

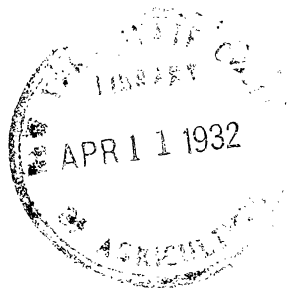
New York State Agricultural Experiment Station

Geneva, N. Y.

FORTY-NINTH ANNUAL REPORT

FOR THE FISCAL YEAR ENDED JUNE 30, 1930

U. P. HEDRICK



PUBLISHED BY THE STATION
UNDER AUTHORITY OF CORNELL UNIVERSITY

CORNELL UNIVERSITY
NEW YORK STATE AGRICULTURAL EXPERIMENT
STATION, GENEVA, N. Y.

STATION STAFF

ULYSSES P. HEDRICK, Sc.D., *Director.*

- ROBERT S. BREED, Ph.D.,
GEORGE J. HUCKER, Ph.D.,
Chiefs in Research (Bacteriology).
HAROLD J. CONN, Ph.D.,
Chief in Research (Soil Bacteriology).
CARL S. PEDERSON, Ph.D.,
Associate in Research (Bacteriology).
P. ARNE HANSEN, B.S.,
Assistant in Research (Bacteriology).
FRED C. STEWART, M.S.,
MANCER T. MUNN, M.S.,
Chiefs in Research (Botany).
MARY E. WOODBRIDGE, M.S.,
OLIVE M. HOEFLE, B.S.,
Assistants in Research (Botany).
WALTER O. GLOYER, M.A.,
W. HOWARD RANKIN, Ph.D.,
EDWARD E. CLAYTON, Ph.D.,
(Riverhead),
JAMES G. HORSFALL, Ph.D.,
JAMES M. HAMILTON, Ph.D.,
Associates in Research (Plant Pathology).
JOHN J. WILLAMAN, Ph.D.,
ARTHUR W. CLARK, B.S.,
DWIGHT C. CARPENTER, Ph.D.,
Chiefs in Research (Chemistry).
LEON R. STREETER, M.S.,
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EDMUND L. GREEN, M.S.,
Associates in Research (Chemistry).
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Z. I. KERTESZ, Ph.D.,
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GEORGE W. PEARCE, M.S.,
Assistants in Research (Chemistry).
ARTHUR C. DAHLBERG, Ph.D.,
Chief in Research (Dairying).
J. COURTENAY HENING, M.S.,
Associate in Research (Dairying).
JULIUS C. MARQUARDT, M.S.,
Assistant in Research (Dairying).
HERBERT L. DURHAM,
Dairy Technologist.
- PERCIVAL J. PARROTT, M.A.,
Vice-Director; Chief in Research (Entomology).
HUGH GLASGOW, Ph.D.,
PAUL J. CHAPMAN, Ph.D.,
Chiefs in Research (Entomology).
FRED Z. HARTZELL, M.A.,
HUGH C. HUCKETT, Ph.D.,
(Riverhead),
FREDERICK G. MUNDINGER, M.S.,
(Poughkeepsie),
S. WILLARD HARMAN, M.S.,
DERRILL M. DANIEL, M.S.,
G. E. R. HERVEY, Ph.D.,
Associates in Research (Entomology).
FOSTER L. GAMBRELL, Ph.D.,
Assistant in Research (Entomology).
RICHARD WELLINGTON, M.S.,
HAROLD B. TUKEY, M.S.,
REGINALD C. COLLISON, M.S.,
Chiefs in Research (Pomology).
FRED E. GLADWIN, B.S. (Fredonia),
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GLEN P. VAN ESELTINE, A.B.,
LESTER C. ANDERSON, B.S. (Hudson),
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BERNHARD R. NEBEL, Ph.D.,
Associates in Research (Pomology).
OLAV EINSET, M.S.,
LEWIS M. VAN ALSTYNE, B.S.,
KARL BRASE,
JAMES D. HARLAN, B.S.,
Assistants in Research (Pomology).
CHARLES B. SAYRE, M.S.,
Chief in Research (Vegetable Crops).
WILLIAM T. TAPLEY, M.S.,
Associate in Research (Vegetable Crops).
LESLIE R. HAWTHORN, M.S.,
PARKS V. TRAPHAGEN,
Assistants in Research (Vegetable Crops).
PATRICK H. CORCORAN, *Agriculturist.*
JAMES D. LUCKETT, M.S., *Editor.*
HERMANN O. JAHN, *Florist.*
H. FREDERICK BORG, A.B., *Librarian.*
JAMES S. LAWSON, Phm.B.,
Museum Preparator.

THE UNIVERSITY OF THE STATE OF NEW YORK

THE STATE DEPARTMENT OF EDUCATION

ALBANY, *January 2, 1931.*

TO THE GOVERNOR AND LEGISLATURE OF THE STATE OF NEW YORK:

SIRS.—Pursuant to law, the Forty-ninth Annual Report of the New York State Agricultural Experiment Station, at Geneva, N. Y., is herewith submitted to the Legislature.

Very respectfully yours,

CHESTER S. LORD,

Chancellor of the University.

FRANK P. GRAVES,

*President of the University and
Commissioner of Education.*

Ithaca, N. Y., *June 30, 1930.*

THE GOVERNOR OF THE STATE OF NEW YORK, *Albany, N. Y.:*

THE COMMISSIONER OF EDUCATION, *Albany, N. Y.:*

THE SECRETARY OF THE TREASURY, *Washington, D. C.:*

THE SECRETARY OF AGRICULTURE, *Washington, D. C.:*

SIRS.—The Act of Congress, approved March 2, 1887, establishing agricultural experiment stations in connection with the land-grant colleges, contains the following provision: "It shall be the duty of each of said stations, annually, on or before the first day of February, to make to the Governor of the State or Territory in which it is located, a full and detailed report of its operations, including a statement of receipts and expenditures, a copy of which report shall be sent to each of said stations, to the said Commissioner of Agriculture, and to the Secretary of the Treasury of the United States."

The Act of the Legislature of the State of New York in 1926 accomplishing the reorganization of the State government, provides that the New York State Agricultural Experiment Station under the administration of Cornell University shall make annual report of its general operations and expenditures to the Commissioner of Education.

In conformity with these laws I have the honor to submit herewith, on behalf of Cornell University, the report for the fiscal year 1929-30 of the New York State Agricultural Experiment Station.

Respectfully submitted,

LIVINGSTON FARRAND,

President of Cornell University.

ITHACA, N. Y., *June 30, 1930.*

To the President of the University :

SIR.—I have the honor to present herewith the Forty-ninth Annual Report of the New York State Agricultural Experiment Station, for the year 1929–30, as prepared by the Director and Chiefs in Research at the Station.

The report sets forth with such clarity the range of investigations under way, the progress thereon during the year, the additions to the plant, and the requirements of the Station, that little need be added. The material presented is an impressive record of service to farmers and of achievement in agricultural research. It merits thoughtful attention from all who are interested in the progress of agriculture in this State.

The Director emphasizes the satisfaction felt throughout the Station by reason of legislative provision for a new Horticultural Research Laboratory. This will directly benefit not only the horticultural research but other divisions of the work by relieving crowding elsewhere. It is an addition of first rank importance to the Station, and brings the building equipment for offices and laboratories to a state of reasonable adequacy for immediate requirements. With the normal growth of the work in future years, some of the older buildings will in time again become inadequate.

In the physical plant, two major needs are yet to be satisfied. The most urgent of these, as pointed out by the Director, is the range of greenhouses which has been requested for some years. Greenhouses are a positive essential for plant research and for many contributory lines. The lack of such facilities imposes a severe and highly uneconomical limitation on the work of the Station. The productivity of the existing staff will be measurably increased when these houses are available. The necessity for them is such that the appropriating bodies will not wisely delay in authorizing their erection.

The second essential need is for a central heating plant to replace the numerous scattered heating equipments in the several buildings. These are expensive to maintain and to operate, and are undesirable in the buildings. It is a situation which warrants early relief.

Of the experimental work itself, the following pages leave no doubt as to its practical significance for the agriculture of New York. It is well selected, well planned, and in the hands of a carefully chosen staff. The evidence is here that the Station fully merits the public confidence which it enjoys.

Respectfully submitted,

A. R. MANN,

Dean and Director of Experiment Stations.

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FORTY-NINTH ANNUAL REPORT

OF THE

New York State Agricultural Experiment Station

DEAN A. R. MANN, *College of Agriculture, Cornell University, Ithaca, N. Y.:*

SIR.—I have the honor to submit to you, in compliance with law, the following report of the New York State Agricultural Experiment Station for the fiscal year ended June 30, 1930, being the forty-ninth report of this institution. The character and progress of the research work which is being conducted under the provisions and appropriations made by the State and Federal governments at the Station are best set forth in the reports of the chiefs of divisions, to which, in particular, your attention is invited. The results of the Station's activities, as told by those in charge of the investigations, are such that the Director is proud of the achievements of his associates, and asks that you, the governing bodies of the institution, and the people of the State to whom this report goes, note well the accomplishments of the year.

The Director's report need be but a summary of administrative matters.

CHANGES IN ORGANIZATION

Before the present Director came to the Station, the scientific work of the institution had been organized by former Directors into nine sub-divisions, as follows: Agronomy, Bacteriology, Chemistry, Biochemistry, Botany, Dairying, Entomology, Horticulture, and Poultry Husbandry. These sub-divisions are known as "Divisions." During the time the present Director has been at the Station, the work of two of these Divisions, Agronomy and Poultry Husbandry, has been transferred to the State College of Agriculture and two Divisions, Chemistry and Biochemistry, have been combined into the Division of Chemistry, leaving six departments of scientific work. Authority has been granted by the Board of Trustees to sub-divide one of these six Divisions, Horticulture, into the Division of Pomology and the Division of Vegetable Crops. Richard Wellington, Chief in Research (Horti-

culture), was made Chief in charge of Pomology. and Charles B. Sayre, Chief in Research (Vegetable Crops), was made Chief in charge of Vegetable Crops. The scientific workers at the Station are now grouped into seven Divisions, as follows: Bacteriology, Botany, Chemistry, Dairying, Entomology, Pomology, and Vegetable Crops.

CHANGES IN THE STATION STAFF

A number of minor changes have been made in the staff during the past year. Mrs. Rachel Hening became Mailing Clerk Sept. 1, 1929, taking the place of Miss Elizabeth Jones, deceased, who had been Mailing Clerk at the Station since February, 1916. Conrad Mohr, Florist at the Station from September, 1924, resigned October 1, 1929, and Hermann Jahn was appointed to take his place. G. W. Churchill, Agriculturist since 1886 resigned December 22, 1929, and his place was taken by Patrick Corcoran, who had been for some years Foreman of Orchards. The resignation of E. V. Shear, Associate in Research (Botany), with headquarters at Vassar College, took effect March 31, 1930, and Dr. J. M. Hamilton was appointed to take his place, beginning work April 1, 1930. Dr. Hamilton did his undergraduate work in the Ontario Agricultural College and in the University of Toronto. His graduate work was done at the University of Wisconsin, from which place he was given his doctor's degree in June 1929. E. L. Green became Associate in Research (Chemistry) January 1, 1930. Mr. Green is a graduate of Washington University, St. Louis, in 1916, with a master's degree from the State College of Agriculture in Washington in 1926. The death of F. H. Hall, Associate in Research (Horticulture) on October 18, 1929, must be noted. Mr. Hall had served the Station since 1897 as Librarian, Station Editor, and Associate in Research (Horticulture). W. T. Tapley was appointed to take the place of Mr. Hall, his appointment taking effect April 15, 1930. Mr. Tapley received a bachelor's degree from the University of New Hampshire in 1916 and a master's degree from the University of Minnesota in 1920. He was Assistant Professor of Vegetable Gardening in Minnesota from 1920 to 1923 and in charge of the vegetable gardening work in State College, Penn., from 1923 to 1926. J. J. Thomas served as Assistant in Research (Chemistry) for the period from January 16, 1930 to July 1, 1930. Floyd E. Lovelace has been appointed

Assistant in Research (Chemistry) the appointment to be effective July 1, 1930, to take the place of M. G. Moore, Assistant in Research (Chemistry), since 1919. Mr. Lovelace is a graduate of the Cornell College of Agriculture in 1928.

THE NEW HORTICULTURAL BUILDING

It is gratifying to note that the last session of the Legislature has authorized the expenditure of \$285,000 for a new horticultural building. From year to year the Directors of this Station have called attention in their annual reports to the pressing need of a horticultural research laboratory. All who have been familiar with the work of the Station agree that the work of the institution could not go forward advantageously until better laboratory facilities were provided for every division of the institution, since the present buildings are inadequate in both space and equipment. Those in charge of the Station have long considered a new horticultural building the chiefest need. Plans for the new building are well along and it is hoped that during this year the building itself will be erected, or at least that its erection will be well under way before the close of the year.

STATION GREENHOUSES

I must call your attention again to the great need of new greenhouses. The present structures are old, in poor repair, and have never been properly equipped for the work for which they are intended. More and more, greenhouses are indispensable to work with plants, in the study of soils, and in breeding and treating insect and fungus pests. New greenhouses, properly constructed, will enable our workers with plants in many cases to grow two crops in a single calendar year, and will afford conditions of control in the study of plants and pests not otherwise to be had. I emphasize again that new greenhouses are indispensable if the efficiency of the experimental work under way at the Station is to be maintained.

PRINTING

The Station is much embarrassed and its usefulness to the agriculture of the State is curtailed by a serious shortage of funds for printing the bulletins and circulars offered by members of the staff. Nearly every year finds the printing fund exhausted early in the

spring, with consequent delays in the presentation of the results of the Station's research work to the farmers of the State. This year is no exception, and manuscripts have already accumulated which will make an immediate and heavy drain on the printing fund for the next fiscal year. The budget for the coming year totals \$375,825. Five years ago the budget for the fiscal year called for \$284,025. The increase during this five-year period is \$91,800, or nearly 33 per cent. During this five-year period, the appropriation for printing has increased only \$1,000, or 12½ per cent.

These figures do not tell the whole story, however, for with substantial increases in the budget at the Station has come a large increase in the number on the staff, and consequently an increase in the output of published material. At the same time the overhead in incidental printing, such as letterheads, forms, records, and various odds and ends, has also mounted with the increase in personnel and in the number of projects. The cost of publication in most instances is an exceedingly small part of the total outlay for Station work, and yet until the results of research are made available thru publication, those who are expected to benefit from the Station's activities must remain uninformed. If the present appropriation of \$9,000 could be increased to \$12,000, the Station work could be presented to the farmers of the State much more effectively. This statement of the need of a larger appropriation for printing may be emphasized by a brief account of the types of publications.

TYPES OF PUBLICATIONS

The final objective of every research project under way at the Station is to place the results as effectively as possible before those who can make the best use of them. For this purpose, the Station maintains three series of formal publications, namely, Technical Bulletins, Bulletins, and Circulars. In each case the material is presented in a form suitable for the audience to which the publication is sent.

As the name implies, the Technical Bulletins treat of the more technical aspects of the Station's work, and are prepared for distribution almost altogether to scientific workers in other institu-

tions similar to this one. These bulletins form the background for many of the Station's more general recommendations and provide a medium for quick and effective dissemination of information about progress in the Station's research program.

The Bulletin series has much wider distribution than the Technical Bulletin series, and the material presented in the Station Bulletins is written more from the standpoint of its application to farm practice or to agricultural industries than as a scientific report. All of the Station Bulletins, however, report the results of experimental work with the difference between these reports and those given in the Technical Bulletins that the former describe experiments of a practical nature or that have progressed far enough to have a practical application.

The Station Circulars are intended only as an aid to correspondence, and thus treat of a wide range of topics about which the Station receives many inquiries. The Circulars, therefore, may or may not have a bearing on Station researches, and in general are compilations of the latest information from all sources on the subject in hand. As a rule, the Circulars are not distributed to mailing lists, but are used to save the writing of detailed information in answering inquiries.

Any consideration of the Station's publication system should take into account the News Service (page 91), as this syndicated press material supplements the more formal publications and is a recognized medium of presenting the results of the Station's experiments to the public. Reliable estimates indicate that at least 25 per cent of the requests for Station bulletins received in the daily mail are stimulated by notices of the publications in the newspapers and farm and trade papers.

Thus it may be seen that thru its publications the Station strives as best it can to put the results of its work before the farmers of the State.

ORIENTAL PEACH MOTH

The Legislature in the last session authorized the expenditure of \$50,000 to control the oriental peach moth, apple maggot, and codling moth, pests which are seriously curtailing the production of tree fruits and their sale, both at home and abroad. Those who have sponsored the appropriation will want to know about the present status of these pests.

The oriental peach moth is now present in Chautauqua, Erie, Niagara, Orleans, Monroe, Wayne, and Ontario Counties in western New York. In the Niagara area the fruit infestation varied from 50 to 80 per cent of the crop in different orchards. Losses in this area for 1929 were estimated to be in the vicinity of \$200,000. The peach moth is therefore well established in this area, and indications are that injury will continue to increase in this important peach-producing section. The pest is also present in Albany, Rensselaer, Greene, Columbia, Ulster, Dutchess, Orange, Putnam, Westchester, and Rockland Counties in the Hudson Valley and Nassau and Suffolk Counties on Long Island.

Since there is as yet no satisfactory method of protecting peach orchards by means of insecticides, the most promising recourse to combat the insect is the utilization of parasites. During the season of 1929 several new colonies of the larval parasite (*Macrocentrus ancylivora*) were established in Niagara County. Twig collections made in this area thruout the summer showed the parasite to be spreading rapidly and to be parasitizing the peach moth larvae in the twigs. Several hundred thousand individuals of the egg parasite (*Trichogramma minutum*) were liberated, and parasitized over 35 per cent of the eggs of the peach moth present in the orchards receiving these liberations. It is hoped that these parasites will soon begin to exert an influence on the peach moth infestation. However, in order that no possibility of control may be overlooked, several growers are cooperating in testing numerous insecticides in an effort to find a suitable spray or dust for New York conditions.

In the Hudson Valley and Long Island areas where the pest has been present for some time, parasites were found last season and a comprehensive survey of the entire area is planned to determine the extent of parasitism and the species involved with the view of colonizing species not now present.

THE APPLE MAGGOT

The apple maggot is of chief concern to the apple industry of the Hudson and Champlain valleys, but in view of a threatened embargo by Great Britain the lighter infestation in western New York may become of sufficient importance to require special treatment for the control of this insect. The recent threatened embargo

by Great Britain against infested fruits seems to be aimed especially at the apple maggot and thus vitally concerns the apple belt of eastern New York. Experiments conducted by Station workers in the Hudson Valley indicate that very good control can be secured against this fruit fly by the use of properly timed arsenical sprays. However, in order to meet the demands of Great Britain for clean fruit, even better control is necessary if the infestation is to be brought to the Imperial Government's requirements. Much has been accomplished regarding the bionomics of the insect, altho more extensive data are needed. Coupled with more intensive spray practices is the problem of spray residue on the fruit. The British tolerance at present is 0.01 of a grain of arsenic per pound of fruit. Chemical analyses of fruit from various parts of the area where apple maggot is a serious problem show that in order to secure freedom from this insect it is necessary to use an amount of arsenic which causes the fruit to show residues dangerously close to the British tolerance.

The Legislature has appropriated funds for an extensive investigation of apple-maggot control, together with studies on washing of fruit, to enable fruit growers to pack apples that will meet the exacting requirements of other nations as well as the demands of the health authorities of this country. Plans have been completed for an economical use of this money to accomplish the objects for which the appropriation was granted.

CODLING MOTH

Thirty years ago a conservative estimate stated that one-third of the New York apple crop was destroyed by the codling moth. This loss amounted to some \$2,500,000 annually, and in addition there was \$500,000 damage to pears. Considerable progress has been made in more efficient control methods since that time and particularly since the special investigations were commenced in 1924. This work pointed out clearly that the "cover" sprays had been made with little definite knowledge of the habits of the insect relative to egg deposition as influenced by differences in seasonal conditions, and largely accounted for the inability of growers in certain areas to secure adequate protection from the pest. This work, continued for several successive years, has shown that it is impossible to predict accurately the time for making spray

applications as based on previous seasons' experience. It is necessary to have first-hand information each year from daily observations of large numbers of insects under orchard conditions to give the correct information. Today the wormy apple is not as serious a problem in New York orchards as formerly, and efforts are now directed chiefly to keeping the so-called "sting" injury at a minimum.

