
New York Agricultural Experiment Station.

GENEVA, N. Y.

DIRECTOR'S REPORT FOR 1912

W. H. JORDAN



PUBLISHED BY THE DEPARTMENT OF AGRICULTURE

BOARD OF CONTROL.

GOVERNOR JOHN A. DIX, Albany.
COMMISSIONER CALVIN J. HUSON, Albany.
THOMAS B. WILSON, Hall.
ALFRED G. LEWIS, Geneva.
BURT E. SMALLEY, Interlaken.
G. HYDE CLARKE, Cooperstown.
HENRY C. HARPENDING, Dundee.
EUGENE M. ANDREWS, Union.
C. WILLARD RICE, Geneva.

OFFICERS OF THE BOARD.

THOMAS B. WILSON,
President.

WILLIAM O'HANLON,
Secretary and Treasurer.

STATION STAFF.

WHITMAN H. JORDAN, Sc.D., LL.D., *Director.*

GEORGE W. CHURCHILL,
Agriculturist and Superintendent of Labor.

WILLIAM P. WHEELER,
First Assistant (Animal Industry).

HARRY A. HARDING, Ph.D.,
Bacteriologist.

HAROLD J. CONN, Ph.D.,
Associate Bacteriologist.

GODFREY L. A. RUEHLE, M.S.,
JAMES D. BREW, B.S.,
Assistant Bacteriologists.

FRED C. STEWART, M.S., *Botanist.*
WALTER O. GLOYER, A.M.,
Associate Botanist.

MANCER T. MUNN, B.S.,
Assistant Botanist.

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

†ALFRED W. BOSWORTH, B.S.,
ERNEST L. BAKER, B.S.,
RUDOLPH J. ANDERSON, B.S.,
Associate Chemists.

ARTHUR W. CLARK, B.S.,
MORGAN P. SWEENEY, A.M.,
OTTO MCCREARY, B.S.,
ORRIN B. WINTER, B.S.,
Assistant Chemists.

GEORGE A. SMITH, *Dairy Expert.*
FRANK H. HALL, B.S.,
Editor and Librarian.

PERCIVAL J. PARROTT, M.A.,
Entomologist.

WILLIAM J. SCHOENE, M.S.,
Associate Entomologist.

HAROLD E. HODGKISS, B.S.,
BENTLEY B. FULTON, B.A.,
Assistant Entomologists.

ULYSSES P. HEDRICK, M.S.,
Horticulturist.

RICHARD WELLINGTON, M.S.,
Associate Horticulturist.

GEORGE H. HOWE, B.S.A.,
CHARLES B. TUBERGEN, B.S.,
Assistant Horticulturists.

ORRIN M. TAYLOR,
Foreman in Horticulture.

JOSEPH F. BARKER, M.S.,
In Charge of Soil Investigations.

RICHARD F. KEELER, A.B.,
Assistant Chemist (Soils).

REGINALD C. COLLISON, M.S.,
Assistant Chemist (Soils and Horticulture).

*F. ATWOOD SIRRINE, M.S.,
Special Agent.

GERTRUDE S. MAYO,
Director's Secretary.

FRANK E. NEWTON,
WILLARD F. PATCHIN,
LENA G. CURTIS,
AGNES E. RYAN,
ESTHER F. HAWKINS,
Clerks and Stenographers.

ADIN H. HORTON,
Computer and Mailing Clerk.

†FRED Z. HARTZELL, M.A.,
Associate Entomologist

†FRED E. GLADWIN, B.S.,
Special Agent.

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.

*Riverhead, N. Y. †Absent on leave. ‡Connected with the Chautauqua Grape Work.

BULLETIN No. 356.

DIRECTOR'S REPORT FOR 1912.

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

Gentlemen.— I have the honor to submit to you herewith a report of this institution for the calendar year 1912. In this report, I have endeavored to set forth as clearly as possible the financial conditions and needs of the Station and, in addition, such a review of our activities and our results as will make clear to you and to the agricultural public the nature of the problems to which we are giving attention and the policy and methods which prevail in carrying on our work. I desire to make sincere acknowledgment to the Board of Control of the Station for the efficient support and direction which I have received in administering the affairs of the Station, and to my associates on the staff for their loyal aid and co-operation.

ADMINISTRATION.

STATION STAFF.

Since presenting my last report, Mr. Martin J. Prucha, Associate Bacteriologist, and Mr. James K. Wilson, Assistant Bacteriologist, who, during 1910 and 1911, were pursuing special studies at Cornell University, have permanently disconnected themselves from this institution. Mr. Prucha is now a member of the faculty of the New York State College of Agriculture.

Mr. John G. Grossenbacher, Associate Botanist, has resigned to enter upon important work in plant pathology with the United States Department of Agriculture.

Mr. James T. Cusick, Assistant Chemist, was transferred on October 1st, to the State Department of Agriculture, as one of its chemists.

All of these gentlemen carry with them the best wishes of their former associates for their future success.

During the year, the following appointments have been made:

Miss Minerva Collins, B. S., a graduate of the University of Kentucky, was appointed to the position of Assistant Botanist on February 15th, which position she held until June 30th. The appointment was of a temporary character in order that certain work in seed inspection might be accomplished.

Mr. Reginald C. Collison, M. S., received an appointment as Assistant Chemist on June 18th. At the time of his appointment, he held the position of Assistant Chemist in the staff of the Ohio State Experiment Station. His work at this institution will be chiefly in the Department of Soil Investigations.

Mr. Walter O. Gloyer, A. M., was selected to fill the place vacated by Mr. Grossenbacher and entered upon his duties on April 15th. He had previously occupied the position of Assistant Botanist at the Ohio State Experiment Station. He is at present engaged in research work in plant pathology.

Mr. Richard F. Keeler, A. B., a graduate of the University of Michigan, received an appointment as Assistant Chemist on April 1, 1912, and is assigned to the Department of Soil Investigations.

Mr. Mancel T. Munn, B. S., was appointed to the position of Assistant Botanist on July 1, 1912. Mr. Munn is a graduate of the Michigan Agricultural College and is at present giving his attention chiefly to seed inspection, with the details of which he had become familiar previous to his appointment.

Mr. Bentley B. Fulton, B. A., was added to the Entomological staff as assistant on June 20th. Mr. Fulton is a graduate of the Ohio State University.

Mr. James D. Brew, B. S., a graduate of Cornell University, was appointed as Assistant Bacteriologist on June 20th. He is giving attention chiefly to the problems of milk sanitation.

In accordance with the action of your Board, three of the above appointments — those of Mr. Collison, Mr. Fulton and Mr. Brew — were made in order to extend the experimental work of the institution more fully over the State. Our activities in this direction will be more fully presented in a subsequent part of this report.

MAINTENANCE FUNDS.

The funds available for the support of the institution during the fiscal year ending September 30, 1912, were as follows:

Salaries	\$52,000
Labor	15,800
Maintenance of the work of the Station departments.....	22,500
General expense, heat, light, water, repairs, etc.....	5,500
Total	<u>\$95,800</u>

Expense of chemical work in analyzing samples of fertilizers and feeds submitted as required by law by the Commissioner of Agriculture:

Fertilizer inspection	\$10,000
Feeding stuffs inspection.....	3,500
Total	<u>\$13,500</u>

The State appropriations for the current fiscal year are as follows:

Salaries	\$52,000
Labor	15,800
Maintenance of work of Station departments.....	24,000
Special grape work in Chautauqua county.....	7,500
General expense, heat, light, water, repairs, etc.....	5,500
Total	<u>\$105,800</u>

Expense of chemical work in analyzing samples of fertilizers and feeds submitted as required by law to the Commissioner of Agriculture:

Fertilizer inspection	\$11,000
Feeding stuffs inspection	4,500
Total	<u>\$15,500</u>

Owing to a failure to receive from the Legislature any appropriation for 1912 for the Chautauqua grape work, it became necessary to support this work from the general funds of the institution during the last four or five months of the fiscal year ending September 30, 1912. This placed limitations on our work both at the Station and in the Chautauqua district.

ESTIMATED FINANCIAL NEEDS OF THE INSTITUTION FOR THE
FISCAL YEAR 1913-1914.

In making public the estimates decided upon by your Board as needed appropriations for the institution during the fiscal year 1913-1914 it is proper that certain explanations should be offered.

It will be noticed that the items requested for the maintenance of the Station for the next fiscal year, outside of the aid given the Commissioner of Agriculture in the administration of agricultural law, exceed the appropriation for the present year by \$16,700. This increase is distributed among the items for salaries, labor and expenses for maintaining the various lines of research and experimentation carried on by the institution.

It is easily seen that this increase is not requested for any single purpose, but is regarded as necessary because of the general enlargement of the activities of the Station due to the steady growth of the demands made upon us by the agricultural public. It should not be forgotten in this connection that agricultural practice has undergone, during the past few decades, very far-reaching changes largely in the direction of a steadily increasing dependence upon the conclusions of science. For this reason, the agricultural public is more and more turning to such agencies as the college of agriculture and the experiment station for the solution of problems and for direction in farm practice. It may be said that there seems to be no limit to what may be expended in agricultural research and education and it is true that the amounts appropriated by the State for the support of its agricultural agencies has been steadily increasing until they are now an important item in the State's annual financial budget.

The real question to be considered, however, is whether these expenditures are profitable, whether it is really worth while to secure and apply knowledge that results in more economical production, whether it is worth while to defend the farmer against pests, which, without the application of modern methods, would render almost impossible the production of certain farm crops. It is safe to assert that the action of the State Legislature in liber-

ally supporting the various agricultural agencies that have been established is heartily ratified, on the basis of experience, by the intelligent agricultural public.

If this institution is to meet the increasing demands made upon it, it must have more liberal financial support and it is for this reason that your Board has asked for enlarged resources for the following fiscal year.

The items decided upon are as follows:

For salaries	\$60,000
For labor	18,000
Maintenance of work of Station departments.....	28,000
Investigations in the interests of grape growing.....	10,000
General expenses, including heat, light, water, repairs, etc.....	5,500
Total	<u>\$121,500</u>

It has become the policy of the State to regulate, through inspection laws, the sale of various commercial articles important to the farmer, including commercial fertilizers, concentrated feeding stuffs, fungicides and insecticides, and agricultural seeds. In addition to this, all glassware used in measuring the fat content of milk and cream, where such products are bought on the fat basis, must be inspected and marked by this institution. The first inspection law enacted in this State related to commercial fertilizers, which was followed some years later by an act regulating the sale of concentrated feeding stuffs. There has gradually followed inspection along the other lines mentioned.

