62	....	......	....	.43	.04	0
May 29 to June 26	.48	.52	.49	.39	.42	....	.62	....	......	....	.43	.04	0
June 26 to July 24	.51	.41	.39	.45	.51	....	.62	....	......	....	.43	.02	.03
July 24 to August 21	.48	.50	.52	.58	.52	.19	.62	....	......	1.86	.43	.04	.01
August 21 to September 25	.62	.59	.55	.64	.59	.20	.50	....	......	....	.43	.03	.01
September 25 to October 23	.68	.69	.76	.61	.67	.17	.62	....	......	....	.43	.02	.03
October 23 to November 13	.71	.75	.77	.73	.70	.06	.42	.04	......	....	.43	.02	.02

PEN NO. 4 — GRAIN DRY AND WHOLE.

Number fowls in pen.	Number days in period.	PERIOD.	Average live weight per fowl at beginning of period.	Average gain or loss in weight per fowl during period.	AVERAGE PER DAY PER FOWL. Ash in food.	Protein in food.	Crude fibre in food	N.-free extract in food.	Crude fats in food.	Approximate nutritive ratio.
			Lbs.	Lbs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	
7	28	November 14 to December 12	6.63	+.78	.32	.63	.24	3.05	.26	1:6.1
7	28	December 12 to January 9	7.41	+.77	.23	.67	.27	3.40	.24	1:6.3
7	28	January 9 to February 6	8.18	—.05	.25	.75	.30	3.82	.28	1:6.3
7	28	February 6 to March 6	8.13	—.09	.24	.68	.25	2.98	.24	1:5.5
7	28	March 6 to April 3	8.04	—.47	.19	.45	.15	1.76	.19	1:5.2
8	28	April 3 to May 1	7.77	—.75	.18	.45	.18	2.08	.18	1:5.9
8	28	May 1 to May 29	7.02	—.32	.17	.40	.17	1.78	.17	1:5.8
8	28	May 29 to June 26	6.70	—.55	.16	.37	.15	1.58	.16	1:5.7
8	28	June 26 to July 24	6.15	—.10	.16	.37	.15	1.58	.16	1:5.7
8	28	July 24 to August 21	6.05	+.06	.19	.50	.18	1.92	.23	1:5.3
8	35	August 21 to September 25	6.11	+.44	.18	.48	.19	2.08	.24	1:5.9
8	28	September 25 to October 23	6.55	+.02	.19	.53	.22	2.37	.25	1:5.9
8	21	October 23 to November 13	6.57	+.14	.19	.52	.23	2.47	.22	1:6.1

PEN NO. 4 — GRAIN DRY AND WHOLE.

PERIOD.	Average per fowl.			Pounds of water-free food per day for each 100 pounds live weight fed.	Cost of food per day for each 100 pounds live weight fed.	Eggs produced during period. Average per hen.		Pounds of water-free food consumed for each pound of eggs produced.	Cost of food for each pound of eggs produced.
	Total food per day.	Total water-free food per day.	Total cost of food per day.			Number.	Weight.		
	Ozs.	Ozs.	Cts.	Lbs.	Cts.		Ozs.	Lbs.	Cts.
November 14 to December 12	5.62	4.48	.36	3.99	5.13	6.29	13.57	9.24	11.95
December 12 to January 9	5.71	4.56	.37	3.65	4.74	3.00	6.50	19.66	25.28
January 9 to February 6	6.37	5.41	.43	4.15	5.28	9.57	19.91	7.61	9.60
February 6 to March 6	7.78	4.40	.37	3.40	4.58	6.71	13.36	9.22	12.48
March 6 to April 3	4.72	2.75	.23	2.21	2.95	4.57	9.34	8.26	11.15
April 3 to May 1	3.67	3.08	.25	2.60	3.38	7.57	12.27	7.03	9.10
May 1 to May 29	3.67	2.70	.21	2.46	3.06	4.57	8.63	8.75	10.72
May 29 to June 26	3.35	2.42	.18	2.36	2.80	5.57	10.70	6.33	7.65
June 26 to July 24	3.35	2.43	.19	2.49	3.11	2.86	5.87	11.57	14.21
July 24 to August 21	5.70	3.04	.26	3.13	4.28	5.28	10.86	7.83	10.88
August 21 to September 25	4.12	3.16	.26	3.12	4.11	6.43	13.02	8.51	11.20
September 25 to October 23	4.66	3.56	.29	3.39	4.42	1.30	2.82	......	......
October 23 to November 13	4.61	3.64	.29	3.43	4.37	0	......	......	......

AVERAGE FOR THE YEAR.

	Average number of fowls.	Average live wt. per fowl at beginning.	Average gain in wt. per fowl for year.	Average Per Day Per Fowl.					Approximate nutritive ratio.
				Ash in food.	Protein in food.	Crude fibre in food.	N.-free extract in food.	Crude fats in food.	
		Lbs.	Lbs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	
Pen No. 1, Leghorn	12	3.21	.3	.18	.45	.18	1.82	.20	1:5.5
Pen No. 2, Leghorn	11	3.45	.6	.18	.44	.18	1.94	.19	1:5.8
Pen No. 3, Cochin	8	6.16	.6	.21	.54	.21	2.23	.22	1:5.5
Pen No. 4, Cochin	8	6.63	.1	.20	.52	.21	2.37	.22	1:5.9

For the pen of Cochins, No. 3, having the ground grain, the amount of water-free substance in the food taken per day per fowl on the average for the whole year was 3.41 ounces. For pen No. 4 having whole grain the average was 3.50 ounces, an excess over the consumption of No. 3 of only about 2.6 per cent.

For pen No. 3 the cost of food per hen for the whole year was 102.22 cents. The average number of eggs was 47.51, weighing 95.39 ounces; 13.01 pounds of water-free food were consumed at a cost 17.15 cents for every pound of eggs produced. The food cost for every dozen eggs 25.8 cents. The market value of eggs laid per hen was 75 cents, being 26.6 per cent. less than the cost of food.

For pen No. 4 the cost of food per hen for the whole year was 103.33 cents. The average number of eggs was 63.72, weighing 126.85 ounces; 10.04 pounds of water-free food were consumed at a cost of 13 cents for every pound of eggs produced. The food cost for every dozen eggs 19.44 cents. The market value of eggs laid per hen was 110.76 cents, exceeding the cost of food by 7.3 per cent.

Although all the hens were fed liberally the average for the year shows that those having the ground grain were satisfied with less actual dry matter in the food. The cost of the ground grain ration was also somewhat less. These differences although noticeable were not so pronounced as similar ones observed during the first year.

The Leghorns having the ground grain laid over 20 per cent. more eggs than those having only whole grain and showed nearly twice as great difference between the market value of the eggs and the cost of food. The best egg production by pen No. 2 during any period was that of one pound of eggs for every 3.52 pound of water-free food consumed. This was exceeded by pen No. 1 during four periods. On the average for the year 22 per cent. more food was taken by pen No. 2 for the same egg production than by pen No. 1.

With the pen of Cochins having the ground grain the laying was much poorer than with the contrasted pen although there was pronounced decrease in laying with both pens over that of the first year. Pen No. 4 laid over one-third more eggs than did pen No. 3, and at a season of the year to make their market value nearly 48 per cent. greater. The consumption of food for the same egg production was with both pens of Cochins much greater than with the Leghorns, but with pen No. 4 was nearly 23 per cent. greater than with pen No. 3.

The results accompanying the contrasted rations fed during this trial showed in general the same differences that occurred during the first year, only that differences were more pronounced.

Aside from the primary consideration of the effect of the contrasted rations, it is of interest with the data at hand to note the differences between the first and second years' production from the same fowls. The Leghorns having the ground grain laid more eggs during the second year than during the first. Rating the eggs laid during the first year at the prices holding for corresponding periods in the second, the eggs for the second year exceeded those of first in market value by about 6.5 per cent. The number was over 8 per cent greater. For pen No. 2 there was a falling off in value of egg production of about 12.7 per cent.

There was a marked falling off in number of eggs for the second year with both pens of Cochins. The egg production being over 20 per cent. lower for the second year. Taking both years together, pen No. 3 was fed at a loss, the value of the product falling considerably short of the cost of food. By considering the poultry value of the hen at the end of the trial there would be a total income exceeding somewhat the total expense for food and growing of pullet, but much less than could have been derived from the sale of the pullet at the market price in the beginning. The showing of pen No. 4, having the whole grain, was considerably better than that of No. 3, possibly on account of the greater exercise induced by the necessity of searching for the grain in straw, a matter of decided importance with such an inactive bird as the Cochin. The value of the product exceeded the cost of food by over 25 per cent during the first year and by less than 8 per cent during the second year. Taking into consideration the cost of growing the pullet, the cost of food for the two years and the final poultry value of the hen, there was an excess in value by the total product over cost of about 34 per cent. But allowing a fair estimate for rent and labor, there would be less net income than could have been obtained by sale of the pullet at the start. The first year's results alone with this pen would make a better showing.

In considering the effect of different rations upon egg production the results from hens of one of the better laying breeds, as in this case the Leghorn, are of the greater importance. While the pen of Leghorns having whole grain fell off in laying during the second year, as well as both pens of Cochins, the Leghorns having the ground grain laid better during the second year than during the first. Allowing for the cost of hatching and the food cost of growing the pullets for this feeding experiment, and considering the market value of the hens at the end, there was for the two years with those having the whole grain an excess in the value of product over the cost of food of 48.6 per cent. With those having the ground grain there was an excess of 68.5 per cent. The actual difference over the total cost of food was about one-third greater with the hens having the ground grain ration.

The primary object in this feeding experiment was to study the relative efficiency of the whole grain and of the partly-ground grain ration. Although the conditions were not entirely favorable for the most economical results from laying hens, the food cost of production of eggs has been given as matter of additional interest.

GIFTS TO THE STATION.

Apple.

August 1. J. E. Sheddan, Friendville, Tenn., buds of Sheddan.

August 3. Eli Marshall, Rheatown, Tenn., buds of Deaderich.

August 3. Stark Brothers, Louisiana, Mo., buds of Senator.

August 17. William H. Smith, Leiper's Fork, Tenn., buds of Allison and Striped July.

N. Hallock, Queens, N. Y., buds of Long Island Russet.

August 21. H. M. McCroskey, Glenloch, Tenn., buds of McCroskey.

August 28. J. E. Lord, Pompanoosuc, Vt., buds of Houghton Sweet.

September 10. Professor Goff, Madison, Wis., buds of Hoadley.

October 15 and November 14. J. D. Johnson, Miranda, Quebec, cions of Fameuse from tree with brilliantly colored fruit.

November 23. A. F. Clark, Raymondville, N. Y., cions of Oel Austin.

December 23. S. D. Willard, Geneva, N. Y., cions of Cox Orange Pippin and Ohio Nonpareil.

Blackberry.

May 23. E. J. Vanbuskirk, Tyre, N. Y., white blackberry.

November 14. J. M. Mersereau, Cayuga, N. Y., ten plants of Mersereau.

Carnations.

June 1. The Cottage Gardens, Queens, N. Y., twelve plants each of Bridesmaid, Alaska, William Scott, Storm King, Lizzie McGowan and Abundance, and six plants of Helen Keller.

Cherry.

August 3. Stark Brothers, Louisiana, Mo., buds of California Advance and Black Tartarian.

September 19. Oregon Wholesale Nurseries, Salem, Oregon, buds of Lambert, Bing and Deacon.

November 25. The Lovett Co., Little Silver, N. J., two trees each of Centennial and Plymouth on Mazzard.

Currant.

October 19. Prof. L. H. Bailey, Ithaca, N. Y., *Ribes alpinum* and *Ribes sanguineum.*

October 23. Missouri Botanical Garden, St. Louis, Mo., *Ribes prostratum* and *Ribes dicantha.*

October 27. Prof. G. C. Butz, State College, Pa., twelve rooted plants of *Ribes floridum.*

October 28. Prof. H. L. Bolley, Fargo, N. Dak., twelve rooted plants of *Ribes rubrum* (or *floridum*).

November 9. Prof. James Fletcher, Ottawa, Canada, four *Ribes bracteosum* and three *Ribes sanguineum.*

November 28. H. S. Anderson, Union Spring, N. Y., five Purity (Johnson's No. 21 White) and three Empire (Johnson's No. 16 Red).

December 22. Prof. J. Craig, Ottawa, Canada, cuttings of black currants as follows: Clipper, Monarch, Dominion, Success, Star, Beauty; also two not named.

Gooseberry.

October 23. Missouri Botanical Garden, St. Louis, Mo., *Ribes gracile, Ribes oxyacanthoides* and *Ribes rotundifolium.*

October 27. Prof. G. C. Butz, State College, Pa., twelve rooted plants of *Ribes rotundifolium.*

October 29. Prof. C. V. Piper, Pullman, Wash., cuttings of *Ribes palousense* Piper and *Ribes niveum.*

November 1. Prof. A. S. Hitchcock, Manhattan, Kans., cuttings of *Ribes gracile.*

November 9. Prof. James Fletcher, Ottawa, Canada, two *Ribes lacustre* var. from British Columbia, four *Ribes Lobbii* and one *Ribes divaricatum.*

November 27. Prof. C. V. Piper, Pullman, Wash., several plants of *Ribes niveum* Lindl.

December 15. Prof. C. V. Piper, Pullman, Wash., cuttings of No. 1801 *Ribes* near *divaricatum, Ribes irriguum?* and No. 0 *Ribes palousense.*

James O. Nickerson, Hemlock, N. Y., Nickerson No. 1.

GRAPE.

November 11. E. A. Riehl, Alton, Ill., two Riehl No. 10, black seedling of Niagara and two Riehl No. 11, red seedling of Niagara.

MISCELLANEOUS.

Northwestern Seed Co., Dundas, Minn., one packet each of *Ageratum Mexicanum*, Frost King field corn, New Victoria spinach, Sweet Mignonette and Denver Market lettuce.

May 14. A. Blanc, Philadelphia, Pa., four plants of Logan berry.

May 29. F. Richards, Freeport, N. Y., one set transplanting implements.

June 18. Percy Little, Northumberland, Pa., one slat barrel.

November 11. Prof. L. H. Bailey, Ithaca, N. Y., the following named begonias: Abundance, Argentea Guttata, Bertha de Chateau Rochere, Credneri, Glauca, Scandens, Hoageana, Gilsonii, Incarnata, Ingranii, Metallica, Rex in variety, Scharffiana, Schmidtii, Sub nigricans, Thurstoni, Undulata and Wetsteini.