With the money appropriated last winter to combat this pest, attention will be given to developing more effective insecticides and to control of the spray residue by washing fruit.

THE EUROPEAN CORN BORER

From time to time, questions come to the Director about the work with the corn borer to control which the Legislature has made special appropriations in its last three sessions. To answer, in part, at least, these questions, a brief statement of the present status of this serious pest is here submitted.

The European corn borer was first discovered in this State during the season of 1919, and at that time it occupied only two small areas, one at Schenectady and the other just south of Buffalo. In the intervening time the insect has spread over practically the whole State, altho it appears to have accumulated in destructive numbers up to the present time in more or less definite areas. These are the counties bordering on Lake Erie and Lake Ontario, the Mohawk Valley, and to some extent on Long Island. In these locations the corn borer has been shown to be capable of inflicting severe injury to sweet corn, and the loss varies from a small percentage of the ears to practically the whole crop, depending on the season and the cultural practices employed. The situation is further aggravated by the fact that considerable sweet corn is grown both for the market and for canning purposes in these areas, and especially in the western part of the State.

In view of the fact that the corn borer is a distinct menace to the sweet corn industry in the State, investigations were undertaken two years ago with the object of making a thoro study of the insect in relation to its environment with the hope that this would shed light on some satisfactory means of control. Considerable information has been gained during this time and it

is shown that much may be done in combating the insect by a modification of the cultural practices. However, the problem is far from solved and it will doubtless be several years before control measures can be recommended which will apply to the whole state and which take into account the soil conditions and climatic factors in the different areas. It will be necessary to study carefully the relation of the insect to climatic conditions in order to explain the fluctuation in abundance from year to year and the apparent accumulation in some areas more than in others. Owing to the fact that cultural practices as a means of combating the insect may not be feasible in all locations other lines of endeavor have included the possible use of insecticides and a study of the parasites of the insect. It is hoped that a thoro research program will eventually result in a satisfactory method of control.

RESEARCH AND REGULATORY PROJECTS

For many years the work at this Station has been classified and conducted under projects. You will please take note of the projects now, 1929-30, under way and the readers of this report will be interested in them, I am sure. The projects are listed under the several divisions of the institution.

DIVISION OF BACTERIOLOGY

1. Sterilization of milking machines. -
2. Soil flora studies.
3. Bacteriological methods of analyzing dairy products.
4. Control of city milk supplies.
5. Dairy utensil flora studies.
 - Sub-project 2. Types of bacteria surviving pasteurization.
 - Sub-project 4. Original contamination of milk from the udder.
 - Sub-project 5. The relation of udder infections to bacterial count standards for raw milk.
6. Investigation of legume nodule bacteria.
7. An investigation on the effect of straw on plants.
8. Cheese flora studies.
 - Sub-project 1. Chemical changes in ripening cheese produced by certain bacteria.
 - Sub-project 2. Swiss cheese studies.
9. Studies on the Coccaceae.
 - Sub-project 1. Udder infections as a cause of epidemic septic sore throat.
10. Studies in bacteriological technic.
11. Tomato products investigation.
13. Standardization of biological stains (with Chemical Foundation).
14. Type species of the genera of bacteria.
 - Sub-project 1. Bacteria of genus *Serratia*.
 - Sub-project 2. Studies on general classification and nomenclature of bacteria.
15. Sauerkraut investigations.
16. Control of commercial kraut manufacture.
17. Correlation of the productivity of certain soil types with the ability of certain bacteria to grow therein.
18. Studies on commercially prepared baby foods.
19. Food spoilage investigations.
20. Studies on thermophilic and thermotolerant bacteria associated with pasteurized milk plants and the way to eliminate such bacteria.
21. Relation of heat-loving bacteria to particular types of pasteurizing equipment.
22. Thermophilic and thermotolerant bacteria in evaporated milk.

23. A study of the efficiency of the Grindrod process of sterilization.
24. Non-lesion cases of animals reacting to the tuberculin test.
25. Routine control of contagious abortion in the dairy herd.
26. Bacterial canker of tomato.

DIVISION OF BOTANY

1. New York plant diseases, III.
2. Control of mosaic in the potato seed plat.
5. Mushrooms and toadstools.
6. Popping of popcorn.
7. Apple diseases.
8. Winter injury of apple trees.
9. Bacterial blight of beans.
10. Hardshell and Sclerema in beans.
11. Aster diseases.
12. Raspberry diseases.
14. Cruciferous crop diseases on Long Island.
15. Improvement of present methods of spraying vegetables.
16. Seed-borne plant diseases.
17. Hard seeds in legumes.
18. Germination studies on vegetable seeds.
19. Lawn grass seed mixtures.
20. Official seed tests.
21. Seed testing service.
22. Apple fruit spot diseases in the Hudson Valley.
23. Root diseases of fruit trees in the Hudson Valley.
24. Domestic vs. foreign red clover and alfalfa seed.
26. Effect of crown-gall upon apple trees.
28. Seed treatment investigations with vegetable crops.
29. A survey of canning crops diseases.
30. Bacterial canker of tomato.
31. Methods of control for cucumber mosaic and wilt diseases.
32. A study of soil temperature and soil moisture in relation to seed germination of peas and beans, seed disinfection, plant vigor, and root development (Purnell).
33. Studies on the sprouting of potatoes.
34. Sulfur: Its relation when used as a fungicide to the health and productivity of the orchard tree.
35. A study of the control of leaf-spot diseases of tomatoes by spraying or dusting, etc.
36. The damping-off of tomato seedlings in greenhouses.
37. Studies on seed corn maggot.
38. Winter washes for sun scald of sweet cherry and catalpa trees.

DIVISION OF CHEMISTRY

1. Preparation of pure casein and a study of its physico-chemical properties (Adams).
 - Sub-project 2. Serological studies on the three species of casein.
 - Sub-project 3. The influence of salts on the properties of gelatin.
2. Toxic residues on fruit.
3. Inspection of commercial fertilizer.
4. Inspection of feeding stuffs.
5. Chemical studies of grape juice.
6. Physical properties of insecticides and fungicides.
7. Effect of oil sprays on fruit trees.
8. Sulfur: Its relations when used as a fungicide to the health and productiveness of the orchard tree.
 - Sub-project 1. The physical properties of elemental sulfur.
 - Sub-project 2. Relation of physical states of sulfur dust to chemical changes under controlled conditions of time, temperature, and humidity.
 - Sub-project 3. Sulfur injury on apple foliage under field conditions.
9. Chemical and physical standards for bordeaux mixture and copper-lime dusts.
10. Improvement of analytical methods.
11. Quality in canning crops.
12. Chemistry of pectin.
13. Inspection of insecticides and fungicides.

DIVISION OF DAIRYING

1. Methods of sampling milk at milk plants.
2. Aging ice cream mixes.
3. Testing Babcock and bacteriological glassware.
4. Dairy herd management.
5. A study of frozen milk and cream.
6. An attempt to devise a method of packaging cheddar cheese without melting or grinding.
7. A study of practical methods of testing milk and its products.
8. Creaming of raw and pasteurized milk.
9. The solubility and keeping quality of milk powders.
10. Manufacture of water ices and sherbets.
11. A comparison of various ice cream stabilizers.
12. Influence of certain salts on the ease of whipping ice cream mixes.
13. A study of flavoring ice cream with cocoa and chocolate.
14. A study of milk strainers for use on the farm.
15. A study of cleaning solutions for milking machines.
16. Line breeding of the herd.
17. Maintenance of a herd free from tuberculosis.

18. Influence of 2 and 3 milkings and feedings per day on the development of dairy cows.
19. Machine versus hand milking as affecting the production of cows.
20. Relation of type of dairy cows to milk production.
21. Maintenance of a herd free from contagious abortion.
22. A study of the manufacture of Neufchatel cheese.
23. Standard sediment discs for control in market milk.
24. A study of mechanical refrigerators for use on dairy farms.
25. A dry air sterilizer for use on the dairy farm.

DIVISION OF ENTOMOLOGY

1. Studies of apple insects.
 2. Studies of pear insects.
 3. Control of injurious insects by dusting.
 4. Peach insects.
 5. Tests of various insecticides for the control of oriental peach moth.
 6. Peach-deforming capsids.
 7. Control of maggots in cabbage seedbeds.
 8. Investigations of the parasites of oriental peach moth.
 9. Adhesiveness of insecticides.
 10. Spider mites as fruit pests.
 11. Raspberry fruit worm in western New York.
 12. Studies on the seed corn maggot.
 13. Studies of raspberry insects.
 14. Control of grape-berry moth.
 15. Paradichlorobenzene for grape root-worm.
 16. Ecological investigation of grape and apple insects.
 17. Study and control of cucumber insects.
 18. Studies of cabbage insects.
- Sub-project 1. Control of aphids and thrips in the cauliflower seedbed.
19. Study and control of potato insects.
 20. Control of pear psylla in Hudson Valley.
 21. Round-headed borer and other apple insects in Hudson Valley.
 23. Control of Mexican bean beetle.
 24. Cherry maggot and its control.
 25. Control of spinach maggot.
 26. Control of carrot rust fly.
 27. Control of onion maggot.
 28. Study of the comparative value of compounds of mercury as soil insecticides.
 29. Life history, occurrence, and control of European corn borer.
 30. Wire-worm investigations.

DIVISION OF POMOLOGY

1. A variety test of apples, pears, peaches, apricots, nectarines, plums, cherries, grapes, and small fruits.
2. Fruit breeding.
3. A test of several methods of propagating apples.
4. A study of strains of Baldwin apples from different sources.
5. An experiment in pruning apples, pears, and plums.
 - Sub-project 1. Little vs. much pruning.
 - Sub-project 2. High vs. low heads for apples and pears.
 - Sub-project 3. Winter vs. summer pruning of apples.
6. Propagation of apples from selected buds.
7. A test of the value of certain stocks for various plums.
8. A test of commercial fertilizers, stable manure, green manures, and lime for grapes.
9. A pruning and training test with grapes.
10. A test of American varieties of grapes on resistant or hardy stocks.
11. A study of types of flowers and intersexes in grapes and other fruits with reference to fruit development.
12. Variety test of 50 kinds of improved European filberts.
13. Botanical study of cultivated esculents (Purnell).
14. A test of fertilizers for red and purple raspberries.
15. A test to determine whether the stock affects the cion.
 - Sub-project 1. A test of bud sports or chimeras propagated by root cuttings.
16. Pollination studies in fruit varieties.
17. Botanical study of cultivated fruits.
18. Cytological research in horticultural plants.
19. Anatomical research in horticultural plants.
20. Morphological basis of chromosome pairing.
21. Thinning grapes thru removal of a number of prospective fruit clusters before the blooming stage.
22. Selective breeding with the Concord grape.
 - Nursery Stock Investigations
 1. Comparison of nursery seedling stocks (apple, cherry, plum, pear, and rose) from various regions.
 2. Source and varieties of seed for nursery seedling stocks (apple, cherry, plum, pear, and peach).
 3. Methods of growing seedling stocks (apple, cherry, plum, pear, and peach).
 - Sub-project 1. Fall planting vs. spring planting.
 - Sub-project 2. Methods of transplanting.
 - Sub-project 3. Production during one year vs. two year growing period.
 4. Study of storage conditions for nursery seedling stocks.
 5. Asexual propagation of nursery seedling stocks.
 6. Use of cover crops to retain fertility of nursery land.
 7. Fertilizer requirements of nursery stock with especial reference to nitrogen needs.

Soil Investigations

1. Orchard and vineyard fertilization studies.
2. Causes of field plot variability.
3. Lysimeter investigations.
 - Sub-project 1. The relation of legumes to the nitrogen problem as affecting soil fertility and plant nutrition.
 - Sub-project 2. The relation of mineral constituents to crops in rotation on two soil types, and the effect of soil depth on such relations.
4. A study of soil requirements.
7. Physiological and nutritional study of the apple tree.
9. Combination of small grains with field peas for forage.
10. Time of cutting alfalfa.
13. Biological researches on soil organic matter.
14. Nutrition of trees by direct injection of reagents into the tissues and the effects of injections on tree reactions.
15. The effects of various soil types on the growth of certain horticultural plants.
16. The effects of long continued applications of certain chemicals, such as calcium carbonate, sodium chloride, ferrous sulfate, calcium sulfate, magnesium sulfate, and sodium sulfate, on soil and plant.

Hudson Valley

1. Fertilizers for apples in the Hudson Valley.
2. Variety tests of fruits in Hudson Valley.
3. Cover crops for orchards.
4. Test of six different commercial nitrogenous fertilizers on apples.
5. Pollination of fruits.
6. Bearing habits of fruit trees.
7. A test of commercial fertilizers for currants.

DIVISION OF VEGETABLE CROPS

1. Study of vegetable varieties.
2. Rotation and fertilizer experiment with vegetable canning crops.
3. Variety test of fall spinach.
4. Producing canning crop tomatoes.
 - Sub-project 1. Tomato selection and breeding.
 - Sub-project 2. Tomato variety testing.
 - Sub-project 3. Comparison of various methods of growing tomato plants and different dates of sowing seed.
 - Sub-project 4. Comparison of various distances of transplanting tomato plants in the field and the effect on yields, costs, and net return.
 - Sub-project 5. Physiological effect and economic value of fertilizing seedling tomatoes at time of transplanting in flats.

5. Experiments in growing sweet corn for canning.
 - Sub-project 1. Comparison of size of seed in its effect on yield, quality, and uniformity of maturity.
 - Sub-project 2. Comparison of various distance of planting and different rates of seeding sweet corn.
 - Sub-project 3. Treatment of seed with organic mercury compounds.
6. Experiment in growing canning crop peas.
 - Sub-project 1. Testing of commercial pea seed stocks.
 - Sub-project 2. Comparison of size of pea seed in its effect on yield, quality, and uniformity of maturity of canning peas.
 - Sub-project 3. Comparison of various rates of seeding peas.
 - Sub-project 4. Treatment of pea seeds with organic mercury compounds.
 - Sub-project 5. Inoculation of seed with nitrogen-gathering bacteria.
 - Sub-project 6. Pea breeding and selection.
 - Sub-project 7. Relation of time of planting to development of vines and yield of peas.
 - Sub-project 8. To determine the effect of different potash fertilizers on rate of growth and maturity of peas and on the quality of the canned product.
7. Vegetable breeding (Purnell).
8. Study of pumpkins and squash to determine canning qualities, etc.
9. Comparison of yields and returns of sweet corn to grower and canner.

EXPENDITURES DURING THE YEAR

The following is a summarized statement of expenditures from all funds available to the Station during the year. The payments for these purposes were made by the Treasurer of Cornell University, as the proper vouchers were sent forward to him, from funds supplied to him by the State Treasurer or otherwise available for the support of the Station. They were chargeable in each case to the several appropriations or other funds as indicated. Full details of these transactions appear in the report of the Treasurer of Cornell University for the year 1929-30.

1. Expenditures contracted for and chargeable to preceding year, but paid for after July 1, 1929:

From appropriations by Chapter 75, Part 1, Laws of 1928:

Maintenance and operation:

Fuel, light, power, and water.....	\$83 43
Printing	386 33
Equipment, supplies, and materials.....	202 34
Traveling expenses.....	390 17
Communication	60 86
Repairs	12 00

Total maintenance and operation.....	\$1,135 13
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Maintenance undistributed:

Long Island Vegetable Research Farm.....	\$122 29
Hudson Valley Horticultural Investigations	
Maintenance and operation.....	287 52
Labor	22 00
Nursery shrubs and plants.....	1,300 97

Total maintenance undistributed.....	1,732 78
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From appropriation by Chapter 84, Part 2, Laws of 1929:

Vineyard at Fredonia: Service and expenses.....	198 00
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2. Expenditures chargeable to current year's funds:

From appropriations by Chapter 593, Laws of 1929:

Personal service:

Salaries	\$179,309 30
Labor	33,349 22

Total personal service.....	212,658 52
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Maintenance and operation:

Fuel, light, power, and water.....	\$8,534 15
Printing	8,210 70
Equipment, supplies, and materials.....	29,647 05
Traveling expenses	4,898 54
Communication	2,762 87

Repairs	\$9,187 87	
Rent	3,130 40	
Fixed charges and contributions.....	114 10	
Contingencies	25 00	
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Total maintenance and operation.....		\$66,510 68
Maintenance undistributed:		
Control of pests of raspberries.....	\$4,497 43	
Long Island Vegetable Research Farm.....	1,587 68	
Hudson Valley Horticultural Investigations....	2,642 21	
Nursery shrubs and plants.....	12,064 07	
Corn borer investigations.....	6,695 28	
<hr/>		
Total maintenance undistributed.....		27,486 67
From appropriation by Chapter 361, Laws of 1929:		
Maintenance undistributed:		
Services and expenses.....		11,542 19
From appropriation by Chapter 85, Part 2, Laws of 1930:		
Maintenance undistributed:		
Vineyard at Fredonia: Service and expenses.....		1,565 97
From appropriation by Chapter 765, Part 1, Laws of 1930:		
Maintenance undistributed:		
Services and expenses.....		1,944 44
From Federal funds:		
Hatch fund:		
Salaries	\$1,250 00	
Labor	250 00	
<hr/>		
Total Hatch fund.....		1,500 00
Adams fund:		
Salaries	\$1,500 00	
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Total Adams fund.....		1,500 00
Purnell fund:		
Salaries	\$4,500 00	
Labor	1,256 50	
Equipment, supplies, and materials.....	243 50	
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Total Purnell fund		6,000 00
From income from sale of farm products:		
Personal service	\$1,347 00	
Labor	5,463 19	
Fuel, light, power, and water.....	476 23	
Sale of books, returned to Comptroller.....	351 75	
Printing	541 35	
Equipment, supplies, and materials.....	3,137 72	

Travel expenses	\$717 51
Repairs	2,176 11
Rent	548 23
Insurance	538 23
Communication	95 57

Total income from sale of farm products..... \$15,392 89

Total expenditures \$349,167 27

APPROPRIATIONS

The funds available to the Station for the year covered by this report from appropriations by the Legislature of 1929 were as follows:

By Chapter 593, Laws of 1929, to be available for the year ended June 30, 1930:

Personal service:

Salaries of staff, etc.....	\$163,810 00
Laborers	32,150 00
Long Island Vegetable Research Farm.....	7,000 00
Hudson Valley Horticultural Investigations.....	10,200 00

Total personal service..... \$213,160 00

Maintenance and operation:

Fuel, light, power, and water.....	8,750 00
Printing and advertising.....	9,000 00
Equipment, supplies, and materials.....	31,670 00
Traveling expenses	5,000 00
Communication	3,000 00
Fixed charges and contributions.....	2,030 00
Rent	3,200 00
Repairs and alterations	12,500 00
Contingencies	100 00

Total maintenance and operation..... 75,250 00

Maintenance undistributed:

Controlling raspberry pests.....	4,500 00
Corn borer investigations.....	7,250 00
Long Island Vegetable Research Farm.....	1,800 00
Hudson Valley Horticultural Investigations....	3,500 00
For study of the problems of productions, storage, and distribution of nursery shrubs and plants, including personal service.....	13,450 00

Total maintenance undistributed..... 30,500 00

By Chapter 361, Laws of 1929, to be available for the year ended June 30, 1930:

Maintenance undistributed:

Investigation of moths and insects, including personal service	\$13,000 00
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Total maintenance undistributed.....	\$13,000 00
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Total available for the year.....	<u>\$331,910 00</u>
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The funds made available to the Station for the year ending June 30, 1931, from appropriations by the Legislature of 1930 are as follows:

By Chapter 85, Laws of 1930, to be available for the year ending June 30, 1931:

Personal service:

Salaries of staff	\$166,450 00
Laborers	34,000 00
Long Island Vegetable Research Farm.....	7,000 00
Hudson Valley Horticultural Investigations....	10,950 00
Diseases of small fruits.....	3,500 00

Total personal service.....	\$221,900 00
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Maintenance and operation:

Fuel, light, power, and water.....	\$9,750 00
Printing and advertising.....	9,000 00
Equipment, supplies, and materials.....	31,500 00
Traveling expenses	5,000 00
Communication	3,000 00
Fixed charges and contributions.....	725 00
Rent	3,200 00
Repairs and alterations.....	13,650 00
Contingencies	100 00

Total maintenance and operation.....	75,925 00
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Maintenance undistributed:

Controlling raspberry pests.....	\$1,000 00
Corn borer investigations.....	7,250 00
Long Island Vegetable Research Farm.....	1,800 00
Hudson Valley Horticultural Investigations....	3,500 00
For study of the problems of productions, storage, and distribution of nursery shrubs and plants, including personal service	13,450 00
Investigation of moths and insects.....	13,000 00
Services and expenses in grape work at Fredonia	2,000 00

Total maintenance undistributed.....	<u>42,000 00</u>
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By Chapter 765, Part 1, Laws of 1930, immediately available for the year ending June 30, 1931:

Maintenance undistributed:

Investigation of moths and insects for services and expenses	\$37,000 00	
	<u> </u>	\$37,000 00

By Chapter 85, Part 2, Laws of 1930, immediately available for the year ending June 30, 1931:

Maintenance undistributed:

Vineyard at Fredonia	\$1,800 00	
	<u> </u>	
Total maintenance undistributed		\$1,800 00

By Chapter 82, Laws of 1930, available for the year ending June 30, 1931:
Construction of Horticultural Building..... \$285,000 00

Total available		\$285,000 00
	<u> </u>	
Total available for the year		\$663,625 00

DIVISION OF BACTERIOLOGY

The Division of Bacteriology has continued its studies on agricultural problems that involve the activities of bacteria of good and bad types. However, these studies usually fall in the first class, as the bacteria that affect agricultural activities are primarily beneficial to the farmer as will be seen from the following list of problems that have been studied during the year: (1) Bacterial changes in artificial manures; (2) control of cultures used in legume inoculation; (3) soil fertility studies; (4) bacteria causing the fermentation of sauerkraut; (5) spoilage of food products; (6) types of bacteria that are important in connection with the pasteurization of milk; (7) types of bacteria naturally present in milk as drawn from the cow, including the study of the milk of one cow that is supposed to have caused a septic sore throat epidemic in a village of the State; (8) types of bacteria producing desirable flavors in dairy and vegetable products; (9) types of bacteria in commercially prepared baby foods and methods of controlling the number of bacteria in such products; (10) comparative studies on casein; and (11) the classification of bacteria into recognizable species.