The chemical and other scientific work involved in this inspection has all been placed among the required duties of the Director of this institution, but for only two lines of inspection, viz., fertilizers and feeding stuffs, are special funds provided to meet the necessary expense. Whatever has previously been accomplished in the analysis of fungicides and insecticides, in the examination of agricultural seeds and in the testing and marking of Babcock glassware has been done by the use of funds not appropriated for these purposes. The time has now come when there must be some recognition in our maintenance appropriation of the expense involved in these required duties.

The expense in these several directions is not itemized for each line of work for the reason that the same force of chemists is active along these several lines, which is true of other departments of the Station, and it is somewhat difficult to make divisions of salaries and other expenses on an exact basis of time used and of laboratory expenditures. The item is, therefore, presented as follows:

Upon enforcing the provisions of the law in relation to commercial fertilizers, concentrated feeding stuffs, fungicides and insecticides, agricultural seeds, and the testing and marking of Babcock glassware.....	\$18,000
---	----------

PUBLICATIONS.

The publications of the Station fall under six heads:

(1) *Technical Bulletins*, the subject-matter of which is technically scientific and sets forth the results of investigations that are regarded as fundamental to succeeding attempts at the solution of practical problems. The bulletins are not intended for popular use and have a limited circulation.

(2) *Complete Bulletins*, which give in full detail the methods followed in studying certain practical problems and the entire data from which the conclusions are drawn. Through such complete statements, every investigator or experimenter is bound to set forth the results of his work in order that his methods and conclusions may be open to the fullest inspection and criticism. This is especially to be desired if it is expected that the dicta of Station publications are to be accepted and applied in practice. The complete bulletins of the Station are evidently found useful by many teachers both in colleges and in schools of a lower grade. They are also sought by a small percentage of persons engaged in practical agriculture.

(3) *Popular Bulletins* are somewhat popular presentations of the more extensive and more technical subject-matter of the complete bulletins. They are intended to make plain to the non-

scientific reader the practical bearing and application of the results of the Station investigations. These bulletins are written by the Station Editor, in all cases in consultation with the member of the staff who is responsible for the complete bulletin under consideration.

The experience of fifteen years has taught us that the presentation to the public of our work through the popular bulletins is a more efficient way and financially a more economical way than to issue the complete form to the entire mailing list. We have reason to believe, also, that the public regards our methods as satisfactory.

A glance at the figures below will show that the complete bulletins are desired by a comparatively small proportion of our mailing list.

(4) *Circulars* are prepared as a means of placing information in the hands of a special class of practitioners, such as cheese-makers or apple growers. These also aid in replying to the numerous requests for information that come to the Station. They are not for distribution to our general mailing list.

(5) *Leaflets*, mostly of such a size as may be enclosed in an ordinary correspondence envelope, are informational briefs that are prepared and used as a means of lessening the immense labor of correspondence that is imposed on the Station, which, at the best, sometimes taxes the energies of the members of the staff to an extent that hampers their more important activities.

(6) *Annual Reports* are intended to be complete presentations of the status and work of the Station, each report covering a calendar, rather than a fiscal, year.

They are made up chiefly of the complete bulletins. In accordance with law, they are submitted to the Commissioner of Agriculture and are printed as a part of his annual report, 2,000 copies being assigned to the Station.

The fruit publications of the Station, viz., The Apples of New York, The Grapes of New York and The Plums of New York, constituted one part of the annual reports of the Station for the

years 1903, 1907 and 1910, respectively. The original editions of these publications were as follows:

Apples of New York.....	19,000
Grapes of New York.....	9,000
Plums of New York.....	9,000

These were divided for distribution into three lots.

Members of the Legislature:

Apples of New York.....	15,000
Grapes of New York.....	5,000
Plums of New York.....	5,000

Commissioner of Agriculture:

Of each publication.....	2,000
--------------------------	-------

Agricultural Experiment Station:

Of each publication.....	2,000
--------------------------	-------

The Legislature of 1912 authorized the printing of 5,000 more copies of The Apples of New York of which 4,530 copies were assigned to the Legislature and 470 copies to the Station. The number which the Station will have for distribution will average less than eight for each county, provided none are retained for future needs. It is evident that from our quota we can not meet extensive demands for this publication. The endeavor will be to place our supply of copies where they will be of the greatest possible use as a means of education.

The supply of both the Grapes of New York and the Plums of New York is now practically exhausted, a limited number of copies being retained to meet future library, school and professional needs within the State.

Bulletins in the several forms are now issued as follows:

POPULAR BULLETINS.

Residents of New York.....	38,465
Residents of other States.....	2,153
Newspapers	780
Experiment stations and their staffs.....	1,756
Miscellaneous	100
Total	43,254

COMPLETE BULLETINS.

Experiment stations and their staffs.....	1,756
Libraries, scientists, etc.....	300
Foreign list	320
Individuals	3,367
Miscellaneous	100
Total	<u>5,843</u>

NEW CONSTRUCTION AND REPAIRS.

The Legislature of 1912 appropriated \$3,000 to replace and equip the carpenter shop destroyed by fire in the winter of 1912. The building is now in process of construction under a contract which leaves a balance sufficient to purchase the necessary tools and other equipment.

The general repairs which it is necessary to make include painting some twenty-seven buildings, repairs to the buildings on the farm purchased in 1911 and the renovation of the interior of the Chemical Laboratory. It is now evident that this will be accomplished at an expense that will leave, out of the \$6,000 appropriated for these purposes, a balance sufficient to make some other needed repairs.

A NEW BUILDING.

An appropriation for the much needed Administration and Demonstration building has been made by three Legislatures and in each instance, disapproved by the Governor on the ground of an insufficiency of funds.

The amount which your Board has decided to ask for this purpose, one hundred thousand dollars (\$100,000), is considerably larger than the previous requests for the following reasons: The Soils Investigation Department, located in the Chemical Building, needs for its development space now used for dormitory purposes, and the space in the present Administration Building (the old mansion house bought with the Station farm) should be converted into living rooms for members of the staff. This means the transference of the library to new quarters, which should be fireproof, as the Station library is now valuable.

Aside from the above reason for the erection of a new building, to contain administrative offices, demonstration space, the library and an audience room, the following needs justify the request of your Board, which are restated here as given in my last two reports.

(1) There is no place at the institution where an audience can be assembled, excepting out of doors in the pleasant days of the warm season. This is wrong; for the work of the Station stands in such relation to educational interests and farm practice that some way of assembling audiences on the Station ground and bringing them into close range with the Station activities and results should be made possible.

(2) It is extremely desirable that space shall be provided where the results of Station work can be illustrated in a concrete form. We have many visitors who state that they come to see what the Station is doing, not realizing that in the progress of our inquiries they can only see a single point in the progress of an experiment or investigation, which to the untrained eye may be meaningless.

Space is needed for the objective display of results that have been reached in dairy work, in the study of farm pests, field experiments and in other directions. Such an exhibit would be especially useful and instructive in connection with meetings here of horticultural societies and other bodies interested in special lines of production.

(3) The number of the scientific staff is now such that more office room is needed. This can be provided by removing the museum collections in the building now occupied by the departments of bacteriology, botany, dairying, entomology and horticulture, to the proposed new building.

(4) The building now used for administrative and library purposes is needed for other uses. It has come to be necessary to arrange for boarding the unmarried members of the staff at some point nearer than the city. Rooms are now available on the Station grounds, but arrangements for meals near the Station are now difficult and uncertain, sometimes impossible. With slight ex-

pense the building now used for offices and library could be adapted to the uses indicated and it would be a much needed convenience. Getting a noon lunch a mile or a mile and a half away occasions either much loss of time or such haste as is equally detrimental to health and good work.

FIELD WORK CARRIED ON BY THE STATION IN VARIOUS PARTS
OF THE STATE.

It is not possible for the Station to study the numerous problems which it undertakes to solve through experiments or observations on the Station farm, or even on farms in the vicinity of the Station. It is necessary to locate field work in those places where the problems exist, as, for instance, among pear growers for the study of the pear thrips, or among potato growers for the study of the methods and economy of spraying. This necessity has led to the location of experimental work, during 1912, in fifty-six towns in the State on ninety-seven farms. There follows a list of this experimental work giving the subject of the experiment, the name of the farmer or fruit grower co-operating and the location of the experiments. Acknowledgment should be made to all of these gentlemen for their hearty co-operation in carrying out the details of the work undertaken.

OUTSIDE WORK CARRIED ON BY THE STATION DURING THE SEASON OF 1912.

BOTANICAL DEPARTMENT: EXPERIMENTAL.

<i>Nature of Experiment.</i>	<i>Co-operator.</i>	<i>Location.</i>
Control of currant diseases.	James R. Clark.....	Milton.
Causes of poor potato stand	F. A. Serrine.....	Riverhead.

ENTOMOLOGICAL DEPARTMENT: EXPERIMENTAL.

Control of apple aphid.....	Frank Bacon.....	Albion.
Control of apple aphid.....	John Beckwith.....	New Haven.
Control of apple aphid.....	William Bugbee.....	Gasport.
Control of apple aphid.....	Lyman Burrows.....	Albion.
Control of apple aphid.....	Chas. Dunkelberger.....	Gasport.
Control of apple aphid.....	Samuel Smith.....	Albion.
Control of cabbage aphid...	Daniel De Lea.....	Seneca Castle.
Control of cabbage aphid...	Tuttle & Russell.....	Williamson.
Control of cabbage aphid...	T. D. Whitney.....	Stanley.
Control of cabbage maggot.	L. A. Page.....	Seneca Castle.
Control of cranberry leaf-hopper	R. C. Brown.....	Riverhead.