December 11. J. L. Childs, Floral Park, N. Y., two tips of hybrid berry. A rubus.

NECTARINE.

August 24. Division of Pomology, Washington, D. C., buds of Kentucky.

PEACH.

August 26. H. Wiard, Syracuse, N. Y., buds of Wiard.

September 19. W. H. Clark, Greece, N. Y., Todd.

November 20. R. G. Chase Co., Geneva, N. Y., two Pride of Idaho and one Early Free (Chase).

November 27. A. Pullen, Milford, Del., two trees each of Bishop Early, Early Rivers, Beers Smock, Old Mixon Free and Wager, and one tree each of Amsden, Crawford Late, Champion, Stevens Rareripe and Elberta.

November 27. T. V. Munson, Denison, Tex., buds of Jennie Worthen and Columbia.

PEAR.

August —. S. B. Heiges, U. S. Pomologist, Washington, D. C., buds of Summer Beauty.

September 19. Oregon Wholesale Nurseries, Salem, Oregon, buds of Late Bartlett.

December 21. Division of Pomology, Washington, D. C., Summer Beauty.

Peas.

May 6. T. H. Horsford, Charlotte, Vt., one packet Electric.

May 11. J. J. H. Gregory & Son, Marblehead, Mass., one packet Hancock.

Plum.

September 19. Oregon Wholesale Nurseries, Salem, Oregon, buds of Golden Prune, Tennant Prune, Pacific Prune and D'Agen Prune.

September 3. Walling & Jarisch, Oswego, Oregon, buds of Champion Prune.

December 12. S. D. Willard, Geneva, N. Y., cions of Baker.

Potato.

L. Atwater, Elba, N. Y., two seedling potatoes.

R. D. Burr, Gloversville, N. Y., seedling potato.

Bonnell, Waterloo, N. Y., tubers of seedling potato.

Peter Henderson & Co., New York, N. Y., tubers of two seedling potatoes.

Raspberry.

May 13. L. J. Farmer, Pulaski, N. Y., eleven plants Phoenix Red.

November 11. John Craig, Ottawa, Canada, six plants each of Carleton and Percy.

November 21. S. L. Quimby, Marlboro, N. Y., ten plants each of Coutant No. 1 and Coutant No. 2.

Strawberries.

May 4. Slaymaker & Son, Dover, Del., twenty-five plants each Slaymaker's Nos. 9, 12 and 25.

May 6. ————————————, twelve plants Demay.

May 8. A. A. Mitchell, Palmyra, N. Y., twenty-five plants of Ganargua. A cross of Wilson and Sharpless.

May 13. L. J. Farmer, Pulaski, N. Y., two dozen plants Atlantic.

May 27. William E. Doxie, Wappinger's Falls, N. Y., five plants Scofield Seedling.

August 25. A. D. Leffel, Springfield, Ohio, twenty plants Anlo.

September 4. Ellwanger & Barry, Rochester, N. Y., fifty plants McKinley.

NEWSPAPERS AND PERIODICALS PRESENTED TO THE STATION.

Acker & Gartenbau Zeitung, Milwaukee, Wis.

Agricultural Epitomist, Indianapolis, Ind.

Agricultural South, Atlanta, Ga.

Agricultural Students' Gazette, Cirencester, Eng.

Albany Weekly Journal, Albany, N. Y.

Allegan Gazette, Allegan, Mich.

American Agriculturist, New York, N. Y.

American Cultivator, Boston, Mass.

American Dairyman, New York, N. Y.

American Grange Bulletin and Scientific Farmer, Cincinnati, Ohio.

American Stock Keeper, Boston, Mass.

Baltimore Weekly Sun, Baltimore, Md.

Canadian Entomologist, Fort Hope, Canada.

Canadian Horticulturist, Toronto, Canada.

Church at Home, Salt Lake City, Utah.

Commercial Gazette, New York, N. Y.

Country Gentleman, Albany, N. Y.

Dairy World, London, Eng.

DeRuyter Gleaner, DeRuyter, N. Y.

Detroit Free Press, Detroit, Mich.

Elgin Dairy Report, Elgin, Ill.

Every Week, Angelica, N. Y.

Farm and Fireside, Philadelphia, Pa.

Farm and Home, Springfield, Mass.

Farmers' Advocate, London, Canada.

Farmers' Guide, Huntington, Ind.

Farmers' Home, Dayton, Ohio.

Farmers' Voice, Chicago, Ill.

Farm Journal, Philadelphia, Pa.

Farm News, Springfield, Ohio.
Farm Poultry, Boston, Mass.
Farm, Stock and Home, Minneapolis, Minn.
Geneva Gazette, Geneva, N. Y.
Gleanings in Bee Culture, Medina, Ohio.
Hoard's Dairyman, Fort Atkinson, Wis.
Homestead, Des Moines, Iowa.
Horticultural Gleaner, Austin, Tex.
Horticultural Visitor, Kinmundy, Ill.
Indiana Farmer, Indianapolis, Ind.
Industrial American, Lexington, Ky.
Iowa Weather Crop Service Review, Des Moines, Iowa.
Ithaca Democrat, Ithaca, N. Y.
Jersey Bulletin, Indianapolis, Ind.
Ladies' Home Companion, Philadelphia, Pa.
Long Island Farmer, Jamaica, N. Y.
Louisiana Planter and Sugar Manufacturer, New Orleans, La.
Market Garden, Minneapolis, Minn.
Maryland Farmer, Baltimore, Md.
Mirror and Farmer, Manchester, N. H.
Montana Fruit Grower, Missoula, Mont.
Monthly Weather Review, Washington, D. C.
National Dairyman, Kansas City, Mo.
National Nurseryman, Rochester, N. Y.
Nebraska Bee-Keeper, York, Nebr.
Nebraska Farmer, Lincoln, Nebr.
New England Farmer, Boston, Mass.
New York Farm and Fireside, Springfield, Ill.
New York Farmer, Port Jervis, N. Y.
Northwest Pacific Farmer, Portland, Oregon.
Oregon Agriculturist, Portland, Oregon.
Poultry Monthly, Albany, N. Y.
Practical Farmer, Philadelphia, Pa.
Prairie Farmer, Chicago, Ill.
Progressive South, Richmond, Va.

Salt Lake Herald, Salt Lake City, Utah.

Southern Cultivator, Atlanta, Ga.

Southern Farmer, New Orleans, La.

Southern Planter, Richmond, Va.

Southern States, Baltimore, Md.

Sugar Beet, Philadelphia, Pa.

Vermont Farmers' Advocate, Burlington, Vt.

Wallace's Farmer, Des Moines, Iowa.

Western Plowman, Moline, Ill.

METEOROLOGICAL RECORD

FOR

1896.

WIND RECORD FOR 1896.

DATE.	January. Northerly. N. W. to N. E.	January. Easterly. N. E. to S. E.	January. Southerly. S. E. to S. W.	January. Westerly. S. W. to N. W.	February. Northerly. N. W. to N. E.	February. Easterly. N. E. to S. E.	February. Southerly. S. E. to S. W.	February. Westerly. S. W. to N. W.	March. Northerly. N. W. to N. E.	March. Easterly. N. E. to S. E.	March. Southerly. S. E. to S. W.	March. Westerly. S. W. to N. W.	April. Northerly. N. W. to N. E.	April. Easterly. N. E. to S. E.	April. Southerly. S. E. to S. W.	April. Westerly. S. W. to N. W.
	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs	Hrs.	Hrs.	Hrs.
1				24.0		4.0	18.0		18.0			6.0				6.0
2			13.0	11.0				22.0				24.0	1.0		11.0	11.0
3			10.0	14.0	2.0			7.0				24.0				24.0
4				24.0		12.0	12.0					24.0				24.0
5	2.0			22.0			23.0					24.0				24.0
6	2.0			8.0		8.0	15.0				5.0	15.0			1.0	8.0
7		1.0	12.0		7.0	2.0		15.0			20.0	4.0				24.0
8	3.0		5.0	15.0				24.0				24.0	10.0			14.0
9			18.0			11.0						24.0	7.0	1.0	4.0	
10	3.0		5.0	4.0	1.0			20.0				12.0			24.0	
11	2.0			5.0			8.0	16.0		19.0					17.0	
12			24.0					24.0	15.0	1.0		8.0		1.0	6.0	
13			1.0	23.0		8.0	6.0	5.0				24.0			22.0	1.0
14				17.0			7.0	17.0				24.0			10.0	7.0
15				24.0			8.0	13.0			4.0	20.0			3.0	15.0
16			7.0	15.0	6.0			8.0			8.0		2.0			8.0
17			7.0	1.0	3.0			7.0	7.0			16.0				24.0
18			5.0				24.0				2.0	21.0			4.0	7.0
19			4.0	1.0				24.0		7.0	13.0			9.0	3.0	3.0
20			13.0	2.0				24.0	1.0	3.0		20.0			2.0	22.0
21			9.0	5.0				24.0				24.0		1.0		9.0
22	2.0			11.0			10.0	10.0			16.0	8.0	3.0			21.0
23			12.0					24.0	5.0			17.0				24.0
24		6.0	18.0		10.0			14.	7.0		2.0			5.0		4.0
25		2.0		4.0			14.0	8.0			24.0				21.0	
26				22.0			7.0	11.0			24.0			2.0	5.0	5.0
27				24.0			24.0				2.0	22.0	4.0		11.0	
28				24.0			12.0	9.0				24.0			24.0	
29			2.0					21.0		24.0				6.0	5.0	
30	1.0		1.0								12.0	5.0	10.0		5.0	
31			2.0									15.0				
Total hours of movement	14.0	9.0	168.0	300.0	29.0	45.0	188.0	350.0	53.0	54.0	132.0	429.0	37.0	25.0	178.0	285.0
Per cent. of time in each direction	2.9	1.8	34.2	61.1	4.7	7.4	30.7	57.2	7.9	8.1	19.8	64.2	7.0	4.8	33.9	54.8

WIND RECORD FOR 1896 — (*Continued*).

DATE.	May. Northerly. N. W. to N. E.	May. Easterly. N. E. to S. E.	May. Southerly. S. E. to S. W.	May. Westerly. S. W. to N. W.	June. Northerly. N. W. to N. E.	June. Easterly. N. E. to S. E.	June. Southerly. S. E. to S. W.	June. Westerly. S. W. to N. W.	July. Northerly. N. W. to N. E.	July. Easterly. N. E. to S. E.	July. Southerly. S. E. to S. W.	July. Westerly. S. W. to N. W.	August. Northerly. N. W. to N. E.	August. Easterly. N. E. to S. E.	August. Southerly. S. E. to S. W.	August. Westerly. S. W. to N. W.
	Hrs.	Hrs.	Hrs.	Hrs.	Hrs	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.
1			24.0					21.0				13.0	2.0		4.0	8.0
2			24.0					24.0	1.0	1.0	8.0	6.0			16.0	6.0
3			24.0				7.0	9.0		4.0		8.0				10.0
4			5.0	14.0			9.0			5.0	11.0					15.0
5		2.0	3.0	18.0			9.0				7.0	11.0				20.0
6				19.0			9.0	2.0	3.0		5.0	5.0	3.0		3.0	12.0
7	13.0	2.0					22.0				8.0	13.0	3.0		2.0	8.0
8	7.0		4.0		1.0		7.0	6.0	6.0			13.0			5.0	8.0
9			3.0	8.0			12.0	10.0		15.0					8.0	10.0
10				24.0				22.0			24.0				3.0	18.0
11				24.0	1.0			20.0				21.0				20.0
12	12.0			12.0				21.0				23.0	2.0			16.0
13	7.0	3.0			7.0	2.0						24.0				18.0
14	5.0	2.0	7.0		9.0	3.0				4.0		13.0	5.0			12.0
15		5.0	4.0	7.0		3.0	9.0		3.0		4.0	3.0			5.0	5.0
16				24.0			11.0					22.0			21.0	
17	2.0	1.0	8.0	4.0			9.0					14.0				22.0
18			1.0	23.0	1.0		4.0	3.0	5.0		5.0					20.0
19	5.0			17.0	3.0		8.0	1.0			22.0				2.0	
20	2.0		3.0	7.0	3.0		4.0	7.0			20.0			4.0	8.0	
21		1.0	23.0		6.0		1.0	5.0			6.0	11.0			7.0	2.0
22			17.0	6.0				23.0	2.0	5.0		5.0			21.0	3.0
23	16.0			5.0		3.0		13.0				19.0				24.0
24	7.0		6.0			4.0	6.0				5.0	11.0			2.0	15.0
25			24.0				24.0		2.0	6.0		9.0		6.0	11.0	
26			22.0	2.0			17.0	6.0				14.0			8.0	16.0
27				23.0				19.0			8.0	9.0				24.0
28	3.0		8.0	4.0			20.0		7.0			6.0			5.0	8.0
29			4.0	20.0			2.0	22.0			7.0	3.0		3.0	13.0	5.0
30			1.0	20.0				20.0			8.0	8.0				24.0
31	3.0		1.0	12.0					12.0			12.0				24.0
Total hours of movement	82.0	16.0	216.0	293.0	31.0	15.0	190.0	254.0	41.0	40.0	148.0	296.0	15.0	13.0	144.0	373.0
Per cent. of time in each direction	13.5	2.6	35.6	48.3	6.9	3.0	38.5	51.6	7.8	7.6	28.2	56.4	2.8	2.4	26.4	68.4

Wind Record for 1896 — (*Concluded*).