ARTIFICIAL MANURE FROM STRAW

The past year has seen the completion of an investigation carried on in cooperation with the Division of Pomology (Orchard Soils Investigations), namely, a study of the production of artificial manure from straw, and Bulletin No. 573 has been issued to discuss this subject. In recent years quite a little attention has been paid to a process of converting straw into manure, as a commercial concern has been selling a mixture of salts to be added to straw in order to stimulate the process and their product has been extensively advertised. The results reported in Bulletin No. 573 indicate that the labor involved, the large amount of water necessary, and the cost of labor, etc., make it questionable whether the method is practical under farm conditions in New York. Cutting down the labor cost and water supply by depending on natural rainfall was not successful in producing a good grade of artificial manure within a reasonable time. The expense of the added ingredients is another thing which tends to make the method impractical, especially if it is necessary to employ the

above-mentioned commercial product to mix with the straw, as the manufacturers of this product claim must be done in order to avoid infringement upon their patent rights. Accordingly, the method is not recommended for general use in this State.

TESTING LEGUME NODULE BACTERIA

During the year Circular No. 114 entitled "The Present Status of Legume Inoculation in New York" has been issued. Partly as a result of this circular and of the investigation of this question reported in the last annual report, legislation has been adopted this year directing the Station to make tests of legume inoculants and to report to the Commissioner of Agriculture and Markets the results of such tests with the object of excluding unsatisfactory cultures of legume nodule bacteria from the market. This legislation does not go into effect until the first of January, 1931, and it will be some time after that before the machinery necessary for this inspection work can be in complete working order; but it is expected that by 1932 purchasers of legume cultures in the State may be protected against the purchase of poor quality or worthless cultures. This protection is needed, not to save the farmer the small cost of the culture, but rather to avoid the danger of partial or even complete failure of his crop.

GROWTH OF BACTERIA IN SOILS OF LOW PRODUCTIVITY

As reported last year, considerable attention has been given to the behavior of bacteria in Volusia silt loam, a hill soil rather low in productivity. It was stated in the last annual report that, altho this soil is quite high in nitrogen, this element is not readily available to plants growing on the soil nor to the bacteria that are being investigated. During the past year laboratory investigations and greenhouse work have been carried on to see whether this nitrogen can be made available to plants and to bacteria. The results so far obtained are important not only because they suggest methods of improving the soil under investigation, but also because they indicate a method in which bacteria may be used to determine what sort of fertilization to give a soil. The manuscript of a bulletin on this subject is now in course of preparation.

SAUERKRAUT FERMENTATION INVESTIGATIONS

Studies on the fermentation of sauerkraut have been continued during the year. The manuscript for a bulletin has been prepared which gives the results of a study of the cultural characters of several hundred kraut cultures isolated at regular intervals during the fermentations. This gives the conclusions reached in regard to the types of bacteria that produce favorable and unfavorable results in the fermentation.

A manuscript is also being prepared for publication which discusses the effect of pure and mixed culture inoculations with various organisms on the sauerkraut fermentation from the standpoint of quality, chemical composition, and changes in the types of bacteria present. The results indicate a failure to improve the quality or the rate of fermentation materially by the pure culture inoculations used thus far and considerable difficulty has been found in controlling the inoculum so as to produce a desirable effect with mixed cultures.

These investigations are being continued and enlarged in the hope of developing better methods of controlling the fermentation of this product. Because of the interest of some of the large kraut manufacturers in the vicinity, facilities for studying the fermentation of kraut under practical factory conditions have been greatly increased. This has also provided opportunities for studying tanks of kraut where the fermentation has not progressed as rapidly or as satisfactorily as it should.

FOOD SPOILAGE STUDIES

Two technical bulletins (Nos. 150 and 151) and Bulletin No. 570 have been published during the year in which the organisms causing spoilage in tomato products have been discussed. The results secured were outlined in the Annual Report for last year.

A study of a bacterial spoilage of a Thousand Island dressing has been made and a report on results secured is to be published in the *Journal of Bacteriology* (in press). The spoilage, which is accompanied by a separation of oil, was believed by the manufacturers to have been caused by the chili sauce used in the preparation. However, the contaminating organisms were found on the peppers and mustard used, and the chili sauce simply

diluted the material to such an extent that it allowed the growth of the bacteria. Studies on the spoilage of other food products have been continued.

DEVELOPMENT OF THERMOPHILIC BACTERIA DURING THE PASTEURIZATION OF MILK

During the year three bulletins have been published dealing with phases of this topic. The first of these is a general bulletin (No. 571) which discusses the relation between the bacteria that survive or grow during the heating of milk to the ordinary pasteurizing temperature, and the development of tiny, so-called "pin-point" colonies on plates made during the routine examination of milk. Data are also given that make it probable that the original sources of the thermophilic bacteria are the dust and dirt that may get into fresh milk during the milking process. Our findings indicate that dairymen normally keep this inoculation to a minimum, but the bacteria, once in the milk, may find conditions sufficiently favorable during the pasteurization process to permit growth to significant numbers. Thereby the commercial quality of the milk is injured; but so far as is known from the extensive investigations made thus far, no danger to human beings who use the milk is introduced by the activities of these bacteria. Practical methods of controlling thermophilic bacteria, developed in a study of conditions in pasteurizing plants in several large cities, are discussed in Technical Bulletin No. 156 and additional reports are in process of publication in journals and trade papers. As some have claimed that these bacteria might be present in the fresh milk as drawn from the cow, studies were made and the results were published in Technical Bulletin No. 158. Our findings agree completely with results that have been published from the University of Illinois in that the few colonies of thermophilic bacteria that developed on the plates were traced to dust contaminations and not to the interior of the udder of the cow.

NUMBER AND TYPES OF BACTERIA IN MILK AS DRAWN FROM THE COW

Altho several previous investigations have been made to determine the average number of bacteria present in fresh herd milk as drawn from the cows (including one previous report from this

Station, Technical Bulletin No. 27), various things have indicated that a broader survey of this situation was desirable. A survey has been made of the bacterial content of the freshly drawn milk of 132 cows from six herds in the vicinity. The final calculated average bacterial count of the milk from these herds was 2,775 per cc as determined by the standard agar plate count, a figure that is somewhat higher than has been previously reported. Individual herds varied from a minimum average of 530 per cc to a maximum of 3,835 per cc. This work has been made possible through the presence at the Station of a fellow of the International Education Board who has continued the work on his return to the Swiss Dairy Research Institute at Liebefeld.

The average number of bacteria found in the milk of 22 Swiss herds containing 241 cows was less than 50 per cent of the numbers found in the six Geneva herds. These findings indicate that still wider surveys should be made as the possible variations in the unavoidable initial contamination of fresh milk are of importance to the Grade A dairymen of the State who do not secure the highest premium unless the count is less than 10,000 per cc. The milk from the Geneva herds contained larger numbers of non-spore-forming rod-shaped bacteria of a type similar to *Bact. lipolyticum* Evans than did the milk of the Swiss herds. The milk from the latter herds showed a predominance of micrococci. Technical Bulletin No. 165 discussing these results is in process of publication.

UDDER INFECTIONS AND THEIR RELATION TO MILK-BORNE EPIDEMICS

It is imperative that dairymen who continue to produce raw milk in this State take special care in controlling udder infections in their dairies. Recent developments have shown that altho certain types of infections of the udder may be of a harmless nature to human consumers of the milk, it is not a safe procedure to tolerate any type of mastitis within the herd.

Members of this Division were called into consultation in connection with an outbreak of septic sore throat, which was subsequently traced to the milk of one cow in the only herd supplying milk to a village. The bacteria in the udder of this particular cow have been studied in detail with the hope that the information so gained might aid in controlling future outbreaks. The cow harboring the septic sore throat organisms was purchased by the Station

and has been under observation for several months. The results of this investigation have agreed with those secured in similar studies elsewhere and indicate that a septic sore throat streptococcus probably caused the epidemic and that the cow was presumably infected by the milker. Studies of the organism to learn more of its characteristics and to gain facts for future use in the identification of this type of streptococcus indicated that the organism causing this epidemic does not seem to show all of the typical characters of *Streptococcus epidemicus* Davis, the organism usually concerned in such outbreaks, and that it was so much like the ordinary human type *Streptococcus pyogenes* Rosenbach that it might well be classified as belonging to the latter species.

TYPES OF BACTERIA PRODUCING DESIRABLE FLAVORS IN DAIRY AND VEGETABLE PRODUCTS (LEUCONOSTOC)

For some time members of this Division have been interested in the bacteria that cause characteristic flavors in certain vegetable foods and dairy products. For this reason the types of bacteria in dairy starters, sauerkraut, butter, and cheese have been studied intensively. One group of bacteria which was found in all of these products has received particular attention, because this group of bacteria is thought to be the cause of flavor and aroma production in many types of food products.

A large number of cultures of this type of organisms (Genus *Leuconostoc*) have been studied to learn the reactions produced by this group when grown in pure cultures. The results of these investigations, which will appear as a bulletin from this Station, indicate that these organisms are capable of producing flavors in a variety of vegetable and dairy products and have a wide distribution in nature. They have been isolated from fermenting cabbage, sugar solutions at sugar refineries, milk, butter and cheese starters, butter, cheese, kefir grains, fermenting pickles, fermenting tomato products, etc.

Methods have been found whereby the members of this group may be identified and the physiological characteristics of each type found in the group have been determined. Results of this work are in manuscript form and will appear as a Station bulletin.

TYPES OF BACTERIA IN COMMERCIALY PREPARED BABY FOODS AND
METHODS OF CONTROLLING THEIR NUMBERS

A study of the bacteria found in commercially prepared infant foods has shown that there is a definite need for a sanitary control of these products. The bacterial counts obtained from commercially prepared infant foods secured in a survey varied up to 600,000 per gram of dried material. The average number was approximately 200,000 per gram. This number of organisms in a baby food was not affected by seasonal variations in the sanitary quality of the milk used in the preparation of these infant foods.

The principal types of organisms found in these foods were of the spore-bearing variety apparently indicating that the method of manufacture was not such as to kill all of the spores in the milk and such other raw ingredients as are used in the preparation of the various types of infant food. Contamination may also take place at certain stages in the process of manufacture. Studies have also been made on the nature of the hemolytic streptococci which occasionally occur.

A survey of the methods used in the plant of an industrial producer of commercially prepared baby foods indicated that it is possible with the introduction of effective sanitary control to decrease materially the number of organisms in the manufactured product. This survey also indicated that sanitary standards which require such foods to be placed upon the market with a bacterial count of less than 10,000 colonies per gram appear to be feasible and obtainable by the manufacturers of these foods.

Further investigation with a sterilizer known as the Grindrod Sterilizer indicates that it may be used successfully to sterilize the milk and certain other ingredients which are to be used in the manufacture of commercially prepared infant foods. The results of these investigations have appeared as Technical Bulletins Nos. 163, 164, and 165.

COMPARATIVE STUDIES ON CASEIN

Assistance has been given to the Division of Chemistry in studies leading to a further identification by means of animal reactions of the three types of casein that have been isolated by a member of that Division. Small laboratory animals, *viz.*, rabbits and guinea pigs, were used. By this method the identity of the various caseins

was further established. The results of this work have been prepared for publication in the *Journal of Infectious Diseases* in collaboration with the Division of Chemistry.

CLASSIFICATION STUDIES

Assistance has been given during the year in the preparation of the Third Edition of Bergey's *Manual of Determinative Bacteriology* and in the translation of the 7th edition of the standard German text covering a similar field, viz., Lehman and Neumann's *Determinative Bacteriology*. It is hoped that the publication of the latter text in English will help in bringing about greater uniformity in the naming and classification of bacterial species.

A method of detecting ammonia production by bacteria in agar slants has been devised during the year and a description of the method published in the *Journal of Bacteriology*. The technic is an improvement over present methods and will be useful in helping to distinguish between closely related species of bacteria. It is only thru the identification of the various types of bacteria that directly affect agriculture that progress can be made in rendering practical recommendations more definite and specific.

ADDITIONAL LINES OF WORK

Assistance has been given the Dairy Division in connection with the routine maintenance of the herd free from tuberculosis and contagious abortion, and in watching the quality of the Station milk supply. The Division has also continued to cooperate with the City of Geneva by supervising the work of the City Bacteriologist in the control of the City water and milk supply. Thru this cooperative work, material was secured for the study of herd milk and other valuable material and experience obtained. The Division has likewise continued to cooperate with the Chemical Foundation in the work on the Standardization of Biological Stains, one member of the Division acting as Editor for *Stain Technology*, a journal devoted to this line of work. Studies are in progress on the relation of thermophilic bacteria to the quality of evaporated milk, the action of organisms in starters on the ripening of cheese, sterilization of fruit juices and vegetable products, and bacterial canker of tomatoes. The latter project is in cooperation with the Division of Botany.

DIVISION OF BOTANY

SPROUTING TESTS OF SEED POTATOES

The preliminary report on this project promised in the last Annual Report has been unavoidably delayed. In the meantime additional experiments have been conducted, chiefly with the variety Irish Cobbler.

For the purpose of studying the manner of sprouting, the following method of sprouting potatoes has been found highly satisfactory: Whole tubers are placed, a single layer deep, in shallow wooden trays which are piled one above another within a tight wooden box having a close fitting cover. The box is set in a room having a temperature between 60 and 80° F. In from three to five weeks, according to the temperature, the tubers will have sprouts 1 to 2 inches long and will be ready for study.

No certain method of detecting tubers affected with leafroll has been discovered. Sprouts distinctly slender or spindling and abnormally long usually indicate leafroll. By discarding tubers with such sprouts about two-thirds of the leafroll can be removed from Irish Cobbler; but with Rural and Green Mountain varieties the method is less successful.

APHIDS ON SPROUTING POTATO TUBERS

Altho in England and Ireland aphids often occur on the sprouts of unplanted potatoes, the phenomenon has not been previously reported from this country. Accordingly, it is of interest that twice during the past three years members of the Station Staff have discovered aphids (*Myzus persicae*) on the sprouts of potato tubers in grocery stores. It is suspected that they may sometimes occur also on sprouting seed potatoes and become an important factor in the spread of leafroll and other virus diseases. Inquiry into the matter is being made by members of the Botanical and Entomological Divisions. The suggestion is made that seed potatoes which have sprouted before planting should be examined for the presence of aphids.

DISEASES OF CANNING CROPS

Of several problems in diseases of canning crops which are being studied, those discussed below are the most important.

Influence of weather on the root diseases of peas.—The extreme susceptibility of peas to various root troubles is an interesting pathological phenomenon which, at the same time, is of major importance to the growers of canning crops. For these reasons a project is under way to determine the fundamental basis of this susceptibility. The relation of the various weather factors, such as temperature, light, and rainfall, to pea-root diseases is being investigated thoroly so that reliable control measures may be devised.

By means of special apparatus installed in the greenhouse, the soil temperature, soil moisture, and light may be regulated artificially and held quite constant. Thus, by varying these factors independently of each other, the cold, wet conditions of early April and the warm, dry conditions of late May may be had side by side. Peas may be made to grow in any desired climate.

The work of the one season during which the investigation has been progressing bears out field observations that, when the soil is contaminated with pathogenic fungi and bacteria, cold, wet weather is more injurious to the pea plant than warm, dry weather. The variety Yellow Admiral appears to be more sensitive to these conditions than the Alaska variety. During the coming year the effect of the various environmental factors will be defined more accurately.

Tomato spraying tests.—The farther south tomatoes are grown the stronger is the recommendation that they be sprayed for diseases. The reason is that if tomatoes are sprayed in the North, so that the foliage remains green, the fruit is delayed so long in ripening that frost kills it. It is necessary to spray long enough to give maximum yield without too much delay in ripening. Last year's results indicate that this may be accomplished.

Damping-off of tomatoes.—Many millions of tomato seedlings are grown in New York for use by growers of canning crops. It is not unusual to find a single individual who grows and sells a million plants. These men frequently are troubled by the death or damping-off of their seedlings, so that the investigation of this problem toward a method of control is desirable.

Steam sterilization of the soil is a proved method for control, but the bother and expense of it have militated against its wide-

spread use. Also, many men who have used this method have abandoned it because they unwittingly recontaminated their soil, which then was a poorer medium for growing tomato seedlings than it was before it was sterilized. For this reason the use of chemicals in control is desirable. Two or three chemical treatments have been devised which give promise of alleviating the malady.

Mosaic in beans.—The Refugee, a very popular variety of canning bean in New York, is extremely susceptible to mosaic, which reduces the yield remarkably. Mosaic is a doubly insidious disease because its presence frequently is not detected by the canners' field men nor by the growers. Investigations as to the loss which the disease entails are going forward so that definite figures may be had to use in trying to induce growers to demand disease-free seed—the one sure means of control.

GENEVA RED KIDNEY BEAN

The Geneva red kidney bean, introduced by the Station in 1927, is now so widely distributed over the State that after this year growers should have no difficulty in obtaining seed of the variety in quantity sufficient for their needs. From 150 2-pound packages of seed distributed by the Station to farmers in 1928, 90 reports were received. The yields reported varied from 4 to 145 pounds per 2-pound package of seed. The largest yield of 145 pounds was reported by F. Van Vleet of Lodi, and the second largest yield of 142 pounds by N. A. Baker of Fairport. The average of the 90 yields reported was 64.2 pounds. It was evident that excessive rain, hail, and infertile soil were chiefly responsible for the low yields obtained on some farms. In general, the Geneva variety succeeded best on farms on which cattle or sheep were maintained.