<i>Nature of Experiment.</i>	<i>Co-operator.</i>	<i>Location.</i>
Control of grape insects ...	James Barnes.....	Prospect Station.
Control of grape insects ...	Louis Bourne.....	Westfield.
Control of grape insects ...	H. L. Cumming.....	Fredonia.
Control of grape insects ...	Charles Horton.....	Silver Creek.
Control of grape insects ...	S. J. Lowell.....	Fredonia.
Control of grape insects ...	M. J. Sackett (2 lines)....	W. Irving.
Control of grape insects ...	Chas. Secord.....	W. Irving.
Control of green pear bug..	G. W. Dauchy.....	Pavilion.
Control of green pear bug..	E. E. Crosby.....	Lockport.
Control of Hessian fly.....	H. F. Daboll.....	Clyde.
Control of Hessian fly.....	Experiment Station.....	Geneva.
Control of Hessian fly.....	G. E. Wolcott.....	Corning.
Control of pear psylla.....	Frank Gibson.....	Albion.
Control of pear psylla.....	F. E. Hanlon.....	Medina.
Control of pear psylla.....	H. B. Treichler.....	Sanborn.
Control of pear thrips.....	Ashley & Rockefeller.....	Germantown.
Control of pear thrips.....	C. E. Hover.....	Germantown.
Control of pear thrips.....	A. W. Hover & Bro.....	Germantown.
Control of pear thrips.....	Clarence Snyder.....	North Germantown.
Control of pear thrips.....	Spencer Bros.	Hudson.
Control of willow beetle ...	Mrs. L. C. Parshall.....	Lyons.
Control of willow snout beetle	W. & T. Smith Co.....	Geneva.
Control of willow weevil...	Stuart Nursery Co.....	Newark.
Control of willow weevil...	W. & T. Smith Co.....	Geneva.

ENTOMOLOGICAL DEPARTMENT: DEMONSTRATION.

Control of green apple aphis.	E. E. Barnum.....	Albion.
Control of green apple aphis.	E. L. Chapman.....	Albion.
Control of green apple aphis.	E. E. Crosby.....	Lockport.
Control of green apple aphis.	Yale Forbes	Brockport.
Control of green apple aphis.	Frank Gibson.....	Albion.
Control of green apple aphis.	F. E. Hanlon.....	Medina.
Control of green apple aphis.	John Larwood.....	Albion.
Control of green apple aphis.	Albert Wood Estate.....	Carlton.
Control of cabbage maggot..	Alfred Armington.....	Orleans.
Control of cabbage maggot..	James Brewer.....	Stanley.
Control of cabbage maggot..	W. T. Cooper.....	Seneca Castle.
Control of cabbage maggot..	Daniel De Lea.....	Seneca Castle.
Control of cabbage maggot..	T. C. Hays.....	Seneca Castle.
Control of cabbage maggot..	Benjamin Jones.....	Orleans.
Control of cabbage maggot..	W. P. Jones.....	Stanley.
Control of cabbage maggot..	L. D. Knapp.....	Seneca Castle.
Control of cabbage maggot..	Robert Ritchie	Seneca Castle.
Control of cabbage maggot..	O. W. Winburn.....	Seneca Castle.
Control of pear psylla	Jay Allis	Medina.
Control of pear psylla	Frank Bacon.....	Albion.
Control of pear psylla	Spencer Brownell.....	Oswego.
Control of pear psylla	E. L. Burt.....	Hilton.
Control of pear psylla	Collamer Bros.	Hilton.
Control of pear psylla	John Cramer	Middleport.
Control of pear psylla	Frank Curtis	Hilton.
Control of pear psylla	Chas. Du Colen.....	Hilton.
Control of pear psylla	C. E. Ernest.....	Gasport.

<i>Nature of Experiment.</i>	<i>Co-operator.</i>	<i>Location.</i>
Control of pear psylla	F. P. Hazelton	Le Roy.
Control of pear psylla	S. S. Hopkins	Youngstown.
Control of pear psylla	H. E. Horn	Albion.
Control of pear psylla	F. B. Howell	Medina.
Control of pear psylla	F. J. Klafelin	Hilton.
Control of pear psylla	S. W. McCollum	Lockport.
Control of pear psylla	E. Moody & Sons	Lockport.
Control of pear psylla	C. G. & R. L. Oaks	North Rose.
Control of pear psylla	A. C. Pease	Oswego.
Control of pear psylla	Ira Pease	Oswego.
Control of pear psylla	L. R. Rogers	Albion.
Control of pear psylla	David Smith	Middleport.
Control of pear psylla	Delos Tenny	Hilton.
Control of pear psylla	F. M. Tenny	Hilton.
Control of pear psylla	W. W. Williams	Hilton.
Control of pear psylla	Albert Wood Estate	Albion.
Control of pear psylla	F. M. Woolworth	Youngstown.
Control of pear psylla	Lawrence Wright	Hilton.

HORTICULTURAL DEPARTMENT: EXPERIMENTAL.

Apple orchards, dwarf	Wood Orchard	Carlton Station.
Apple orchards, dwarf	F. E. Dawley	Fayetteville.
Apple orchards, dwarf	Edward Van Alstyne	Kinderhook.
Apple orchards, fertilizers for	W. D. Auchter	South Greece.
Apple orchards, tillage of ..	W. D. Auchter	South Greece.
Apple orchards, tillage of ..	Grant Hitchings	South Onondaga.
Grapes, fertilizers for	H. Benjamin	Fredonia.
Grapes, fertilizers for	S. S. Grandin	Westfield.
Grapes, fertilizers for	C. M. Hamilton	Ripley.
Grapes, fertilizers for	Miss Frances Jennings ..	Silver Creek.
Grapes, fertilizers for	H. G. Miner	West Sheridan.

SOILS DEPARTMENT: EXPERIMENTAL.

Alfalfa, fertilizers for	W. P. Mead	Jamestown.
Alfalfa, fertilizers for	E. N. Bolt	Watkins.
Apples, fertilizers for	R. B. Densmore	Albion.
Nursery stock, fertilizers for	W. & T. Smith Co.	Geneva.
Peaches, fertilizers for	T. H. King	Trumansburg.
Pears, fertilizers for	Lawrence Howard	Kinderhook.
Pears, tillage and cover crops	L. L. Morrell	Kinderhook.
Young vineyard, fertilizers for	D. W. Blood	Fredonia.
Young vineyard, fertilizers for	S. E. Stone	Fredonia.

THE STATION FARM.

The Station farm, including the grounds on which the buildings are located, now comprises about two hundred and twenty (220) acres. Approximately four-fifths of this area is devoted to experi-

ments, horticultural work occupying the larger part. Only a small part of the land is given up to general farming as a means of sustaining the dairy herd.

The Station authorities are sometimes questioned as to the profits of the farm under scientific management. The farm does not return a profit in dollars and cents and if it did, it would be a miserable failure. It is regarded very properly as a piece of apparatus to be used in agricultural investigation and when so used, it not only returns no profits, but is a heavy bill of expense. This would be easily understood by anyone who would take the trouble to learn the details of our experimental work. For instance, the varieties of fruit on the farm number several thousand, at times as many as 10,000. With the large fruits there are but two or three trees of a variety and with the small fruits only a short row of vines or bushes for each kind. Careful records are kept of these fruits which, in the case of the varieties that we have bred, are much in detail and time-consuming. The fruits can not be handled to advantage commercially because there is so small an amount of each kind.

As another illustration, there is under cultivation a twelve-acre field that has been handled experimentally for sixteen years. This field is divided into eight plats and is devoted to a rotation of crops. In order to secure the data desired, the weighed fertilizers and farm manures are put on with great care so as to secure uniform distribution. The crops are weighed and sampled. Great pains is taken to secure uniformity of treatment on all the plats outside of the differences in fertilizers. This requires care in every detail at a much greater expense than would be incurred on a farm managed merely for commercial purposes.

The dairy herd here is a fine one and very productive, but it is constantly under experimental observation for such purposes as testing milking machines, determining the important factors in milk sanitation and making observations of other kinds. Now all this work can not be done in the way which is essential to accurate experimentation without incurring several times the expense that

would be necessary for mere commercial operations. It is for these reasons then that an experimental farm should be regarded as a failure if it returns a financial profit, because the existence of such profit would mean that little experimental work of a high character is carried on.

INVESTIGATION.

ANIMAL NUTRITION.

The problems pertaining to the feeding of animals are among the most complex and difficult of solution with which science has to deal. This is due largely to the fact that the processes of nutrition are hidden. Direct observations are, in the main, not possible, and the conclusions reached must be largely inferential in their nature. When a milch cow, for instance, consumes a given quantity of food of a certain kind, we have as exterior results the production of a certain quantity of milk and the maintenance of the body of the animal at a given weight, or with a gain or loss in body substance as the case may be. These measurements give little clue to the function of the various constituents of which the food is composed.

The study of the problems of animal nutrition enters the field of both chemistry and physiology and the patient studies carried on during the past half century have revealed a great many facts which we now regard as thoroughly established. We know much about the functions of ash constituents, proteins, carbohydrates and fats and we have quite definite data as to the quantities of nutrients necessary to support the various classes of animals under given conditions. This knowledge is embodied in feeding standards.

In recent years, these standards appear to be shifting from quantities of nutrients to energy measurements, this change having been brought about by exhaustive studies of energy and heat relations by the aid of what is known as the respiration calorimeter.

At present, studies in animal nutrition are turning from what may be called bookkeeping with the animal organism, that is, a study of balances of matter and energy, to researches concerning the specific reactions of individual compounds upon the animal organism, and it is along this line that we may expect the most useful future progress in the knowledge of feeding animals.

Some seven years ago, the writer instituted investigations that were intended, as their primary object, to get additional data, if possible, concerning the relation between the production in the milch cow of the phosphorus-bearing body in the milk, known as casein, and the supply in the food of certain phosphorus-bearing compounds. In attempting to carry on such an investigation, it was found desirable to compare a ration having a high phosphorus content with one low in phosphorus, even lower than the demands of a producing cow. This led to the leaching of wheat bran with a slightly acid solution in order to reduce the phosphorus content to the lowest possible limit, this so-called "washed bran" to constitute a considerable part of the low phosphorus ration. In comparing a ration containing unwashed bran with one containing washed bran, marked physiological differences in effect were observed, these differences being the following:

1. Drier and much firmer feces with the washed bran ration, accompanied by a constipated condition, requiring in some cases the use of a purgative.