DATE.	September.				October.				November.				December.			
	Northerly. N. W. to N. E.	Easterly. N. E. to S. E.	Southerly. S. E. to S. W.	Westerly. S. W. to N. W.	Northerly. N. W. to N. E.	Easterly. N. E. to S. E.	Southerly. S. E. to S. W.	Westerly. S. W. to N. W.	Northerly. N. W. to N. E.	Easterly. N. E. to S. E.	Southerly. S. E. to S. W.	Westerly. S. W. to N. W.	Northerly. N. W. to N. E.	Easterly. N. E. to S. E.	Southerly. S. E. to S. W.	Westerly. S. W. to N. W.
	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.
1	......	......	....	22.0	......	......	8.0	12.0	......	......	8.0	11.0	......	......	....	24.0
2	......	......	10.0	8.0	1.0	......	....	17.0	......	......	3.0	16.0	......	15.0	3.0	4.0
3	......	......	21.0	3.0	14.0	......	....	....	3.0	3.0	3.0	2.0	......	2.0	2.0	16.0
4	......	......	....	21.0	7.0	......	....	....	......	......	24.0	....	......	......	19.0	5.0
5	7.0	......	11.0	....	7.0	......	....	5.0	......	......	18.0	6.0	......	......	19.0	5.0
6	......	......	22.0	....	......	......	....	14.0	......	......	....	21.0	2.0	......	10.0	10.0
7	......	......	....	20.0	......	6.0	....	10.0	......	......	10.0	13.0	11.0	......	....	......
8	......	......	4.0	6.0	......	......	....	24.0	......	......	....	19.0	......	7.0	6.0	1.0
9	......	......	6.0	....	......	......	....	14.0	......	......	2.0	19.0	......	......	....	22.0
10	......	8.0	5.0	2.0	2.0	2.0	4.0	....	......	......	14.0	3.0	......	......	....	18.0
11	......	3.0	....	8.0	......	11.0	....	....	......	......	13.0	11.0	1.0	......	7.0	15.0
12	......	......	....	10.0	1.0	7.0	....	....	2.0	......	5.0	11.0	......	......	24.0	......
13	21.0	......	....	3.0	7.0	3.0	....	2.0	......	......	....	18.0	......	......	10.0	14.0
14	9.0	2.0	1.0	2.0	12.0	......	....	12.0	3.0	......	6.0	12.0	10.0	......	....	7.0
15	3.0	......	2.0	11.0	......	......	....	24.0	......	......	15.0	9.0	7.0	8.0	....	......
16	12.0	......	....	....	......	......	....	20.0	......	......	20.0	3.0	18.0	......	....	6.0
17	2.0	7.0	4.0	2.0	......	3.0	....	11.0	4.0	......	....	17.0	3.0	5.0	3.0	10.0
18	......	......	3.0	11.0	......	4.0	1.0	4.0	......	......	13.0	4.0	......	......	18.0	6.0
19	2.0	......	10.0	....	......	......	....	21.0	......	......	....	24.0	......	......	24.0	......
20	......	......	....	24.0	......	......	17.0	4.0	5.0	2.0	12.0	4.0	5.0	2.0	....	14.0
21	......	......	4.0	10.0	......	9.0	....	9.0	......	......	18.0	4.0	......	9.0	....	4.0
22	2.0	......	3.0	5.0	......	......	....	23.0	8.0	......	....	9.0	......	15.0	....	......
23	4.0	......	....	20.0	......	......	7.0	6.0	......	......	21.0	1.0	17.0	......	....	7.0
24	......	......	....	15.0	6.0	......	....	13.0	......	......	8.0	10.0	......	......	....	24.0
25	......	......	9.0	7.0	......	......	6.0	7.0	......	7.0	3.0	4.0	......	......	7.0	17.0
26	......	......	24.0	....	2.0	......	2.0	6.0	......	......	24.0	....	4.0	2.0	3.0	15.0
27	......	......	9.0	8.0	......	......	3.0	4.0	......	2.0	20.0	1.0	......	8.0	4.0	......
28	6.0	......	....	15.0	......	......	11.0	....	......	......	....	24.0	......	......	24.0	......
29	......	4.0	5.0	....	......	......	21.0	....	......	......	....	21.0	......	......	11.0	4.0
30	......	2.0	15.0	7.0	......	2.0	15.0	1.0	......	......	....	24.0	......	......	5.0	10.0
31	......	......	....	....	......	......	16.0	6.0	......	......	....	....	9.0	......	....	10.0
Total hours of movement	68.0	26.0	168.0	240.0	59.0	47.0	111.0	269.0	25.0	14.0	260.0	327.0	87.0	73.0	199.0	268.0
Per cent. of time in each direction	13.5	5.2	33.5	47.8	12.1	9.7	22.8	55.4	4.0	2.2	41.5	52.3	13.9	11.6	31.7	42.7

SUMMARY OF DIRECTION OF WIND FOR 1896.

	Northerly. N. W. to N. E.	Easterly. N. E. to S. E.	Southerly. S. E. to S. W.	Westerly. S. W. to N. W.
	Hours.	Hours.	Hours.	Hours.
January	14.	9.	168.	300.
February	29.	45.	188.	350.
March	53.	54.	132.	429.
April	37.	25.	178.	285.
May	82.	16.	216.	293.
June	34.	15.	190.	254
July	41.	40.	148.	296.
August	15.	13.	144.	373.
September	68.	26.	168.	240.
October	59.	47.	111.	269.
November	25.	14.	260.	327.
December	87.	73.	199.	268.
Total hours of movement	544.	377.	2102.	3684.
Per cent. of time in each direction	8.2	5.6	31.3	54.9

Sunshine Record for 1896 by Negretti and Zambra Instrument.

January.

Date.	Before 9 a. m. Hrs.	Before 9 a. m. Min.	9 to 12. Hrs.	9 to 12. Min.	12 to 3. Hrs.	12 to 3. Min.	After 3 p. m. Hrs.	After 3 p. m. Min.	Total hours. Hrs.	Total hours. Min.	Hours sunrise to sunset. Hrs.	Hours sunrise to sunset. Min.
1	0	00	0	00	0	00	0	00	0	00	9	09
2	0	00	0	00	0	00	0	00	0	00	9	09
3	0	00	1	00	3	00	1	00	5	00	9	10
4	0	00	0	00	1	05	1	00	2	05	9	11
5	0	00	1	00	0	40	0	40	2	20	9	12
6	0	30	1	45	0	30	0	00	2	45	9	13
7	0	00	0	00	0	00	0	00	0	00	9	14
8	0	00	0	00	0	00	0	00	0	00	9	16
9	0	00	0	00	0	00	0	00	0	00	9	17
10	0	00	0	00	0	00	0	00	0	00	9	18
11	0	00	0	00	0	00	0	00	0	00	9	19
12	0	00	0	00	0	30	0	00	0	30	9	21
13	0	00	0	00	0	00	0	00	0	00	9	22
14	0	00	0	00	0	00	0	00	0	00	9	23
15	0	00	0	00	1	00	0	30	1	30	9	26
16	1	00	2	20	3	00	1	30	7	50	9	27
17	0	00	0	00	0	00	0	15	0	15	9	29
18	0	00	1	30	0	15	0	00	1	45	9	30
19	0	00	0	00	0	00	0	00	0	00	9	32
20	0	00	0	00	0	00	0	00	0	00	9	34
21	0	00	0	00	0	00	0	00	0	00	9	36
22	0	00	0	00	0	15	0	15	0	30	9	38
23	0	00	0	00	0	00	0	00	0	00	9	39
24	0	00	0	00	0	00	0	00	0	00	9	41
25	0	00	0	00	0	00	0	00	0	00	9	41
26	0	00	0	00	0	00	0	00	0	00	9	45
27	0	40	1	20	2	50	1	40	6	30	9	47
28	0	00	0	45	0	45	0	05	1	35	9	49
29	0	00	1	55	2	50	1	30	6	15	9	52
30	0	00	0	00	0	00	0	00	0	00	9	54
31	0	00	0	15	0	15	0	00	0	30	9	57
Total hours	2	10	11	50	16	55	8	25	39	20	293	54
Per cent. of possible	4.4		12.7		18.2		14.3		13.4		....	

February.

Date.	Before 9 a. m. Hrs.	Before 9 a. m. Min.	9 to 12. Hrs.	9 to 12. Min.	12 to 3. Hrs.	12 to 3. Min.	After 3 p. m. Hrs.	After 3 p. m. Min.	Total hours. Hrs.	Total hours. Min.	Hours sunrise to sunset. Hrs.	Hours sunrise to sunset. Min.
1	0	00	0	00	0	00	0	15	0	15	9	59
2	0	10	1	35	3	00	2	05	6	50	10	01
3	0	00	0	00	0	00	0	00	0	00	10	03
4	0	00	0	00	0	00	0	00	0	00	10	07
5	0	00	0	00	0	00	0	45	0	45	10	09
6	0	00	0	00	0	00	0	00	0	00	10	11
7	0	00	0	00	0	55	0	05	1	00	10	13
8	0	00	0	00	0	00	0	00	0	00	10	16
9	0	00	0	00	0	00	0	00	0	00	10	18
10	0	00	0	00	0	00	0	00	0	00	10	21
11	1	05	2	45	3	00	2	00	8	50	10	24
12	0	00	1	00	1	30	1	35	4	05	10	26
13	0	00	0	00	0	00	0	00	0	00	10	29
14	0	00	0	00	0	20	1	00	1	20	10	33
15	0	45	2	00	0	00	0	00	2	45	10	34
16	0	00	0	00	0	15	0	30	0	45	10	37
17	0	00	2	10	3	00	2	50	8	00	10	39
18	0	50	3	00	2	30	0	00	6	20	10	42
19	0	00	0	40	2	10	1	50	4	40	10	45
20	0	55	1	10	0	00	0	00	2	05	10	47
21	0	30	1	05	0	00	0	00	1	35	10	50
22	0	00	0	00	3	00	2	30	5	30	10	53
23	0	00	0	00	0	00	0	00	0	00	10	56
24	0	00	0	00	0	10	0	55	1	05	10	58
25	0	30	1	05	0	55	2	00	4	30	11	01
26	0	00	0	00	0	00	0	00	0	00	11	04
27	0	10	1	30	3	00	2	30	7	10	11	07
28	0	00	2	35	2	30	0	05	5	00	11	10
29	0	00	0	00	0	00	0	00	0	00	11	12
30	....		....		....		....		....		....	
31	....		....		....		....		....		....	
Total hours	4	55	20	35	26	05	20	55	72	30	306	45
Per cent. of possible	8.3		23.7		30.0		31.7		23.6		....	

SUNSHINE RECORD — (*Continued*).

DATE.	March.												April.											
	Before 9 a. m.		9 to 12.		12 to 3.		After 3 p. m.		Total hours.		Hours sunrise to sunset.		Before 9 a. m.		9 to 12.		12 to 3.		After 3 p. m.		Total hours.		Hours sunrise to sunset.	
	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.
1	0	00	0	00	0	00	0	00	0	00	11	16	0	00	0	00	0	00	0	00	0	00	12	44
2	0	00	0	30	0	30	0	00	1	00	11	18	0	00	0	00	0	00	0	00	0	00	12	47
3	0	00	0	00	0	35	0	50	1	25	11	21	0	00	0	00	2	30	3	00	5	30	12	49
4	0	00	0	00	3	00	1	20	4	20	11	24	0	00	0	00	0	55	0	00	0	55	12	53
5	2	40	3	00	3	00	3	00	11	40	11	27	0	50	3	00	3	00	3	00	9	50	12	56
6	1	35	2	40	0	10	1	10	5	35	11	30	0	00	0	00	0	00	0	00	0	00	12	59
7	0	00	0	00	0	10	1	30	1	40	11	33	0	00	0	50	0	00	0	10	1	00	13	01
8	2	20	1	00	3	00	2	00	8	20	11	35	1	45	0	40	0	00	0	00	2	25	13	04
9	1	45	3	00	3	00	0	45	8	30	11	38	0	00	0	00	0	00	0	00	0	00	13	07
10	0	00	0	00	0	00	0	00	0	00	11	41	0	00	0	00	0	00	0	00	0	00	13	09
11	0	00	0	00	0	00	0	00	0	00	11	44	0	00	0	00	0	00	0	00	0	00	13	12
12	0	00	0	00	0	00	0	00	0	00	11	47	0	00	0	00	0	00	0	00	0	00	13	15
13	0	00	0	09	0	00	0	00	0	00	11	50	0	20	1	50	2	00	1	10	5	20	13	18
14	0	00	0	00	1	20	1	25	2	45	11	53	0	55	2	25	0	00	0	00	3	20	13	21
15	1	10	3	00	0	30	1	35	6	15	11	55	0	00	0	00	0	00	0	00	0	00	13	23
16	1	45	3	00	3	00	1	45	9	30	11	58	0	00	0	00	0	00	0	00	0	00	13	26
17	0	00	0	25	0	20	1	15	2	00	12	01	0	50	2	30	3	00	1	50	8	10	13	29
18	1	55	2	45	0	15	0	00	4	55	12	04	0	10	0	35	0	00	0	00	0	45	13	31
19	1	05	2	30	1	15	0	50	5	40	12	07	0	00	0	00	0	00	0	00	0	00	13	34
20	1	45	3	00	1	15	0	00	6	00	12	10	0	00	0	00	1	10	0	40	1	50	13	36
21	0	00	0	00	0	10	0	15	0	25	12	13	1	30	1	20	0	45	1	20	4	55	13	39
22	0	10	2	00	3	00	2	05	7	15	12	16	0	00	2	10	3	00	2	00	7	10	13	42
23	2	00	3	00	3	00	0	30	8	30	12	18	0	00	0	00	0	00	1	15	1	15	13	45
24	0	00	0	00	0	00	0	00	0	00	12	21	1	00	3	00	3	00	2	00	9	00	13	47
25	0	00	0	00	0	00	0	00	0	00	12	24	0	00	2	15	1	00	0	00	3	15	13	50
26	1	00	2	50	1	30	2	00	7	20	12	27	0	00	0	00	0	00	0	00	0	00	13	52
27	1	00	1	00	0	00	0	00	2	00	12	29	2	00	2	55	3	00	2	00	9	55	13	55
28	0	00	0	00	0	00	0	00	0	00	12	33	1	30	2	30	1	50	1	50	7	40	13	57
29	2	00	3	00	3	00	2	20	10	20	12	36	0	00	0	00	0	00	0	00	0	00	13	59
30	1	00	3	00	3	00	2	00	9	00	12	39	1	25	2	50	3	06	2	00	9	15	14	03
31	1	00	2	10	0	00	0	00	3	10	12	41	......		......		......		......		......		......	
Total hours	24	10	41	50	35	00	26	35	127	35	371	09	12	15	28	50	28	10	22	15	91	30	402	03
Per cent. of possible	27.5		45.0		37.6		27.4		34.4		....		12.9		32.0		31.2		20.0		22.6		.. ..	

SUNSHINE RECORD — (*Continued*).

