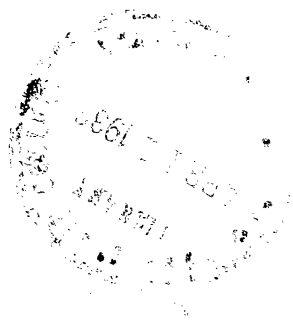


New York Agricultural Experiment Station.

Geneva, N. Y.

FORTY-EIGHTH ANNUAL REPORT FOR THE FISCAL YEAR ENDED JUNE 30, 1929

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.*

GEORGE W. CHURCHILL, *Agriculturist.*
REGINALD C. COLLISON, M.S.,

Chief in Research (Agronomy).

JAMES E. MENSCHING, M.S.

Associate in Research (Agronomy).

JAMES D. HARLAN, B.S.,

Assistant in Research (Agronomy).

WILLIAM P. WHEELER.

*Associate in Research
(Animal Industry).*

ROBERT S. BREED, Ph.D.,

Chief in Research (Bacteriology).

HAROLD J. CONN, Ph.D.,

*Chief in Research (Soil Bacteri-
ology).*

GEORGE J. HUCKER, Ph.D.,

*Associate in Research (Bacteri-
ology).*

CARL S. PEDERSON, M.S.,

P. ARNE HANSEN, B.S.,

*Assistants in Research (Bacteri-
ology).*

FRED C. STEWART, M.S.,

Chief in Research (Botany).

MANCEL T. MUNN, M.S.,

Associate 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. (River-
head),

ELMER V. SHEAR, JR., M.S. (Pough-
keepsie),

JAMES G. HORSFALL, Ph.D.,

*Associates in Research
(Plant Pathology).*

JOHN J. WILLAMAN,

Chief in Research (Chemistry).

DWIGHT C. CARPENTER, Ph. D.,

ARTHUR W. CLARK, B.S.,

LEON R. STREETER, M.S.,

Associates in Research (Chemistry).

MORGAN P. SWEENEY, A.M.,

WILLIAM F. WALSH, B.S.,

MILLARD G. MOORE, B.S.,

FRANK KOKOSKI, B.S.,

Assistants in Research (Chemistry).

ARTHUR C. DAHLBERG, M.S.,

Chief in Research (Dairying).

JULIUS C. MARQUARDT, M.S.,

J. COURTENAY HENING, M.S.,

Assistants in Research (Dairying).

PERCIVAL J. PARROTT, M.A.,

HUGH GLASGOW, Ph.D.,

Chiefs in Research (Entomology).

FRED Z. HARTZELL, M.A.,

HUGH C. HUCKETT, Ph.D. (River-
head),

FREDERICK G. MUNDINGER, M.S.
(Poughkeepsie),

*Associates in Research (Ento-
mology).*

S. WILLARD HARMAN, M.S.,

FOSTER L. GAMBRELL, M.S.,

DERRILL M. DANIEL, M.S.,

*Assistants in Research (Entom-
ology).*

ULYSSES P. HEDRICK, Sc.D.,

HAROLD B. TUKEY, M.S.,

CHARLES B. SAYRE, M.S.,

RICHARD WELLINGTON, M.S.,

Chiefs in Research (Horticulture).

FRED E. GLADWIN, B.S. (Fredonia),

GEORGE H. HOWE, B.S.,

FRANK H. HALL, B.S.,

GLEN P. VAN ESELTINE, A.B.,

LESTER C. ANDERSON, B.S. (Hudson),

GEORGE L. SLATE, M.S.,

*Associates in Research (Horticul-
ture).*

OLAV EINSET, B.Agr.,

LESLIE R. HAWTHORN, M.S.,

LEWIS M. VAN ALSTYNE, B.S.,

PARKS V. TRAPHAGEN,

*Assistants in Research (Horticul-
ture).*

CONRAD MOHR, *Florist.*

JAMES D. LUCKETT, M.S., *Editor.*

VIOLA ELVER, *Librarian.*

JAMES S. LAWSON, Ph.D.,

Museum Preparator.

THE UNIVERSITY OF THE STATE OF NEW YORK

THE STATE DEPARTMENT OF EDUCATION

ALBANY, *January 2, 1930.*

Hon. JOSEPH A. MCGINNIES, *Speaker of the Assembly, Assembly Chamber, Albany, N. Y.:*

SIR.—Pursuant to law, the Forty-eighth 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., August 1, 1929.

His Excellency, FRANKLIN D. ROOSEVELT, *Governor of New York, Albany, N. Y.:*

Hon. FRANK P. GRAVES, *Commissioner of Education and President of the University of the State of New York, Albany, N. Y.:*

SIRS.—In compliance with the requirements of the Education Law of the State of New York, and of the provisions of the act of the United States Congress of 1887, known as the Hatch Act, authorizing the establishment of agricultural experiment stations in the several states, I have the honor, on behalf of Cornell University, to transmit herewith the Forty-eighth Annual Report of the New York State Agricultural Experiment Station at Geneva, New York, for the fiscal year ended June 30, 1929.