2. A marked disturbance of appetite (in Experiment 3) when a sudden change was made from the washed bran ration to the one containing the unwashed bran, indicating some specific physiological influence of the compound or compounds removed from the bran by leaching.

3. A greatly reduced flow of urine following a change from the unwashed bran to the washed bran ration, the reverse taking place when a reverse change was made.

4. An increase in the flow of milk consequent upon the withdrawal from the ration of the phytin and other water-soluble constituents of bran.

5. A reduction, sometimes large, in the percentage of fat in the milk consequent upon the withdrawal from the ration of phytin and other water-soluble constituents of bran.

6. A decreased production of butter-fat during the period the washed bran ration was fed, notwithstanding a somewhat increased flow of milk.

7. The entire cessation of the œstrum period with cow 1 and a temporary disturbance of this period with cow 2.

8. The foregoing effects were observed chiefly in experiments 1 and 3, in which the difference in the phosphorus content of the two rations was brought about by leaching the phytin and other soluble compounds out of the wheat bran. In experiment number 2 where the phytin content was small and remained unchanged, similar physiological influences were not sufficiently marked to place much emphasis upon them.

No definite conclusions were reached as to the compound, or compounds, withdrawn from the bran by washing, which caused these differences. In view of the fact that the principal body leached from the bran was a phosphorus compound believed to be phytin, it was inferred that the physiological effects observed were due to this substance, but it was distinctly stated in Technical Bulletin No. 1 that no definite conclusion was reached. Subsequent experimental work conducted by Mr. A. R. Rose corroborated the observations of the former experiments in some particulars, but not in others. The details of this later work are given in Technical Bulletin No. 20.

While there is no doubt but that the leachings from the wheat bran contained substances having marked physiological reactions, we are not yet able to connect these reactions with specific compounds. One of our weaknesses in an attack upon this problem is a lack of definite knowledge concerning the exact nature of the phosphorus-bearing compounds in the various feeding stuffs. At the time of the first experiment, it was believed that the main phosphorus-bearing body of wheat bran was phytin. More recent researches indicate that this is not the case. The investigation of

other feeding stuffs appears to show that while all feeding stuffs contain organic phosphorus compounds, somewhat similar, these compounds differ, as, for instance, the compound in corn meal is phytin, while in cottonseed meal and wheat bran, it is not. Below is a summary of the studies of these phosphorus-bearing compounds up to the present time, which studies are being continued.

In Technical Bulletin No. 19 are reported results of an investigation concerning the chemical properties of phytic acid, particularly as to its salts with inorganic bases. A continuation of this work was reported in Technical Bulletin No. 21. In these bulletins, experiments towards the synthesis of phytic acid are also reported. As it was believed that phytic acid was an ester or complex compound of inosite and phosphoric or pyrophosphoric acid, efforts were made to synthesize the substance by acting on inosite with those acids under different conditions. In these reactions, however, only inosite esters of the respective acids were formed which, although similar to, were not identical with, phytic acid.

Technical Bulletin No. 22 contains a report of the chemical investigation of the organic phosphoric acid of wheat bran. It had been believed previously that wheat bran contained phytin but as only a substance of quite different composition could be isolated, the opinion seems justified that it is not phytin, but a differently constituted compound, which is present in wheat bran.

The importance of cottonseed meal as a feeding stuff and the fact that it is believed to contain some poisonous principle led to an investigation of the organic phosphoric acid present in this material. The results are reported in Technical Bulletin No. 25. It was found that the organic phosphoric acid of cottonseed meal was chemically very similar to phytic acid and, while its physiological effects have not yet been fully studied, it was shown that it does not possess any marked toxic properties.

It should be observed that such physiological studies based largely upon chemical investigations are time-consuming and expensive, but as a matter of fact, they are the only means of reaching the knowledge that is fundamental in animal nutrition. Very

many so-called practical feeding experiments have been carried on, and while these are very useful as a test of theories and of formulæ based upon severer investigation it is safe to say that they will not form foundation material for the science of cattle feeding.

BACTERIOLOGICAL STUDIES.

The science of bacteriology has come to have very definite relations to farm practice in several directions. We now know that soil bacteria are important agents in the preparation of plant food. These organisms are intimately associated with the development of leguminous plants such as alfalfa and clover, and one of the triumphs of modern agricultural science is the inoculation of the soil with bacteria as one essential preparation for the growth of alfalfa and other legumes.

Barn and dairy sanitation, now established on a fairly definite basis, is the outcome of bacteriological investigations; for it is this class of organisms that is responsible for the degradation of dairy products through undesirable and excessive fermentation, to say nothing of the presence of disease germs. The technical processes used in the manufacture of butter and cheese are based upon fermentative changes caused by lactic acid ferments and other forms of germ life.

Progress in bacteriological investigation has to quite an extent been limited by the development of methods of work and the extent of our knowledge of the various classes of bacteria and their reactions. For this reason, it has been found necessary and is still necessary to devote much time to the technics of the laboratory and the study of the various types of organisms irrespective of their economic relations.

Several years ago the Station began a study of the changes which occur in the curing of cheese, changes brought about through the action of ferments, both chemical and bacterial. In making these investigations it was found desirable to suppress the action of one class of ferments or of all ferments in order to discover, if possible, what agencies were operating to cause the

breaking down of the cheese substance. This led to the study of the influence of chloroform in varying quantities not only upon bacteria but also upon the chemical ferments known as enzymes. It also was found necessary to gain a more complete knowledge concerning the classes of bacteria found in fermenting cheese as the first step in gaining some knowledge of the specific action of the several classes. This led to an extensive technical study of cheese flora with the result that a marked advance was made in our knowledge of the various groups of bacteria involved in the problem of cheese curing. These are technical studies which may appear to the unscientific mind as not coming within the limits of practical agricultural investigation, but without which successful investigation along the lines indicated could not be carried on. It should be stated that these cheese studies are not yet completed. It is felt, however, that a large amount of fundamental knowledge has been obtained and the outlook for directly practical results is hopeful.

The bacteriological staff has devoted much time to studies in connection with milk sanitation. In recent years, great interest has been shown in the production for commercial use of milk that is as free as possible from germ life in order that the health of the consumers may not in any way be threatened by unsanitary milk or milk carrying disease germs. There has appeared in the large markets what is known as certified milk — in other words, milk produced at great cost because of the precautions necessary, or regarded as necessary, to reduce the germ content of the milk to a very low figure. Certified milk production, as carried on in some places, has involved the washing of the stable walls, the bathing of the animals, scrupulous neatness on the part of the employees drawing and handling the milk, and great precaution in cooling and bottling of the milk. Such methods have been financially possible only through the disposal of the milk at very high prices. These expensive methods of producing sanitary milk were adopted without any definite knowledge as to the absolute or relative influence of the various factors involved, such as the

cleanliness of the walls, the cleanliness of the animals and their attendants, the condition of the barn air, or in fact any other factor.

For the last five or six years, the Station has been engaged in a study of the relative influence and importance of these factors. These studies have been instituted on the theory that in the production of thoroughly sanitary milk, too much importance is being given to certain operations and that milk of the most healthful character may be placed on the market without the excessive cost that has been incurred by certain certified milk producers. These investigations are still in progress.

Certain results have been made public, however. Probably no single factor has a greater influence upon the bacterial content of the milk than the form of milk pail used, and attention was first given to this part of the problem. The inquiry involved a comparison between the old type of open pail and pails with a partially closed top. These tests were extensive and were made under such conditions as could be steadily maintained in good dairy management and tests were made only when these conditions seemed to be normal. Various narrow-mouthed pails were compared with the open pail. A large number of observations showed that the covered pail reduced the number of bacteria in the milk from 50 to 70 per cent. The covered pail is now in general use in stables where an attempt is made to improve the sanitary quality of the milk.

One of the most important publications issued by this Station is Bulletin No. 337, giving the results of an effort at improving the milk supply of the city of Geneva. The connection of the Station with this municipal experiment was indirect and unofficial. In 1907, the head of the Bacteriological Department of the Station became a member of the Geneva board of health and in this way an opportunity was offered for an officer of the Station to aid in instituting an effort at improving the milk supply of the city, which, at that time, was none too good.

The means adopted for securing an improvement in the sanitary condition surrounding the production of the city milk supply

included a regular and systematic inspection of all the dairies furnishing milk to the city, the grading of these dairies on the basis of a score card, the publishing of the scores given to the several farms and payment for the milk somewhat on the basis of the sanitary quality of the product. The dairies were classified as excellent, good, medium and poor. The initial inspection showed that 37.5 per ct. were "poor," 57.5 per ct. "medium," and 5 per ct. "good." After three years of inspection and publicity of the results, the first quarter of the fourth year showed that 12.8 per ct. of the dairies ranked as "excellent," 87.2 per ct. as "good," the "medium" and "poor" grades having entirely disappeared. This desirable result was made possible through the co-operation of the board of health of the city and the milkmen. A similar result may be secured in any of the smaller cities of the State if similar means are adopted. One fact should be borne in mind, however, that dairy farmers and milk dealers will not undertake the labor and expense necessary to the production and sale of clean milk unless the consumer is willing to pay a price commensurate with the cost of the milk delivered at his door.

One of the innovations in dairy farming is the milking machine. When this machine was first introduced, questions were at once raised as to its efficiency and economy. It was important to know what the effect of the machine would be on the sanitary quality of the milk, and whether its continued use would affect the quantity of milk produced, or would cause troubles with the udder of the cow. It seemed to the management of the Station that these were among the questions that it should attempt to answer. The first results of our inquiries in this direction that were made public related to the influence of the milking machine on the germ content of the milk. The conclusions reached were based upon numerous and long continued observations. The investigation required a study of numerous factors involved in the use of the milking machine, such as operation of filters, treatment of the rubber parts of the machine with septicides, and so on. After considerable experience and the attainment of the desirable con-

trol of the use of the machines, it was found that the bacterial content of the milk remained well below 10,000 per cubic centimeter, ranging in a majority of cases between 2,000 and 5,000. These tests were carried out under ordinarily good barn management and indicate that the milking machine, properly handled, may be made an important factor in the production of sanitary milk.