In field tests of the present season Geneva will be compared with the California and Chilean varieties. Individual and also mass selection of the Geneva will be continued at the Station in order to maintain a high-yielding strain. Such methods have been successful also in improving the eating quality of the Geneva.

RASPBERRY DISEASES

The study on the rate of spread and symptoms of red raspberry mosaic, yellow mosaic, and mild streak in three varieties of black raspberries was concluded in 1929 and the results are ready for publication. As a result of this study, the symptoms of red raspberry mosaic, as expressed in black varieties, are found to include the types of mottling on the foliage of fruiting laterals that were previously known as mild mosaic. In Plum Farmer mild mosaic on the foliage of fruiting laterals was definitely correlated in 80 per cent of the plants with red raspberry mosaic showing later, and only 5 per cent of those showing mild mosaic did not develop recognizable symptoms of red raspberry mosaic. In Cumberland, mild mosaic on the foliage of fruiting laterals was correlated with 91 per cent of those showing definite red raspberry mosaic symptoms later, but 67 per cent of the plants which showed mild mosaic did not develop recognizable red raspberry mosaic symptoms. The conclusion is drawn that a more susceptible variety, such as Plum Farmer, shows this high correlation of mild mosaic and red raspberry mosaic because of the identity of the two types of symptoms and that in a less susceptible variety, as Cumberland, the identity is not so clearly established but none the less true. The failure to transmit mild mosaic experimentally hampers the definite proof of this fact by direct means.

Yellow mosaic was found to spread more slowly in Plum Farmer and Cumberland than does red raspberry mosaic. All plants affected by yellow mosaic are severely diseased. They die so quickly that they do not function for any great length of time as foci for the spread of yellow mosaic, and this is believed to limit the rate of spread.

Mild streak was found to spread very slowly in Plum Farmer and Cumberland, which accounts for the fact that this disease is of minor importance in these varieties in this State. The variety Ohio, however, was found to be very susceptible to mild streak and it spreads rapidly in this variety.

Severe streak and the two forms of leaf-curl did not occur in the experimental plantings. None of these diseases are important in New York.

In a plat containing 62 varieties and 125 Station seedlings (all red varieties) yellow mosaic has become abundant enough to yield

some data on the susceptibility of a large number, but red raspberry mosaic is present only in a few. Positive results indicate that Cuthbert as one parent leads to susceptibility to yellow mosaic when Newman or Herbert is the other parent. Also, in the case of Herbert, the crosses containing June as the other parent show definite susceptibility to yellow mosaic. Crosses of Herbert and Newman have remained practically free from yellow mosaic or have shown resistance. Of the 14 seedlings of this parentage, one of which is the new variety Newburgh, 12 are free from yellow mosaic, 1 is resistant, and 1 is moderately susceptible. Of the 42 seedlings containing Newman as a parent, 86 per cent are free from yellow mosaic after three seasons. Of the 25 seedlings containing Cuthbert as a parent, only 56 per cent are still free from yellow mosaic. The results of several years' record on the behavior of varieties and seedlings as to susceptibility and klen-dusity to virus diseases will be assembled soon for publication.

The plats in which the stock of new varieties are propagated for distribution by the New York Fruit Testing Association are maintained free from all virus diseases. Two small areas of leaf-curl in Lloyd George were the only diseased plants found in these plats in 1929. Active cooperation is maintained with the Department of Agriculture and Markets in the inspection and certification of raspberry plantings from which stock is offered for sale.

INJURY CAUSED BY SULFUR FUNGICIDES

One phase of this cooperative project on the physical properties of elemental sulfur was concluded and published as Technical Bulletin No. 160, "The Fineness of Ground Sulfur Sold for Dusting and Spraying." (See abstract under Division of Chemistry.) Further investigations have been made on the conditions under which sulfur causes injury to foliage. The results indicate that sulfur causes slight injury to the cuticle and predisposes the leaf to over transpiration. Under conditions which demand a greater supply of water than is available to the leaves, the leaf tissues are killed. Under less critical conditions the direct injury to the cuticle caused by the sulfur is not sufficient to lead to over transpiration and no scorching of the foliage results. Further work on the nature of the injury to the cuticle is being done.

WASHING FRUIT TO REMOVE SPRAY RESIDUE IN THE HUDSON VALLEY

Altho spray residue on apples and pears in the Hudson Valley rarely contains an amount of arsenic which makes it injurious to the health of consumers, it is unsightly and often injures the sale of the fruit. In this investigation an effort was made to find the best method of removing spray residue and other adhering impurities, such as dust and sooty fungus. Various materials and methods were tested and studies made of several factors which enter into the problem. The keeping quality and appearance of treated and untreated fruit in storage was compared.

Everything considered, the best results were obtained by giving the fruit a brief bath in very dilute hydrochloric acid and rinsing immediately in water. The concentration of acid and length of treatment need to be varied according to conditions. A bath of one minute in acid concentrations of from 1 to 100 to 1 to 500 meets the requirements in most cases, so far as spray residue is concerned.

Properly managed, the acid washing of fruit is rapid, cheap, safe, and effective. A full account of this investigation has been published in Bulletin No. 575.

PLANT DISEASE INVESTIGATIONS ON LONG ISLAND

Mosaic disease of crucifers.—On Long Island rutabagas are frequently attacked by a mosaic disease which is sometimes seen also on brussels sprouts, cauliflower, and black mustard. A study of the disease has been made to determine how important it is likely to become. White and black mustards, Chinese cabbage, turnips, rutabagas, and rape were found to be susceptible to attack. Brussels sprouts and cauliflower, altho susceptible, were not easily infected. Cabbage was either highly resistant or immune to the disease with some evidence that it may serve as a carrier. In rutabagas, at least, it is not transmitted thru the seed. It is believed that the disease will continue to be of only minor importance on Long Island because of the natural resistance of the most important crucifers—cabbage, cauliflower, and brussels sprouts—and also because these crops are grown during the cool weather of fall, whereas the disease develops best at high temperatures. An account of this investigation has been published in the *Journal of Agricultural Research*.

Studies on the black-rot or blight disease of cauliflower.—Bulletin No. 576, bearing this title, gives the results of seven years' investigation of the cauliflower black-rot on Long Island. The principal subjects treated are: The overwintering of the disease in the field; the manner in which the seed becomes infected; the development of the disease in the seedbed and in the field; the relation of weather to the disease; the ways in which the disease is spread; and methods of control. Under the last-named topic there is included a discussion of the nutritional and cultural factors involved, the removal of diseased plants and leaves, spraying, dates of planting, resistant varieties, weeds as sources of infection, selection of the soil for the seedbed and the field, and seed disinfection. The conclusion is reached that we now have a thoroly practical method for the control of black-rot in cauliflower. Essentially, it consists in treating the seed with hot water and locating the seedbed on disease-free soil.

Dust treatment for cut seed potatoes.—Work with dust treatment for cut seed potatoes in 1929 showed that gypsum and sulfur dusted on the seed after cutting may exercise a very injurious effect. Thus, seed pieces dusted with these materials and stored four weeks before planting gave a poorer stand and lower yield than the check lots. This injury was not apparent when the same materials were used on the same seed two weeks before planting or less. Certain other dusts have not shown the injurious effects that the sulfur and gypsum have, and it is believed that a satisfactory and safe dust treatment for cut seed potatoes will be developed.

Wilt disease of cucumbers.—In an experiment comparing the merits of various dusts and sprays in the control of bacterial wilt disease (*Bacillus tracheiphilus*), the best results were secured with a spray containing kayso, 3 pounds; calcium arsenate, 3 pounds; and water to make 50 gallons; and a 20–25–55 monohydrated copper sulfate, calcium arsenate, and hydrated lime dust. A weak bordeaux, 1½–3–50, stunted the vines while giving good disease control and a 1–15 calcium arsenate gypsum dust, tho it apparently gave good beetle control and did not stunt the vines, failed to give as good wilt control as the kayso-calcium arsenate spray or copper sulfate-calcium arsenate dust.

Hot water treatment of cruciferous seeds.—Hot water treatment and germination testing of cauliflower, brussels sprouts, and cab-

bage seed following recommendations of the Station (Bulletin No. 550) are being successfully carried on by the Suffolk County Farm Bureau. A little more than 1,000 pounds of cauliflower and brussels sprouts seed were tested and treated this spring, which, allowing from 2 to 3 ounces of seed per acre, means enough to plant between 5,000 to 8,000 acres.

WORK OF THE SEED TESTING LABORATORY

Official seed testing.—During the year, 145 officially collected samples of field seeds were received from the Commissioner of Agriculture and Markets. Technical analyses of these samples were made and reported to the Commissioner who administers the seed law. The results of this analytical work are published by the Commissioner. In general, it is quite evident that the seed law is being complied with in a very satisfactory manner by both seedsmen and miscellaneous dealers. This inspection, however, does not cover farmer to farmer sales, or what is often referred to as “over-the-fence” trading. It would seem that now it is simply a matter of the buyer taking advantage of the protection afforded by the seed law, and in every instance acting as his own “seed inspector”.

In addition to the official samples above mentioned, there were received and tested 47 special replicate referee samples from the International and the North American Seed Analysts’ Associations. Upon these samples special tests were made looking forward to uniformity in methods of testing and evaluation of seed stock in order to facilitate commerce in seeds.

Vegetable seed packets.—In addition to the above-mentioned officially collected field seed samples there were received from the Commissioner of Agriculture and Markets 614 sealed paper packets of vegetable seeds purchased upon the open market. Tests of these packets show that 5.7 per cent of them were either unfit or absolutely worthless for seed purposes. They were either too weak to grow or contained no live seeds whatever. Only 45 per cent of the packets were above the reasonable standards accepted for vegetable seeds. The results showed plainly that in New York the older better-known, and well-established “commission-box” or “packetting” seedsmen place a fairly good grade of seed in their packets. However, there is still opportunity for improvement in this type of

seed merchandising. At present prices the buyer of closed packets of seed is entitled to a uniformly good quality of dependable seed.

Routine or service work.—The amount of service work coming under the general heading of public service project work is increasing rapidly. The number of seed samples of all kinds received for the regular routine analysis was 7,087. This number is larger by about 1,500 than the number received during any previous year. In all, 8,342 tests were made during the year. The increase is due to a demand for information as to the quality of the seed stock in order to comply with the law requirements and to check up on the planting value of the seed, and to the growing interest in the matter of freedom from disease of seed stocks used in the production of special truck and canning crops.

Besides the regular official and routine analyses enumerated above, many special determinations have been made during the year. These have included identity as to kind, variety, and possible origin, extent and nature of seed injury and scarification, and extent of staining in imported seeds.

The effect of hot-water treatment on cabbage seed to control disease was measured upon some 106 samples of seed representing in all 350 pounds of seed. Germination tests were made both before and after treatment in order to ascertain the amount of possible injury to the stock in question.

Lawn grass seeds.—There has been a marked increase in the demands made as to the quality and identity of grass seeds used to plant lawns, golf courses, and civic parks. As more knowledge is gained and competition becomes keener there is greater need of vigilance in securing suitable grass seeds for these special purposes. Several state institutions and city commissions have turned to the seed laboratory for aid in their grass seed purchases.

Seed studies.—The large volume and variety of material received has presented an excellent opportunity for study along several lines, particularly in basic scientific facts upon which to base routine laboratory practice. A comparison of routine laboratory germination results with those secured in soil or in the open field has yielded valuable results in that it is evident that more care must be exercised in the securing of seed stock of strong vitality.

Seed-borne diseases.—During the season 2,571 combined germination and disease tests were made. These tests were conducted

largely with garden peas, beans, and sweet corn, and were made at the request of seed growers, canners, and truck crop farmers. The results in general show a great improvement in the freedom from disease of these staple crops, also that it is entirely practical to put into practice in the routine seed laboratory many of the findings of plant pathologists in regard to seed-borne diseases.

Drill survey.—A drill survey undertaken in cooperation with the Department of Plant Breeding of the College of Agriculture and Farm Bureau managers by means of which samples of spring grains were actually taken from grain drills in the field last spring showed the great importance of taking special care in properly cleaning and treating these seed grains used for seeding. Many of the samples taken from the drills showed the seed to be unfit and even seriously objectionable for planting purposes. The results showed the source of many of the seed-fouling weed-seeds to be in the seed used for planting.

Field trials or "trial ground" work.—In an effort to put into practice or effect recent legal enactments for trial-ground plantings, 67 samples of seed corn taken upon the open market were planted. The results showed that many of the descriptive names used for varieties were utterly meaningless, often confusing, and sometimes misleading. There was some substitution of unknown varieties of similar appearance for some of the more recent popular varieties of ensilage corn. Some lots of western corn offered as ensilage corn proved entirely unsatisfactory for use in this State. At the time of the first frost these lots were still in the milk or soft stage and made very poor ensilage, at least as compared with the more quickly maturing sorts offered, which were often two weeks or more ahead of the late western corns. This type of work promises to be one of the most valuable phases of the seed control work or better seed program. Trial grounds were also utilized for planting out many of the kinds of vegetables which mature from seeds planted directly in the field or garden as found among the commission packet seeds collected by the Commissioner of Agriculture and Markets. The crops were grown to maturity and notations made upon trueness to type and uniformity of stock, as well as a comparison of field versus laboratory germination results. There was found to be substitution of varieties in some instances. How-

ever, the substitution was often in the interest of the planter in that as good as or a better variety was offered in place of the one named on the packet.

DIVISION OF CHEMISTRY

AGRICULTURAL LIMING MATERIAL

The question has arisen as to the most useful method of making and reporting the analysis of agricultural liming materials. At present calcium oxide and magnesium oxide are determined separately and reported as such. Because of the lower atomic weight of magnesium, however, limestones having the highest magnesium content should theoretically have the greatest neutralizing value, pound for pound. If this is actually the case in practice, and experimental evidence indicates that it is, it might be desirable to state the neutralizing value of a limestone, or to convert the magnesium into its equivalence of CaCO_3 . In order to ascertain the opinion of soil scientists and the practice at other experiment stations, about 18 questionnaires were sent out to various institutions in this country as a preliminary move. The opinion is rather general that magnesium should be allotted its full neutralizing value; and that the determination of the neutralizing power of a liming material is far easier to perform in the laboratory than an analysis for calcium and magnesium.

Furthermore, there is evidence accumulating that many soils contain too little magnesium for proper plant growth, and this condition will become more aggravated with the continued use of pure commercial fertilizers. Because of these various facts, serious consideration is being given to reporting lime analyses so as to give full credit to the neutralizing value of the magnesium.

CHEMICAL STUDIES ON CANNERY PEAS

Since quality in canned peas is decided largely by the toughness of the peas, a puncture tester was adapted for measuring the toughness of the fresh peas. It was found (1) that the toughness increases regularly with size, (2) that varieties differ in puncture value, and (3) that the toughness determined for the raw peas coincided with that of the processed peas as judged by experienced critics.

Chemical analyses were made for reducing sugars, sucrose, starch, soluble and insoluble nitrogen, ash, calcium, and alcohol-insoluble residue. By applying these analyses and the puncture test to various lots of whole peas and of pea skins, a more complete picture is now at hand than has ever been secured before of the changes which peas undergo during ripening, and of the varietal characteristics. As a result, the following tentative physical and chemical criteria have now been established for high-quality canning peas: The puncture value should not be over 40 grams per square millimeter, the starch-sugar ratio should not be over 1.0, the insoluble-soluble nitrogen ratio should not be over 3.0, and the CaO content of the fresh skins should not be over 0.06 per cent. We do not know as yet just which of these, if any, can be used practically in cannery practice.

No conclusion has been reached as to the effect of fertilizers. At present the potassium, calcium, and possibly the chloride content of the peas seems to be important. Peas grown in water culture with high and low contents of potassium and of calcium showed a remarkable inverse relation between these two elements. When the potassium was high, the calcium was low, and *vice versa*. This was most marked in the leaves and least marked in the skins. The tougher peas are characterized by a higher calcium content and the factors affecting this are now being studied.

Definite changes in the composition of shelled peas begin to take place immediately. The most important and striking of these is a decrease in sugars and an increase in polysaccharides. Sucrase, diastase, and protease are very active in macerated peas, and hence must cause deterioration in peas bruised in the viner.

DAIRY CHEMISTRY

During the past year the research work with casein has progressed considerably further. Last year we announced the discovery that "casein" is a mixture of proteins, and gave the molecular weight of each molecular species present. Casein is not only a mixture of proteins of different molecular weights, but different samples of casein prepared by the method of Van Slyke and Baker are different mixtures. This appears to be one of the reasons why no two experimenters agree in their results on casein,

inasmuch as no two workers probably ever had the same mixture of materials. To expect the precipitation of a single milk protein by the addition of acid to milk seems to be as unreasonable as to expect a separation between the metals antimony, arsenic, bismuth, calcium, copper, lead, mercury, and tin by the precipitating action of hydrogen sulfide. In neither case does the general reagent effect a separation of one specific chemical species.

Two publications dealing with the above have appeared during the current year in which are described our researches on the molecular weights of the proteins found in casein thru the use of the ultra-centrifuge.

Studies have been completed and are in press which show that the three proteins found in casein are distinguishable from one another by serological reactions. These studies furnish the first recorded use of mono-molecular proteins in serological work. Incidentally, they show that a coctoprecipitin specific for a heated antigen, and which distinguishes it from unheated antigen, can be produced by the rabbit. This matter is not only of academic interest but of considerable practical importance as well. By anaphylactic reactions we were able to show definitely that the alcohol-soluble protein extracted from casein by Osborne and Wakeman some years ago is not the same as our acid-alcohol soluble protein having a molecular weight of 375,000. We had not thought that they were the same protein at any time, as Osborne and Wakeman found about 0.7 per cent of their alcohol-soluble protein in casein, while in our experiments we reported that in the neighborhood of one-third of the total crude casein was the acid-alcohol soluble protein of molecular weight 375,000. Further work has shown that the amount of the latter protein in crude casein varies considerably, but we have never found less than 15 per cent in any we have examined. Whether different breeds of cattle or different individuals among the animals are responsible for the differences we have recorded, or whether certain food requirements have been lacking in the ration that would permit only a smaller production of the 375,000 weight protein at times, we are unable to say. It is hoped that these matters may receive attention in the near future, inasmuch as the different proteins separated from casein show considerable differences toward the

action of rennet. The practical importance of these contemplated studies to the manufacture of cheese and other dairy manufactures, as well as their bearing on the food value of the materials, should be evident at once.

The amino-acid content of these proteins is under investigation, particularly with respect to those amino-acids that have been shown to be essential constituents of the diet.

CHEMISTRY OF INSECTICIDES AND FUNGICIDES

Spray residue on apples.—Samples of apples were obtained from several fruit growing sections of the State and the amount of arsenic in the adhering residue determined. The samples taken were considered to be representative of the present commercial spraying practice in the State. Of the many samples analyzed only three contained arsenic in excess of the tolerance allowance of 0.01 grain of arsenious oxide per pound of fruit. On the average, samples of apples taken from standard packages contained but two-thirds of the amount found on samples taken from the tree. A report of these investigations has been published as Bulletin No. 579.

Studies on dusting sulfur.—A study of the fineness of dusting sulfur sold in the State is being made in cooperation with the Division of Botany in conjunction with a project on sulfur injury to orchard crops. Finely ground flour sulfur prepared for use as a fungicide is commonly sold as “300-mesh sulfur,” but no accurate standards exist for determining this grade. A standard method of sieving sulfur is described which gives reliable results for sieves as fine as No. 325 of the United States sieve series established by the Bureau of Standards.

A micro-projection method of measuring sulfur particles is described briefly in Technical Bulletin No. 160.

Six brands of ground sulfur sold for use as a fungicide were examined by the sieving and the actual measurement methods. The sieving method proved useful only to distinguish one brand from the other five. The inferior brand contained 23 per cent by weight of sulfur that would not pass a No. 325 sieve. The other five brands were found to pass the No. 325 sieve to the extent of 98 per cent or better. These small percentages were found to be due to aggregates in most cases.

By the micro-projection method it was found that the five brands that were equally fine by the sieving test varied greatly as to their actual fineness. The extremes for the five brands on the basis of calculated weight were 74 per cent and 96 per cent less than 27 microns (theoretical sieve No. 600) and 38 per cent and 84 per cent less than 18 microns (theoretical sieve No. 800). The methods used and more details of the results obtained are given in Technical Bulletin No. 160.