DATE.	May.												June.											
	Before 9 a. m.		9 to 12.		12 to 3.		After 3 p. m.		Total hours.		Hours sunrise to sunset.		Before 9 a. m.		9 to 12.		12 to 3.		After 3 p. m.		Total hours.		Hours sunrise to sunset.	
	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.
1	0	00	0	00	0	00	0	00	0	00	14	04	2	20	2	50	2	50	3	15	11	15	15	05
2	1	00	3	00	1	00	0	45	5	45	14	08	2	45	3	00	3	00	3	30	12	15	15	06
3	0	00	0	00	0	00	0	00	0	00	14	10	3	15	3	00	2	50	3	20	12	25	15	07
4	1	10	0	50	1	50	2	00	5	50	14	12	0	40	0	20	3	00	3	20	7	20	15	08
5	2	00	3	00	3	00	3	30	11	30	14	15	3	10	3	00	2	50	3	15	12	15	15	09
6	1	00	2	20	3	00	3	15	9	35	14	17	0	00	0	00	2	20	1	35	3	55	15	11
7	3	15	3	00	3	00	3	10	12	25	14	19	1	30	1	35	3	00	0	00	6	05	15	11
8	0	00	0	00	2	00	3	00	5	00	14	21	0	30	1	25	1	15	0	00	3	10	15	12
9	2	30	3	00	3	00	3	00	11	30	14	23	0	50	0	15	0	30	0	10	1	45	15	12
10	2	30	3	00	3	00	3	10	11	40	14	26	0	30	3	00	3	00	3	25	9	55	15	14
11	2	40	2	00	2	50	3	10	10	40	14	28	3	30	3	00	3	00	0	20	9	50	15	14
12	0	25	0	30	0	40	2	30	4	05	14	31	1	00	2	00	3	00	3	00	9	00	15	15
13	3	15	3	00	3	00	3	20	12	35	14	33	3	00	3	00	3	00	3	10	12	10	15	15
14	1	10	2	40	3	00	2	30	9	20	14	35	0	00	0	00	0	10	1	25	1	35	15	16
15	2	15	2	50	3	00	3	10	11	15	14	37	3	00	3	00	3	00	2	30	11	30	15	16
16	3	10	3	00	2	50	3	00	12	00	14	39	0	00	0	00	1	00	0	00	1	00	15	16
17	0	00	0	30	1	15	3	20	5	05	14	41	1	55	1	30	1	10	2	00	6	35	15	17
18	3	10	1	00	0	00	1	30	5	40	14	43	3	20	3	00	3	00	3	30	12	50	15	16
19	0	00	0	00	0	00	2	40	2	40	14	45	2	50	2	50	2	00	0	25	8	05	15	17
20	3	00	3	00	0	05	0	00	6	05	14	47	0	50	1	30	0	40	1	50	4	50	15	17
21	1	30	0	15	2	25	3	00	7	10	14	49	2	00	2	50	0	00	1	55	6	45	15	17
22	3	15	2	30	0	10	2	35	8	30	14	50	1	20	1	50	2	10	1	40	7	00	15	17
23	0	00	0	00	2	30	3	30	6	00	14	52	2	40	3	00	1	30	1	30	8	40	15	16
24	0	10	1	00	0	15	0	50	2	15	14	54	1	10	0	00	0	00	0	00	1	10	15	16
25	0	25	0	25	0	00	0	00	0	50	14	55	0	00	0	00	0	50	1	30	2	20	15	16
26	0	05	2	10	1	00	3	00	6	15	14	57	2	30	3	00	3	00	3	00	11	30	15	15
27	3	00	3	00	1	00	2	00	9	00	14	58	1	40	2	50	1	40	3	00	9	10	15	15
28	0	00	0	00	0	20	1	40	2	00	14	59	2	15	2	40	1	35	1	45	8	15	15	15
29	1	10	0	20	2	30	2	00	6	00	15	01	3	20	1	30	2	50	3	20	11	00	15	14
30	3	00	3	00	2	55	1	30	10	25	15	03	3	15	3	00	3	00	3	15	12	30	15	14
31	1	00	2	40	0	20	1	10	5	10	15	04	....		....		....		....		....		....	
Total hours	46	05	52	00	49	55	68	15	216	15	453	16	55	05	58	55	61	10	60	55	236	05	456	49
Per cent. of possible	34.2		55.9		53.7		51.7		47.7		....		39.8		65.4		67.9		43.9		51.7		....	

SUNSHINE RECORD — (*Continued.*)

DATE.	July.												August.											
	Before 9 a. m.		9 to 12.		12 to 3.		After 3 p. m.		Total hours.		Hours sunrise to sunset.		Before 9 a. m.		9 to 12.		12 to 3.		After 3 p. m.		Total hours.		Hours sunrise to sunset.	
	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.
1	2	15	3	00	3	00	3	00	11	15	15	13	0	50	0	50	0	15	0	00	1	55	14	27
2	2	20	3	00	2	05	2	00	9	25	15	13	1	00	2	40	2	20	2	30	8	30	14	25
3	1	10	2	40	0	45	0	30	5	05	15	12	2	00	3	00	2	30	3	00	10	30	14	23
4	0	05	0	25	0	00	0	00	0	30	13	12	2	00	3	00	3	00	0	30	7	30	14	20
5	0	00	0	20	1	30	1	45	3	35	15	10	2	20	2	30	1	00	0	15	6	05	14	17
6	2	25	2	20	1	00	1	30	7	15	15	10	0	30	2	50	3	00	3	30	9	50	14	15
7	0	00	0	00	2	40	2	00	4	40	15	09	2	20	1	20	0	05	1	10	4	55	14	13
8	1	30	0	50	1	00	0	05	3	25	15	07	1	15	2	20	0	10	3	20	7	05	14	10
9	0	00	0	05	0	45	1	35	2	25	15	06	0	05	1	15	0	00	0	00	1	20	14	08
10	3	00	3	00	3	00	2	00	11	00	15	04	0	30	1	15	0	30	2	10	4	25	14	06
11	2	30	2	10	3	00	3	30	11	10	15	04	2	00	2	50	0	10	1	50	6	50	14	03
12	2	00	3	00	2	50	3	00	10	50	15	02	0	30	1	55	0	00	2	30	4	55	14	01
13	0	40	0	00	0	00	0	00	0	40	15	01	0	20	0	00	0	00	2	30	2	50	13	58
14	2	45	1	50	3	00	3	30	11	05	14	59	2	30	3	00	0	00	2	50	8	20	13	56
15	0	00	0	00	2	40	1	45	4	25	14	58	1	45	0	35	0	05	1	50	4	15	13	53
16	3	30	3	00	3	00	3	30	13	00	14	57	0	00	0	00	0	00	1	20	1	20	13	51
17	3	10	2	30	2	30	3	50	12	00	14	55	3	30	2	00	0	00	0	50	6	20	13	48
18	3	00	2	45	2	15	2	20	10	20	14	53	0	15	1	00	0	00	1	00	2	15	13	46
19	0	00	0	00	0	00	0	00	0	00	14	52	1	10	1	40	0	00	1	25	4	15	13	43
20	0	00	0	00	0	00	0	00	0	00	14	50	2	50	1	20	3	00	3	00	10	10	13	40
21	3	00	2	15	2	50	1	45	9	50	14	48	0	00	0	15	0	00	0	00	0	15	13	37
22	2	30	2	00	0	00	0	00	4	30	14	46	3	00	2	40	1	30	0	00	7	10	13	35
23	1	00	1	10	2	30	1	00	5	40	14	44	0	00	0	20	0	00	0	20	0	40	13	32
24	0	00	0	00	0	00	0	00	0	00	14	44	2	40	2	50	1	50	3	00	10	20	13	30
25	2	20	3	00	1	30	3	30	10	20	14	42	3	00	3	00	3	00	3	20	12	20	13	27
26	3	00	3	00	0	00	0	00	6	00	14	40	1	10	0	10	0	00	1	15	2	35	13	24
27	0	00	0	50	0	05	1	20	2	15	14	38	0	00	0	00	2	10	2	00	4	10	13	22
28	2	00	1	15	0	10	1	20	4	45	14	35	0	00	0	00	2	20	2	50	5	10	13	19
29	3	00	1	25	0	00	0	05	4	30	14	33	2	35	3	00	3	00	3	00	11	35	13	17
30	2	30	0	40	0	00	2	00	5	10	14	31	2	30	3	00	3	00	1	40	10	10	13	14
31	2	40	2	10	1	00	2	50	8	40	14	29	0	00	0	50	3	00	2	00	5	50	13	11
Total hours	52	20	48	40	43	05	49	40	193	45	462	17	42	35	51	25	34	55	54	55	183	50	428	51
Per cent. of possible	38.6		52.3		46.3		35.3		41.9		....		35.6		55.3		37.5		44.0		42.8		....	

Sunshine Record — (*Continued*).

DATE.	September.												October.											
	Before 9 a. m.		9 to 12.		12 to 3.		After 3 p. m.		Total hours.		Hours sunrise to sunset.		Before 9 a. m.		9 to 12.		12 to 3.		After 3 p. m.		Total hours.		Hours sunrise to sunset.	
	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs	Min.	Hrs.	Min.
1	2	00	3	00	2	40	3	15	10	55	13	08	0	00	2	10	0	00	0	00	2	10	11	44
2	1	50	2	20	0	00	0	00	4	10	13	06	1	20	1	40	0	00	0	00	3	00	11	41
3	0	00	0	00	0	00	0	00	0	00	13	03	0	00	0	00	0	00	0	00	0	00	11	38
4	2	50	3	00	1	50	1	40	9	20	13	00	0	00	0	00	0	00	0	00	0	00	11	35
5	0	00	0	00	0	00	0	00	0	00	12	58	0	00	0	00	0	00	0	00	0	00	11	32
6	0	00	0	00	0	60	0	00	0	00	12	55	0	00	0	00	0	00	0	00	0	00	11	30
7	1	00	0	50	1	45	1	35	5	10	12	51	0	00	0	00	0	00	0	00	0	00	11	27
8	1	40	3	00	3	00	2	25	10	05	12	49	0	10	0	00	0	00	0	00	0	10	11	24
9	2	35	3	00	0	00	0	00	5	35	12	46	0	00	0	00	0	30	0	30	1	00	11	21
10	0	30	3	00	3	00	1	40	8	10	12	43	1	10	2	50	3	00	1	50	8	50	11	18
11	1	05	3	00	2	20	0	45	7	10	12	40	1	00	3	00	3	00	0	50	7	50	11	15
12	0	40	1	15	0	00	0	00	1	55	12	37	0	00	0	00	0	00	0	00	0	00	11	13
13	0	00	0	00	0	00	0	20	0	20	12	35	0	00	0	00	0	00	0	00	0	00	11	10
14	0	45	1	10	1	05	0	35	3	35	12	32	0	00	0	00	0	00	0	00	0	00	11	07
15	0	00	0	00	2	40	1	05	3	45	12	29	1	15	3	00	0	00	0	00	4	15	11	04
16	1	05	2	40	0	00	0	00	3	45	12	26	0	00	0	00	0	00	0	00	0	00	11	01
17	0	15	0	50	0	00	0	00	1	05	12	24	0	00	0	00	0	00	0	00	0	00	10	59
18	1	35	1	40	0	00	0	40	3	55	12	21	0	00	0	00	0	00	0	00	0	00	10	56
19	0	00	0	00	0	00	0	00	0	00	12	18	0	00	0	00	0	00	0	00	0	00	10	53
20	0	20	2	50	0	00	0	00	3	10	12	15	0	00	0	00	0	00	0	00	0	00	10	51
21	0	00	0	00	0	00	0	00	0	00	12	13	0	00	0	00	0	00	0	00	0	00	10	48
22	0	00	0	00	0	00	0	00	0	00	12	10	0	00	1	00	2	45	1	25	5	10	10	45
23	0	40	0	30	0	00	0	00	1	10	12	06	1	05	3	00	0	10	0	00	4	15	10	42
24	0	00	0	00	0	00	0	00	0	00	12	03	0	00	0	00	1	00	1	30	2	30	10	40
25	0	20	0	00	0	00	0	00	0	20	12	01	0	00	0	30	0	00	1	00	1	30	10	38
26	0	00	0	00	0	00	0	20	0	20	11	58	1	00	3	00	3	00	1	00	8	00	10	36
27	0	00	0	15	0	40	0	45	1	40	11	55	1	50	3	00	3	00	1	45	9	35	10	33
28	0	00	0	45	0	00	0	00	0	45	11	52	0	00	0	00	0	00	0	00	0	00	10	30
29	0	00	0	00	0	00	0	00	0	00	11	50	0	35	2	15	1	45	0	45	5	20	10	27
30	2	15	2	15	1	30	0	00	6	00	11	47	0	00	0	00	0	50	1	40	2	30	10	25
31	....	....	....	....	....	....	....	....	....	....	....	....	1	40	3	00	3	00	1	50	9	30	10	21
Total hours	21	25	35	20	20	30	15	05	92	20	373	51	11	05	28	25	22	00	14	05	75	35	342	04
Per cent. of possible	21.5		39.3		22.8		16.2		24.7		....		12.9		30.0		23.7		19.9		22.1		....	

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SUNSHINE RECORD — (*Concluded*).

DATE.	November. Before 9 a. m. Hrs.	Min.	9 to 12. Hrs.	Min.	12 to 3. Hrs.	Min.	After 3 p. m. Hrs.	Min.	Total hours. Hrs.	Min.	Hours sunrise to sunset. Hrs.	Min.
1	0	10	3	00	2	50	0	50	6	50	10	19
2	1	30	3	00	3	00	1	25	8	55	10	17
3	0	15	3	00	3	00	0	50	7	05	10	15
4	0	00	0	00	1	30	0	00	1	30	10	11
5	0	00	0	00	0	00	0	00	0	00	10	09
6	0	00	1	00	1	30	0	00	2	30	10	07
7	0	00	0	15	1	40	0	00	1	55	10	05
8	0	00	1	15	1	30	0	15	3	00	10	02
9	0	05	1	10	0	15	0	50	2	20	10	00
10	1	30	2	50	1	45	0	00	6	05	9	58
11	0	00	0	00	0	50	1	00	1	50	9	56
12	0	00	0	40	2	50	1	10	4	40	9	53
13	0	00	0	00	0	20	0	00	0	20	9	51
14	0	20	0	00	1	10	1	30	3	00	9	49
15	0	00	0	10	1	50	0	20	2	20	9	46
16	0	20	2	50	3	00	0	40	6	50	9	44
17	0	00	0	10	0	00	0	00	0	10	9	42
18	1	00	2	50	0	30	0	00	4	20	9	40
19	0	00	0	00	0	40	0	00	0	40	9	39
20	0	15	0	30	0	20	0	00	1	05	9	36
21	0	00	0	00	0	00	0	00	0	00	9	34
22	0	00	0	00	0	00	0	00	0	00	9	33
23	1	30	1	50	1	00	0	00	4	20	9	31
24	0	00	0	00	0	00	0	00	0	00	9	30
25	0	00	0	00	0	00	0	00	0	00	9	27
26	0	00	2	50	2	10	0	10	5	10	9	26
27	0	00	0	00	0	00	0	00	0	00	9	24
28	0	00	0	00	0	00	0	00	0	00	9	23
29	0	00	0	30	0	00	0	10	0	40	9	21
30	0	40	1	00	2	20	0	10	4	10	9	20
31	...	...	...	...	...	...	...	...	...	...	...	...
Total hours	7	35	28	50	35	00	9	20	80	45	293	28
Per cent. of possible	11.8		32.0		38.9		18.9		27.5		....	