Another important line of investigation recently instituted by the bacteriological department is the study of soil bacteria, especially as influenced by the application to the soil of lime and other substances. We have come to understand that soil flora are intimately related to fertility and it is well within the range of probability that the effect of lime or other materials applied to the soil may be in part due to a modification of the kind and activities of soil bacteria. This investigation has not proceeded beyond the preliminary steps that are necessary to the carrying on of an extended piece of research.

Vegetable growers have at times met with serious losses from what are known as soft rots. The soft rot of cabbage has received the attention of the Station for some years. It is now known that the causal organism, or group of organisms, is bacterial in its character. As far back as 1902, this Station and the Experiment Station of Vermont entered into a co-operative investigation of the soft rots of cabbage, cauliflower and turnip. This investigation has not proceeded farther than a study of the various strains of organisms related to the soft rots and an attempt at their classification. The knowledge gained forms a basis for further inquiry as to the possible control of vegetable soft rots.

CHEMICAL WORK.

The most laborious and expensive chemical work performed at the Station is the analysis of various materials that are inspected under the authority of the State Commissioner of Agriculture. Samples of fertilizers, feeding stuffs, fungicides and insecticides are selected in the open market by the agents of the Commissioner, which samples are forwarded to the Station for analysis. The an-

nual number of samples of all kinds now analyzed is at least 1600. This work has been increasingly expensive, so far as feeding stuffs are concerned, because of changes in the law requiring not only a chemical analysis, but a determination of the ingredients in the various samples. The results of these various examinations are published annually in the bulletins which are distributed to a list of over 40,000 persons.

The desire is often expressed by dealers and farmers that these analyses might be published each year before it is necessary to purchase these commodities. It is not possible to accomplish this. For instance, samples of fertilizers can not be taken with any economy whatever until the goods for a given year are well distributed in the market. To take samples at the manufacturing establishments would be little short of mockery. This means, then, that sampling will not begin actively until early in March and it is impossible to select a thousand or more samples and secure their analysis before the sale and use of fertilizers begin. The fertilizer bulletins are chiefly valuable in indicating to purchasers those brands of fertilizers that have uniformly been as good as the guarantees, and purchasers may safely bank upon the continued reliability of goods that have been maintained up to their guarantees during a period of years.

At the present time, the feeding stuff trade is a source of perplexity both to the inspecting authorities and the consumer. There are now being placed upon the market many brands of feeding stuffs that are made up in part of inferior materials such as ground corncobs, oat hulls, low grade screenings and the like. Manufacturers are becoming somewhat expert in the use of these inferior materials in such a way as to deceive the purchaser and make difficult their identification. The Station is doing its best to so display the composition of these questionable goods that the consumer will have no difficulty in understanding what he is buying. It is to be feared that farmers are not paying sufficient attention to the published reports setting forth the real character of the proprietary feeding stuffs now in the market. The State is

endeavoring to defend the farmers against fraud and it remains for purchasers to make an intelligent use of the information that is placed in their hands.

Chemical investigation is now related to almost every line of farm practice. At this Institution, much attention has been given to the chemical side of the dairy question. The extensive work which was begun more than twenty years ago, touching the relation of milk to manufactured products, especially cheese, has been largely instrumental in establishing certain standards by which milk of various grades is now purchased for manufacturing purposes. Investigations that were carried on in the earlier days at this Station also threw a good deal of light upon the causes of waste in butter and cheese making. This is all set forth in the Anniversary Report of the Station published January 1, 1908.

More lately, the attention of the Chemical Department has been directed toward the changes which occur in cheese during the process of fermentation. While these changes are almost entirely brought about through the actions of ferments, they must be measured in kind and quantity by chemical methods. These later results, including a determination of the influence of temperature upon cheese curing, are also summarized in the annual report mentioned above.

One of the most important pieces of work undertaken by the Chemical Department since 1907 was an investigation of the composition and economical manufacture of the lime-sulphur wash. This wash has come to have an important place in fruit growing as a means of preventing the ravages of fungus and insect pests. The results of this investigation were embodied in a formula to be followed by the manufacturer such as would accomplish the desired combination of the lime and sulphur without waste. The investigation also provided the data for a more accurate standardization of lime-sulphur washes of varying strengths and for the proper dilution of the commercial preparations when used for various purposes.

An interesting investigation that was carried on by the Chemical Department and one giving results of much promise was the study

of the effect of treating milk with carbon dioxide gas under pressure. Pasteurized milk charged at a high pressure with carbon dioxide was kept for five months with little increase of acidity. Fresh milk similarly treated kept nearly as long in some instances. In view of the fact that carbonated milk is a pleasant beverage and constitutes a healthful drink, this method of keeping it for a long time in a fresh condition makes it possible for this drink to be commonly served during the heated season without loss to the manufacturer.

Other chemical studies essential to the methods of investigating milk and its products have been carried on, such as a volumetric method for determining casein, useful in cheese factories, and a study of the constitution of casein.

A fundamental question in relation to the composition of milk and the various transformations through which milk goes in the manufacture and ripening of cheese is the relation of calcium to casein. This investigation has been carried on for several years. Some new compounds of calcium with casein and paracasein have been found which have important relations to the changes taking place when milk is made into cheese. Not only have calcium compounds been formed and studied but also combinations of casein with sodium, potassium, ammonium, borium and strontium. From the results of the investigations thus far carried on, as summarized in Technical Bulletin No. 26, there appear to be not less than four different compounds of calcium and casein.

CROP PRODUCTION.

It is undoubtedly true that farmers are more or less given to looking for new crops that have unusual properties rather than to attempting improvements in the culture of crops already established. In a majority of instances, the new crops introduced in later years have not proved to have any advantages over those long under cultivation. This is not true of alfalfa, however. The establishment of this plant on the farms of this State marks a notable step in advance in the production of cattle feed. Not

only is the acreage production of nutritive material large, but the alfalfa plant has a distinct value as a soil renovator and as a means of maintaining the necessary nitrogen supply of the farm. There is probably no other instance that can be mentioned in which scientific investigation has been of more marked benefit than in the increase of alfalfa-growing areas.

Leguminous plants, including alfalfa, sustain a peculiar relation to bacteria. Plants of this class act as hosts to certain forms of germ life and unless, for instance, numbers of this bacterium are present in the soil, alfalfa does not flourish. Moreover, the prosperity of this essential bacterium depends very much upon the soil reaction, whether highly acid or not, and so it has been found that the acidity of a particular field needs to be corrected before the soil can be used successfully in alfalfa growing.

For several years, the Bacteriological and Botanical Departments of the Station gave much attention to the conditions favorable to the growth of the alfalfa plant. In a bulletin published in 1908, there is reported the results of experiments in the inoculation of soil for alfalfa growing in 67 fields distributed among 33 counties of this State. It was found that the bacteria, which enable alfalfa to appropriate nitrogen from the air, were almost universally present, but in sufficient numbers in only about one-fourth of the 67 fields to produce the desired inoculation. On 33 of the 67 fields which were tested the application of soil from an old alfalfa field rich in the necessary bacteria changed alfalfa growing from a failure to a success in those particular fields. On 15 fields, a successful crop was produced without this inoculation. This showed beyond question that in many parts of the State soil inoculation is essential to the establishment of the alfalfa plant. Inoculation was but part of the problem; the influence of liming, or the modification of soil acidity, was still to be considered and to what extent liming New York soils was necessary to successful alfalfa production. A bulletin published in 1909 gave the results of more than 100 co-operative experiments in growing alfalfa in about half of the counties of the State.

These observations showed that where neither lime nor inoculation was practiced, the chance of a successful crop of alfalfa was not more than one in five. The addition of lime raised the chance of successful crops to two out of five, and with inoculation alone success was attained in about three-fifths of the trials; but where both lime and inoculation were resorted to, success was attained in four-fifths of the experiments. On the basis of such results, alfalfa growing has developed rapidly in the State and is now an important adjunct to dairy farming in many sections.

Other troubles developed in alfalfa production. One of the most serious of these was the adulteration of alfalfa seed chiefly with the seeds of other legumes such as yellow trefoil, bur clover and sweet clover, and with the seed of dodder. In order to correct the evil of adulteration, the Botanical Department of the Station invited farmers to submit samples of alfalfa seed for examination. Bulletin No. 305 showed that out of 548 samples of alfalfa seed examined, 126 contained dodder. This was an important fact because dodder is a parasitic plant which preys upon alfalfa, clover and other legumes and, if allowed to spread, becomes a source of great loss.

The Botanical Department devised a means of ridding alfalfa seed of the seeds of this pest by the use of a screen which would allow the dodder seed to pass through, but held back the alfalfa. This contrivance was widely advertised. Dodder has now largely disappeared from commercial alfalfa seed in this State.

The examination for the other adulterants mentioned, such as trefoil, led purchasers of alfalfa seed to be cautious in buying, and dealers in seed to be careful concerning what they offered in the market.

Various fungus diseases of the alfalfa plant have been given consideration, but none of these appear to be especially destructive, the most important disease being what is known as leaf spot. It is observed at the Station that in years when there is sufficient moisture this fungus seldom develops to any extent.

DAIRYING.

Dairying is the leading agricultural industry in this State. Dairy products are probably sold from not less than 200,000 farms, involving the keeping of more than a million and a half of cows. The annual sale of dairy products at the time of the last census could not have been less than \$60,000,000, and notwithstanding the magnitude of this industry it is unprofitable on many farms, although in many cases this may not be realized. The lack of profit is due to several factors, among which are the low price at which bulk milk is sold and the keeping of inferior cows.

The keeping of careful records of the feeding and production of the Station herd gives an opportunity to illustrate the influence upon profit of the individuality of the animals. The animals in the Station herd present a high grade of efficiency and they are more uniform in their productive capacity than would be the case on any but very exceptional farms. Nevertheless, the range of yield during three years' records was from 3,350 pounds of milk for the poorest cow to 10,150 pounds for the largest yielding cow. This means that one animal produced three times as much milk as the other and twice as much butter-fat, with the consumption by the better animal of only one-tenth more food.

The following is a quotation from the conclusions presented in Bulletin No. 322, published in 1910: "If for the poorer half of the herd, we had substituted animals equal to those in the better half, it would have increased the yearly revenue \$237.40 if we had sold milk at current shippers' prices, or \$379.90 if we had sold butter-fat, with an added expense of only \$40 as the cost of the extra food consumed by the better cows."