The year has witnessed important changes intended to better define the work of the Station. In effecting these changes the University has been motivated by considerations of sound State policy and effectiveness of work. Every effort has been expended in the selection and replacement of personnel to maintain, and wherever possible to improve, the quality of service for which the Station is conspicuously known. The results of the investigations conducted by the staff during the year, as presented in this report, are convincing as to the essential value of this institution to the farmers of the State and the general welfare. I transmit this report for publication and dissemination in the confident belief that the public, and particularly the farming public, will profit by the advances in knowledge which it presents.

Respectively submitted,

LIVINGSTON FARRAND,
President of Cornell University.

DOCTOR LIVINGSTON FARRAND, *President of Cornell University, Ithaca, N. Y.:*

SIR.—I have the honor to submit herewith the Forty-eighth Annual Report of the New York State Agricultural Experiment Station at Geneva, being for the fiscal year ended June 30, 1929.

On October 1, 1928, Dr. Ulysses Prentiss Hedrick was elected Director of the Station in succession to Director Frank B. Morrison, who on that date became Professor of Animal Husbandry and Head of the Department in the State College of Agriculture at Ithaca. The selection of Dr. Hedrick has proved a happy choice. Prepared in botany and horticulture at the Michigan Agricultural College, he gained professional experience in his field at the Oregon and Utah Agricultural Colleges and at the Michigan institution, where he was advanced to a professorship in horticulture. In 1905, he was called to the State Experiment Station at Geneva as Chief in Horticulture, which position he has held since. He is, therefore, eminently qualified by reason of his knowledge of the agriculture, and more especially the horticulture, of New York, and of all phases of the work of the Station, to guide the energies of this institution for the larger service of the State and the advancement of science in its relations with agriculture. Widely known through his publications in horticulture, broadly acquainted and informed through his travels in this country and abroad, experienced in scientific research and its application, he is a fitting successor to the distinguished directors who have preceded him.

At the close of the year P. J. Parrott, Chief in Entomology at the Station since 1904, and one of the leaders in economic entomology in America, was appointed Vice-director of the Station and continued also as Chief of Entomology.

From year to year the duties of the Station are expanded by acts of the Legislature. These new responsibilities are welcomed and carefully discharged. Inasmuch, however, as they have not been accompanied by increased housing over a long period of years, they have resulted in a congestion which seriously impedes the work. When the horticultural research laboratory building, which has been requested now for many years, is provided, read-

justments can be brought about which will benefit many branches of the Station's work. So much has been said regarding this paramount need of the Station that little can be added. We may repeat, however, that the need is imperative. We renew our recommendation that no steps be omitted which may be needful to insure an appropriation for its erection by the Legislature of 1930.

Other fiscal needs of the Station are clearly set forth in the appended report. I fully concur in the recommendations of the Director in connection therewith.

The primary business of the Station is to conduct researches in certain designated fields of economic importance to the agriculture of New York. How well this has been done during the past year is revealed in the following pages. The reading of this record inspires enthusiasm for the work and confidence in the workers. It is a record of sound achievement of great practical significance for all the people. It is by such progress in the knowledge of agriculture that the permanent well-being of the State is assured and the business of farming made inviting to men of ability and purpose. I commend the report to the Trustees of the University and the people of the State.

Respectfully submitted,

A. R. MANN,

Dean and Director of Experiment Stations.

August 1, 1929.

CONTENTS

	PAGE
Reorganization.....	9
Changes in Station staff.....	10
The new horticultural building.....	12
Equipment, supplies, repairs, clerical help, labor, and printing.....	12
Salary scale.....	14
Retirement of Dr. Lucius L. Van Slyke.....	14
Investigations of certain moths and insects.....	17
The corn borer.....	17
Present work of the Station.....	18
Ready for larger responsibilities.....	18
Expenditures during the year.....	19
Appropriations.....	21
Progress of Station work.....	24
Division of Agronomy.....	24
Lysimeter investigations.....	24
Field plat studies.....	24
Investigations on artificial manures.....	25
High-nicotine tobacco investigations.....	25
Physiological and nutritional studies with fruit trees.....	26
Fertilizers in nurseries.....	27
Soil maintenance in orchards.....	27
Biochemistry of soil organic matter.....	28
Division of Bacteriology.....	28
Organisms commonly found in milk and dairy products.....	28
Bacteria that survive and grow during commercial pasteurization of milk.....	29
Sanitary milk control.....	31
Microscopic appearance of raw milk.....	31
Studies on powdered infant foods.....	31
Studies on the Grindrod impact sterilizer.....	32
Organisms found in normal udder.....	33
Behavior of bacteria in certain soils of low productivity.....	33
Standardization of biological stains.....	34
Study of legume nodule bacteria.....	34
Spoilage of tomato products.....	35
Division of Botany.....	36
Sprouting tests of seed potatoes.....	36
Raspberry diseases.....	36
Injury caused by sulfur fungicides.....	37
Premature defoliation of cherry trees.....	37
Diseases of canning crops.....	38
Relation of environment to pea root-rot.....	38
Tomato spraying experiments.....	38
Fruit disease investigations in the Hudson River Valley.....	39
Removal of spray residue from apples and pears.....	39
Root diseases of fruit trees.....	39
Fruit-spot diseases of apples.....	40
Plant disease investigations on Long Island.....	40
Spraying experiments with bush lima beans.....	40
Potato seed treatment experiments.....	40
Breeding cucumbers resistant to mosaic disease.....	40
Toxicity of mercury and copper compounds used in seed treatment and spraying.....	41
Hot water treatment of cauliflower seed.....	41
Work of the seed testing laboratory.....	41
Official seed testing.....	41
Routine or service work.....	42
Seed studies.....	42
Seed-borne diseases.....	42