DATE.	December. Before 9 a. m. Hrs.	Min.	9 to 12. Hrs.	Min.	12 to 3. Hrs.	Min.	After 3 p. m. Hrs.	Min.	Total hours. Hrs.	Min.	Hours sunrise to sunset. Hrs.	Min.
1	0	45	2	30	3	00	1	20	7	35	9	19
2	0	00	1	30	0	05	0	10	1	45	9	17
3	0	20	2	40	2	50	0	10	6	00	9	16
4	0	05	0	45	0	00	0	00	0	50	9	15
5	0	00	0	00	0	00	0	00	0	00	9	14
6	0	45	3	00	3	00	0	40	7	25	9	13
7	0	00	0	00	0	00	0	00	0	00	9	12
8	0	00	0	00	0	00	0	00	0	00	9	11
9	0	00	0	00	0	00	0	00	0	00	9	10
10	0	00	0	15	0	00	0	15	0	30	9	09
11	0	00	0	00	0	00	0	00	0	00	9	08
12	0	00	0	50	1	40	0	10	2	40	9	08
13	0	30	3	00	3	00	0	15	6	45	9	07
14	0	00	0	00	2	30	0	50	3	20	9	07
15	0	00	0	15	0	15	0	00	0	30	9	06
16	0	00	0	00	0	00	0	00	0	00	9	06
17	1	15	3	00	2	50	0	00	7	05	9	05
18	0	00	0	00	0	00	0	00	0	00	9	04
19	0	00	1	00	2	30	0	10	3	40	9	05
20	0	00	0	30	0	00	0	00	0	30	9	05
21	0	00	0	00	0	00	0	00	0	00	9	05
22	0	00	0	00	0	00	0	00	0	00	9	05
23	0	00	0	00	0	00	0	00	0	00	9	05
24	0	00	0	00	1	35	0	35	2	10	9	05
25	0	00	0	25	0	20	0	00	0	45	9	05
26	0	00	0	00	0	00	0	00	0	00	9	06
27	1	00	3	00	3	00	1	20	8	20	9	06
28	1	00	3	00	1	50	0	45	6	35	9	06
29	0	00	0	00	0	00	0	00	0	00	9	07
30	0	00	0	00	0	00	0	15	0	15	9	08
31	0	00	0	00	0	15	0	00	0	15	9	08
Total hours	5	40	25	40	28	40	6	55	66	55	283	23
Per cent. of possible	11.2		27.6		30.8		14.8		23.6		....	

Summary of Sunshine Record for 1896.

	Before 9 a. m.		9 to 12.		12 to 3.		After 3 p. m.		Total hours.		Hours sunrise to sunset.	
	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.
January	2	10	11	50	16	55	8	25	39	20	293	54
February	4	55	20	35	26	05	20	55	72	30	306	45
March	24	10	41	50	35	00	26	35	127	35	371	09
April	12	15	28	50	28	10	22	15	91	30	402	03
May	46	05	52	00	49	55	68	15	216	15	453	6
June	55	05	58	55	61	10	60	55	236	05	456	49
July	52	20	48	40	43	05	49	40	193	45	462	17
August	42	35	51	25	34	55	54	55	183	50	428	51
September	21	25	35	20	20	30	15	05	92	20	373	51
October	11	05	28	25	22	00	14	05	75	35	342	04
November	7	35	28	50	35	00	9	20	80	45	293	28
December	5	40	25	40	28	40	6	55	66	55	283	23

READING OF MAXIMUM AND MINIMUM THERMOMETERS AT 7 A. M.

DATE.	JANUARY.		FEBRUARY.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		OCTOBER.		NOVEMBER.		DECEMBER.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1	29.5	20.5	36.0	30.0	36.5	29.0	55.0	28.0	72.0	43.0	63.0	57.5	78.5	55.5	73 0	54.0	70.0	47.0	65.0	47.0	66.0	45.5	29.0	16.0
2	27.0	18.0	46.0	31.0	32.0	19.0	48.0	30.0	68.0	51.0	64.0	48.0	91.5	62.0	77.5	60.0	66.0	42.5	60.0	40.0	64.0	38.0	26.0	13.0
3	42.0	25.0	33.0	17.5	32.0	13.0	40.5	20.0	68.0	50.0	65.0	41.0	94.0	67.0	77.0	59.0	75.0	48.0	65.5	42.0	55.0	37.0	32.0	13.0
4	26.0	10.0	31.0	18.0	20.0	11.0	26.0	19.0	74.0	46.0	81.0	54.0	89.5	65.5	82.0	59.0	74.5	47.0	50.5	45.5	63.5	38.0	30.0	16.0
5	14.0	04.5	35.5	29.5	15.0	09.0	32.0	19.0	77.5	57.0	81.0	54.0	82.0	62.0	89.0	68.0	64.0	44.0	53.0	47.0	62.0	50.0	36.5	18.5
6	08.0	-16.5	37.0	31.0	25.0	10.0	41.0	27.0	70.0	47.0	85.0	63.0	71.0	62.0	96.0	70.0	63.0	47.5	51.0	42.0	66.0	41.0	42.5	36.0
7	12.5	-10.0	37.5	30.0	41.0	18.0	48.0	26.0	65.0	40.0	78.0	64.0	81.5	59.0	96.0	70.0	72.5	52.5	53.0	44.0	48.0	34.0	55.5	33.0
8	19.5	04.0	33.0	25.0	41.0	18.0	37.0	28.0	71.5	49.0	88.5	64.0	72.0	55.0	88.0	67.0	71.0	47.0	50.0	37.0	60.0	34.0	35.5	32.0
9	22.0	09.0	32.0	23.5	28.0	20.0	45.0	25.5	73.0	52.0	83.0	64.0	79.5	60.0	89.0	71.0	75.0	48.0	48.0	34.5	49.0	29.0	41.5	33.0
10	22.0	15.5	27.0	18.0	27.0	19.0	51.5	29.0	86.5	69.0	82.5	55.0	81.5	58.0	88.0	70.0	78.0	52.0	48.0	29.0	41.0	25.0	42.5	32.0
11	21.0	16.0	34.0	21.0	31.0	15.0	46.0	34.0	87.5	68.0	65.0	51.0	80.0	65.0	90.0	72.0	86.0	57.0	56.0	32.0	44.5	25.0	43.0	33.0
12	22.0	16.0	27.0	13.0	23.0	13.0	51.5	38.5	82.5	53.0	70.0	53.0	88.0	68.0	89.5	68.0	95.0	66.0	58.0	41.5	57.0	37.5	41.0	32.0
13	40.0	18.0	29.0	13.0	17.0	04.5	65.0	49.5	66.0	43.0	72.0	43.5	92.0	78.0	87.0	64.0	79.5	61.0	53.0	43.0	48.0	32.0	52.0	33.5
14	22.0	17.0	37.0	12.0	21.0	03.0	83.0	51.0	75.0	48.0	76.0	52.0	79.0	65.0	77.0	62.0	72.5	58.0	48.0	42.5	38.0	25.0	58.0	31.5
15	23.0	13.0	32.0	19.0	25.0	12.0	74.0	46.0	83.0	61.0	72.5	50.0	81.0	65.0	83.0	57.0	82.5	61.0	53.5	41.0	43.0	23.5	34.0	16.5
16	22.0	09.0	48.0	07.5	24.0	16.0	81.5	51.0	74.0	55.0	75.0	56.0	86.0	52.0	87.0	65.0	69.0	45.0	64.0	36.5	58.5	38.0	27.5	16.0
17	34.0	23.0	11.0	-21 0	29.0	18.0	87.0	60.0	79.0	56.0	74.0	57.0	71.0	52.0	83.0	54.0	70.5	50.0	50.0	37.0	67.0	46.0	25.0	18.0
18	35.0	21.5	04.0	-08.0	34.0	23.0	82.5	54.0	80.0	57.5	74.0	54.0	76.0	49.0	71.0	52.5	74.5	51.0	40.0	36.5	66.5	44.0	37.0	18.5
19	36.0	26.0	21.0	08.0	41.5	26.0	80.0	60.0	77.5	56.0	83.0	56.0	81.5	59.0	70.0	51.0	75.0	52.0	45.5	29.0	70.0	37.0	39.5	20.0
20	35.0	31.0	28.5	09.0	35.5	19.0	83.0	50.0	58.0	40.0	88.0	62.5	76.0	65.0	65.0	46.0	62.0	42.5	45.0	30.5	40.0	20.0	24.5	17.5
21	33.0	21.0	12.0	06.0	20.5	12.0	75.0	53.0	69.5	43.0	89.0	67.0	78.5	66.0	72.0	53.0	61.5	42.0	51.0	43.0	33.5	19.5	20.5	19.5
22	35.0	21.0	14.0	10.5	44.0	16.0	66.0	35.0	71.0	54.0	84.0	66.0	88.5	65.0	75.0	57.0	68.0	47.0	48.0	32.0	41.0	31.0	28.5	8.0
23	29.0	17.0	41.0	22.0	37.5	08.0	52.0	36.0	63.0	43.0	78.0	49.0	86.0	57.5	83.0	61.0	53.0	36.0	49.0	30.0	33.0	25.0	20.0	10.0
24	34.0	28.0	43.0	35.0	22.0	-02.0	62.0	38.0	63.0	43.0	72.0	50.0	70.0	55.0	82 0	61.0	52.0	39.0	56.0	29.5	46.5	20.0	16.0	8.0
25	36.0	31.0	37.0	09.0	25.0	15.0	57.0	42,0	75.0	50.0	65.0	56.5	63.0	55.5	81.0	51.0	52.0	39.0	45.5	32.5	52.0	35.0	21.0	6.5
26	39.0	30.0	19.0	07.5	39.5	35.0	59.0	42.0	75.0	47.0	72.0	56.0	78.0	55.0	78 0	57.0	75.0	55.0	44.0	29.5	54.0	36.0	28.0	11.0
27	32.0	15.0	34.0	18.0	40.0	13.0	65.0	42.0	81.5	56.5	81.0	55.0	83.0	66 0	82 0	51.0	80.0	57.0	62.5	31.0	69.0	52.0	33.0	2.5
28	26.5	19.5	40.5	23.0	26.0	16.0	62.0	51.0	73.0	50.0	79.5	56.0	83 0	65 0	70.0	51.0	69.0	49.5	64.0	40.0	65.0	40.0	21.0	2.0
29	27.0	13.0	49.0	32.0	40.0	32.0	60.0	50.0	71.0	51.0	78.0	56.0	88.5	65.0	68.0	44.0	66.0	49.0	65 0	42.0	41.0	25.0	31.0	11.5
30	44.0	26.0	......	......	50.0	38.0	66.0	38.0	62.5	48.5	75.0	46.0	87.0	66.0	72.0	51.0	67.0	59.0	77.5	53.0	29.5	20.0	41.0	29.5
31	35.0	11.0	......	......	56.5	32.0	.....	.....	71.0	50.0	.....	...	88.5	58.0	83.5	57.5	......	......	69.0	49.0	......	......	46.0	35.0
Average	28.5	16.2	31.3	16.9	31.6	17.1	59.4	39.1	73.0	50.9	76.5	55.2	81.5	61.2	80.8	59.2	70.6	49.7	54.5	38.4	52.4	33.4	34.1	20.1

READINGS OF THE STANDARD AIR THERMOMETER.