As emphasizing the results with the Station herd, mention may be made of the records at the Stations of two farmers, one of whom received in one year \$877 from the product of eight cows, while the other farmer received only \$868 from the product of twenty-two cows. The Dairy Department of the Station has urged upon the dairymen of the State the wisdom of ascertaining the productivity of the individuals in their herds and the weeding out as fast as possible of the poorer animals.

As previously suggested, one of the questions involved in testing the efficiency of the milking machine was the effect of its continued use upon the yield of milk and the welfare of the animal, especially in the maintenance of the udder in a normal condition. The acquisition of accurate data on this point is difficult. It is not possible to milk the same animal by hand and by the machine throughout the same lactation period, and for this reason it was necessary to determine the yield of milk between two methods with a generous number of animals and through several lactation periods. There was involved in this study not only the effect of machine milking upon yield, but also the question of economy in the use of the machine in the saving of the time of men. The following is a summary of the conclusions given in Bulletin No. 353, reprinted in this report:

One of the limiting factors in the development of the dairy business is the difficulty in obtaining regular and efficient milkers. Interest in the milking machine is largely due to the possibility of displacing a considerable amount of low-grade labor by a single higher grade, better paid man.

This study of the effect of hand and machine methods of milking upon the flow of milk covered over four years. At each succeeding period of lactation the manner of milking was changed so that each cow was alternately milked by machine and by hand during succeeding periods. Satisfactory data were thus obtained from 71 lactation periods.

The normal variation in flow in a large group of cows is at least 1 per ct. The effect of the manner of milking, provided it is thoroughly done, is less than this amount and therefore is not measurable.

In a dairy of 15 cows one man using two machines will milk cows within an average time of 3 minutes but the time lost in preparing and cleaning the machine will equal 1 minute per cow. With larger dairies this latter item will be proportionately reduced.

The Station is now in possession of a herd of milch goats numbering forty-two animals. While the milch goat is not ordinarily thought of as a dairy animal, it is believed that as a source of milk for certain purposes, it will have a place of increasing importance in this country, particularly as a source of food for very young children who are unable to thrive on food of any other kind.

The purpose of keeping this herd is to determine the cost of maintenance, the yield of milk and the uses to which the milk can be put. Very encouraging success has already been reached with infants and young children who were not previously prospering. No results have been published, however, and will not be until data are secured covering a considerable period of time and a large amount of experience in the use of the milk.

The Station has no animals for sale. It will retain all desirable animals and the undesirable ones will be disposed of otherwise.

FRUIT PRODUCTION.

The Experiment Station has devoted a great deal of attention to the interests of the fruit grower. Not only has the Horticultural Department directed its energies almost wholly along this line, but the Departments of Botany and Entomology have been occupied to a great extent with the study and control of the pests from which the fruit grower must be defended. It is quite natural that a generous share of the Station's activities should be directed toward aiding the fruit interests, partly because these are greatly important in this State and are increasing in magnitude, and partly because fruit production has offered definite problems that have been available for study. Moreover, among the fruit growers of the State have been many men who have had the disposition and the ability to co-operate with the Station in the study of their problems.

The Station has made extensive observations as to the character and value of varieties of fruit. This has been accomplished partly by the cultivation of a large number of varieties of several classes of fruit on the Station grounds. The usefulness of variety tests

at a single locality has been the subject of much discussion and, doubtless, much work of this kind has been of little benefit. It is felt, however, that the variety studies at the Station have been of great value. They have provided the foundation data for the preparation of three important publications, "The Apples of New York," "The Grapes of New York," and "The Plums of New York." Other publications are in preparation and contemplated. More than this, the Station has served as a bureau of information, and the members of the Horticultural Department have needed to be in immediate contact with an extensive museum of living fruits in order to speak from actual observation.

The efforts of the Station have not been confined to old varieties, but it has been active in the study of the new fruits that have been offered to the public and has, on its own account, in the course of its breeding experiments, developed a number of new varieties that promise to be of great value. These new varieties include small fruits, such as strawberries and raspberries, as well as grapes and apples. Some of them have been distributed throughout the State for trial by practical fruit growers and so fast as additional varieties seem to be worthy of a more extensive trial, they will also be distributed.

One of the most laborious pieces of work that the Station has ever undertaken was the preparation of the fruit publications referred to above. The collection and organization of the data presented in these volumes has been a work of great magnitude and it is very gratifying that these volumes seem likely to occupy an important place in the horticultural literature of the world. They have been in great demand, much beyond the supply, not only within the borders of the State, but also throughout the United States and in foreign countries. It has not been possible to meet fully the outside demand without doing injustice to local needs, but it has been felt wise to place a limited number of volumes where they would serve to promote the interests of fruit growing in a widespread way. For this reason, other experiment stations, important libraries and a limited number of professional men have been supplied with these publications.

The extensive studies of the fruits of the State made necessary in the preparation of these fruit publications made it possible to prepare bulletins giving advice as to the varieties, particularly of apples, best adapted to the various sections of the State. The bulletin on apple distribution has been much in demand and without doubt has been found to be very suggestive and useful.

The field work of the Horticultural Department of the Station has not been limited to the Station farm although there has been developed on the farm, including the breeding experiments, a collection at one time of approximately 10,000 varieties of fruits, both large and small. In order to study important problems, the Station has acquired the control of several areas of land in various parts of the State. Some years ago, the question of the use of dwarf trees in apple culture was much discussed and in co-operation with a committee of the New York State Fruit Growers' Association, three dwarf orchards of two acres each were established in the State, one in the western portion, one near Syracuse and one in the Hudson River valley. The results of five years' observation has been rather discouraging as to the general value of dwarf trees, considered from the standpoint of acreage production. This type of orchard seems to be promising in the production of a limited number of varieties, such as the McIntosh Red, the Lady, the Wealthy and the Jonathan, particularly the two former. The experiments show, however, that with the most of the leading commercial sorts of apples, standard trees are preferable.

Ten or twelve years ago, a very active controversy developed over methods of orchard management. The merits of cultivation combined with the use of cover crops as against what was termed "sod culture" were warmly debated. This matter being so important, the Station leased an orchard of ten acres which seemed to be well adapted to the pursuit of experimental work for the comparison of the two methods under discussion. Nine years' results have been secured and the work will be continued only one year more. So far as the results of this orchard are concerned, that is located on land typical of large areas in western New York, the verdict is decidedly in favor of cultivation and the use of cover

crops. This outcome is in accordance with the judgment of a large proportion of the best orchardists in the State. It is not claimed on the basis of this experiment that sod culture, so-called, is never advisable; for there are some notable instances of its success where the conditions are somewhat unusual. In some localities, sod culture may be the only feasible method of maintaining an orchard. Notwithstanding all this, the experiment stands as an object lesson to the orchardists of western New York which, if generally heeded, would greatly increase the output of apples and the profits of the grower.

An experiment conducted on the Station farm, which was begun some fifteen years ago, has given results that have attracted wide attention, and the publication of them has caused a great variety of comment. Reference is made to an experiment in growing apple trees to test the influence and economy of applying commercial fertilizers as well as farm manure. The most careful and extensive observations have revealed no more than a hardly appreciable difference between the growth and yield of the trees which were given good cultivation with cover crops but no fertilizer of any kind, and those trees receiving the same culture and liberal applications of fertilizers and farm manure in addition. The statements in the Station bulletin setting forth the facts pertaining to the experiments have been sharply criticised by commercial interests.

As in the case of the experiment in orchard management, so here it is not claimed that fertilizers are never useful in apple production, but it is believed that on large areas of orchard land in the western half of the State, good cultivation and the use of cover crops will abundantly maintain the desired growth and yield of fruit. There are other reasons for the belief that a great deal of money is spent for fertilizers in fruit production which might be saved if the right methods of culture were followed. The members of the Station staff are bound to set forth honestly, and so far as it is in their power, judicially, the results of the experimental work which they carry on. No amount of prejudice

will brush away facts. Caution should be exercised, however, as to making too broad an application of local observations.

During the year 1912, several bulletins have been published by the Horticultural Department, a summary of the main facts and conclusions therein presented being given below:

Influence of crossing in increasing the yield of the tomato.—Bulletin No. 346 shows that an infusion of new blood obtained by crossing closely related varieties of tomatoes increases the vigor of the plant and the yield of fruit to a marked degree. It is uncertain, from the experiments carried on, whether the stimulating effects of the crossing are due to an increase in size or in number of cells. The results obtained seem to warrant the crossing of tomatoes not only by growers but by seedsmen who wish to furnish the best grade of seed. The production of such seed would, of course, require time and care and the seed would have to be sold at higher prices. Recommendations are given for making tomato crosses and also suggestions as to how new characters may be obtained and maintained. Other field or garden crops are named that are thought capable of improvement by crossing.

An experiment in breeding apples.—There have been few efforts to improve apples, nearly all varieties having come from chance seedlings. With the knowledge of recent discoveries in plant-breeding we ought to breed this fruit more advantageously than in the past. Bulletin No. 350 is a record of an experiment in breeding apples in the light of the new knowledge. The material for this experiment came from 148 crosses made in 1898 and 1899. Grafted trees of these crosses began to bear in 1904 and the seedlings came in fruiting in 1908. The crosses have been studied from both the grafts and seedlings, the orchards having had the care usually given commercial plantations.

The crosses which have fruited, with the number of each, are: From Ben Davis X Esopus 4; from Ben Davis X Green Newtown 13, from Ben Davis X Jonathan 11, from Ben Davis X McIntosh 11, Ben Davis X Mother 20, from Esopus X Ben Davis 29, Esopus X Jonathan 2, McIntosh X Lawver 1, Ralls X Northern Spy 9, Rome X Northern Spy 1, and Sutton X Northern Spy 5. These seedlings show marked vigor and are healthier and more

productive than others from self-pollinated seeds, of which considerable numbers are growing at the Station, comparable in age to the crossed seedlings. Contrary to the usual belief, these seedlings have not "reverted to the wild," but show to a marked degree the characteristics of the parents. So evident is the inheritance of parental characters that one familiar with the varieties crossed could in most cases select the parents for individual seedlings. Indeed, so surprisingly uniform has been the transmission of the good qualities of the selected varieties that the fruit of 14 of the 106 fruiting seedlings is considered as good or better than either of the parents, and the trees are satisfactorily productive. These seedlings have been named from counties in New York State and are already distributed to some extent among apple growers.