Progress of Station work—Continued:

Work of seed testing laboratory—Continued:

PAGE

Drill survey.....	43
Field trials or "trial ground" work.....	43
Vegetable seed packets.....	43
Division of Chemistry.....	43
The chemistry of casein.....	43
Fertilizer and feeding stuffs inspection.....	45
Chemistry of insecticides and fungicides.....	46
Nicotine content of tobacco grown for use as an insecticide.....	46
Toxic residues on fruit.....	46
Studies on dusting sulfur.....	46
Physical properties of insecticides.....	46
Division of Dairying.....	47
Dairy herd management.....	47
Dairy products.....	48
Ice cream investigations.....	48
Cheese investigations.....	49
Market milk investigations.....	50
Inspection of Babcock and bacteriological glassware.....	51
Division of Entomology.....	52
Studies on apple insects.....	52
Studies on pear insects.....	53
Insect pests of canning crops.....	54
Studies on grape insects.....	56
Studies on the oriental peach moth.....	56
The European corn borer.....	56
Studies on cucumber insects.....	58
Studies on potato insects.....	58
Studies on cauliflower insects.....	59
Studies on fruit insects in the Hudson River Valley.....	60
Division of Horticulture.....	60
Tests of fruit varieties.....	60
Fruit breeding experiments.....	61
Pollination experiments.....	61
Stock, pruning, and bud selection experiments.....	62
Work at the Chautauqua vineyard station.....	62
Horticultural work in the Hudson River Valley.....	62
Botanical work in the Division.....	63
Vegetable variety tests.....	63
Canning crops investigations.....	64
Experiments with tomatoes.....	64
Experiments with peas.....	65
Rotation experiments.....	66
Experiments with corn.....	66
Nursery investigations.....	67
Comparison of nursery seedling stocks.....	67
Sources and varieties of seed for stocks.....	68
Methods of producing seedling fruit stocks.....	69
Storage of nursery stocks.....	69
Asexual propagation of seedling stocks.....	70
Fertilizer and cover crops for nursery stocks.....	70
Publications and exhibits.....	71
Bulletins and circulars.....	71
The mailing lists.....	72
The News Service.....	72
Exhibits.....	73
Bulletins and circulars.....	74
Technical bulletins.....	74
Bulletins.....	74
Circulars.....	75
Journal articles.....	76

FORTY-EIGHTH 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, 1929, being the forty-eighth report of this institution. The progress of stations such as this depends upon the development of its component parts, as you well know, and the growth of these parts can be studied best in the reports of the chiefs in research of the several divisions. To these I invite your attention. I shall report only on the main affairs in the management of the Station during the past year.

REORGANIZATION

During the year several changes have been made in the organization of the Station. The chief items in this reorganization are the discontinuance of the Division of Agronomy and of the Division of Poultry Husbandry. Two of the workers in the Division of Agronomy, R. C. Collison, Chief in Research, and J. D. Harlan, Assistant in Research, have been transferred to the Horticultural Division, under the titles Chief in Research (Orchard Soil Investigations) and Assistant in Research (Orchard Soil Investigations), respectively. W. P. Wheeler, Associate in Research (Animal Husbandry), in charge of poultry investigations, retired at the end of the fiscal year. While all experimental projects with poultry have been dropped, a small part of the poultry plant is retained under the charge of a laborer for the time being.

I have to report further as regards reorganization that the chiefs in research in all divisions have compared the projects under way in their divisions with those in charge of similar work at Cornell, with the view of coming to agreements as to the projects that can best be carried on at the two stations so that the work in the several fields is well covered for the State. I am pleased

to assure you that the men in this Station without exception tell me that they have brought their work in accord with that of fellow workers in the Cornell Experiment Station. There is now, it seems to me, no cause for complaint that there is waste of effort by duplication in the work of the two institutions. Inspections of projects by the constituents of the Station are invited that they may see that there is no unreasonable duplication of the work that is being done at Cornell. I say "unreasonable," because, as you well know, with some projects a certain amount of duplication is essential and to be sought rather than thwarted.