DATE.	January.			February.			March.			April.			May.			June.		
	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.
1	22.0	22.5	23.0	35.0	39.0	42.0	30.0	30.0	28.0	30.0	41.0	46.0	34.0	63.0	64.0	51.0	60.0	60.0
2	26.0	35.5	32.0	31.0	29.5	25.0	19.0	20.0	17.0	34.0	35.0	26.0	53.0	67.0	61.0	52.0	63.0	60.0
3	25.0	24.0	19.0	18.0	22.0	25.0	14.0	13.0	16.0	21.0	24.0	26.0	58.0	72.0	65.0	49.0	72.0	73.0
4	10.0	12.0	8.0	30.0	33.0	35.0	12.5	13.0	12.0	20.0	27.0	27.5	52.0	72.0	70.0	62.0	77.0	76.0
5	4.5	5.0	-1.0	21.0	36.0	35.0	10.0	22.5	22.0	30.5	37.0	35.0	56.0	68.0	65.0	65.0	84.0	81.0
6	-15.0	-1.0	-9.5	34.0	34.0	34.0	18.0	34.0	40.0	30.0	43.0	32.0	51.0	65.0	56.0	69.0	68.0	76.0
7	12.0	16.5	12.0	30.0	30.5	30.0	37.0	35.0	30.0	27.0	35.0	32.0	47.0	68.0	65.0	74.0	85.0	79.0
8	10.0	17.0	13.0	27.0	31.0	27.0	26.0	26.5	25.0	31.0	43.0	37.0	56.0	62.0	71.0	67.0	68.0	67.0
9	21.0	23.0	27.0	24.0	26.0	22.0	21.0	24.0	23.0	29.0	49.0	46.0	69.0	83.5	81.0	69.0	71.0	60.0
10	18.0	20.0	18.0	25.0	30.0	29.0	19.0	29.0	24.0	35.0	44.0	44.0	76.0	86.0	82.0	55.0	63.0	60.0
11	16.0	25.0	22.0	21.0	24.0	17.0	15.0	21.0	11.0	39.0	46.0	49.0	71.0	82.0	79.0	55.0	67.0	66.0
12	30.0	33.0	30.0	17.0	26.0	19.0	13.0	14.0	11.0	46.0	58.0	62.0	55.0	65.0	61.0	57.0	71.0	67.0
13	18.0	19.0	18.0	29.0	34.0	34.0	5.5	19.0	21.0	52.0	82.0	68.0	54.0	73.0	65.0	55.0	74.0	66.0
14	20.0	23.0	19.0	22.0	28.0	23.0	8.0	23.0	20.0	56.0	66.0	65.0	56.0	79.0	76.0	61.0	71.0	65.0
15	13.0	21.0	15.0	27.0	46.0	35.0	17.0	21.0	23.0	63.0	78.0	73.0	67.0	71.0	67.0	59.5	72.0	71.0
16	12.0	28.0	23.0	8.0	8.0	-0.0	19.0	27.5	25.0	61.0	83.0	69.0	62.0	76.0	71.0	61.0	72.0	67.0
17	29.0	34.0	29.0	-20.5	2.0	-6.0	19.0	32.0	30.0	68.0	81.0	69.0	58.0	71.0	74.0	60.0	70.0	68.0
18	26.0	34.0	34.0	-4.0	14.0	20.0	26.0	40.0	35.0	61.0	80.0	73.0	69.0	77.0	69.0	60.0	80.0	75.0
19	33.0	34.0	32.0	12.5	24.0	17.0	29.0	23.0	32.0	64.0	81.0	67.0	57.0	51.0	57.0	63.0	85.0	76.0
20	31.0	31.5	32.0	9.0	12.0	8.0	20.0	17.0	14.5	54.0	72.0	63.0	44.0	66.0	66.0	71.0	88.0	75.0
21	32.0	31.0	31.0	8.0	12.5	12.0	16.0	35.0	36.0	55.0	63.0	56.0	54.0	62.0	64.0	79.0	69.0	78.0
22	21.0	21.5	19.0	12.5	29.0	31.0	37.0	30.0	20.0	37.0	49.0	49.0	70.0	81.0	74.0	70.0	76.5	69.0
23	28.0	34.0	34.0	40.0	43.0	40.0	9.0	20.0	14.0	44.0	58.0	54.0	51.0	59.0	59.0	58.0	72.0	68.0
24	31.5	31.5	33.0	36.0	33.5	25.0	-1.0	24.0	19.5	43.0	57.0	51.5	50.0	72.0	70.0	60.0	62.0	59.5
25	36.0	38.5	35.0	10.0	11.0	10.0	23.0	39.0	38.0	46.0	51.0	54.0	59.0	68.0	61.0	58.0	62.0	66.0
26	15.0	31.0	31.0	18.5	26.0	27.0	38.0	35.0	20.5	53.0	62.0	57.5	65.0	79.5	72.0	71.0	80.0	74.0
27	15.0	20.0	21.0	23.0	35.0	32.0	13.0	21.0	19.0	54.0	64.0	56.0	60.0	72.0	62.0	65.0	78.0	75.0
28	25.0	24.0	17.0	40.0	47.0	44.0	18.0	35.5	34.0	52.0	60.0	56.0	54.0	60.0	64.0	71.0	76.0	70.0
29	26.0	37.0	33.0	32.0	32.5	32.0	39.0	46.0	42.5	52.5	65.0	54.0	53.0	58.0	59.0	66.0	69.0	66.0
30	28.0	30.0	27.0	......	......	......	42.0	54.0	46.0	44.0	69.0	68.0	56.0	68.0	60.0	56.5	71.5	75.0
31	12.0	29.5	33.0	......	......	......	34.0	54.0	46.5	......	......	......	64.0	61.0	58.0	......	......	......
Average	20.4	25.4	22.9	21.6	27.5	25.2	20.8	28.3	25.7	44.4	56.8	52.2	57.7	69.6	66.7	62.3	72.6	69.6

READINGS OF THE STANDARD AIR THERMOMETER — (*Concluded*).

DATE.	July.			August.			September.			October.			November.			December.		
	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.
1	67.0	87.0	81.0	61.0	72.0	66.0	50.0	64.5	59.0	50.0	60.0	53.0	47.0	63.0	51.5	16.0	24.0	18.0
2	69.0	91.0	83.5	66.0	72.0	72.5	49.0	70.0	70.0	43.0	53.0	50.0	39.0	52.5	43.5	13.0	20.0	19.5
3	73.0	88.0	76.0	63.0	78.0	77.5	67.0	71.0	59.0	46.0	49.0	49.0	38.0	59.0	54.5	17.0	28.0	23.0
4	72.0	81.0	70.0	70.0	86.5	80.0	52.0	60.5	55.0	49.0	52.0	50.5	51.5	58.0	56.0	19.0	30.0	31.0
5	64.0	69.0	72.0	73.0	92.0	87.0	48.0	61.5	58.0	47.0	50.0	49.0	57.0	62.5	64.0	36.5	41.5	41.0
6	67.0	79.5	76.0	75.0	88.0	72.0	63.0	70.0	64.0	46.0	57.0	50.5	41.0	46.0	45.0	39.0	53.0	38.0
7	61.0	61.0	65.0	72.5	85.0	81.0	55.0	69.0	64.0	45.0	47.5	39.0	33.0	55.5	50.5	33.0	35.5	33.0
8	61.0	76.0	74.0	72.0	86.0	85.0	52.0	73.0	66.0	38.0	41.0	40 0	37.0	45.0	39.0	34.5	38.3	39.0
9	63.0	75.5	78.0	76.0	87.0	82.0	53.0	75.0	67.0	37.5	45.0	40.0	32.0	38.0	32.0	33.0	37.0	38.0
10	67.0	81.0	79.0	76.0	89.0	84.0	57.0	80.0	80.0	31.5	54.0	51.0	26.0	42.0	43.5	38.0	41.0	36.0
11	68.0	84.0	84.0	76.0	86.0	82.5	65.0	92.0	82.0	43.0	57.5	51.0	42.5	50.0	41.0	35.0	39.0	39.0
12	76.0	89.0	85.0	71.0	82.0	82.0	67.0	79.0	70.0	41.0	50.0	50.0	40.0	45.0	36.0	34.0	47.0	44.0
13	77.0	73.0	73.0	67.0	76.0	69.0	64.0	67.0	65.0	43.5	46.5	45.5	34.0	35.5	32.0	42.0	57.5	42.5
14	68.0	78.0	74.0	67.0	79.5	77.0	62.0	79.0	70.0	45.5	50.0	50.0	25.5	32.0	21.0	32.0	33.0	23.5
15	74.0	82.0	71.0	57.0	82.0	82.0	63.0	67.0	65.0	44.0	62.5	54.0	38.5	54.0	49.0	17.0	25.0	24.0
16	58.0	69.0	66.0	72.0	70.0	70.0	50.0	68.0	60.0	49.0	50.0	42.0	47.0	64.0	58.0	20.0	22.0	23.0
17	60.0	71.5	71.0	54.0	68.0	65.0	57.5	72.0	67.0	38.0	41.0	41.5	63.0	65.0	52.0	19.0	32.0	28.0
18	60.0	78.0	77.0	55.5	66.0	62.0	52.0	69.0	65.0	39.0	40.0	38.5	51.0	68.0	66.5	36.0	36.0	36.0
19	67.0	70.0	74.0	53.0	62.0	61.0	56.0	58.0	45.5	31.0	43.0	36.0	38.0	36.0	26.5	20.5	23.5	22.5
20	67.0	72.0	73.0	53.5	70.5	66.0	45.0	55.0	54.0	44.0	47.5	46.0	20.0	28.0	28.0	20.0	30.0	26.5
21	72.0	85.0	79.0	60.0	72.0	66.5	48.0	62.0	60.0	45.5	42.0	39.0	33.0	36.0	41.0	20.5	19.0	15.0
22	70.0	86.0	72.0	61.5	78.0	77.0	52.0	50.9	44.0	35.0	46.0	40.0	31.5	31.0	31.0	8.0	17.0	17.0
23	60.0	69.0	66.0	75.0	74.0	75.0	37.0	48.0	45.0	30.0	53.0	47.0	28.0	40.0	40.0	15.0	13.0	10.0
24	61.0	58.0	68.0	65.0	78.0	69.0	50.0	65.0	59.0	40.0	42.0	38.0	46.0	46.5	39.0	8.0	10.0	10.5
25	60.0	74.0	73.0	57.0	77.0	72.0	50.0	65.0	59.0	34.5	43.0	39.0	37.0	43.0	40.0	21.0	25.0	21.0
26	72.0	83.0	76.0	62.0	77.5	77.0	59.0	80.0	68.0	32.5	58.5	51.5	53.0	65.0	60.0	28.0	31.0	26.0
27	70.0	80.0	75.0	55.5	67.0	62.0	64.0	68.0	56.0	40.0	62.0	57.0	62.0	61.0	57.0	3.0	17.0	9.0
28	72.0	84.0	80.0	56.0	67.0	61.0	51.0	59.0	56.0	43.0	59.0	57.0	40.5	36.0	33.0	12.0	28.0	26.5
29	72.0	85.0	81.0	52.0	69.0	67.0	52.0	66.0	62.0	54.5	68.0	66.0	26.0	28.0	25.0	30.0	42.0	37.0
30	72.0	82.0	80.5	64.0	80.0	76.0	60.0	62.0	53.0	56.5	59.0	61.0	20.0	26.0	21.0	36.0	40.0	44.0
31	63.0	71.0	70.5	58.0	67.0	61.0	....	....	....	50.5	64.0	57.0	......	......	......	35.0	30.0	25.0
Average	67.2	77.8	75.0	64.4	76.9	73.1	55.0	67.5	61.6	42.5	51.4	47.7	39.3	47.1	42.8	24.9	31.1	28.0

PRECIPITATION BY MONTHS SINCE 1882.

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
1882	......	......	......	......	......	3.69	2.42	2.37	1.25	0.62	1.22	0.55	......
1883	0.48	1.44	0.88	1.58	4.45	4.12	2.98	3.47	2.12	2.10	1.54	0.73	25.89
1884	1.83	2.01	2.54	0.83	2.49	2.01	2.33	1.44	3.17	1.67	1.01	0.97	22.30
1885	1.07	0.61	0.12	1.26	1.58	2.49	4.64	5.02	2.11	2.88	1.36	0.76	23.90
1886	1.13	0.95	1.13	4.13	1.92	2.92	4.41	2.86	2.31	1.79	3.48	1.24	27.87
1887	0.18	2.97	0.48	1.37	0.46	2.01	6.37	3.03	0.75	1.74	1.58	1.35	22.29
1888	0.78	1.04	1.43	3.09	2 79	3.88	0.99+	4.02	2.73	3.47	2.02	1.24+	27.48
1889	2.99+	0.25	0.66+	3.28	1.21	7.47	4.57	1.98	2.50	3.32	3.44	1.62	32.28
1890	2.16	1.45	2.16	2.20	5.49	5.26	1.07	4.34	5.81	4.54	2.40	......	36.88
1891	1.44	1.57	3.25	1.63	0.49	4.31	3.52	3.16	0.47	2.65	0.74	3.29	27.52
1892	0.57	0.88	0.55	0.67	4.04	3.95	1.89	4.77	1.12	1.34	2.67	0.72	23.17
1893	1.62	3.71	1.94	2.59	4.92	3.08	3.68	5.38	2.68	1.59	1.09	1.56	33.84
1894	2.21	2.71	1.36	2.43	7.03	1.77	1.50	1.22	4 64	3.59	0.43	0.47	29.36
1895	0.96	—0.00	0.29	1.33	2.88	......	......	2.66	0.94	0.72	2.31	2.49	......
1896	1.19	2.28	0.84	0.41	2.31	3.71	4.12	3.33	4.27	2.26	2.18	0.71	27.61

READING OF SOIL THERMOMETERS.

DATE.	One Inch.			Two Inches.			Three Inches.			Six Inches.			Nine Inches.			Eighteen Inches.		
	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.
June 1	66.0	67.0	64.0	66.0	67.5	65.0	65.0	66.0	65.0	65.0	66.0	64.5	65.5	65.0	65.0	66.0	66.0	66.0
2	67.0	70.0	68.0	66.5	69.0	68.0	67.0	68.5	67.0	68.5	78.0	67.5	68.0	69.0	68.0	66.0	66.0	66.0
3	61.5	64.0	63.0	61.5	64.0	63.5	61.0	64.5	63.5	64.0	64.0	64.0	64.5	64.5	64.0	65.5	65.5	65.5
4	59.5	62.5	61.0	60.5	63.0	62.0	60.5	62.0	61.5	62.0	62.0	62.0	63.0	63.5	63.0	65.0	65.0	65.0
5	62.0	69.0	68.0	62.0	69.0	68.0	62.5	68.5	67.5	63.0	68.5	67.0	63.5	65.0	64.5	65.0	65.5	65.5
6	63.0	65.0	64.0	63.5	65.5	64.5	63.0	64.0	63.0	62.0	63.0	63.0	63.0	64.0	64.0	65.0	65.0	65.0
7	63.0	75.0	73.0	63.5	75.5	73.0	63.0	75.0	72.0	64.0	74.0	71.5	64.0	68.0	69.0	65.0	65.5	65.5
8	64.0	76.0	73.0	64.0	74.0	73.0	64.0	73.0	73.0	63.5	71.0	69.0	63.0	68.0	67.0	65.0	65.5	65.0
9	63.0	77.5	73.0	63.0	75.0	72.5	63.0	74.0	72.0	64.5	70.5	71.0	64.5	68.0	68.0	65.0	65.5	65.5
10	61.0	65.0	63.0	61.0	65.5	63.5	61.0	65.0	62.0	62.0	64.0	62.0	63.0	64.5	63.0	65.0	65.0	65.0
11	62.0	63.0	62.0	62.0	63.0	62.5	62.5	63.5	62.0	63.0	64.0	63.0	63.5	64.5	64.0	64.5	65.0	65.0
12	61.0	63.0	62.0	61.0	63.0	61.0	61.0	62.0	61.0	62.0	63.0	61.5	63.0	63.5	62.0	64.5	64.5	64.5
13	55.0	60.0	58.0	55.0	60.5	58.0	56.0	62.0	58.0	56.0	62.0	58.0	57.0	63.0	60.0	63.5	63.5	63.0
14	58.0	62.0	60.0	58.5	62.0	60.5	58.0	62.5	62.0	59.0	63.0	63.0	60.0	65.0	64.0	63.0	63.0	63.0
15	58.0	63.0	62.0	58.0	63.5	62.0	58.0	63.0	63.0	59.0	64.0	63.0	60.0	65.0	64.0	63.0	63.0	63.0
16	59.0	62.0	60.0	59.0	63.0	61.5	58.0	63.0	62.0	59.0	64.0	62.5	64.0	65.0	63.0	63.0	63.0	63.0
17	58.0	60.0	59.0	58.0	61.5	59.0	59.0	62.0	59.0	59.5	62.5	60.0	60.0	63.0	62.0	62.5	63.0	62.5
18	60.0	71.0	65.0	60.5	71.5	65.0	60.0	71.0	74.0	61.0	72.0	73.0	62.0	70.0	68.0	63.0	63.0	63.0
19	58.0	68.0	62.0	58.0	68.0	62.5	58.0	68.0	61.0	59.0	69.0	60.0	60.0	68.0	63.0	63.0	63.0	63.5
20	61.5	64.0	63.0	61.5	64.5	63.5	61.0	64.0	63.5	64.0	64.5	64.0	63.0	64.5	64.0	63.5	63.5	63.5
21	59.5	62.5	60.0	60.0	63.0	60.5	60.5	62.0	60.0	62.0	62.0	62.0	63.6	63.0	62.5	63.0	63.0	63.0
22	61.0	63.0	59.0	61.0	63.5	68.5	61.5	64.0	59.0	62.0	63.0	60.0	63.0	64.0	61.5	63.0	63.0	63.0
23	55.0	62.0	58.0	55.0	62.0	58.5	55.0	62.5	59.0	57.0	63.0	60.0	58.0	65.0	62.0	62.5	63.0	63.0
24	61.5	64.0	63.0	61.5	64.5	63.5	61.0	64.0	63.5	64.0	64.5	64.0	64.5	61.5	64.0	63.5	63.5	64.5
25	59.5	62.5	65.5	60.5	63.0	66.0	60.5	62.0	65.5	60.5	62.0	64.5	63.0	62.0	63.0	63.0	63.0	62.5
26	65.0	78.0	72.5	65.0	78.0	73.0	63.0	75.0	72.5	63.5	66.5	70.0	63.0	64.0	66.0	62.0	62.5	62.5
27	63.0	79.0	73.5	63.0	79.0	73.5	62.5	73.0	72.5	64.5	67.0	70.0	64.5	64.5	67.0	63.0	63.5	63.5
28	67.0	75.5	71.5	67.5	75.0	71.5	66.0	73.0	70.5	66.0	67.0	69.0	66.0	65.5	66.5	63.5	64.0	64.0
29	61.5	70.0	69.0	61.5	69.0	69.0	61.5	68.0	69.0	64.0	65.5	68.0	64.5	64.0	65.5	64.0	64.5	64.5
30	57.5	76.0	72.5	57.5	76.0	72.5	58.0	70.0	71.0	62.0	64.0	68.0	63.0	63.0	65.0	63.5	63.0	63.0
Average	61.0	67.3	64.9	61.2	67.4	65.5	61.0	66.5	65.2	62.2	65.5	64.8	62.9	65.0	64.4	63.9	64.1	64.0
Average for depth given	....	64.40	....	....	64.70	....	....	64.23	....	....	64.17	....	....	64.10	....	....	64.00	.....