Injury caused by sulfur fungicides.—See report of the Division of Botany.

INSPECTION LABORATORY

During 1929, there were received for analysis 855 samples of fertilizers, 2,175 samples of feeding stuffs, and 108 samples of insecticides and fungicides. Of the total number of samples received, 824 samples of fertilizers and 1,059 of feeding stuffs were received during the period of January 1 to July 1, 1929. The remainder of the samples were received during the period of July 1, 1929, to January 1, 1930.

The present trend in commercial mixed fertilizers appears to be towards the use of high-analysis or concentrated fertilizers as shown by a continued increase in the number of concentrated mixtures.

Of the total number of samples inspected, 4.8 per cent showed material deficiency in nitrogen, 5.0 per cent in available phosphoric acid, and 8.2 per cent in potash.

The general quality of the feeding stuffs sold in this State compares favorably with those sold in other states. About 5 in every 100 samples have material deficiencies in protein and fat. The percentage of samples misbranded and not licensed is also about 5.

The trend in types of feeds appears to be towards practical applications of the results of investigations in animal nutrition with reference to special purpose feeds.

In the inspection of insecticides and fungicides no material deficiencies were found in arsenic and sulfur content. The greatest number of deficiencies were found in mixtures containing copper. Of the 23 samples containing copper, 4 were found materially deficient which is equivalent to 17.4 per cent. One sample supposed to contain nicotine contained practically none.

The insecticide and fungicide field is expanding quite rapidly as shown by the number of new materials appearing on the market for use as insecticides and fungicides.

INVESTIGATIONS ON GRAPE JUICE MANUFACTURE

A study is being made of the colloidal material in Concord grape juice, with special reference to its rôle in the preparation of commercial grape juice. It affects the color and clarity of the juice and the speed of crystallization of the tartrate. Thus, if it is removed, the crystallization is much more rapid, and it is hoped that a way can be found to do this commercially so as to shorten the time of preparation. The removal of the colloids makes a sparkling clear juice. The color of this juice may be lighter or darker, depending on how the colloids are removed. The colloidal material consists of about 8 per cent protein and 7 per cent pectin, the rest being polysaccharides, the nature of which is not known at present.

A sample of alleged grape sirup was given a thoro examination, and found to contain no detectable quantity of natural grape juice. The federal authorities therefore declared the product to be mis-branded.

DIVISION OF DAIRYING

DAIRY HERD MANAGEMENT

A brief statement was made in the last Annual Report of the rather detailed study being conducted on the tuberculin testing of the herd in cooperation with the Division of Bacteriology, the Department of Agriculture and Markets, and the Veterinary College. This work is being continued not only from the standpoint of the maintenance of a herd free from tuberculosis, but also from the viewpoint of determining the specific causes for slight irregularities secured in our disease-free herd. At the present time two cows are being subjected to detailed study for acid-fast organisms which have been associated with tuberculin reactions at the Veterinary College at Ithaca.

The herd is free from contagious abortion and will hereafter be regularly tested by the agglutination method. This year's test is the second one made on the herd and insufficient information has been collected to give any report.

Two investigations, commenced in 1921, have progressed sufficiently to compile the data collected during the course of the coming year. One of these is concerned with the influence of two versus three milkings and feedings per day on the development of dairy cattle and the other has dealt with the influence of hand milking on the production records of cows which have been regularly milked by machine. It is very probable that this information is sufficiently complete to publish results during the year.

ICE CREAM INVESTIGATIONS

Studies have been conducted at the request of the research committee of the International Ice Cream Association on the value of aging mixes for various periods of time. The results of this investigation (Technical Bulletin No. 161) have shown that for mixes of suitable composition which have been properly pasteurized there is little need for the long aging periods which are now commonly employed thruout the ice cream industry. Some aging at a comparatively cold temperature, that is from 35° to 45°F, seems necessary, but this period can be reduced to 2 or 4 hours instead of the customary 18 to 24 hours. The principal value which has been attributed to the longer aging periods has been the improvement in whipping properties of the mix and the better body and texture of the resulting ice cream. These improvements are exceedingly minor in character after 4 hours.

The relative merits of cocoa and chocolate for flavoring ice cream are still being discussed without much experimental data on the subject. The problem is being studied by mixing together cocoa and cocoa fat to make a chocolate. The original cocoa and the prepared chocolate are then being used to flavor ice cream. The investigation has proceeded far enough to make it evident that the cocoa butter does have considerable influence on the properties of chocolate ice cream.

The manufacture of ices and sherbets has been studied for many years and during the past year this work has been brought up-to-date in an article published in the *Ice Cream Trade Journal*. These studies have been of value in improving and standardizing the manufacture of ices and sherbets not only from the standpoint of the ingredients added for securing the desirable flavors,

but also from the standpoint of stabilization of these products during storage in the hardening room.

It has been known for many years that the viscosity of a given ice cream mix is quite variable. In recent years the maximum viscosity has been termed the apparent, while that viscosity which is secured after the product has been thoroly agitated by a whipper or beater has been termed basic. Some of the factors which influence the basic viscosity of ice cream mixes are being studied to secure a better understanding of the importance of basic viscosity and the factors which influence it.

MILK STRAINERS

For several years most of the milk strainers, cotton pads, and flannel cloths which have been offered to dairymen have been collected and tried experimentally at this Station. The results secured have been variable and generally so unsatisfactory from the standpoint of the use of this equipment on the farm that a more detailed study has been made of the principles involved in milk straining. For several months in cooperation with one of the dairy farm organizations of this State and a manufacturer of milk strainers, plans have been developed for modifying strainers to incorporate those principles which have proved most satisfactory. At the present time it is believed that a suitable straining device has been perfected to be recommended with certain types of cotton pads or flannel cloths. The results of this investigation will be prepared in a popular bulletin in the near future.

COOLING MILK

More than two years ago experiments were started on an electric refrigerator from the standpoint of its adaptability to dairy farm purposes. The first report on this work has been made in Bulletin No. 581. It has been shown that this type of refrigeration is very dependable and satisfactory. The electric consumption has been 1 kilowatt hour per 100 pounds of milk when the electric cooler has been obliged to do all of the cooling of the milk.

Experiments have demonstrated the desirability of thoroly insulating milk cooling tanks for use on the farm. Tests have

shown that the insulation pays for itself several times during the first summer's use.

Various methods for cooling milk in the tank have been used. The results have shown that when there is an ample supply of refrigeration available in the form of ice and water at 40°F or below, it is possible to cool milk freshly produced satisfactorily by placing the 10-gallon cans of milk directly into the cooling water in an insulated tank without any pre-cooling. These results are applicable only to the conditions specified and may not apply fully to the usual farm conditions where milk is cooled in running water at 50° or higher in a non-insulated concrete tank. Milk does not cool very rapidly in 10-gallon cans when not stirred, since approximately 2 hours are required to secure a temperature of 50° or below during the summer months. Under most circumstances some bacterial growth would occur, but it was shown that this is not the case due to the germicidal property which exerts its effect in milk for several hours after it is drawn from the cow.

The studies on milk cooling are being continued not only from the viewpoint of electric refrigeration, but also to gain further data on the use of natural ice.

DRY-AIR STERILIZATION

It is generally recognized that except for occasional udder infections the bacterial count of milk is influenced to the greatest extent by the sterilization and drying of the utensils and the prompt cooling of the milk to a low temperature. For many years utensils at this Station have been sterilized by steam, but much difficulty has been encountered in drying them. It is well known that the drying of utensils is just as important as their proper sterilization. In the hope of remedying this situation, milk cans, pails, etc., are now being sterilized by placing them while still wet in an oven heated by gas to a temperature above the boiling point of water. This procedure ought to create steam in the cans as the temperature reaches the boiling point of water and ought to dry the utensils after this temperature is exceeded. Data on this method of sterilizing will be collected until the value of the method has been established.

CREAMING OF MILK

A rather extensive report of the experiments on the creaming of milk has been made in Technical Bulletin No. 157. Two popular bulletins on this work are being prepared for publication. These studies have shown that the cream layer volumes forming on milk of individual cows are exceedingly variable, but for the milk of a large number of cows the volume is approximately four times the fat content. The volume of the cream forming on raw milk was greatly altered by temperature of storage. These variations are eliminated by subsequent pasteurization. The critical temperature for vat pasteurization is approximately 145°F for 30 minutes, a temperature which is sufficient to show noticeable reductions in the creaming properties of milk.

Photographs have been secured showing the clustering and rising of the fat globules in milk into the cream layer. The clusters are sufficiently large to be plainly observed without magnification. Clusters of this size have not been observed by other investigators due to the employment of high creaming temperatures and chambers too small for the clusters to form. A theory of the cause of the clustering of the fat globules based on the calcium ion concentration in milk has been presented. The rate of fat cluster formation and the precipitation of calcium ions have already been utilized in the modification of two types of pasteurizing equipment to secure maximum creaming.

These studies on the creaming of milk are being continued, for there are several new problems of practical importance which have arisen in continuous and intermittent pasteurization.

MILK SAMPLING METHODS

In most cans of night's milk delivered to milk plants the fat has separated into the cream layer thus making it essential that the milk be thoroly mixed before a sample is taken for a fat test. In recent years it has been quite generally assumed that the agitation accompanying the emptying of 10 gallon cans of milk into the weigh tank is sufficient to redistribute the fat uniformly thruout the mass. This practice of sampling milk without special agitation other than that obtained thru dumping is quite general thruout the eastern states. Experiments are now being conducted to determine the accuracy with which the fat content of milk is determined when samples are taken in this manner as compared

with samples taken after milk has been thoroly agitated by other means. The studies have been made during the winter months, but it is necessary to secure data during the summer months in order that the results will represent conditions thruout the year as they exist at our local milk plants.

MILK POWDER SOLUBILITY

The solubility of milk powders as an indication of their suitability for use in the manufacture of ice cream and cream cheese is being studied. The American Dry Milk Institute is cooperating in securing samples of powder of known history and of varying quality. The accuracy of methods for determining the solubility of milk powders and the possibility of modifying these methods to refine them further is being considered.

A preliminary report on the relationship of solubility of milk powders to their utilization in ice cream and cream cheese will be presented this summer at the annual meeting of the American Dairy Science Association.

INSPECTION OF BABCOCK AND BACTERIOLOGICAL GLASSWARE

This work has been continued at the Station in accordance with the provision of the State laws. The tests made during the past year are summarized as follows:

SUMMARY OF ALL GLASSWARE TESTED FROM JUNE 1, 1929, TO MAY 31, 1930.

TYPE OF GLASSWARE	Number received	Number inaccurate	Number broken
<i>Babcock:</i>			
Milk bottles, 8 per cent.....	34,707	31	60
Cream bottles, 50 per cent, 9-gram, 6-inch.....	2,779	1	3
Cream bottles, 50 per cent, 9-gram, 9-inch.....	317	0	1
Cream bottles, 50 per cent, 18-gram, 9-inch.....	204	0	2
Pipettes, plain 17.6 cc.....	5,913	433	53
Miscellaneous, not marked S. B.....	109	0	2
Total Babcock.....	44,029	465	121
<i>Gerber:</i>			
Milk bottles (butyrometers).....	430	0	0
Milk pipettes, 11 cc.....	58	0	0
Milk syringe.....	1	0	0
Total Gerber.....	489	0	0
<i>Bacteriological:</i>			
Pipettes, 1.0 cc.....	19,788	460	104
Pipettes, 0.01 cc.....	200	2	0
Total bacteriological.....	19,988	462	104
Total glassware, all kinds.....	64,506	927	225

DIVISION OF ENTOMOLOGY

APPLE INSECTS

Because of its importance to the apple industry the rosy aphid continues to receive a large amount of attention. The merits of new insecticides which show promise of greater adaptability to the needs of certain growers than standard preparations are being given consideration. The outbreak during the past year revealed the need of greater emphasis on the manner or method of application or, as it is perhaps better expressed, the skill exercised by the orchardist in the manipulation of the spray equipment in order to secure the desired protection to his trees. For that reason there was prepared Bulletin No. 582, entitled "The Rosy Aphid in Relation to Spray Practices in 1929." It is pointed out that, while the insect is not a difficult pest to combat, its successful control does require somewhat more careful, intelligent work on the part of the operator than with many others of our common fruit pests. To obtain satisfactory results, it is essential that the spray be applied at the proper time and in such a manner that all the green tips of the buds are completely covered. Moreover, experience has shown that if one tree is thoroly sprayed before passing to another, the greater are the chances of success. Unskillful or a faulty system of spraying appears to be responsible for by far the greater proportion of failures.

Because of the premature shedding of injured young apples and the necessity of rejecting malformed fruits from the pack, the leaf roller (*Archips argyrospila* Walk.) is the cause of no little concern each year to varying numbers of growers in western New York and the Hudson Valley. Standard spray practices as conducted by careful growers, at least, undoubtedly afford a large degree of protection or seemingly the insect would be of more general concern. A singular feature of the pest is that it is able to build up heavy infestations in plantings subject to more or less intermittent treatment with arsenicals and so thoroly establish itself that special clean-up measures are required to reduce the number of caterpillars to the point that they are no longer capable of causing commercial loss. To cope with such emergencies chief dependence is placed on oil sprays. Since spray oils do not behave alike with respect to killing efficiency and safeness to orchard trees,

our studies seek particularly to determine the reasons for these differences as a basis for standardizing such preparations whereby maximum efficiency may be combined with a large degree of safety.

The eye-spotted bud moth (*Spilonota ocellana* schiff.) has appeared in alarming numbers during the past few years in the western part of the State and has been the cause of considerable apprehension among apple growers. This insect is a general feeder as it is also found on cherry, peach, plum, prune, pear, and quince. Experiments conducted during the past season have shown that there are two periods when effective treatment may be practiced, namely, early in the spring when the overwintering larvae become active and during the summer when the eggs are hatching. In heavily infested orchards nicotine was the only material used in the early applications to which the overwintering larvae were noticeably susceptible. Lead arsenate was of little value in the spring, but in the summer, during the egg-hatching period, thoro applications of either lead arsenate or nicotine were effective. Insect enemies of the bud moth are on the increase, prominent among which are two wasps, *Ancistrocerus tigris* Sauss. and *Ancistrocerus catskillensis* Sauss. These two species accounted for large numbers of the larvae during the season.

Experiments to determine the response to light by certain orchard pests have been continued. The bud moth and fruit tree leaf roller received major attention this past season. Over 27,000 of the former and 16,000 of the latter insects were caught in a section of an orchard that was illuminated with electricity for the experiment. It was found that temperature was an important regulator of flight, as few Lepidoptera were active when the thermometer fell to 60° F or below. Injury by the bud moth as well as the degree of infestation was noticeably reduced in the lighted area. A progress report on this study is now available as Bulletin No. 583.

During the season of 1929 apple leaf hoppers were abundant in many orchards. Those found in greatest numbers were *Typhlocyba pomaria*, *Empoasca fabae*, and *Empoasca maligna*. Several other species taken from apple trees, but less abundant, included *Idiocerus provancheri*, *Thamnotettix clitellarius*, *Gypona octolineata*, and one species of the genus *Erythroneura*. The collection

and classification of the various species will be continued and methods of control will receive consideration.

A number of orchards, most of which are in Wayne County, have suffered considerably from attacks of the cranberry root-worm (*Rhabdopterus picipes* Oliv.). This insect, as the name indicates, is primarily a pest of the cranberry, but it also attacks the apple, disfiguring the fruits with a characteristic type of feeding scar which has appeared on over 70 per cent of the crop in some instances. As no work has been done with this insect as an apple pest, the life history and methods of control are now under investigation.

The codling moth continues as the most important single insect pest of apples. Wormy fruit is not a problem, the sting usually being the more conspicuous form of injury. Where the recommended summer cover sprays were thoroly applied this past season, injury was kept at a minimum. The seasonal activities of the moth continue to be watched carefully in the various zones, and the information is made available to the Spray Service to allow for the proper timing of the summer cover applications.

Control by means of various attractants, such as lights and baits, and also the use of bands on the trees, have proved to be only supplementary means of control and their use, considering the expense incurred, is not warranted in most cases.

New and promising insecticides continue to receive attention, but none, as yet, have been found superior to the standard arsenate of lead. In this connection the arsenical residue problem is receiving attention. Bulletin No. 579 gives the analysis of 94 samples of commercially grown apples from all sections of the State showing the amount of residue, with but few exceptions, to be well within the tolerance limits. Washing the fruit with dilute hydrochloric acid to remove spray residues also received attention, but this work was only preliminary to that planned for the coming season.

PEAR INSECTS

The most serious insect menace to pear growing in New York is the pear psylla, while in the Hudson Valley the pear midge is beginning to assume the proportion of a major pest, at least in certain leading varieties.

The extensive investigations of oil sprays, that have been in progress during the past four years have been continued the past year. These studies corroborate the previous results in showing that the use of oil sprays just previous to the opening of the buds is very effective in reducing the injury by pear psylla during spring and early summer. However, oils vary in their toxicity to trees, so a major portion of the investigation has been to determine what types of oil are least injurious to trees and at the same time will control psylla. Considerable effort has been made to determine such related factors as time of treatment, damage, pressure, variety and condition of the trees as regards toxicity to the latter as well as effecting control of the insect. A point has been reached where reasonably definite recommendations can be given as regards control of the pear psylla by means of oil. At present, however, it is recommended that pear trees be sprayed with oil for not more than two successive years since there is danger of injury to the weaker trees if the applications are continued over too long a period of years.

Another phase of psylla control has been the use of cheaper materials which may be combined with reduced dosages of nicotine for summer treatment, thus effecting considerable economy. The results are very promising and are being continued with the object of making improvements in materials and securing more extensive data covering a greater range of environmental conditions.

CANNING CROP INSECTS

Of the various insect pests that have a bearing on the production or handling of canning crops, the following have received attention during the past season: The carrot rust fly, the cabbage maggot, the cherry fruit fly, the seed-corn maggot, the spinach leaf miner, the onion maggot, and the raspberry fruit worm. Most of these are necessarily long-term problems, involving as they do investigations that must frequently extend over several years. While several of these studies are practically completed, all of them have required and have received some attention during the past season.

The general procedure followed in the prosecution of several of these studies has been outlined in previous reports and need not be repeated here.

Practical control measures have been worked out for several of the pests enumerated. The more recent studies on these particular insects have had to do largely with an attempt to improve and perfect the methods of control already available.

In the case of the spinach leaf miner and seed-corn maggot control measures available are far from satisfactory and much needs to be done before the control of these pests is on a thoroly satisfactory basis.

The raspberry fruit worm has only recently developed into a serious canning crop pest, particularly in those sections where purple varieties are chiefly handled. The presence of this insect has resulted in the confiscation of shipments of the canned fruits and threatens to demoralize the raspberry canning industry in important sections of the State.

The work so far carried out on the control of this pest in purple canning varieties indicates that the insect will be an exceedingly difficult one to combat, but it is hoped that by the control measures now being employed the number of larvae will be reduced so as to meet any reasonable tolerance.

STUDIES ON FRUIT INSECTS IN THE HUDSON VALLEY

The pear midge has become a pest of major importance in the Hudson Valley. During previous years facts were obtained on the life history and habits of the insect as well as on certain control measures. This year experiments were again conducted in the vicinity of Hudson, Germantown, and Plattekill, and various materials were used in control tests. At Plattekill a second series of treatments was varied in time and number of applications per tree in an effort to determine the most critical period for control as correlated with bud development. Several varieties, including Kieffers, Bartletts, and Clapps, were used in the study. Results so far indicate that lime-sulfur-nicotine sprays applied twice in the interval after the cluster buds have begun to separate and as the first trace of pink shows, but before the white of the petals is easily seen, afford efficient protection. Other materials in combination with nicotine, such as soap, oil, bordeaux, and tobacco dust, appear to give the same degree of control as does lime-sulfur and nicotine. The investigations are to be continued and a search for parasites also made.