CHANGES IN STATION STAFF

A number of important changes have been made in the staff during the past year. Dr. L. L. Van Slyke, Chief in Research (Chemistry), retired February 1, 1929. An account of his services to the agriculture of the State follows in another paragraph.

So too, W. P. Wheeler, Associate in Research (Animal Husbandry), retired June 30, 1929. Mr. Wheeler has been at the Station during his active life, a period of forty-one years, and has contributed much to the betterment of the poultry industry of New York.

A third member of the Station force to retire on the pension so generously provided by the State is H. W. Hadlow, Superintendent of Buildings, whose time of service came to an end June 30, 1929, after having served the Station most faithfully for thirty-seven years.

P. S. Prickett, Assistant in Research (Bacteriology), resigned to go into other work July 9, 1928; L. K. Jones, Associate in Research (Botany), resigned to accept a more lucrative position at Pullman, Wash.; F. B. Morrison, Director of the Station from October 1, 1927, to October 1, 1928, resigned to become Professor of Animal Husbandry at the State College of Agriculture at Cornell. During his stay of one year Director Morrison did much to reorganize the business affairs of the Station and made notable changes in its scientific work as well. James E. Mensching, Associate in Research (Agronomy), gave up his position on June 30, 1929, to go into commercial work. Viola Elver, Librarian, resigned June 30, 1929, to accept a position in other work at the State College of Agriculture at Cornell.

The several retirements and resignations noted above made necessary the appointment of a number of new members to the staff, besides which there were several additions. J. P. McCollum, P. Carodemus, and P. V. Traphagen were appointed and served a few months each in the Divisions of Horticulture, Chemistry, and Agronomy, respectively, their appointments all beginning July 1, 1928. The writer of this report, who has been in charge of the Division of Horticulture from August 1, 1905, was made Director of the Station October 1, 1928. For the time, he remains in charge of the Division of Horticulture. Paul A. Hansen became Assistant in Research (Bacteriology), October 1, 1928. Mrs. Eva Knowlton and Miss Evelyn West were Associates in Horticulture and Bacteriology, respectively, from January 1 to July 1, 1929.

The resignation of Dr. L. L. Van Slyke made necessary the appointment of a new chief in the important Division of Chemistry in the Station. This place is now filled by Dr. J. J. Willaman by an appointment made effective April 1, 1929. Dr. Willaman came from the University of Minnesota, where he had had a notable career and had made a splendid record. In this Station he will devote the major part of his time to research in the chemistry of plants.

Dr. J. G. Horsfall became Associate in Research (Botany), February 1, 1929. His special field will be that of the pathology of the several canning crops usually grown in this State. P. J. Parrott, since 1904 in charge of the work in Entomology at this Station, was made Vice-Director and Chief in Research in Entomology July 1, 1929. Mr. Parrott will retain active management of the Division of Entomology, the work of which he has made well known not only in the State and country but internationally in the treatment of orchard insects. Z. I. Kertesz, a graduate of the University of Budapest, was made an Assistant in the Division of Chemistry, July 1, 1929. H. Frederick Borg has been appointed Librarian. Bernhard R. Nebel, a graduate of the University of Halle, Germany, who did notable work as a post-graduate student at this institution last year, becomes Associate in Research (Horticulture), September 1, 1929. G. E. R. Hervey, a graduate of Ontario Agricultural College, Guelph, Ontario, was appointed to the position of Associate in Research (Entomology), July 1, 1929.

THE NEW HORTICULTURAL BUILDING

It is gratifying to note that in the last session of the Legislature a bill was passed authorizing the preparation of plans for the horticultural building so long needed. My predecessors have called attention during the past several years in their annual reports to the pressing need of a horticultural research laboratory. All who have been familiar with the work of the Station have agreed that the work of the institution could not go forward advantageously until better laboratory facilities were provided for every division of the Station, since the present buildings are inadequate in space and equipment. The congestion in the laboratories of the Station has been so intense that the situation has been most disheartening to all members of the staff. Those in charge of the Station, as you well know, have long considered this new research laboratory the chiefest need. It is to be hoped that nothing will prevent the appropriation of money to erect the building for which plans are now being prepared.

I must call your attention again to the great need of an appropriation for the erection of greenhouses. The present structures were built some thirty-odd years ago, and have never been properly equipped for the work for which they were intended. Now, more than ever, greenhouses are indispensable to research work with plants, in the study of soils, and in breeding and treating insects and fungous pests. Properly constructed greenhouses would enable our workers with plants in many cases to grow two crops in a single calendar year and would also afford conditions of control in the study of plants and pests alike not otherwise to be had. New greenhouses, I say again, are indispensable if the range and efficiency of the experimental work under way at this Station be maintained. Perhaps I should add that the frame work and the boilers and their accessories for heating the greenhouses we now have are so nearly worn out that the present structures may at any time completely fail and the Station thus be left without glass houses of any kind.