Grape stocks for American grapes.—Bulletin No. 355 is the report of an experiment in grafting grapes on roots of several species with the hope of improving the viticulture of New York. The experiment was tried with 19 varieties each having some weakness which it was hoped could be overcome by grafting on one of three different stocks. The vines passed through many vicissitudes during the ten years the test was carried on, but despite these it was evident throughout the experiment that the grafted grapes surpassed those on their own roots. The grafted vines were most productive and showed greatest vigor. The grapes on the grafted vines ripened a few days earlier than those on their own roots. The experiment suggests that it would be profitable to grow some of the fancy grapes of this region on grafted vines and that it is well within the bounds of possibility that main-crop grapes can be profitably grafted. It is recommended that grape growers try small vineyards of grafted grapes, using as stocks the three tried in this experiment.

Pedigreed nursery stock.—Circular 18 from this Department holds that there is but slight foundation for the claims of nurserymen and fruit growers who advocate propagating trees only from buds taken from selected trees. The assertions that trees propagated from selected stock are better than those taken from other trees of the same variety far outstrip the evidence. To attempt

putting in practice the reform demanded would revolutionize nursery practice — sheer folly without real, precise, abundant evidence of good to be accomplished. The chief defense of the position taken in the circular is that the variations commonly found in trees are fluctuating ones due to environment and are not, unless in very exceptional cases, transmissible. It must be proved that a character of any particular tree is transmissible before it will be worth while propagating for that character.

INJURIOUS INSECTS.

The efforts of the Entomological Department of the Station have been devoted largely to the defense of the farm and orchard against insect pests. This has involved not only a study of the means of preventing the ravages of well-known insects, but also an investigation of the life history of new forms of insect life with a development of the means of preventing the injuries they would cause.

The insects of which the life history has been studied during the last five years, in part through laboratory investigation, and in part through field observations, are the following: The poplar and willow borer, leaf-blister mites, the tussock moth, grape-leaf hopper, the fidia or root worm, tree hoppers, the ermine moth and the pear thrips. The important better known insects with which this Department has dealt are the San José scale, the cabbage maggot and the pear psylla.

With the newer insects, the following results have been secured: The studies of the poplar and willow borer resulted in recommending the cutting out and destroying in June of the parts affected with the grubs and, in addition, spraying during July with bordeaux mixture containing an arsenical poison.

The ravages of the leaf-blister mite have been general throughout the apple-growing areas of western New York. Experiments demonstrated that the lime-sulphur wash, oil emulsions and miscible oils are efficient remedies for this pest. It is found that orchards regularly sprayed with any of these mixtures are not

subject to injuries by the mite. Generally one application of either of these sprays has prevented the spotting of the foliage.

The caterpillars, or larvæ, of the tussock moth damage young apple and pear fruits. This pest seldom appears in destructive numbers. When it does, the egg masses should be collected and destroyed and arsenical sprays should be used to prevent devastation by the caterpillars.

The very serious pest in the grape regions of New York, especially in Chautauqua county, is the grape leaf hopper and the results of our experiments appear on the following pages in a summary of Bulletin No. 344.

The ermine moth, an insect of somewhat recent importation, and the pear thrips, an insect very destructive in certain sections of the State, especially in the Hudson River valley, have also been studied and the results of the investigations and experiments appear later in the summaries of Technical Bulletin No. 24 and Bulletin No. 343.

In view of the fact that cabbage growing is an important industry in this State, much attention has been given to insects attacking the cabbage plant, particularly the turnip flea beetle and the cabbage maggot. An efficient prevention of the depredation of these insects, particularly the maggot, was found in the screening of cabbage seed beds with cheesecloth. This method of growing the young plants conserves the moisture in the bed, raises the temperature and furnishes congenial conditions for growth so that plants under cloth start sooner, grow faster and reach the desired size a week or ten days earlier than plants in the open. Moreover, this screening completely protects the seedlings from maggot injury with the result that the growing crop is not injured by this insect. It was found, also, that certain grades of cheesecloth would prevent injury by the flea beetles.

Some seven years ago the apple growers of the State were greatly concerned over the spread and destructive effects of the San José scale, an insect that first made its appearance in this country in California, and through the distribution of nursery stock and by other means, has spread over a large portion of the

fruit growing regions. Even some of the more intelligent apple growers nearly concluded that they would be obliged to give up apple growing. It was feared that in the case of large trees no means of preventing the destructive effects of the scale could be devised. There was laid upon the Station the imperative duty of giving to this insect a large amount of attention, for it was true that unless some means could be found of minimizing its destructive effects an end to apple growing in the State of New York would inevitably come. Investigations in regard to the use of various spraying liquids were begun at this and other stations with the result that today the San José scale is no longer feared as a menace to fruit growing. This Station was able to demonstrate in an orchard at Youngstown, N. Y., that large trees already badly affected could be restored to a productive condition and so maintained. It has been finally concluded that no spraying liquid is equally efficient with the lime-sulphur wash, and the fruit growers of the State have been put in possession of the details of manufacturing for themselves this wash in an economical way and at much less cost than is involved in the use of commercial preparations. It is not too much to claim when it is stated that this one service to the fruit-growing interests of New York has repaid the State many times over for the cost of the scientific agencies that are now working in the interest of the farmer.

The pear thrips.—In Bulletin No. 343 the attention of fruit growers is called to the discovery of the pear thrips (*Euthrips pyri* Daniel) in the Hudson River valley. The occurrence of the pest in New York is of special interest as this is the only region in the United States, outside of the heretofore recognized area of infestation in California, where the thrips is known to exist.

It is noted that in its appearance and habits the thrips is quite different from all other insects which growers in this State have been accustomed to combat. The adult, which is largely responsible for the injuries to the trees, is a small, darkish brown, winged insect measuring about one-twentieth of an inch in length. It appears in destructive numbers when the buds are opening, attacking the tenderest of the flower parts. The eggs are mostly

deposited beneath the epidermis of the blossom and fruit stems. Hatching takes place in a few days and the larvæ seek preferably the calyx cups, undersides of calyces, and the folds or under surfaces of the tender, expanding leaves. The larvæ feed for about two weeks and drop to the ground, in which they form a protecting cell. In this cell the insect completes its transformations and emerges from the ground in the spring as an adult. The thrips is single brooded, and the most active and destructive stages are coincident with the period that includes the life events of the swelling and opening of the buds and dropping of blossoms and calyces. If the thrips are numerous the injured buds of pear trees become sticky with a brownish liquid and cease to develop, while the blossom clusters have a stunted, shriveled and brownish appearance as if blasted. Apple trees, while visited by large numbers of the adults, suffer to a much less extent, but dwarfed and curled leaves and occasionally stunted fruits may be observed in most orchards. The stems of sweet cherries are especially attractive to the adults for the deposition of the eggs, and as a rule they show considerable scarification. The effects of this injury on fruit yields was not ascertained.

During 1911 the actual range of the distribution of the thrips in this State was not determined. It was quite destructive to pear orchards generally about North Germantown, Germantown and Cheviot, and there were reasons for believing that the pest was distributed over a large area of the Hudson River valley. In western New York specimens of the insect were found on apples growing about Geneva.

A brief report is given of experiments to develop efficient methods of control. Spraying with nicotine extract in combination with kerosene emulsion or soap when buds are breaking and until they are entirely opened is the most promising means of protecting the trees.

The grape leaf-hopper and its control.—This Bulletin, No. 344, is a report of the life-history studies on this insect and of various experiments to devise an effective and safe insecticide for the protection of grape vineyards. Considerable emphasis is

placed upon the effects of the destructive work of the insect upon the quality of the fruit, as well as on the yields, which has not been fully appreciated by growers generally. It is shown that the grape leaf-hopper feeds by sucking, and preferably on the under sides of the leaves. It pierces the skin of the leaf, feeds until satisfied and then withdraws its proboscis or sucking tube, thus leaving an opening from which the plant juices dry out, not only from the pierced cell but from adjoining ones. There is soon formed about each puncture a spot of dead tissue. When the insects are superabundant there is a severe drain on the vitality of the leaf and it takes on an unhealthy yellow hue. The death of so many starch-making cells lessens the amount of wood produced and of fruit formed; and seriously affects the quality of the fruit, making it ill-flavored or sour and poorly colored. The rich blue-black of the Concord becomes a lifeless reddish color while the attractive flavor may be lost so that grape-juice makers and most buyers of grapes for the table reject the fruit.

Brief descriptions are given of a number of spraying experiments which showed that a spray containing two one-hundredths of 1 per ct. of nicotine (Black Leaf 40, one gallon to sixteen hundred gallons of water) is the most effective and safest insecticide for the control of this pest. The bulletin concludes with general directions for spraying. The application of the mixture can be done by the usual hand-spraying with trailing hose or by an automatic leaf-hopper sprayer which is completely described. The latter device was developed during the year's work and has proven most satisfactory. With high pressure and the proper adjustment of the nozzles almost complete protection has been afforded to a number of commercial vineyards.

The apple and cherry ermine moths.—In Technical Bulletin No. 24 attention is called to the occurrence of these insects in the United States and to their economic importance as fruit pests. These insects were introduced in shipments of foreign nursery stock and appeared in plantations of apple and cherry seedlings. It is stated that since the insects were first detected in 1909 special precautions have been taken by the agents of the Division of

Nursery Inspection of the New York Department of Agriculture with plantings of foreign-grown seedlings, and during the past four years infested plants have been collected in thirteen localities in the State.

A report is given of life-history studies on some of the insect material which was forwarded to this Station for identification. Two species of moths were bred — *Yponomeuta malinellus* Zell., which thrives largely on apple and *Y. padellus* L., which is a more general feeder, showing preference for hawthorn, plum and cherry. Both species are common and destructive fruit insects in Europe. The bulletin closes with a discussion as to the rôle these insects are destined to play as fruit pests in the United States. Careful inspections of nursery plantations and the surroundings of nurseries indicate that these lepidopterons have not gained a footing in New York. In states where there has not been such inspection the danger that such has taken place is obviously great. With the ability of these insects to survive the conditions incidental to the importation of nursery stock from abroad and to escape ordinary nursery inspection, the wonder is that they have not before this succeeded in establishing themselves along the avenues of trade in America.