With respect to the apple maggot, experimental work was undertaken again in the vicinity of Milton, N. Y. Many emergence traps were set under trees to catch the adults or flies as they came from the soil. Tho the number of flies appearing in the traps was not so great as anticipated, a definite emergence peak developed and this was slightly earlier than the previous year. Protective treatments were made relative to this critical period when the flies were found to be the most numerous. In practically all cases flies bred in early-maturing fruit reached the peak of emergence sooner than did flies from later varieties of apples. Several materials were used in the experimental work as carriers of lead arsenate. The results of the trials to date show that two sprays, the first just before the peak of emergence and a second a week or ten days later, will give control of the pest in average years. Dusts used during dry seasons appear promising.

Pear psylla studies were not pursued to any great extent last season due to the pressure of other problems. However, an internal parasite of psylla nymphs (*Psylledontus insidiosus* Crawford) was found quite numerous in one orchard and attempts were made to secure its complete life history. Several new contact sprays, including pyrethrum-penetrol, penetrol-nicotine, oil-nicotine, and soap and nicotine, were tried against the psylla in the vicinity of Plattekill. The study is to be continued during the present summer.

STUDIES ON ORNAMENTAL INSECT PROBLEMS

The work on this problem was begun in 1928 and has dealt primarily with a study of the insects which attack evergreens in the nursery, particularly those insects which infest Norway spruce. With the increased interest in the growth of evergreens as a constituent of ornamental plantings, there has developed a greater appreciation of the importance of the insects which attack them. Perhaps the two most important and destructive evergreen pests with which nurserymen have to contend are the spruce gall aphid (*Adelges abietis*) and the spruce mite (*Paratetranychus ununguis*). The former species produces the characteristic pineapple-like galls at the base of the new growth and renders the tree unsatisfactory for sale. The latter pest feeds upon the needles and causes them to turn yellow in color due to the depleted chlorophyll supply.

While the employment of certain oil sprays has given promising results in experimental tests, only a few growers so far have used these materials in their own nurseries. Thus far no serious injury has resulted from the use of these treatments, yet in a few cases injury has been observed. Good results have also been secured from the use of nicotine, lime-sulfur, and nicotine-soap solutions. In view of the lack of sufficient data over an extended period some of these treatments cannot be recommended unreservedly to the general public at the present time. Experiments are now under way for the purpose of securing data relative to efficiency of the different brands of oils and other materials and the effect of these on the health of the trees.

STUDIES ON THE ORIENTAL PEACH MOTH

The oriental peach moth (*Grapholitha molesta*) continues to spread rapidly eastward from the original point of infestation in Niagara County. New points of infestation are constantly appearing due to the natural spread of the moths by flight and to shipments of infested fruit. All of the important peach-producing counties of western New York now show some degree of infestation, with the heaviest damage in the Niagara area where the losses in 1929 were estimated to be in the vicinity of \$200,000.

In view of the continued inability of insecticides to give satisfactory control economically in efforts looking to the control of the peach moth, special emphasis has been placed on the breeding and distribution of promising parasites. During the seasons of 1928 and 1929 several liberations of parasites were made at selected points in Niagara and Chautauqua Counties. These colonies are now well established, the parasites are spreading rapidly, and it is hoped that they will soon begin to exert an influence on the peach moth infestation in those areas. Liberations during 1930 will follow the eastward spread of the peach moth and as many colonies as possible will be established. However, in order that no possibility of control may be overlooked, several growers are co-operating in testing numerous insecticides in an effort to find a suitable spray or dust for New York conditions.

The status of the pest on Long Island and in the Hudson River Valley is slightly different from that in western New York. The

peach moth has been present on Long Island since 1916 and, altho not definitely reported from the Hudson area until 1926, it was undoubtedly present some years before injury was observed. In 1929, Albany, Rensselaer, Greene, Columbia, Ulster, Dutchess, Orange, Putnam, Westchester, Rockland, Suffolk, and Nassau Counties were found to be infested. However, parasites were found and a comprehensive survey of the entire area is planned to determine the extent of parasitism and the species involved with the view of colonizing species not now present.

THE EUROPEAN CORN BORER WITH RESPECT TO SWEET CORN IN NEW YORK

During the season of 1929, work on the various phases of the corn borer problem was continued and dealt chiefly with an endeavor to find some way of reducing the infestation of the insect by means of various cultural practices, such as disposing of corn stalks and remnants by siloing and plowing, and determining an approximate date when corn may be planted in order to escape serious infestation. Other lines of work which have received emphasis are the life history, determination of the extent of injury in New York, a study of various insecticides to be applied against the young caterpillars, and the parasites of the insect with special reference to the egg parasite (*Trichogramma minutum*).

As reported last year, cultural practices, such as siloing and plowing under infested debris, appear to be the most satisfactory means at the present time of reducing the corn borer infestation. If conditions are such that the corn can be cut low and placed in the silo, the problem of combating the insect is comparatively easy. On the other hand, in some areas where canning corn is grown and the acreage is large, the stalks cannot all be utilized by putting them in the silo, and in many cases they are left standing in the field all winter. Under such conditions the problem is considerably more complicated. Stalks left standing in the field all winter cannot be plowed under satisfactorily in the spring and the only alternative is to rake them up and burn them. Owing to the ability of the moths to migrate from field to field, plowing as a means of combating the insect must necessarily be

on a community basis. It must, furthermore, be exceedingly thorough with no trash or debris left on the surface when the operation is completed.

Our experiments over the past two years have shown that the time of planting of the corn has an important bearing on the rate of infestation. In general, it appears that the earliest planted corn carries the heaviest infestation, with a gradual reduction in later plantings. During the past two seasons corn planted the first week in June and later has escaped with little loss from the insect.

Another phase of the problem which has received considerable attention in the past two years is the possible use of insecticides as a means of combating the insect. This appears now as a rather promising field of attack, especially for growers of early sweet corn for the market and also in areas where the conditions are such that plowing under stalks is not feasible. Out of a large number of materials which have been tried as insecticides, only a few combinations have shown much promise. Calcium fluosilicate has been shown to give a considerable reduction in larval population, and arsenate of lead when used with either fish oil or oil emulsion also appears promising. A large number of dusts have been tried but none of them have proved effective.

This project will be continued along the lines indicated in this report with the emphasis placed on the activities of the insect in relation to cultural practices. A study will also be made of the extent of the injury in New York from year to year in an effort to correlate the fluctuation in abundance of the insect with meteorological conditions.

MEXICAN BEAN BEETLE INVESTIGATIONS

This is a cooperative project with the United States Department of Agriculture, Bureau of Entomology. The investigations have consisted of the testing of various insecticides to determine the effect on the growth and yield of beans and the toxicity to the Mexican bean beetle as a basis for a practical control remedy. A study has been made of the seasonal life history as well as native parasites of insects related to the Mexican bean beetle to determine the probabilities of biological control with native parasites.

The life history of the bean beetle in New York has been studied for two years. The area infested by this bean pest now includes the counties of Chautauqua, Cattaraugus, Allegany, Erie, Wyoming, Livingston, Steuben, Ontario, Yates, Seneca, Schuyler, Chemung, Tioga, Tompkins, Broome, Delaware, Orange, Rockland, Ulster, Westchester, Putnam, and Dutchess.

STUDIES ON CAULIFLOWER INSECTS

The cabbage maggot (*Hylemyia brassicae* Bouché) was again an important insect pest of the "early" planted cauliflower seedbed. Seed sown after June 1 resulted in plants that escaped injury and hence did not require treatment for this pest.

Of the materials tested in the early seedbed to check maggot injury, none gave evidence of sufficient merit to supplant the standard treatment with mercuric chloride. Tests were carried on with mercurous chloride at various strengths in aqueous suspensions and in gypsum dust mixtures for maggot control. A 5 per cent mixture of bentonite with water was most effective in maintaining the salt in suspension uniformly. An aqueous mixture containing 5 per cent bentonite and mercurous chloride at the strength 1-300, and a dust mixture composed of gypsum and mercurous chloride at 2 per cent strength gave more effective results than a solution of mercuric chloride when only one application was made, but such results were only measurably satisfactory and were improved by additional applications.

Aphids and thrips (*Myzus persicae* Sulz. and *Thrips tabaci* Lind.) were severely injurious to plants in the "late" sown cauliflower seedbeds. Plants which were ready to transplant by late June escaped injury in the seedbed. Similarly, "early" sown plants escaped injury from worms to a great degree, such as the larvae of the diamond back moth, the cabbage looper, and the cabbage white butterfly, while the "late" sown beds were severely injured by these pests unless protective measures were taken.

STUDIES ON POTATO INSECTS

Experiments in dusting and spraying potatoes were continued on Long Island during 1929 as in the past three years. The season was marked by unusually dry weather and a severe attack of aphids and leafhoppers. Except for the low-lying Hampton

section, the yield of tubers averaged much below the normal owing largely to lack of moisture and in part due to severe insect injury.

It was again evident that spraying regularly thruout the season at weekly intervals with standard materials by means of low-pressure machines accomplished little other than to check injury by the Colorado potato beetle. Regular applications of standard dust mixtures gave slightly inferior results to spraying.

Treatments of nicotine spray and nicotine dust during early July for aphid control resulted in the former case in only slight benefits from treatment, whereas with nicotine dust there was a marked reduction in infestation and a substantial increase in yield.

The importance of early planting to obtain maximum yields was again emphasized by the results obtained from experiments where potatoes were planted at 10-day intervals thruout the planting season. The highest yields were obtained at the earliest planting, irrespective of whether spraying was continued after the blossoming period or not. Later planted potatoes showed a marked increase in yield from continued spraying. In general, the increase became more marked the later the potatoes were planted, but invariably such increase was not sufficient to offset the reduction in yield due to the time at which the potatoes were planted.

Timely applications of 2 per cent nicotine-lime dust to which was added an arsenical gave effective protection against these insects. In all, three applications were necessary at weekly intervals during July.

STUDIES ON CUCURBIT INSECTS

Cucumber plants were protected from injury by the striped and spotted cucumber beetles by means of timely applications of arsenical-hydrated lime and arsenical-gypsum dust mixtures, and of an arsenical-kayso spray mixture. Plants sprayed yielded a heavier crop than those dusted.

Squash plants were protected during June from injury by cucumber beetles and during July from injury by the squash borer by means of weekly applications of the above-mentioned dust and spray mixtures. The treatments were only partially effective in reducing the extent of borer infestation. As with cucumbers, squash plants that were sprayed yielded a heavier crop than those dusted.

DIVISION OF POMOLOGY

TEST OF FRUIT VARIETIES

The testing of fruit varieties is one of the oldest and still one of the most essential projects under way. The main value of such a test is that it furnishes material for plant breeding, pollination, pruning, and other studies, and also information in regard to the characteristics of new varieties. Approximately 3,000 varieties and a number of species of tree, vine, and small fruits are under test at Geneva. In addition a number of grape and small fruit varieties are under trial at Fredonia, and most of the new Station varieties at Kinderhook.

Every year the valueless varieties are discarded and new or untried kinds are procured for trial, the main sources of supply being the United States Department of Agriculture, the several state agricultural experiment stations, foreign investigational institutions, and domestic and foreign nurseries, fruit growers, and fruit breeders. Many of the newer sorts, even tho not superior to our standard kinds, possess one or more characteristics, such as hardiness, quality, earliness, etc., which are useful in the breeding of new varieties.

In a few cases, varieties or seedlings are received for trial with the provision that no propagating material will be distributed without the consent of the donator. Such kinds are marked "under restrictions." All new unrestricted varieties that are deemed as worthy of trial in New York are propagated and distributed by the New York State Fruit Testing Cooperative Association, Inc., Geneva, N. Y. As this Association distributes stock to approximately 2,000 fruit growers who are located under varied soil and climatic conditions, the value of the new kinds is determined in a comparatively short time.

FRUIT BREEDING

During the past year approximately 3,000 apple, pear, cherry, plum, and peach seedlings; 1,200 ribes; 116 raspberry; 2,000 strawberry; and 153 grape seedlings were set in plats for fruiting. In addition, over 9,000 seedlings of apples, pears, apricots, cherries, peaches, nectarines, plums, grapes, nuts, strawberries, and rubus varieties were grown from seed and moved to either the nursery

or fruiting plats. A total of 246 crosses and selfs were made with apples, pear, cherries, plums, peaches, nectarines, apricots, strawberries, blackberries, and grapes, and approximately 20,000 seeds were secured. This seed, as in the past, was enclosed in wire cages and stratified in sand shortly after harvest and early in March it was sown in the greenhouse.

Records were taken during the fruiting and growing season on about 1,500 raspberry seedlings, 1,200 *Prunus tomentosa* (Chinese dwarf cherry) seedlings, 1,200 grape seedlings, and a few seedlings of apples, cherries, apricots, and strawberries. A number of promising selections were made in the grape, raspberry, and *Prunus tomentosa* seedlings. The promising kinds are being propagated for a more extensive trial. A few of the strawberries under second test were deemed worthy of naming and these kinds are being propagated for trial in various parts of the State.

POLLINATION EXPERIMENTS

For many years horticultural workers have been collecting data on the self- and cross-fruitfulness of fruit varieties and during the past ten years Dr. A. B. Stout, Director of Laboratories of the New York Botanical Garden, has been cooperating in the pollination studies. The fruitfulness of the grape has been treated in several publications, but much of the data in regard to the fruitfulness of the other fruits had not been published. The past year all the available results on the fruitfulness of the commercial varieties of apples, pears, plums, cherries, and peaches were collected and published in Bulletin No. 577. Further work on pollination studies with the grape and methods of technic in studying pollination problems were prepared for publication.

PRUNING, STOCK, PROPAGATION, AND BUD SELECTION EXPERIMENTS

The pruning of apples, pears, and plums shows clearly that low-headed, lightly pruned trees make the best orchard plants. Such trees adapt themselves better to all orchard operations, such as pruning, cultivation, spraying, and harvesting, besides developing larger bearing areas for the production of fruit. Low-headed, little-pruned trees of these kinds have consistently produced greater yields of fruit.

In the stock experiments, all standard varieties of plums propagated on Myrobalan roots continue to be far superior to those growing on other stocks, such as St. Julien, Americana, Marianna, and peach roots. Sweet, sour, and Duke cherries thrive much better on Mazzard than on Mahaleb roots. Fruit growers are urged to plant trees propagated only on the Mazzard seedlings.

The propagation tests with apples show that varieties propagated by top-grafting or top-budding are little different from the same sorts budded in the nursery in the usual manner. Rome Beauty propagated from high- and low-yielding trees which have been fruiting for 12 years show no distinct differences.

The only bud selections that have shown any superiority over their parents are the so-called red sports, of Duchess of Oldenburg, Gravenstein, Twenty Ounce, Tompkins King, Delicious, Northern Spy, and Rome Beauty. Several of these bud sports are now recommended for planting instead of the older sorts, such as Red Gravenstein, Red Twenty Ounce, Red Spy, Red Rome, Starking, and Richared, the last being sports of Delicious.

WORK AT THE CHAUTAUQUA VINEYARD LABORATORY

The work at the Vineyard Laboratory during the past year has in the main followed the lines of endeavor initiated over 20 years ago when it was established. Hence, the main projects have now run continuously for that period. They include a comparative tests of nitrogen, phosphorus, and potassium, singly and in combination, and with stable manure. A test is also under way on the better-known methods of vine training, including the influences of the time of pruning on yields, growth, maturity, and the relationships of time of pruning to frost and freezing. The tests include Concord and several other important commercial varieties. A study is being made of the behavior of several varieties when grafted on various root-stocks as compared with the same varieties growing on their own roots, with especial attention directed to vigor, productiveness, and sugar content. The breeding of new varieties and their testing, including those from other sources, is also under way.

From the first a variety vineyard has been a large part of the work. This has included at some time or other over the period

practically every worthwhile sort brought to our attention. While many varieties have been eliminated, each year sees the addition of several named sorts from outside origination. In 1929 several hundred seedling vines from chosen parentage were planted. Two chief purposes have been sought in the breeding of these, namely, the production of high quality early and mid-season red varieties, and the shortening of the time required to ripen some very worthy sorts which are normally too late for New York latitudes. The work initiated two years ago to study the influences of fruit thinning has now progressed to the stage of a major project. Tests of several forms of synthetic nitrogens are now going into their fifth season. In 1929 several plats of Concord vines were allotted to rather comprehensive tests of a new phosphorus carrier, viz., colloidal phosphate. A comparison of fall and spring applications of nitrate of soda has now become one of the regular projects.

HORTICULTURAL WORK IN THE HUDSON RIVER VALLEY

Horticultural experiments have been conducted in the Hudson River Valley since 1924. The fertilizer experiments on a bearing Newtown orchard, a young bearing McIntosh orchard, and a McIntosh orchard planted in 1924 have been published during the past year. These experiments are being continued in the same way, except that a pruning experiment has been combined with the fertilizer experiment on Newtowns.

The variety test of apples, pears, peaches, plums, grapes, and small fruits, and tests of several of the nitrogen-carrying fertilizers in three orchards of McIntosh and one currant patch are being continued. The commercial fertilizer experiment on currants is also being continued.

Two new experiments were started this year. One consisting of the application of varying amounts of a nitrogen-carrying fertilizer on a bearing Delicious orchard and the other of a pollination study of the Chase cherry.

BOTANICAL WORK

The systematic botanist has continued during the year work on the vegetable monographs and has rewritten the incomplete account of the "Botany of the Beans" left by his predecessor.

He has made arrangements to study material in some of the chief European herbaria in connection with this and other papers in progress.

Preliminary cytological work on the scallop group of pumpkins had negative results. Work was continued on the "Botany of the Cultivated Cucurbits" and on the "Revision of the Martyniaceae"; and preliminary field work was conducted on the study of the cultivated Solanaceae. A considerable amount of material was gathered in anticipation of a "Monograph of the Onions and their Allies."

Field studies of the Malaceae were continued and supplemented by a series of crossing experiments among the species of *Malus*. These crossing experiments have now been carried on for two years and data of considerable interest assembled. A beginning was made in the study of variation of vegetative characters of seedlings of horticultural varieties for purposes of identification of nursery stock.

Several hundred specimens from all groups studied have been added to the Station herbarium. A large amount of material was identified for various nurseries thruout the State. A series of "type descriptions" for ready reference is being compiled for each group of plants to be monographed for the series of monographs in course of publication by this Station.

NURSERY INVESTIGATIONS

In general the results of the season of 1929 agreed with those reported last year which were incorporated in part in Bulletin No. 569 published in the spring of 1929.

Seed supplies.—That the source and variety of seed for seedling stock production is still an important problem is shown by the fact that one shipment of 27 pounds of Mazzard seed contained 8 pounds of abortive kernels and gave a very poor stand of seedlings, whereas other lots of both Mazzard and Mahaleb from different parts of the country gave excellent germination. Domestic supplies were generally equal or superior to foreign supplies, with the further advantage of greater dependability. Foreign orders for pear seed were not filled.

Production of branch-root seedlings.—An improved type of planting board has expedited the transplanting of seedlings the

first year, but as yet the cost is too high to make transplanting commercially possible, even tho this method gives a superior stock. The apple and pear seedlings which have been kept small during the first season by close planting, and which have been lined out for a second season 2 to 3 inches apart in the row, in rows a foot apart, have given satisfactory branch root stock of good size, and with a minimum of effort. Furthermore, the performance of these stocks when lined out for budding has been the equal of the finest commercial lining-out stock.

Performance of lining-out stock.—The superiority of branch-root seedlings over straight-root seedlings continues to evidence itself under New York conditions. Furthermore, the transplanted seedlings are generally of better vigor and are better able to withstand unfavorable conditions the first season. The imported branch-root stock was again generally of excellent quality, whereas domestic stock was variable, comparison having been made between stocks from all the principal seedling producing sections of Europe and America. Mazzard and Mahaleb stocks were especially variable, those from some sections of America being equal to the imported European stocks and others being almost worthless. Winter Nelis pear seedlings were uniform, stocky, and vigorous, and Bartlett seedlings, too, have characters of good stock under the conditions which they were used. Whether they will withstand blight attacks, however, is an open question.