EQUIPMENT, SUPPLIES, REPAIRS, CLERICAL HELP, LABOR, AND PRINTING

There is urgent need for moderate increases in the several funds for operating expenses, particularly in the fund for repairs. The

repair fund has been inadequate for years, having been nearly the same amount for the past several years, tho larger for the coming year by \$5,000, for special purposes, and meanwhile the cost of making repairs has greatly increased. Due to inadequate provision of funds for this purpose in the past, the Station buildings and equipment are suffering marked depreciation. Unless two barns and a dwelling house can be repaired within the coming year, they might better be torn down, and several other wooden buildings will soon be in the same condition.

Similarly, but not quite so acutely, the funds for equipment, supplies, labor, clerical help, and printing are now inadequate. During the last few years, appropriations for these items have been increased little or not at all. Meanwhile, the Legislature has several times responded favorably to requests from the people of the State for increased appropriations for particular types of special investigations by this Station. Thus, funds have been provided for the investigation of insect pests and diseases affecting raspberry crops (Forty-first Annual Report, page 20); for the L. I. Vegetable Research Farm (Forty-second Annual Report, page 20); for the Hudson River Valley Horticultural Investigations (Forty-second Annual Report, pages 16 to 18); for the investigation and production of canning crops (Forty-fourth Annual Report, pages 13 and 14); for the study of methods of production, storage, and distribution of nursery shrubs and plants (Forty-sixth Annual Report, page 13); and for investigations of certain moths and insects and of the corn borer (page 17 of this Report).

The sums appropriated for these several investigations provide very well indeed for the research work, travel, equipment, and the labor away from the Station, but there is insufficient money in any of these funds to supply clerical help, keep up over-head charges in the Station buildings, and to pay for incidental printing. We are beginning to suffer particularly in the last item. At one time the appropriation for printing at this Station was \$15,400. During Governor Miller's administration, this was cut to \$7,000. Little by little, this has been increased until the coming year we have \$9,000. Meanwhile, a number of important bulletins have accumulated which cannot be printed this year and probably not all during the coming year because of lack of funds. The present appropriation ought to be increased to at least \$12,000.

SALARY SCALE

I cannot refrain from mentioning, as the directors at this Station have done for several years past, the great desirability in increasing the salary scale of the research workers in this institution. If this Station is to function well in helping to build up the agriculture of the State, it must purchase the services of those best qualified to carry on scientific studies in the several fields of agriculture. To do this it must compete with similar institutions in every other State in the United States, and with the colleges and universities as well, many of which pay higher salaries than this Station is able to do. Increased costs in living are forcing up salaries of scientific workers in educational and commercial institutions to higher and higher levels, and unless this Station can keep up with competition in the salary scale it becomes but a stepping stone for its successful workers and the agriculture of the State suffers in the loss of trained scientific men. I am pleased to tell you that increases amounting to \$7,050 were given to twenty of the fifty-six members of the staff this year. It is very desirable that the salaries of several other members of the staff should be raised next year.

RETIREMENT OF DR. LUCIUS L. VAN SLYKE

After thirty-eight years of service in charge of the Division of Chemistry at this Station, Dr. Lucius L. Van Slyke retired February 1, 1929. It is fitting that a record of his standing and services to agriculture be made in this report.

Of Dr. Van Slyke's attainments in the scientific world those who are competent to judge agree that he has long been one of the leaders in research in dairy chemistry. His colleagues know that it was largely due to his work that this Station early attained and has long held prestige in the dairy world. Dr. Van Slyke should be remembered by the farmers of New York State also for his organization and supervision of the chemical inspection of commercial fertilizers and feeding stuffs. This was one of his first tasks upon taking charge of the Chemical Division at this Station, and so well was the work planned in this important field that the organization and the methods Dr. Van Slyke employed became at once models for similar work in other institu-

tions, few of which had then undertaken this work. Perhaps it is not too much to say that at a time when research in agriculture received scant support from farmers in this State, Dr. Van Slyke's work in the inspection of commercial fertilizers and feeding stuffs, better than any other effort of the Station, brought this institution to the notice of New York farmers and won their hearty support. Dr. Van Slyke, during his thirty-eight years of service here, was productive in publications, some of which are epoch-making in the fields which they cover and show the breadth of his work and its value to the agriculture of New York. We append a summary of his bulletins and circulars. In no other way can we show in a more striking manner the varied activities and the great value of Dr. Van Slyke's work to the agriculture of the State.