Reading of Soil Thermometers — (*Continued*).

Date.	One Inch.			Two Inches.			Three Inches.			Six Inches.			Nine Inches.			Eighteen Inches.		
	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m	12 m.	6 p. m.	7 a m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.
July 1	63.0	81.5	77.0	63.0	81.0	76.5	63.0	74.0	75.0	64.5	67.0	71.5	64.5	64.5	64.5	63.5	63.5	63.5
2	57.5	76.0	72.5	57.5	76.0	72.5	58.0	70.0	71.0	62.0	64.0	68,0	63.0	63.0	65.0	62.5	63.0	63.0
3	71.5	85.5	75.5	71.0	83.0	75.5	70.0	78.0	74.5	70.0	71.0	73.0	69.0	69.0	70.0	66.0	66.0	66.0
4	70.0	77.5	73.0	69.5	76.6	72.5	69.0	74.0	72.0	68.5	70.5	71.0	68.5	68.5	69.0	66.0	66.0	66.0
5	68.0	74.0	76.5	68.0	73.0	76.0	68.0	70.0	75.0	67.5	68.5	73.0	67.0	67.5	69.0	66.0	66.0	66.0
6	67.5	80.0	76.0	67.5	78.5	76.0	67.0	76.0	75.5	68.5	70.5	73.0	68.0	68.0	70.0	66.0	66.0	66.0
7	67.0	66.5	71.0	66.5	66.0	70.5	67.0	66.0	71.0	68.5	68.0	70.0	68.0	67.5	68.0	66.5	66.0	66.0
8	63.0	79.0	75.5	63.0	77.0	74.0	63.0	73 5	74.0	66.0	68.0	72.0	66.5	66.5	58.5	66.0	66.0	65.5
9	66.0	72.5	74.0	66.0	71.5	73.5	66 0	70.0	73.0	67.5	68.0	71.0	67.5	67.0	68.0	66.0	66.0	66.0
10	64.0	76.0	73.0	64.0	73.0	73.0	64,0	71.0	73.0	67.0	68.0	71.0	67.0	66.5	68.0	66.0	66.0	66.0
11	65.0	80.5	78.5	65.0	78.0	78.5	65.0	76.5	77.5	68.0	70.0	74.0	66.0	67.5	70.0	66.0	66.0	66.0
12	69.5	81.5	79.5	69.5	80.0	79.0	69.0	77.5	78.5	69.0	70.5	75.5	69.0	59.0	71.5	67.0	67.0	67.0
13	72.5	76.0	75.5	72.0	75.0	75.0	71.5	74.0	74.0	70.5	72.0	73.0	70.5	70.0	70.5	68.0	68.0	67.5
14	69.5	83.5	77.0	69.0	79.0	76.0	68.5	76.5	76.5	70.0	72.0	75.0	69.0	69.5	71.5	67.5	67.5	67.5
15	70.9	78.0	73.5	70.0	76.5	73.0	70.0	74.5	73.5	70.5	73.0	73.5	70.0	70.0	71.0	68.0	68.0	68.0
16	63.0	78.5	71.5	63.0	74.0	71.0	63.5	72.5	72.0	67.5	68.0	72.0	68.0	68.0	69.0	68.0	67.0	67.0
17	63.0	76.5	74 0	63.0	73.5	74.0	63.0	67.5	72.0	67.0	67.5	72.0	67.0	67.0	69.0	67.0	67.0	66.5
18	62.0	77.5	75.0	62.0	75.0	74.5	62.0	73.0	74.0	66.0	68.0	71.0	67.0	66.5	67.5	66.5	66.5	66.0
19	67.5	69.0	71.0	67.5	68.5	70.5	67.0	68.0	70.0	68.5	68.0	68.0	68.0	67.5	67.5	66.5	66.5	66.5
20	67.5	69.0	71.5	67.5	69.0	71.5	67.0	68.0	70.5	68.0	68.0	69.5	68.0	67.0	67.5	66.0	66.0	66.0
21	59.5	80.0	78.0	69.0	79.0	78.0	68.0	75.0	78.0	69.0	71.0	74.0	68.0	68.0	71.0	66.0	66.0	66.5
22	71.0	82.0	74.0	71.0	80.0	74.0	71.0	78.0	74.0	70.0	73.0	74.0	70.0	70.0	72.0	67.5	67.5	68.0
23	65.5	73.0	71.0	65.7	70.5	70.5	66.0	69.0	70.0	69.0	68.0	70.5	70.0	68.5	69.0	68.0	68.0	67.5
24	64.0	64.0	64.0	94.0	64.0	64.0	64.0	64.0	64.0	65.5	66.0	66.0	67.0	66.0	66.0	67.0	67.0	66.0
25	62.0	73.5	71.0	92.0	71.5	70.5	61.0	66.0	69.0	64.0	66.0	99.0	64.0	65.0	67.0	65.5	65.5	65.0
26	67.0	75.0	71.5	66.0	74.0	71.0	64.0	71.0	70.0	65.0	67.0	69.0	65.0	66.0	68.0	66.0	65.5	65.5
27	69.0	74.5	74.0	69.0	73.5	74.0	68.5	72.0	73.0	68.0	69.0	71.0	67.0	67.5	69.0	66.0	66.0	66.0
28	70.5	78.0	79.0	70.0	77.0	79.0	69.0	75.0	76.3	69.5	71.0	74.0	68.5	70.0	71.0	67.0	67.0	67.0
29	70.0	81.0	76.0	70.5	78.5	76.0	69.0	75.0	76.0	71.0	72.0	74.0	69.0	70.0	72.0	68.0	68.0	68.0
30	71.5	77.5	78.0	71.0	76.5	77.5	70.5	74.5	76.5	71.5	72.5	75.0	70.5	70.0	72.0	68.5	68.5	68.5
31	68.5	76.5	74.0	68.0	74.5	73.0	68.5	73.0	73.0	71.0	71.5	73.0	71.0	70.0	71.0	69.0	69.0	69.0
Average	67.0	76.6	74.2	66.8	74.9	73.9	66.5	72.4	73.3	68.0	69.3	71.8	67.8	67.8	69.1	66.6	66.5	66.4
Average for depth given	....	72.60	....	....	71.86	....	....	70.73	....	....	69.70	....	....	68.23	....	....	66.50	....

READING OF SOIL THERMOMETERS—(*Continued*).

DATE.	One Inch.			Two Inches.			Three Inches.			Six Inches.			Nine Inches.			Eighteen Inches.		
	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.
August 1	65.0	70.5	68.0	64.5	69.0	68.0	65.0	68.0	68.0	68.0	68.0	69.0	69.0	68.0	68.0	68.5	68.0	68.0
2	68.0	73.5	73.5	67.0	72.0	73.0	66.0	70.0	73.0	67.0	68.0	70.5	67.0	67.0	68.5	67.0	67.0	67.0
3	67.0	75.5	74.5	66.5	73.5	74.0	66.5	71.0	73.5	67.0	68.0	71.5	68.0	68.0	69.0	67.0	67.0	67.0
4	68.0	78.0	75.0	67.5	76.0	74.5	67.0	73.0	74.5	69.0	70.0	72.5	69.0	69.0	70.0	68.0	68.0	68.0
5	71.0	79.0	77.5	70.5	78.5	77.0	70.0	75.0	76.5	70.0	72.0	74.5	70.0	70.0	72.0	68.0	68.5	68.5
6	72.5	80.5	77.0	72.5	79.0	76.5	72.0	77.0	76.0	72.5	74.0	75.0	71.5	72.0	73.0	69.0	69.5	70.0
7	73.0	80.5	80.0	72.5	79.0	79.5	72.0	77.0	78.0	72.5	74.0	76.0	72.0	72.0	73.0	69.0	70.0	70.0
8	73.0	81.0	80.5	73.0	79.0	78.5	72.0	77.0	77.5	73.5	74.0	76.0	73.0	72.0	74.0	70.5	70.5	70.5
9	75.0	81.5	81.0	75.0	80.0	80.0	74.5	78.0	79.0	74.0	75.0	77.0	73.0	73.0	74.0	71.0	71.0	71.0
10	75.0	80.0	79.0	75.0	79.0	78.0	74.0	77.5	78.0	74.5	75.5	76.5	74.0	74.0	74.5	71.5	71.5	71.5
11	73.0	81.5	80.0	73.0	80.6	79.5	73.0	78.0	79.0	74.5	75.0	77.0	74.0	73.5	75.0	71.5	71.5	72.0
12	73.0	80.0	80.5	73.0	79.0	79.0	73.0	77.0	78.0	74.0	75.0	76.5	73.5	73.0	74.0	72.0	72.0	72.0
13	70.0	77.0	74.0	71.0	71.5	74.0	71.5	74.5	73.5	73.0	73.0	74.0	73.0	73.0	73.0	72.0	72.0	71.5
14	69.0	77.5	76.5	69.0	76.0	76.0	69.0	74.0	75.0	71.0	72.0	74.0	71.0	71.0	72.0	71.0	71.0	71.0
15	67.5	75.5	75.5	67.5	74.0	75.0	70.0	73.0	74.0	70.0	71.0	73.0	71.0	70.0	71.0	70.5	70.5	70.0
16	70.5	72.5	73.0	70.0	72.5	73.0	70.0	72.0	72.0	71.0	71.5	71.0	70.5	70.5	70.0	70.0	70.0	70.0
17	63.0	69.5	68.0	64.5	69.0	68.0	64.0	68.0	68.5	68.0	68.0	69.0	69.0	68.0	68.5	70.0	69.0	69.5
18	62.0	67.0	66.0	62.5	66.5	66.0	62.5	66.0	66.5	66.0	66.0	67.5	67.0	66.5	67.0	68.0	68.0	67.5
19	61.0	67.5	67.0	61.0	66.5	66.5	61.0	65.0	66.5	65.0	65.0	67.0	65.5	65.0	66.0	67.0	67.0	66.5
20	57.0	67.5	66.5	57.5	66.5	66.5	58.0	65.0	66.0	63.0	64.0	66.5	64.0	64.0	64.0	66.0	66.0	65.5
21	61.5	66.5	66.0	61.5	66.0	66.0	61.5	64.5	66.0	64.0	64.5	66.0	64.0	64.0	65.5	65.5	65.5	65.5
22	62.5	70.0	71.0	62.5	69.0	70.5	62.0	68.0	70.0	64.5	66.0	68.0	65.0	65.0	65.0	65.5	65.5	65.5
23	69.5	71.0	72.0	69.0	71.0	72.0	68.0	70.0	71.0	68.0	68.5	70.0	67.0	67.0	68.0	66.0	66.0	66.5
24	73.0	71.5	61.5	73.0	71.5	62.0	71.0	71.0	62.5	68.0	70.5	66.0	67.0	68.0	66.5	67.0	66.5	66.0
25	71.0	70.5	65.0	70.5	70.5	65.5	68.5	70.0	66.0	67.0	69.0	68.0	67.0	67.0	67.0	66.0	66.5	66.0
26	63.0	70.5	71.0	63.5	70.0	71.0	63.5	68.0	70.0	66.0	66.5	69.0	66.0	66.0	67.0	66.5	66.5	66.0
27	60.5	67.0	67.0	61.5	68.0	67.5	62.0	67.0	67.5	65.5	66.0	68.0	66.0	65.5	66.0	66.0	66.0	66.0
28	60.0	66.0	61.0	60.0	66.0	61.5	60.5	65.0	61.5	64.0	65.0	66.5	65.0	64.5	65.0	65.5	66.0	65.0
29	55.0	65.5	65.0	56.0	66.0	65.0	57.0	64.0	65.0	62.0	63.0	65.0	63.0	63.0	64.0	65.0	65.0	64.5
30	61.0	68.0	69.0	61.0	68.0	68.5	60.0	65.5	67.5	62.0	64.0	66.5	63.0	63.0	64.0	64.0	64.5	64.0
31	62.5	66.5	66.0	63.0	67.0	66.0	63.0	65.5	66.0	65.0	65.5	66.5	64.5	64.5	65.0	65.0	65.0	64.5
Average	66.9	73.2	71.9	66.9	72.2	71.6	66.7	70.8	71.2	68.4	69.3	70.8	68.5	68.3	69.0	68.1	68.1	68.0
Average for depth given	......	70.66	......	....	70.23	......	......	69.57	.....	......	69.50	......	......	68.60	......	......	68.06	......