Maturity and storage of stock.—There seems to be no artificial condition that will replace proper maturity. With roses, early digging resulted in plants which were either dead shortly after planting the following Spring, or which were weak. It made no difference whether the plants were stored in a moist bank cellar or in a dry cellar. Roses dug when fully mature came thru the winter in storage satisfactorily. Mahaleb seedlings emphasized maturity even more. Early Fall diggings were the poorest when lined out the following Spring, those dug the last week in November were better, while the best plants were those which were left outdoors with some shelter, being equal to the best European Mahalebs that were secured. The storage work was extended to include cherry trees, with which nurserymen have been having serious losses, several different treatments being tried, the stock then being lined-out in the field for observation.

In connection with storage and maturity problems, the early Fall freeze of 1928 emphasizes the importance of maturity. Occurring at such an early date as it did, it found much stock in an immature condition. Stock which was in sheltered spots, stock which was mature, or budded stock which had had the buds protected by plowing-up to them was little injured. On the other hand, immature stocks, such as *Rosa odorata*, budded roses which had not been plowed-up to, and stock in low or exposed places suffered most. Apples whose maturity had been delayed by aphid injury or Mazzard cherry stock which had been injured by attacks of leafspot were killed back by the freeze, whereas apple and cherry stocks kept free from aphid and leaf-spot by spraying with a bordeaux-lead-nicotine-sulfate spray were not injured in any way.

Performance of one-year buds.—The growth of one-year budded trees and plants was comparable to that of the stocks upon which they were budded the preceding season. Seedlings of Rome Beauty and Ben Davis continued to be as successful in producing good vigorous one-year trees as they had been as lining-out stock. Seedlings of Winter Nelis and Bartlett produced good trees when budded to Bartlett, Anjou, Kieffer, Seckel, and Sheldon, Bartlett seedlings producing somewhat the taller tree and Winter Nelis giving a somewhat stockier tree. *Pyrus Calleryana* winter-killed. Imported French pear seedlings gave as high as 92.5 per cent stand of buds.

Vegetative propagation.—Cuttings of *Rosa multiflora Japonica* made at different periods during the summer in peat, peat and sand, and sand alone, made best plants when taken about August 15 and when grown in a mixture of peat and sand or in sand alone. In peat alone the cuttings were too soft and likely to winter injury. In sand they ripened earliest, and in peat and sand they were intermediate in maturity. Cuttings produced in this way have been quite satisfactory as lining-out stock the following season.

In contrasting fall-made and spring-made root cuttings of some vegetatively propagated apple stocks, the cuttings made in the fall gave 98, 88.2 and 85.5 per cent rooting, while cuttings made in the spring of the following year ran only 47, 21, and 23 per cent.

ORCHARD SOIL INVESTIGATIONS

The work of the Station in the field of orchard soil investigations replaces the work of the Agronomy Division which has been discontinued as a separate division. The work of the latter has had a distinctly horticultural bearing for years and the change of activity will more closely coordinate the work of the Division of Pomology.

However, there are certain fundamental projects of agronomic bearing which will be continued for some time in order to bring the results to a practical and logical conclusion. These are reported on here as well as the distinctly horticultural soil projects which have either been under investigation for some years or have been recently initiated.

The work along soil lines during the past year has been centered around the following projects: (1) Orchard soil management studies, (2) causes of field plot variability, (3) lysimeter investigations, (4) manure studies—artificial manures, (5) nutritional studies of apple trees, (6) studies of certain unproductive soil types, (7) soil type relations of horticultural plants, (8) injection methods for feeding trees, and (9) the effects of long-continued application of certain salts on soil conditions and plant growth.

Orchard soil management studies.—This work deals with practical orchard fertilization methods, using commercial forms of nitrogen, phosphorus, and potassium, but with present emphasis on nitrogen carriers, since this element at present seems most important in influencing fruit yields.

The five orchards under investigation last year are being continued and two other orchards added, namely, a Baldwin orchard and a McIntosh orchard in Wayne County. It is hoped to determine not only the soil management conditions under which commercial fertilizers may prove of value, but also the most economical and effective forms and the best methods, time, and quantities of application.

Soil type and management largely determines the latter points. For example, one apple orchard which has been clean cultivated for years is responding in a marked way to applications of fertilizer nitrogen, while another orchard under a different soil man-

agement system has made almost too much growth under clean cultivation without fertilizers.

Present results indicate that there may be a considerable difference in the value of various nitrogen carriers. Such work as this, however, must be carried thru a number of years to give dependable results. At the present time some 9 or 10 forms of nitrogenous fertilizers are being compared, besides some of the newer forms of synthetic high analysis mixed fertilizers.

Field plat variability.—The uniform treatment studies of the 224 small plats in this project have been continued the past year. They are still in alfalfa which is exceptionally uniform in stand. Plat records will be taken again this year. To make this work comprehensive a large number of additional physical determinations must be made on the soils from these plats before the necessary correlations can be made.

Lysimeter investigations.—It is planned to terminate this project in its present form this year which will give a continuous record for 16 years, or four complete rotations. The various soil depths will then be sampled in such a way as to disturb their relationships as little as possible, since the same soils will be used for further lysimeter investigations with trees. It is very desirable to do this not only because the soils are now after 16 years in a condition more nearly approximating a field condition, but also because a 16-year record of soil performance is now available.

The water and nitrogen relations of the crops in the various rotations on the two soil types have been interpreted and written up and will be published this summer. Many most interesting relations have come to light which will be further substantiated when the final balance of nutrients is determined in the soil itself.

The relations of the soils and crops to nutrients other than nitrogen will be reserved for a later publication in the lysimeter series, as will also the data on the composition of the precipitation at Geneva.

The lysimeter method has proved to be an effective one for a study of certain soil problems which, on account of their nature, cannot be satisfactorily studied by either purely field or small pot methods.

Artificial manure.—This project was terminated during the past year. The results are similar to those already stated in the last

Annual Report. Since that report, however, the studies have been published as Bulletin No. 573.

Briefly, neither the method of rotting down straw to artificial manure, as originally published, nor any of several modifications of it were considered as a practical procedure which would be generally utilized by the New York farmer. The method is worth a trial in market gardening where greater effort in securing supplies of organic matter seems justified.

Nutritional studies of the apple tree.—This project was originally planned to determine the nutritive requirements of young apple trees, and the degree of variability in vegetative growth of seedling apples. Some of the results of this work will be published this summer under the title of "Variability and Size Relations of Apple Trees."

During the past year a large number of vegetatively propagated apple trees were grown in an infertile fine sand soil in culture jars to which was added various nitrogen carriers. Nitrogen absorption was studied in these trees and was found to bear some interesting relations to results secured in the field when the same carriers are used on bearing trees and compared on the basis of growth and yields. This phase of the work will be repeated the coming year using vigorous one-year nursery trees.

This culture work thus serves as a quantitative check on the nitrogen work with orchard trees and will also be extended to include other elements.

A still better quantitative check and means of studying the nutrition of the tree will be furnished when the present lysimeter experiments are finished and the tanks then used for the study of these nutrition problems.

Unproductive soil types.—During the past year some cooperative studies were begun by this Division and the Division of Bacteriology on the nitrogen and biological relations of Volusia soils. This is a series of soils of generally low productivity which is characteristic of much of the hill lands of southern New York. These soils are somewhat peculiar in that many of them have a relatively high total nitrogen content, but a low nitrogen availability. Some means of initiating biological transformations in this soil nitrogen presents a real problem. If such a means can be found it may also prove of great value in determining the status of the nitrogen in other soil types.

Last year's work was confined to laboratory and greenhouse studies of this problem. The work has now reached a phase, however, where it will this year be studied in the field on typical Volusia soil.

The general problems of the Volusia series of soils have occupied the attention of this Station, as well as that of soil workers at the State College of Agriculture at Ithaca, for many years. The extent of the Volusia series and allied soil types is so great and their problems so many and acute that the two institutions are cooperating in the work on this project.

Soil types and horticultural plants.—It is a well-known fact that horticultural plants have certain soil requirements. A very practical phase of this matter is encountered when a new orchard for example is set out and the question of proper site is considered. Altho without doubt trees will tolerate a wide range of soil conditions, it is extremely important to know the optimum requirements and the effects on growth and development of various important types of New York soils.

In this field of study the physical properties of soils are undoubtedly the determining factors, rather than the chemical. Subsoil type and structure as influencing drainage, root penetration, and aeration are very important. Soil texture also has been found to be very important. The bearing of these matters on the proper selection of an orchard site, and on the development of the tree are being considered in this new project.

Various important soil types will be brought together on the Station farm where conditions of climate will be identical and uniform stock of the more important horticultural species will be grown on these types. The effect of these varying types will be noted in its bearing on root and top development.

This project is an outgrowth of some studies which have been made for some years at this Station on the correlation of tree performance with various measurable factors in the tree's environment. This last question will be dealt with to some extent in a bulletin soon to be published on "Variability and Size Relations of Apple Trees."

Injection methods of feeding trees.—This new project is simply a part of the general program of tree nutritional studies. It is thought that this method may be an important new approach to

the question of how the tree utilizes its food supplies. By such a method high and low planes of nutrition may be maintained and exact dosage administered, when such is not possible by ordinary soil applications.

Preliminary studies have shown the method to be workable and to offer considerable promise in a study of certain nutritional problems.

Older field plat studies.—Since 1890, this Station has been carrying on some soil plat studies in which annual applications of such salts as sodium chloride and sulfate, magnesium, calcium, and iron sulfates and high calcium limestone are made and a great variety of crops grown on the plats. For many years this work was carried on by the Station poultryman, but unfortunately all analytical work on the crops and soils could not be maintained.

It is hoped that in the near future this work can be continued and published as it presents some very interesting problems in relation to crop growth and composition, and to changes due to the continued salt applications in the physical properties and base relations of the soils involved. As to point of time it ranks with the pioneer soil work of this country.

DIVISION OF VEGETABLE CROPS

CANNING CROPS INVESTIGATION

This year will complete the fifth season of field experiments with canning crops. Three new experiments with canning crops were begun this year.

Experiments with tomatoes.—A new experiment was started last year to determine the physiological effect and economic value of fertilizing tomatoes in the transplanted seedling flat. The unique feature of this experiment is that the fertilizer treatments begin when the tomato seedlings are only two weeks old instead of waiting until the plants are set in the field, which would be when the plants are 10 to 12 weeks old. The objects were to determine if applying any fertilizer earlier in the life of the plant would appreciably or economically affect its earliness of maturity, and also to determine by chemical analyses if plants fertilized liberally before transplanting could store up any element that otherwise might later be a limiting factor.

The first year's results indicated that excessive amounts of fertilizer were used in the flats, and that where nitrogen, phosphorus and potash fertilizers were used separately in such liberal quantities each single fertilizer upset the balance of the nutrient ratio and caused a severe stunting of the plants. A most interesting feature, however, was that when the same quantities of these fertilizers were combined the total complete fertilizer supplied a balance in the nutrient ratio and the largest, most vigorous plants were produced in this way.

In this, the second year of this experiment, smaller amounts of the various fertilizers were applied to the flats and no injurious effects resulted. Very striking differences in the character and growth of the plants were produced by the different fertilizer treatments in the flat.

In the field experiments with tomatoes, outstanding increases in yield were obtained from liberal applications of superphosphate. When this was supplemented with a moderate application of nitrate fertilizers, additional increases in yield were obtained, but there was little benefit from potash fertilizers. This experiment was on Ontario loam soil.

Comparing 150, 300, 600, and 1,200 pounds per acre of 4-16-4 fertilizer on tomatoes, the highest net returns were obtained by the heaviest application of fertilizer.

Comparing yields of tomatoes from seed sown March 10, March 25, and April 10, the advantage has been with the late seeding. Two out of four years the largest yields were obtained from the March 25 seeding, and two years the April 10 seeding produced the largest yields. Plants grown in a coldframe without transplanting until they were set in the field did not produce nearly as good a yield as plants that had been transplanted to flats in the seedling stage. The coldframe-grown plants developed a long tap root and did not survive field transplanting as well as the more branching-rooted plants from the flats.

Comparing the yields of tomatoes spaced in the field 3 by 3 feet; 3 by 4 feet; $3\frac{1}{2}$ by 4 feet; 4 by 4 feet; and 4 by 5 feet, the heaviest yield per acre was obtained from the closest spacing, but the largest net return was obtained where the plants were set $3\frac{1}{2}$ by 4 feet apart.

Variety testing and tomato breeding in an effort to develop better canning varieties is being continued.

Experiments with peas.—A new experiment was started last year to determine the effect of different potash fertilizers on the yield, rate of growth, and maturity and chemical composition of peas, and on the quality of the canned product. This experiment was started because of the popular belief that muriate of potash might cause premature ripening and poor quality peas. The first year's field results indicated that the form of potash made little, if any, difference. However, the canned peas from plats that had been fertilized with each of three forms of potash were slightly tougher than peas that had not received any form of potash fertilizer. Chemical analyses of these peas showed that the tougher peas were higher in calcium. During the winter, peas were grown in solution cultures for testing and analysis and it was found that high potassium in itself did not make hard peas, but that potassium might influence the metabolism of the pea in such a way as to cause a greater uptake of calcium. High calcium in the peas was definitely correlated with greater toughness.

This year this experiment in the field has been greatly enlarged. The fertilizer treatments have been increased and now include different forms of calcium as well as different forms of potash. In addition, the entire series is duplicated on a soil low in calcium and potassium, as well as on a soil high in both of these elements. In this experiment a remarkable result was observed that may prove of the utmost importance to growers of peas and to the canning industry. A very severe infestation of *aphanomyces* root-rot developed in the peas in this experiment. The significant result was that the series of plats receiving heavy applications of calcium sulfate and a series receiving calcium chloride resisted the root-rot and produced heavy yields of peas, while the plats which had not received either form of calcium as a soil amendment were so seriously infected with root-rot that less than half a normal yield was produced. All treatments were in quadruplicate and were scattered thruout the area which made the resistance of these soil treatments to the root-rot particularly striking.

In addition a planting of peas was made at the Long Island Vegetable Research Farm at Riverhead, Long Island, where there

is a series of plats having 13 different degrees of soil acidity ranging from pH 4.2 to pH 7.2. These peas will also be tested for toughness and chemically analyzed to determine if there is any correlation between soil treatment, chemical composition of the peas, and quality.

Field fertilizer experiments with peas have indicated that phosphorus is the principal limiting element. A moderate amount of readily available nitrogen also helped to increase the yield. It appears that about 300 pounds per acre of a complete fertilizer high in phosphorus or of superphosphate alone is the most economical amount to use on canning peas.

In a comparison of methods of fertilizing peas very striking results have been obtained showing that fertilizer drilled in with the seed is likely to do more harm than good, and that the fertilizer should be drilled in first and the peas seeded in a separate operation. The differences are particularly marked in dry periods following planting. This year the differences were very outstanding. A large number of growers and canners visited the Station to see this experiment and were greatly impressed.

A comparison of the seeding of peas at the rate of 3, 4, 5, and 6 bushels of seed per acre with four varieties in each of four years has consistently shown that 5 bushels of seed per acre will produce the largest net return.

The advantage of early planting of all varieties of peas has again been very marked. This is particularly true of the so-called "late sweet" varieties. The largest yields have consistently been obtained by planting as early as the soil is in good condition to work in the spring.

A comprehensive variety test of large-seeded varieties of peas was started this year to determine the yields and returns and canning quality of many new and some of the older varieties of peas not commonly used for canning. Twenty-two varieties are being grown for this test in which an accurate record will be made of the yields, time of maturity, and chemical analyses for starch, sugar, and calcium. Thru the cooperation of the American Can Company and the Geneva Preserving Company these varieties will be canned by commercial methods under uniform conditions and will be rated for canning quality. Public preference seems to be changing and there is an increasing demand for large peas.

The object of this experiment is to find high-quality varieties to meet this new demand. In a preliminary test of four varieties last year, the Onward variety made a very high quality canned product. Pea breeding in an effort to develop better canning varieties is being continued.

Experiments with corn.—A new experiment was started this year to determine (1) the relative yields of sweet corn when harvested at the proper stage of maturity for whole kernel pack as compared with the yield when harvested for cream style pack, (2) the relative yields in cans per ton of raw product at each stage of maturity, and (3) the suitability of various varieties for the whole kernel style pack. Thirty varieties and strains are included in this test. The commercial canning tests will be made thru the cooperation of the American Can Company and the Geneva Preserving Company.

The fertilizer experiment with sweet corn has been doubled this year. In previous years the fertilizers have all been applied broadcast. The broadcast series is continued again this year, and, in addition, the entire series is duplicated using the same amounts of fertilizers, but applied in the hill instead of broadcast.

Experiments with pumpkin and squash.—This year a very comprehensive experiment was started to compare 26 varieties and strains of pumpkin and squash and to determine the relation between the composition of the raw product and quality of the canned product. Each variety is being grown in quintuplicate and, in addition to accurate records of yields and earliness of maturity, chemical analyses will be made of each variety for starch, sugar, and soluble and insoluble solids. Commercial canning tests will be made of each variety, and the quality and consistency of each will be correlated with the chemical analysis of the raw product.

Experiments with beans.—Two types of fertilizer experiments with beans are being conducted. In one case a comparison is made of 15 different kinds and amounts of fertilizers for beans. In the other experiment a comparison is made of three methods of applying fertilizer to beans, namely, drilling in the fertilizer before planting, drilling in the fertilizer with the seed, and drilling in the fertilizer between the rows while sowing the seed. Very marked differences have been obtained in this experiment

showing the great advantage of drilling in the fertilizer before sowing the seed.

Experiments with cabbage.—To determine the best kind and amount of fertilizer for kraut cabbage, a comparison is being made of 15 different kinds and amounts of fertilizers. Four years results have shown that phosphorus is the principal limiting element. Cabbage also responds well to readily available nitrogen. A complete fertilizer high in phosphorus is recommended. Comparing 150, 300, 600, and 1,200 pounds per acre of 4-16-4 fertilizer, the highest net returns were obtained from the heaviest rate of fertilizing.

Experiments with carrots.—A variety and strain test of carrots is being conducted in cooperation with the Department of Vegetable Gardening at Cornell University. Under the supervision of Cornell the same strains of carrots are being grown on muck soils. At Geneva these strains are being grown on upland soil (Ontario loam). Comparative yield records will be taken and canning tests made to determine if any difference in quality of the carrots results from differences in soil in which they are grown.

Permanent systems of canning crops production.—The two rotation experiments are being continued to demonstrate permanent systems of canning crops production. One is a four-year rotation of tomatoes, stringless beans, beets, peas, and sweet clover seeded in the peas. This rotation is compared with continuous cropping of tomatoes. Altho the yield of tomatoes on the one crop area was better than the rotated tomatoes the first two years, by the fourth year the yield was significantly better on the rotated crop area. The physical condition of the soil on the rotation series, particularly following sweet clover, was markedly better than on the continuous tomato series.

There is also a four-year rotation of sweet corn, kraut cabbage, peas, and red clover seeded in the peas, and clover hay the fourth year. This was compared with continuous cropping of peas. After two years in succession peas were no longer profitable and were a total failure the fourth year. On the other hand, the fifth crop of peas grown in rotation is making a vigorous growth and gives every indication of producing a profitable return.

TESTS OF VEGETABLE VARIETIES

The Peas of New York, being Part I of *The Vegetables of New York*, was completed and distributed in 1929. This publication is the first of a series which is to include all vegetables grown in New York. This work began in 1922 and has included tests of varieties of the following vegetables: Asparagus, beans, carrot, red celery, corn, cucumber, egg plant, leek, martynia, muskmelon, okra, parsnips, peas, peppers, radish, rhubarb, squash, pumpkin, vegetable marrow, and tomato.

The object of this work is to grow all varieties of vegetables that can be obtained; to record their performance under conditions which exist at the Station; to describe all varieties so that they may be identified; to determine synonyms and solve problems of nomenclature; to study the resemblance of varieties in reference to their history, origin and parentage; to determine the varietal susceptibility to insects and fungi; and to describe and classify plant characters as an aid in vegetable breeding work.

During 1929, 450 varieties of tomatoes, 170 varieties of peppers, 96 varieties of carrots, and 40 varieties of parsnips were grown for test. Preliminary records were taken on a total of some 150 other varieties of vegetables. For the 1930 season there will be about 300 varieties of sweet corn and 400 varieties of beans grown. It is expected that the material on beans and also on corn will be prepared for publication after the 1930 records are completed.