GENERAL SUMMARY AND CLASSIFICATION OF STATION BULLETINS
PUBLISHED BY DR. L. L. VAN SLYKE (1890-1928)

	No. of bulletins	No. of pages
I. Dairy Research		
1. Chemistry of milk.....	8	100
2. Dairy breeds in relation to composition of milk and yield of milk, cream, butter, and cheese.....	4	111
3. Cheese-making experiments. Condi- tions of operations. Chemistry of milk in relation to cheese. Chemical changes in milk in cheese-making. Chemistry of cheese.....	15	947
4. Relation of fat and casein to cheese yield as a basis for paying for milk at cheese factories.....	2	82
5. Cheese-ripening, conditions and chemi- cal changes	6	169
6. Chemical compounds in cheese.....	3	56
7. Chemistry of casein.....	10	304
8. Chemistry of sour milk.....	4	96
9. Manufacture and composition of Edam and Gouda cheese.....	1	36
10. Proteins in butter.....	1	25
II. Preparation and chemistry of spraying materials	5	132
III. Experiments with fertilizers for potatoes...	2	28
IV. Experiments with testing sugar-beets.....	2	58
V. The chemistry of home-made vinegar.....	1	55
VI. Inspection of fertilizers, feeds and insecti- cides		
1. Analyses of fertilizers.....	35	2160
2. Analyses and discussion.....	5	137
3. Discussion of composition and use....	2	223
4. Discussion of composition and cost...	12	220
5. Discussion of analyses of feeding stuffs	2	41
6. Analyses of insecticides and fungicides.	7	77
VII. Circulars	3	27
Total for all publications.....	130	5,084

INVESTIGATIONS OF CERTAIN MOTHS AND INSECTS

During 1927 and 1928 the oriental fruit moth, a most destructive insect pest of nearly all hardy fruits, was found in the State. Wherever this pest has attacked fruits in other parts of the world, it has been most destructive, and the fruit growers of New York are quite rightly alarmed at its introduction and spread in this State. Also, it has been apparent for several years that several other insects were not being as well controlled with the remedies in the hands of fruit growers as might be wished. To provide means of studying these several insects and moths as to life histories and treatment, the last Legislature passed an act making an appropriation of \$13,000 "for the investigation of certain moths and insects" by this Station. The moneys thus appropriated are to be used by the Station, in addition to other funds from the general appropriation, for investigations of insect pests. This act took effect immediately, and work was begun by the Station April first. In the three months that have passed satisfactory progress has been made in these investigations and this new work bids fair to become a significant contribution to the welfare of New York fruit growers.

THE CORN BORER

The corn borer, now known by all intelligent agriculturists, became thoroly well established in New York several years ago. Its control has been and is largely in the hands of the Department of Agriculture and Markets at Albany. This Department, however, does not have adequate facilities for research work with the borer, and last year turned over to this Station the sum of \$8,500. This year a direct appropriation was made to the Station of \$7,250 to carry on research work with the corn borer.

The importance of this investigation need not be emphasized. The terrible toll this pest takes in infested areas from both sweet corn and field corn makes the profitable culture of these two important crops well nigh impossible in regions where the insect is left to itself. Last year, the research work carried on with this insect showed that much can be done in the control of the pest, and further advances in means of checking the spread of the borer may be expected in the work this year and in the years to come.

PRESENT WORK OF THE STATION

A study of the reports of the chiefs in research which follow this introduction shows that the Station has under way 147 projects. That is, research workers of the staff have in hand 147 lines of investigation, each of which is supposed by the workers and the Director to have value to the agriculture of the State. Some of these projects were started many years ago, and are kept going thru the years because the constituents of the Station in this or that field ask for guidance, to give which means continuous investigation. Others of the projects are new and the value of some may be problematical. And yet, with all there has been a demand from one worth-while source or another for the investigation. I again invite your attention, and that of the readers of this report, to the scope and importance of the research work now under way as discussed in the reports of the several chiefs in research.

READY FOR LARGER RESPONSIBILITIES

In closing this introduction, I have to say that the Station feels that it is ready for larger responsibilities that are ready to fall. It has, I am sure, a full conception of its obligation to agriculture. It has now, more than ever in the past, well-assigned and well-defined duties. It seeks to maintain an atmosphere of conservative research and to work in a patient, truth-loving spirit. It asks from the State generous support for maintenance and further development that it may render every possible aid to agriculture and in high measure meet the demands which agriculture now makes on institutions such as this.

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 1928-29.