READING OF SOIL THERMOMETERS — (*Continued*).

DATE.	ONE INCH.			TWO INCHES.			THREE INCHES.			SIX INCHES.			NINE INCHES.			EIGHTEEN INCHES.		
	7 a. m	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.
September 1	56.5	65.5	65.0	57.5	66.0	65.0	58.5	63.0	65.0	62.5	63.0	65.0	63.0	63.0	63.0	64.5	64.0	64.0
2	55.0	64.5	65.5	56.0	64.5	65.0	56.5	62.0	64.0	60.5	61.0	63.5	62.0	61.0	62.0	63.5	63.5	63.0
3	64 0	66.0	63.5	64.0	66.0	64.0	63.0	65.0	65.0	64.0	64.5	64.5	63.0	63.0	64.0	63.0	63.0	63.0
4	57.0	65.5	64.0	57.5	66.5	64.0	58.0	64.0	64.0	61.5	62.5	64.5	62.0	62.0	63.0	63.0	63.0	63.0
5	54.5	57.5	56.5	55.0	58.0	57.0	55.5	57.5	57.0	57.5	59 0	59.0	60.0	60.0	60.0	63.0	62.5	62.0
6	59.5	63.0	60.0	59.5	63.0	61.0	59.0	62.0	61.0	60.0	62.0	62.0	60.0	60.0	61.0	61.5	61.5	61.5
7	57.5	64.0	65.0	57.5	65.0	65.0	58 0	63.0	64.0	60.0	61.0	63.5	60.0	60.5	61.5	61.5	62.0	62.5
8	55.5	66.0	65.5	55.5	66.0	65.5	56.0	64.5	65.0	60.0	61.0	63.5	60.0	60.0	62.0	61.5	62.0	61.5
9	57.0	63.0	67.5	57.0	68.0	76.0	57.5	65.0	66.5	60.5	62.0	65.0	60.5	61.0	62.5	62.0	62.0	63.0
10	60.0	69.5	71.5	59.0	70.0	70.5	59.0	66.5	69.0	62.0	63.0	66.5	62.0	62.0	63.0	62.5	62.5	63.5
11	65.0	75.5	75.5	65.0	75.5	74.5	64.5	73.0	73.0	65.5	67.0	70.0	64.5	65.0	66.5	63.0	64.0	64.0
12	68.0	76.0	75.0	68 0	76.0	75.5	67.5	73.0	72.0	68.0	69.0	68.0	67.0	67.0	66.5	65.0	65.0	65.0
13	67.5	69.5	70.5	67.5	69.5	70.0	67.0	68.5	69.5	68.0	68.0	69.0	67.0	67.0	67.0	66.0	66.0	66.0
14	65.0	74.0	72.0	65.0	74.0	72.0	65.0	71.0	71.0	66.5	67.5	70.0	66.0	66.0	67.0	66.0	66.0	65.5
15	64.0	67.0	65.0	75.0	67.0	65.0	64.0	67.0	64.0	66.0	68.0	66.5	66.0	67.0	66.0	66.0	66.0	66.0
16	69.0	67.5	68.0	69.0	67.5	69.0	68.0	67.0	68.0	68.0	68.5	63.5	67.0	67.0	64.5	66.0	66.0	65.5
17	68.5	66.0	61.0	70.0	66.0	61.0	67.0	66 0	61.0	64.0	66.0	63.5	61.0	65.0	64.0	65.0	65.0	64.0
18	66.5	66.0	58.0	66.5	66.0	59.0	65.0	66.0	59.0	64.0	65.0	62.5	63.5	64.0	63.0	64.5	64.0	64.0
19	66.0	65 5	61.0	66.0	65.5	61.5	64.5	65.0	61.0	63.0	65.0	63.0	63.0	63.5	63.0	64.0	63.5	63.5
20	62.0	60.0	53.0	62.0	61.0	53.5	62.0	61.5	54.5	63.0	63.0	58.0	63.0	62.5	60.0	63.5	63.0	62.0
21	58.0	58.5	57.0	58.0	58.0	56.5	59.0	59.0	58.0	58.5	60.0	59.0	59.0	60.0	60.0	62.0	61.5	61.5
22	53.0	58.0	59.5	53.0	58.0	60.0	53.0	57.0	60.0	56.5	57.0	59.5	58.0	58.0	59.0	61.0	61.0	60.5
23	56.0	56.5	53.0	56.0	56.5	54.0	58.0	58.0	58.0	58.0	58.0	58.0	59.0	58.5	58.0	60.0	60.0	60.0
24	49.0	55.0	54.0	49.5	56.0	54.0	50.5	55.5	54.0	54.0	55.0	56.5	56.0	56.0	56.0	60.0	60.0	58.5
25	50.0	56.5	57.0	50.0	57.5	57.5	50.0	56.0	57.0	53.0	54.0	57.0	55.0	55.0	56.0	58.0	58.0	58.0
26	51.0	58.0	58.5	51.0	59.0	58.5	51.0	57.0	58.0	55.0	56.0	57.0	56.0	56.0	57.0	58.0	58.0	58.0
27	56.0	63.5	61.0	56.0	64.0	62.0	55.5	61.0	61.0	57.0	58.0	60.0	57.0	58.0	58.0	58.0	59.0	59.0
28	57.0	61.5	60.5	57.0	60.5	60.5	57.0	60.0	60.0	59.0	60.0	61.0	59.0	50.0	60.0	60.0	60.0	60.0
29	60.0	61.0	60.0	60.0	61.0	60.0	59.0	59.5	59.0	58.5	59.0	58.0	58.5	58.5	58.5	60.0	60.0	60.0
30	59.0	59.5	55.0	60.0	60.5	55.5	60.0	60.0	56.0	61.0	60.5	58.0	60.0	60.0	58.0	60.0	60.0	60.0
Average	59.6	64.0	62.6	59.8	64.4	63.1	59.6	63.1	62.5	61.2	62.1	62.5	61.4	61.2	61.7	62.4	62.4	62.3
Average for depth given	......	62.07	......	......	62.43	......	......	61.73	......	......	61.93	......	......	61.43	......	......	62.37	......

READING OF SOIL THERMOMETERS — (*Concluded*).

DATE.	ONE INCH.			TWO INCHES.			THREE INCHES.			SIX INCHES.			NINE INCHES.			EIGHTEEN INCHES.		
	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.
October 1	59.0	58.0	52.0	60.0	59.0	52.0	59.0	58.0	52.5	58.0	58.0	57.0	58.0	58.0	57.0	59.5	59.5	59.0
2	57.5	56.0	55.0	58.5	56.5	55.5	58.0	57.0	57.0	57.0	58.0	58.0	57.0	57.0	56.0	58.5	58.0	58.0
3	54.0	55.0	55.0	54.0	55.5	55.0	54.0	55.0	55.0	56.8	56.0	56.5	56.5	56.5	56.5	58.0	58.0	58.0
4	54.0	56.0	55.5	54.0	56.0	56.0	54.0	55.5	56.0	56.0	56.0	56.5	56.0	56.0	56.0	57.5	57.5	57.5
5	52.5	54.0	54.0	52.0	54.0	54.0	53.0	54.0	54.0	55.0	55.0	55.5	55.5	55.0	55.0	57.0	57.0	57.0
6	52.0	55.0	54.0	52.5	55.5	54.5	51.5	55.0	54.0	55.0	55.0	55.0	55.0	55.0	56.0	56.5	56.0	56.5
7	51.0	52.0	50.0	51.5	52.5	50.0	52.0	52.0	50.5	54.5	54.0	53.5	55.0	54.5	54.0	56.5	56.5	56.5
8	46.5	48.0	47.0	47.0	49.0	46.0	48.0	49.5	48.0	52.0	51.5	50.0	53.0	52.0	50.5	55.5	55.0	55.0
9	45.0	50.0	50.0	46.0	50.5	50.0	47.0	49.5	50.0	50.0	50.0	51.5	51.0	51.0	51.0	54.0	54.0	53.5
10	41.0	50.5	50.0	42.5	52.0	50.0	44.0	49.0	50.0	48.0	49.0	51.0	50.0	50.0	51.0	53.0	53.0	53.0
11	45.0	52.0	52.0	45.0	53.5	52.0	45.0	51.0	52.0	48.5	49.5	52.0	50.0	50.0	51.0	53.0	53.0	52.5
12	48.0	50.5	48.0	48.0	51.0	48.0	48.0	50.0	48.5	50.0	50.5	50.0	51.0	50.0	50.5	52.5	53.0	53.0
13	50.0	50.5	50.0	50.0	51.0	50.0	49.0	50.0	50.5	51.0	51.0	51.0	51.0	50.0	50.0	52.5	53.0	53.0
14	49.0	51.5	50.0	49.0	52.0	51.0	49.0	50.5	50.0	50.5	51.0	50.0	51.0	51.0	51.0	52.5	52.5	52.5
15	47.0	55.0	54.0	47.0	56.0	55.0	48.0	53.5	53.0	50.0	51.5	51.0	51.0	51.0	51.0	52.5	53.0	53.0
16	51.0	51.0	49.0	51.0	51.0	49.0	51.0	51.0	49.5	52.0	52.0	51.5	52.0	52.5	52.0	53.0	53.0	53.0
17	46.5	47.5	46.0	37.0	48.0	46.0	47.0	48.0	46.5	50.0	49.5	48.5	50.0	50.0	50.0	52.5	52.0	51.5
18	46.0	46.0	40.0	46.5	47.0	41.0	46.0	46.0	42.0	48.5	49.0	46.0	50.0	50.0	47.5	52.0	52.0	51.0
19	44.0	45.0	42.0	45.0	45.5	42.0	45.0	46.0	42.0	46.5	46.5	45.0	47.0	47.0	46.0	50.5	50.5	50.0
20	45.0	46.0	45.0	45.0	46.0	44.0	45.0	45.5	44.0	46.0	47.0	46.0	46.0	46.5	46.0	50.0	50.0	50.0
21	46.5	46.0	44.0	47.0	47.0	45.0	46.5	47.0	45.0	47.5	48.0	48.9	47.5	48.0	48.0	50.0	49.5	49.0
22	40.0	45.0	44.0	41.0	46.5	45.0	42.0	46.0	45.5	45.0	45.5	47.0	44.5	46.0	47.0	49.0	49.0	49.0
23	39.0	46.0	46.5	39.5	47.5	46.5	40.0	45.5	46.0	44.0	44.0	46.5	45.5	45.5	46.0	48.5	48.5	48.0
24	42.0	43.5	42.0	42.5	44.0	43.0	43.0	44.0	43.5	45.0	45.5	46.0	46.0	46.0	46.0	48.0	48.0	48.0
25	39.0	44.0	42.5	40.0	44.0	43.5	40.5	43.0	44.0	43.5	43.0	45.0	45.0	45.0	45.0	48.0	48.0	47.5
26	37.5	47.5	47.0	38.5	47.5	47.0	39.0	45.0	46.5	42.5	43.5	46.0	44.0	45.0	45.0	47.0	47.5	47.0
27	41.5	51.5	50.0	42.5	51.5	50.0	42.5	48.5	49.0	45.0	46.0	48.5	45.5	45.5	47.0	47.0	48.0	47.0
28	44.5	50.5	51.5	45.0	50.5	51.5	45.0	48.0	50.5	47.0	47.0	49.0	47.0	47.0	48.0	48.0	48.0	48.0
29	51.0	58.0	57.5	51.0	57.5	57.5	50.0	54.5	56.0	50.0	51.0	53.5	49.0	49.5	51.0	49.0	49.0	49.5
30	53.5	56.0	57.0	53.5	56.0	57.5	52.5	54.5	56.0	52.5	53.0	54.0	51.5	52.5	52.0	50.5	50.5	51.0
31	52.0	56.0	53.5	52.5	56.5	54.0	52.5	54.5	54.0	53.5	53.5	54.5	53.0	52.5	53.0	51.5	52.0	52.0
Average	47.4	50.8	49.5	47.9	51.3	49.7	48.0	50.2	49.7	50.0	50.3	50.8	50.5	50.5	50.5	52.4	52.4	52.2
Average for depth given	....	49.23	....	....	49.63	....	....	49.30	....	....	50.37	....	....	50.50	....	....	52.33	....

Summary of Soil Thermometers.

	One Inch.				Two Inches.				Three Inches.				Six Inches.				Nine Inches.				Eighteen Inches.			
	7 a. m.	12 m.	6 p m	Average.	7 a. m.	12 m.	6 p. m.	Average.	7 a. m.	12 m.	6 p. m.	Average.	7 a. m.	12 m.	6 p. m.	Average.	7 a. m.	12 m.	6 p. m.	Average.	7 a. m.	12 m.	6 p. m.	Average.
	Ave.	Ave.	Ave.		Ave.	Ave.	Ave.		Ave.	Ave.	Ave.		Ave.	Ave.	Ave.		Ave.	Ave.	Ave.		Ave	Ave	Ave	
June	61.0	67.3	64.9	64.40	61.2	67.4	65.5	64.70	61.0	66.5	65.2	64.23	62.2	65.5	64.8	64.17	62.9	65.0	64.4	64.10	63.9	64 1	64.0	64.00
July.....................	67.0	76.6	74.2	72.60	66.8	74.9	73.9	71.86	66.5	72.4	73.3	70.73	68.0	69.3	71.8	69.70	67.8	67.8	69.1	68.23	66.6	66.5	66.4	66.50
August..................	66.9	73.2	71.9	70.66	66.9	72.2	71.6	70.23	66.7	70.8	71.2	69.57	68.4	69.3	70.8	69.50	68.5	68.3	69.0	68.60	68.1	68.1	68.0	68.06
September	59.6	64.0	62.6	62.07	59.8	64.4	63.1	62.43	59.6	63.1	62.5	61.73	61.2	62.1	62.5	61.93	61.4	61.2	61.7	61.43	62.4	62.4	62.3	62.37
October..................	47.4	50.8	49.5	49.23	47.9	51.3	49.7	49.63	48.0	50.2	49.7	49.30	50.0	50.3	50.8	50.37	50.5	50.5	50.5	50.5	52.4	52.4	52.2	52.33

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