VEGETABLE BREEDING

A new greenhouse cucumber.—As a result of a cross between Arlington White Spine, an American type of cucumber, and Rochford Market, an English forcing type, a new parthenocarpic greenhouse cucumber has been produced.

In 1929, seeds of this cucumber were distributed to a number of experiment stations. Based on the reports from these tests, as well as the success of certain selections in the season of 1929 at Geneva, a much more extensive distribution has been made during the past spring. These samples, under the name "Geneva," have been sent primarily to commercial growers in this State.

Bulletin No. 580, entitled "Geneva, A Greenhouse Cucumber that Develops Fruit Without Pollination," was published in

February 1930, and describes in detail the history of the experiment up to the present year. The reports of the commercial growers who are now testing it will determine the future of this new cucumber. Irrespective of its appeal to different markets, the Geneva unquestionably will set fruit without pollination. Since its characters are fixed, it should make a good cucumber for further breeding experiments. The work is being continued this year with the intention of making further crosses and selections.

Pea breeding experiments.—In 1926, a number of crosses were made. In the season of 1929, a number of very promising selections from these crosses, especially from the point of view of yield, were noted, but it was evident that no selections were as yet pure lines. The work is being continued with the hope that some of these more promising selections can be isolated into pure lines, and then be vigorously tested against existing commercial varieties. At this time the outcome cannot be predicted accurately.

Artichoke breeding.—Because of the possible importance of Jerusalem artichoke tubers as a source of fructose and inulin, 43 varieties and strains were planted at the Station this year. It is planned to develop thru selection, inbreeding, and interbreeding varieties of Jerusalem artichokes which will contain in their tubers higher percentages of fructose and inulin than are found in existing sorts and which will also possess other desirable characteristics, such as larger, smoother, tubers more compactly grouped. The Chemistry Department will cooperate in this project and analyze each strain for fructose and inulin.

If superior strains of artichokes can be found or developed, it should prove of considerable commercial importance to the State. It would create another cash crop for New York farmers as well as a product for commercial manufacture.

PUBLICATIONS AND EXHIBITS

BULLETINS AND CIRCULARS

The editing and publication of the formal bulletins and circulars issued by the Station occupied a large proportion of the time of the Editor during the past year. Of these publications, a list of which will be found at the end of this report, 13 were technical bulletins containing 333 pages; 14 were general bulletins with

354 pages; 10 were circulars, including reprints and revisions of earlier numbers and containing 84 pages; and 1 report, that for the year ended June 30, 1929, with 78 pages. In all, there were 38 publications containing 849 pages, with a total edition of 201,000 copies.

MAILING LISTS REVISED

The revision of the mailing lists mentioned in the last report was completed during the year, and a considerable increase in the number of names on the several subject matter lists has resulted. The Station continues to send its bulletins to all who ask for them, but an effort is made to limit the distribution to the fields of agriculture in which the individual is especially interested.

In addition to the mailing out of bulletins to the regular mailing lists, a considerable number of publications are sent out in response to requests received in the daily mail. This number averages about 200 pieces a day, and on many days exceeds 1,000. Several factors enter into the number and extent of these requests, some of which will be mentioned below.

THE NEWS SERVICE —

The syndicated press service which supplies news items of timely interest about the work of the Station to the daily and weekly newspapers of the State and to farm and trade papers continues to be well received. Evidence of this is to be had not only in the appearance of the material in the papers, but, of even more significance, in the great number of requests for information and publications traceable directly to these stories. A conservative estimate has been made that one-fourth of the requests for Station bulletins mention specifically that a notice of the publication was seen in some newspaper or farm or trade paper. A total of 317 stories were sent out during the year.

By an arrangement with the Extension Department at the College of Agriculture, special material is being prepared each month for the several farm bureau publications in the State and is being sent to these publications along with the news items emanating from the College. The Station supplied news material directly to the farm bureau papers in the past, but the present arrangement is proving more satisfactory for all concerned. In a similar way,

one or two special articles are prepared each month for the *Extension Service News* published by the College of Agriculture.

Mention was made in the last report of the so-called "mat service" thru which pictures in mat form are sent to certain New York State dailies with brief stories. This service has suffered somewhat from lack of funds, both for the making of suitable pictures, which are essential to the success of a service of this sort, and for the making of the cuts and mats. It is hoped that financial difficulties may be overcome so that this service can eventually be developed on a weekly basis. The possibilities for effective publicity by means of pictures at an extremely small cost are obvious to one who observes the trend towards the pictorialization of news in general and the increasing interest in farm news and pictures on the part of many daily papers.

POSSIBLE NEW EDITORIAL SERVICES

Discussion of the news service is not complete without mention of the use of the Station's news material over the radio. No special effort has been made as yet to cultivate the radio as a medium for disseminating information about the work of the Station, altho the possibilities in this direction are recognized, together with the need for closer contact with the leading radio broadcasting stations of the State. At present, at least one such station is using nearly all of the Station's news releases by way of "filler" and news items. The response to these broadcasts in the form of inquiries for further information and for publications mentioned is indicative of what might be expected if this popular medium of publicity were made use of more fully.

One other news agency that has been neglected, unquestionably with loss to the Station, is the large national press services which would use material from this Station if they could be given priority on releases and some special attention in the preparation of the material. As it is, an occasional release from the Station is rewritten by one of the leading press services and sent out to its members.

To develop these and other possible news channels, such as special feature articles for magazines, Sunday features for the metropolitan dailies, etc., in the way in which they should be

developed, would make demands upon the time and resources of the Editorial Division which we cannot meet under existing circumstances. Attention is called to these possibilities, however, for the consideration of those who administer the affairs of the Station in contemplating the future course and development of the editorial work here.

EXHIBITS

The editor has continued to serve as chairman of the Staff committee on exhibits. The diamond jubilee meeting of the State Horticultural Society held in Rochester in January seemed to call for a special effort in the way of educational exhibits from the Experiment Station and the College of Agriculture. A combined exhibit was planned, therefore, in which the several research divisions at the Station and departments at the College which are in close touch with the horticultural interests of the State joined forces to show how the two institutions are cooperating in the interests of the fruit grower. The station was represented by exhibits from the Seed Laboratory and from the Divisions of Horticulture, Entomology, Plant Pathology, Chemistry, and Publications. A smaller exhibit from the Station, comprising chiefly an apple variety exhibit, was also made at the eastern meeting of the Society at Poughkeepsie.

The 1929 State Fair exhibit of the Station was characterized by a combined exhibit of all Divisions at the Station as contrasted with a separation of the dairy and related exhibits as has been the case in the past. The new arrangement proved highly successful in portraying the varied activities of the Station and in giving the State Fair visitor something of a picture of the organization as a unit. It is planned to repeat the same general arrangement this year.

LIST OF PUBLICATIONS

TECHNICAL BULLETINS

- No. 150. July. The types of organisms found in spoiled tomato products, by Carl S. Pederson. Pages 46, figs. 16. Distributed September 27, 1929.
- No. 151. July. The fermentation of glucose, fructose, and arabinose by organisms from spoiled tomato products, by Carl S. Pederson. Pages 22. Distributed September 27, 1929.
- No. 152. July. Chemical studies of grape pigments: V. The anthocyanins in Ives grapes, by R. L. Shriner and R. J. Anderson. Pages 11. Distributed September 27, 1929.
- No. 153. August. The number and type of bacteria in commercially prepared infant foods, by G. J. Hucker and Alice M. Hucker. Pages 28. Distributed November 29, 1929.
- No. 154. August. The sanitary control of commercially prepared infant foods, by G. J. Hucker and Alice M. Hucker. Pages 16. Distributed November 29, 1929.
- No. 155. August. The Grindrod impact sterilizer, by G. J. Hucker and Alice M. Hucker. Pages 31, figs. 3. Distributed November 29, 1929.
- No. 156. September. The control of bacteria during pasteurization, by M. W. Yale. Pages 25. Distributed November 29, 1929.
- No. 157. October. The creaming of raw and pasteurized milk, by A. C. Dahlberg and J. C. Marquardt. Pages 80, plates 4, figs. 5. Distributed February 19, 1930.
- No. 158. October. VII. The udder as a possible source of thermophilic bacteria, by P. Arne Hansen. Pages 14. Distributed February 19, 1930.
- No. 159. April. Cross-unfruitfulness in the apple, by Olav Einset. Pages 24. Distributed June 2, 1930.
- No. 160. April. The fineness of ground sulfur sold for dusting and spraying, by L. R. Streeter and W. H. Rankin. Pages 16, figs. 3. Distributed June 2, 1930.
- No. 161. April. The best period for aging ice cream mixes, by J. C. Hening. Pages 24, figs. 4. Distributed June 13, 1930.

REPORT

Forty-eighth annual report for the fiscal year ended June 30, 1929, by U. P. Hedrick. Pages 78. Distributed October 15, 1929.

BULLETINS

- No. 570. August. Control of spoilage in tomato products, by Carl S. Pederson and Robert S. Breed. Pages 16. Distributed September 27, 1929.
- No. 571. August. Bacteria that survive and grow during the pasteurization of milk and their relation to bacterial counts, by Paul S. Prickett and Robert S. Breed. Pages 25, figs. 3. Distributed September 27, 1929.

- No. 572. August. Limitations as to sunlight requirements of hens, by W. P. Wheeler. Pages 14. Distributed September 27, 1929.
- No. 573. August. Artificial manure from straw, by R. C. Collison and H. J. Conn. Pages 17. Distributed September 27, 1929.
- No. 574. October. Five years' results with fertilizers in three Hudson River Valley apple orchards, by H. B. Tukey and L. C. Anderson. Pages 31, figs. 7. Distributed February 19, 1930.
- No. 575. October. Washing fruit to remove spray residue in the Hudson Valley, by E. V. Shear. Pages 34. Distributed February 19, 1930.
- No. 576. November. Studies of the black-rot or blight disease of cauliflower, by E. E. Clayton. Pages 44, figs. 9. Distributed February 19, 1930.
- No. 577. November. Pollination of fruit trees, by Richard Wellington, A. B. Stout, Olav Einset, and L. M. VanAlstyne. Pages 54, figs. 7. Distributed February 19, 1930.
- No. 578. December. New or noteworthy fruits, X, by G. H. Howe. Pages 12, plates 4. Distributed February 19, 1930.
- No. 579. December. Spray residues, by Leon R. Streeter and S. Willard Harman. Pages 12. Distributed February 19, 1930.
- No. 580. February. Geneva, a greenhouse cucumber that develops fruit without pollination, by Leslie R. Hawthorn and Richard Wellington. Pages 11, fig. 1. Distributed April 1, 1930.
- No. 581. February. Electric cooling of milk on the farm, by J. C. Marquardt and A. C. Dahlberg. Pages 20, figs. 3. Distributed April 1, 1930.
- No. 582. February. The rosy aphid in relation to spray practice in 1929, by P. J. Parrott and Hugh Glasgow. Pages 32, figs. 7. Distributed April 1, 1930.
- No. 583. February. Responses to light of the bud moth and leaf roller, by Donald L. Collins and Maurice W. Nixon. Pages 32, figs. 23. Distributed April 19, 1930.

CIRCULARS

- No. 31 (Revised). March. Strawberries, by G. L. Slate. Pages 11.
- No. 33 (Revised). March. Raspberries, blackberries, and dewberries, by G. L. Slate. Pages 10.
- No. 101 (Revised). March. Vinifera or European grapes in New York, by Richard Wellington. Pages 8.
- No. 104 (Reprinted). November. Grape pruning, by F. E. Gladwin. Pages 16, figs. 8.
- No. 105 (Revised). August, February, and June. Available publications. Pages 7.
- No. 114. November. The present status of legume inoculation in New York, by H. J. Conn. Pages 6.
- No. 115. March. How to whip cream, by J. C. Henning. Pages 5, figs. 4.

JOURNAL ARTICLES

In addition to the bulletins and circulars listed above, a number of technical papers reporting on various phases of the research work under way at the Station have appeared in scientific journals or trade papers during the past year. These papers are listed below.

- Anderson, L. C. Some soil problems in the Hudson Valley in relation to fruit growing. *Proc. 75th Ann. Meet., New York State Hort. Soc.*, 175-182. 1930.
- Breed, Robert S. Thermophiles in pasteurized milk and their relation to various types of pasteurizers. *Proc. 22d Ann. Conv., Intern. Assoc. Milk Dealers (in press)*. 1929.
- Breed, Robert S. Bergey's Manual of Determinative Bacteriology Index. *Baltimore: Williams & Wilkins Co. Ed. 3. 1930.*
- Breed, Robert S. Laboratory Manual of Bacteriological Methods of Lehmann & Neumann. Translation from 7th German edition. *New York: G. E. Stechert & Co. 1930.*
- Breed, Robert S. Determinative Bacteriology of Lehman & Neumann, 2 vols. Translation of 7th German edition. *New York: G. E. Stechert. Vol. I, 1930; Vol. II, in press.*
- Breed, Robert S. Heat-resistant and heat-loving bacteria in pasteurized milk. *New York State Assoc. Dairy and Milk Inspectors, 2d Ann. Rpt.*, 26-46. 1929.
- Breed, Robert S. Heat-resistant and heat-loving bacteria in pasteurized milk. *Pennsylvania Assoc. Dairy and Milk Inspectors, 5th Ann. Rpt.*, 129-143. 1929.
- Breed, Robert S. Bacterial counts in sanitary milk control. *Creamery and Milk Plant Monthly*, 18, Nos. 7 and 8. 1929.
- Breed, Robert S. Raw milk under the microscope. *Creamery and Milk Plant Monthly*, 18, No. 9. 1929.
- Breed, Robert S. Some additional stories about scientific names. *Science*, 70, 480. 1929.
- Clayton, E. E. A study of the mosaic disease of crucifers. *Jour. Agr. Res.*, 40, 263-270. 1930.
- Conn, H. J. The identity of *Bacillus subtilis*. *Jour. Infec. Dis.*, 46, 341-350. 1930.
- Conn, H. J. Progress in the standardization of stains: Safranin. *Stain Tech.*, 4, 65-68. 1929.
- Conn, H. J. Progress in the standardization of stains: Influence of impurities upon dyes. *Stain Tech.*, 4, 68-69. 1929.
- Conn, H. J. Progress in the standardization of stains: Hematein and acid fuchsin. *Stain Tech.*, 4, 97. 1929.
- Conn, H. J. Progress in the standardization of stains: Dyes for bacteriostatic work. *Stain Tech.*, 5, 1-2. 1930.
- Conn, H. J. The history of staining: Aniline dyes in histology. *Stain Tech.*, 5, 3-12. 1930.

- Conn, H. J. Progress in the standardization of stains: Research on the chemistry of dyes. *Stain Tech.*, **5**, 37-38. 1930.
- Conn, H. J. The history of staining: Development of bacteriological staining methods. *Stain Tech.*, **5**, 39-48. 1930.
- Dahlberg, A. C. New developments in methods used in making ices and sherbets. *Ice Cream Trade Jour.*, **26**, No. 7. 1930.
- Dahlberg, A. C. The year's research record. *Ice Cream Trade Jour.*, **25**, No. 7. 1929.
- Dahlberg, A. C. Dairy scientists discuss new discoveries. *Ice Cream Trade Jour.*, **25**, No. 4. 1929.
- Dahlberg, A. C., and Marquardt, J. C. Better milk cooling equipment on the farm. *Proc. 29th Ann. Conv. Intern. Assoc., Ice Cream Man.*, 1929; also, *Dairymen's League News*, **13**, 42. 1929.
- Daniel, D. M. Technic employed in transferring parasites of the oriental peach moth (*Laspeyresia molesta* Busch). *Jour. Econ. Ent.*, **22**, 801-805. 1929.
- Daniel, D. M. Oriental peach moth parasite work in New York. *Jour. Econ. Ent.*, **23**, 215-217. 1930.
- Dorner, W. The bacterial flora of aseptically drawn milk. *Jour. Bact.*, **19**, 44-45. 1930.
- Gladwin, F. E. New grape varieties and their uses. *Canning Age*, **11**, 419-421. 1930.
- Hansen, P. Arne. Ein neues Ammoniakreagens und seine Anwendung in der Bakteriologie. *Centr. für Bakteriologie, Parasitenkunde und Infektionskrankheiten I Abt. (Originale)*, **115**, 388-390. 1930.
- Hansen, P. Arne. The detection of ammonia production by bacteria in agar slants. *Jour. Bact.*, **19**, 223-229. 1930.
- Hansen, P. Arne. An investigation of thermophiles in freshly drawn milk. *Jour. Bact.*, **19**, 46. 1930.
- Harman, S. W. The bud moth in western New York. *Jour. Econ. Ent.*, **22**, 660-662. 1929.
- Harman, S. W. The efficiency of various insecticides in controlling the bud moth. *Jour. Econ. Ent.*, **23**, 184-187. 1930.
- Hartzell, F. Z. Toxicity of sprays and spray ingredients on pear psylla nymphs. *Jour. Econ. Ent.*, **23**, 190-197. 1930.
- Hedrick, U. P. Historical sketch of the New York State Horticultural Society. *Proc. 75th Ann. Meet., New York State Hort. Soc.*, 105-120. 1930.
- Hening, J. C. The effect of aging on ingredients. *Ice Cream Trade Jour.*, **25**, 75-76. 1929.
- Hening, J. C. New angles of aging the mix. *Proc. 29th Ann. Conv. Intern. Assoc., Ice Cream Man.*, **2**, 76-79. 1929. Also, *Creamery and Milk Plant Monthly*, **19**, 117-120. 1930. Also, *Ice Cream Trade Jour.*, **25**, 75-76. 1929.
- Hervey, G. E. R. The European corn borer with respect to sweet corn in New York. *Jour. Econ. Ent.*, **23**, 154-157. 1930.
- Horsfall, James G. Some tomato troubles in the Hudson Valley. *Proc. 75th Ann. Meet., New York State Hort. Soc.*, 172-174. 1930.

- Howe, G. H. Histories of apple varieties shown at Rochester and Poughkeepsie in 1930. *Proc. 75th Ann. Meet., New York State Hort. Soc.*, 287-296. 1930.
- Hucker, G. J., and Hucker, Alice M. Organisms associated with commercially prepared infant foods. *Amer. Jour. Dis. of Children*, **38**, 310-313. 1929.
- Huckett, H. C. New Canadian Anthomyids belonging to the genus *Hylemyia* Rob.-Desv. (Muscidae, Diptera). *Can. Ent.*, **61**, 110-119; 136-144; 161-168; 180-190. 1929.
- Huckett, H. C. A note on the habits of *Hylemyia trivitta* Stein. *Bul. Brooklyn Ent. Soc.*, **24**, 294. 1929.
- Huckett, H. C. The relationship between date of planting Green Mountain potatoes and yield of tubers in spraying experiments on Long Island. *Amer. Potato Jour.*, **7**, 27-30. 1930.
- Huckett, H. C. Results from the use of nicotine in the control of sucking insects on potatoes on Long Island. *Jour. Econ. Ent.*, **23**, 169-174. 1930.
- Kertesz, Z. I. New qualitative test for saccharase. *Biochem. Zeit.*, **209**, 492-494. 1929.
- Kertesz, Z. I. Recalculated tables for the determination of reducing sugars by Bertrand's method, with English and German test *Budapest: Kertesz*. 36 pages. 1930.
- Marquardt, J. C. Improving the quality of cheddar cheese by pasteurizing the milk. *Food Ind.*, **1**, No. 7. 1929.
- Marquardt, J. C. The effect of temperature upon the chemical, physical, and biological properties of milk. *Milk Dealer*, **18**, No. 2. 1929.
- Marquardt, J. C. Homogenization of cream for cream cheese making. *Milk Dealer*, **19**, No. 3. 1929.
- Marquardt, J. C. How milk is affected by filtration and clarification. *Milk Dealer*, **19**, No. 2. 1929.
- Marquardt, J. C. Making cream cheese to a formula. *Food Ind.*, **2**, No. 2. 1930.
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U. P. HEDRICK,
Director.

July 1, 1930.