1. Expenditures contracted for and chargeable to preceding year, but paid for after July 1, 1928:

From appropriations by Chapter 55, Laws of 1927:

Maintenance and operation:

Fuel, light, power, and water.....	\$308 66
Printing	1,303 28
Equipment, supplies, and materials.....	1,607 78
Traveling expenses	196 61
Communication	48 06
Repairs	29 25
Rent	590 00

Total maintenance and operation..... \$4,083 64

Maintenance undistributed:

Long Island Vegetable Research Farm.....	\$72 35
Hudson Valley Horticultural Investigations..	188 98

Total maintenance undistributed..... 261 33

From appropriation by Chapter 75, Part 2 Laws of 1928:

Labor	\$392 50
Equipment, supplies, and materials.....	266 68

Total maintenance undistributed..... 659 18

From appropriation by 570, Laws of 1927:

Maintenance undistributed:

Equipment, supplies, and materials.....	\$101 32
Labor	45 00

Total maintenance undistributed..... 146 32

2. Expenditures chargeable to current year's funds:

From appropriations by Chapter 75, Laws of 1928:

Personal service:

Salaries	\$173,852 24
Labor	31,577 32

Total personal service..... 205,429 56

Maintenance and operation:

Fuel, light, power, and water.....	\$8,666 56
Printing	8,537 03
Equipment, supplies, and materials.....	27,180 92
Traveling expenses	4,608 76
Communication	2,895 57
Rent	3,155 40
Repairs	7,487 51
Contingencies	42 00

Total maintenance and operation..... 62,573 75

Maintenance undistributed:

Control of pests of raspberries.....	\$4,499 93
Long Island Vegetable Research Farm.....	1,631 09
Hudson Valley Horticultural Investigations...	2,990 52
Nursery shrubs and plants.....	11,945 11

Total maintenance undistributed..... 21,066 65

From appropriation by Chapter 84, Part 2, Laws of 1929, immediately available:

Compensation insurance	\$855 00
Repairs and alterations, etc.....	2,999 10
Vineyard at Fredonia: Service and expenses...	1,600 40

Total maintenance and operation..... 5,454 50

From appropriation by Chapter 520, Part 1, Laws of 1928, immediately available:

Personal service	1,749 67
------------------------	----------

From appropriation by Chapter 361, Laws of 1929:**Maintenance undistributed:**

Personal service	\$389 00
Equipment, supplies, and materials.....	1,052 04

Total maintenance undistributed..... 1,441 04

From Federal funds:**Hatch fund:**

Salaries	\$1,230 86
Labor	269 14

Total Hatch fund..... 1,500 00

Adams fund:

Salaries	\$1,500 00
----------------	------------

Total Adams fund..... 1,500 00

Purnell fund:		
Salaries	\$3,000 00	
Labor	1,058 06	
Equipment, supplies, and materials.....	941 94	
	<hr/>	
Total Purnell fund.....		5,000 00
From Ring Memorial fund:		
Equipment, supplies, and materials.....	\$2 60	
	<hr/>	
Total Ring Memorial fund.....		2 60
From income from sale of farm products:		
Personal service	\$1,620 64	
Labor	7,879 57	
Fuel, light, power, and water.....	60 33	
Sale of books, returned to Comptroller.....	176 50	
Equipment, supplies, and materials.....	2,702 80	
Travel expenses	1,160 52	
Repairs	2,383 65	
Rent	250 00	
Insurance	755 18	
Communication	61 03	
	<hr/>	
Total income from sale of farm products.....		17,050 22
		<hr/>
Total expenditures	\$322,768 35	
	<hr/>	

APPROPRIATIONS

The funds available to the Station for the year covered by this report from appropriations by the Legislature of 1928 were as follows:

By Chapter 75, Laws of 1928, to be available for the year ended June 30, 1929:

Personal service:		
Salaries of staff, etc.....	\$163,830 00	
Laborers	30,400 00	
Long Island Vegetable Research Farm....	6,500 00	
Hudson Valley Horticultural Investiga- tions	10,200 00	
	<hr/>	
Total personal service.....		\$210,930 00
Maintenance and operation:		
Fuel, light, power, and water.....	8,750 00	
Printing	9,000 00	
Equipment, supplies, and materials.....	27,500 00	
Traveling expenses	5,000 00	

Communication	3,000 00	
Fixed charges and contributions.....	75 00	
Rent	3,200 00	
Repairs and alterations.....	7,500 00	
Contingencies	100 00	
		<hr/>
Total maintenance and operation.....		64,125 00
Maintenance undistributed:		
Controlling raspberry pests.....	4,500 00	
Long Island Vegetable Research Farm...	1,800 00	
Hudson Valley Horticultural Investiga-		
tions	3,500 00	
For the study of the problems of produc-		
tion, storage, and distribution of nur-		
sery shrubs and plants, including per-		
sonal service	13,450 00	
		<hr/>
Total maintenance undistributed.....		23,250 00
		<hr/>
Total available for the year.....		<u>\$298,305 00</u>

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 1929, to be available for the
year ending June 30, 1930:

Personal service:

Salaries of staff.....	\$163,810 00
Laborers	32,150 00
Long Island Vegetable Research Farm...	7,000 00
Hudson Valley Horticultural Investiga-	
tions	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 Investiga- tions	3,500 00
For the study of problems of production, storage, and distribution of nursery shrubs and plants, including personal service	13,450 00

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

Total available for the year.....	\$318,910 00
-----------------------------------	--------------

PROGRESS OF STATION WORK

DIVISION OF AGRONOMY

The work of the Division of Agronomy during the year 1928-29 has been along the following general lines: (1) Lysimeter investigations, (2) field plat studies, (3) investigations on artificial manures, (4) high-nicotine tobacco investigations, (5) physiological and nutritional studies with apple trees, (6) fertilizers for nursery trees, (7) soil maintenance in orchards, and (8) relation of certain soil organisms to the character of soil organic matter.