PLANT DISEASES.

The annual loss to the agriculture of New York from the devastations of fungus and other plant diseases is very large. These diseases are in the nature of parasites living upon such hosts as fruit trees, the potato and other important agricultural plants. Their successful prevention is often very difficult and, in some cases, practically impossible, for the treatment that would be severe enough to destroy the fungus would also be fatal to the host.

Economically considered one of the most important pieces of work carried on by the Botanical Department has been the so-called ten-year experiments in spraying potatoes. Before this experiment began, it was known that the proper application of the bordeaux preparation would practically control potato blight.

It was not definitely determined that annual spraying would be profitable during a series of years because the blight does not attack the potato plant every season and when this disease is not prevalent, spraying is less necessary. The year 1911 was the tenth year of this experiment and there follows later a summary of the results, showing that the average results for the ten years indicate a material net profit from the annual spraying.

During recent years, the attention of the Station has been called to a very prevalent disease of fruit trees known as the "crown rot." In all sections of the State much loss has been caused by this affection. Various explanations have been offered, such as the attack of a fungus, and arsenical spraying. Extended investigations by this Station have led to the conclusion that this disease (if it may be called such) is due chiefly to winter injury. An account of the investigation is given in Technical Bulletin No. 23 of which a summary is given on p. 561.

The Botanical Department of the Station has demonstrated its usefulness in maintaining a very careful survey of the plant diseases prevalent in the State. As an illustration of the value of the watchfulness that has been maintained, this Department first called attention to the existence of the currant rust in this country, doubtless imported from Europe. This disease caused great damage to pine forests in other countries and it has been found necessary to destroy thousands of imported pine trees that were affected with this pest. More recently, it has been found that the currant rust is now well distributed in portions of New York in currant plantations and this matter will require the most careful attention by the State to prevent serious loss from its possible spread to our pine forests.

The Botanical Department has also been asked to advise in the matter of controlling that most destructive disease, the chestnut blight, which is causing the death of large numbers of chestnut trees, particularly in Pennsylvania and in certain sections of New York. The head of this Department has united with other specialists in urging that much more study must be given to the life history of the disease and to the manner in which it is spread

before we shall be in a position to enter upon an active campaign for the purpose of preventing further injury.

Several new diseases have been studied, particularly diseases of the raspberry and the currant, and while no means has been discovered for preventing the blight affecting these two classes of plants, a foundation knowledge has been laid for further efforts.

For several years, the Station has consented to the inspection of samples of seeds sent in by farmers. The opportunity thus offered has been utilized by very many persons. The Legislature of 1912 passed a seed inspection law, which throws upon the Station the duty of examining all samples of seeds sent to it officially by the Commissioner of Agriculture. Later may be seen a summary of the work accomplished during 1911 as given in Bulletin No. 345. During 1912 a larger number of samples have been examined because of the legislation before mentioned.

Seed testing.—During 1911, 1,015 samples of agricultural seeds were tested for purity. Dodder was found in 12.9 per ct. of the alfalfa samples and 4.74 per ct. of the red clover samples. Two samples of red clover and twelve of alsike clover were found to be adulterated. Many samples of alfalfa contained seeds of Russian thistle and roquette, but these weeds are quite harmless in New York. The bleaching of oats by means of sulphur fumes injures their germination. Several failures in oat seedlings were found to be due to this cause. Full details of the seed work have been published in Bulletin 345.

Potato-spraying experiments.—The series of experiments designed to determine the profit from spraying potatoes was closed in 1911 and the results published in Bulletin 349. These experiments demonstrate beyond doubt that the spraying of potatoes is highly profitable in New York.

In the so-called ten-year experiments, the ten-year average increase in yield is as follows:

At Geneva, three sprayings, 69 bushels per acre.

At Geneva, five to seven sprayings, 97.5 bushels per acre.

At Riverhead, three sprayings, 25 bushels per acre.

At Riverhead, five to seven sprayings, 45.7 bushels per acre.

In the farmers' business experiments (6 to 15 each year) the nine-year averages are as follows:

Increase in yield, 36.1 bushels per acre.

Total expense of spraying, \$4.74 per acre.

Net profit from spraying, \$14.43 per acre.

In 1911, the Station made a comparative test of lime-sulphur, lead benzoate and bordeaux mixture for spraying potatoes. The results of the experiment plainly show that neither lime-sulphur nor lead benzoate can be profitably substituted for bordeaux in spraying potatoes. Both lack the stimulative influence possessed by bordeaux while lime-sulphur also dwarfs the plants and lowers the yield. A repetition of the experiment in 1912 gave similar results. For details of these experiments see Bulletins 347 and 352.

Crown-rot of fruit trees.—Crown-rot is a disease of trees in which patches of dead bark or bare wood occur on the trunk near the surface of the soil. An extended investigation of this disease shows that it is due chiefly to winter injury. It is most liable to occur on trees in wind-exposed situations, particularly on those which have made very rapid growth and gone into the winter with their wood unripened. Hence, it appears probable that it may be at least partially prevented by planting the varieties which are least susceptible, providing windbreaks, heading low, avoiding excessively rapid growth and inducing early ripening of the wood. In order to prevent trunk rot which often follows the initial injury the areas of dead bark should be detected and treated as early as possible. The trunks of young apple trees should be carefully examined twice a year—May and July. Wherever dead bark is found it should be carefully cut away, the wound disinfected with a 1 to 1,000 solution of corrosive sublimate and then covered with grafting wax or gas tar to keep out moisture and induce healing. A full account of the investigation is given in Technical Bulletin 23.

PLANT NUTRITION.

The only work in plant nutrition, the results of which have been published during the past five years, is a report of experiments

on Long Island to test the comparative merits of methods of application of fertilizers and the efficiency of the various forms of nitrogen. These tests showed little difference in the efficiency of organic nitrogen from dried blood as compared with inorganic nitrogen from nitrate of soda. It was noticed, however, that where there was sufficient rainfall, there was a more rapid growth of vines from the nitrate of soda. As to the manner of application, there appeared to be a small difference in favor of distributing the fertilizer in rows. The advantage was slight, however. These tests ratify much more extended experiments made some years ago in showing that when fertilizers are used in excess of 1,000 lbs. per acre, there is not a corresponding increase of yield and either practically no profit or a loss.

During the past sixteen years, there have been maintained on the Station farm, fertilizer experiments having for their object a comparison of certain methods of maintaining soil fertility. No reports have yet been made of this work, but after harvesting a crop of 1913, the results for this long period of time will be made public.

POULTRY PRODUCTION.

While but little has been published in recent years from the Poultry Department of the Station, work has been going on steadily chiefly along breeding and nutrition lines. This work is of such a nature that it is necessary to continue it for a long period of time in order to get results that are reliable and upon which conclusions can be based.

PUBLICATIONS ISSUED DURING 1912.

BULLETINS.

No. 343. January. The pear thrips. P. J. Parrott. Pages 28; color plate 1, plates 4, figs. 5. Popular edition, pages 6, plate 1.

No. 344. February. The grape leaf-hopper and its control. F. Z. Hartzell. Pages 15; plates 4, figs. 3. Popular edition, pages 5, plates 1, figs. 2.

No. 345. February. Seed tests made at the Station during 1911. G. T. French. Pages 14. Popular edition, pages 3.

No. 346. March. Influence of crossing in increasing the yield of the tomato. Richard Wellington. Pages 20. Popular edition, pages 6.

No. 347. March. A comparative test of lime-sulphur, lead benzoate and bordeaux mixture for spraying potatoes. F. C. Stewart and G. T. French. Pages 14; plates 4. Popular edition, pages 1.

No. 348. May. Analyses of materials sold as insecticides and fungicides. Pages 14.

No. 349. June. Potato spraying experiments, 1902-1911. F. C. Stewart, G. T. French and F. A. Serrine. Pages 41. Popular edition, pages 9.

No. 350. June. An experiment in breeding apples. U. P. Hedrick and Richard Wellington. Pages 46; plates 17. Popular edition, pages 10.

No. 351. September. Inspection of feeding stuffs. Pages 131.

No. 352. November. Lime-sulphur vs. bordeaux mixture as a spray for potatoes. M. T. Munn. Pages 7; plate 1. Popular edition, pages 1.

No. 353. November. Milking machines: Effect of machine method of milking upon the milk flow. G. A. Smith and H. A. Harding. Pages 35; plate 1, fig. 1. Popular edition, pages 9.

No. 354. November. Report of analyses of commercial fertilizers collected by the Commissioner of Agriculture during 1912. Pages 120.

No. 355. December. Grape stocks for American grapes. U. P. Hedrick. Pages 32; plates 5. Popular edition, pages 8.

No. 356. December. Director's report for 1912. W. H. Jordan. Pages 48.

TECHNICAL BULLETINS.

No. 19. April. Phytin and phosphoric acid esters of inosite. R. J. Anderson. Pages 15.

No. 20. May. A study of the metabolism and physiological effects of certain phosphorus compounds with milch cows, II. A. R. Rose. Pages 30; figs. 4.

No. 21. June. Phytin and pyrophosphoric acid esters of inosite. II. R. J. Anderson. Pages 14.

No. 22. September. The organic-phosphoric acid compound of wheat bran. R. J. Anderson. Pages 14.

No. 23. September. Crown-rot of fruit trees; field studies. J. G. Grossenbacher. Pages 57; plates 23.

No. 24. November. The apple and cherry ermine moths. P. J. Parrott and W. J. Schoene. Pages 40; plates 9, figs. 10.

No. 25. December. The organic phosphoric acid of cottonseed meal. R. J. Anderson. Pages 10.

No. 26. December. Composition and properties of some casein and paracasein compounds and their relation to cheese. L. L. Van Slyke and A. W. Bosworth. (In press.)

CIRCULARS.

No. 18. February. Pedigreed nursery stock. U. P. Hedrick. Pages 8.

No. 19. February. Grape culture. F. E. Gladwin. Pages 8.

New York Agricultural Experiment Station,
Geneva, N. Y., December 31, 1912.

W. H. JORDAN,
Director.