LYSIMETER INVESTIGATIONS

The original plan of this work was to study the soil nitrogen balance when legume and non-legume rotations are used, also other mineral relationships under these rotations. Two soil types are used, one a productive high lime soil and the other an acid soil of relatively low productiveness. Alfalfa as the legume is compared with timothy as the non-legume in rotations including, in addition, two small grain crops. Complete in-go and out-go of mineral constituents is determined in order to arrive at the actual balance over a period of years.

This work is now in its fourth rotation, and altho some delay has been experienced in getting analytical data up to date, the work of the first three rotations (12 years) will be published soon.

It is the plan, at the end of the fourth rotation next year, either to remove or carefully sample the soils in the tanks to determine their nitrogen and other mineral relations at the end of the 16-year period. The tanks will then be used for metabolism studies with fruit trees in some investigations in which this Station has long been interested.

FIELD PLAT STUDIES

The trend of this work, which was originally along soil fertility maintenance lines, during the past few years has dealt more particularly with the reasons and causes underlying variability in plat yields. A considerable series of uniform treatment yields of various field crops have been secured along with much data on the physical and chemical make-up of the plats. These data are being handled by correlation methods in the endeavor to

establish relationships between the various environmental factors and the crop response of the plats.

The plats are now in alfalfa. Records will be taken this year which will practically terminate this piece of work. Some of these plats about which considerable is now known can then be used in certain orchard soil projects which are now under consideration.

INVESTIGATIONS ON ARTIFICIAL MANURES

The work on this subject during the past year has been confined to methods of producing artificial manures with a minimum of labor. Natural rainfall has been depended on and various methods used to secure a greater capacity of the mass to hold water. Mixtures of muck and peat have been used for this purpose. It must be said, however, that no method has been found which in the climate of western New York will quickly rot straw to artificial manure without the application of additional water and considerable labor. This work will probably be terminated this year and the final results published. This is a joint project between this Division and that of Soil Bacteriology.

HIGH-NICOTINE TOBACCO INVESTIGATIONS

In 1922 some work was begun at this Station on the production of high-nicotine tobaccos for use as insecticides. The main purpose was to secure ultimately cheaper nicotine for New York fruit growers.

It has been demonstrated that high-nicotine tobacco of the species known as *Nicotina rustica* can be fairly successfully grown in New York and a content of about 5 per cent nicotine in the dry leaf fairly well maintained. It has been shown also that the yields of nicotine per acre are fairly good, but they would hardly justify New York fruit growers for the expenditure of time and labor involved, especially since this tobacco is now being grown in gradually increasing amounts in the Southwest where yields as well as nicotine content are very much higher and where the plants are handled by modern drying and grinding machinery.

The problem of bringing together the two phases of this work, that is the culture of high-nicotine tobacco and its commercial manufacture, is a very practical and important one and will be solved ultimately.

The investigations on the culture and nicotine content of this plant were completed and the results were published in Bulletin No. 562. The study of the place of tobacco preparations of this kind in practical insect control is yet to be completed. If the Station's work on this problem has no other effect than to stimulate greater efforts toward cheaper nicotine production, it will have been worth while.

PHYSIOLOGICAL AND NUTRITIONAL STUDIES WITH FRUIT TREES

The projects under this heading are aimed at some of the fundamental relationships between the tree and its nutrient environment. Field, greenhouse, and laboratory studies contribute to the various phases of the work. The field studies bear on the subject of the effects of mineral elements on the behavior of the tree in the orchard. The greenhouse studies bear on the more obscure relations of nutrients to the tree and its various parts and functions, while the laboratory studies have to deal more especially with chemical studies of the tree as affected by nutrients, or other environmental factors.

Some work of the greenhouse type has been done with French crab seedlings, showing some of the nutrient relationships for vegetative growth, as well as the fact that such seedlings are exceedingly variable in reaction to similar treatment. The great desirability of performing work on nutrient relations with stock of high uniformity is indicated. The work on some phases of these relationships is being carried on at present with vegetatively propagated material. As this work expands the Station lysimeters will be utilized for certain problems dealing with tree metabolism and soil relations, where the trees can be more carefully and accurately observed.

The whole question of the varying reactions of different varieties and also of different individuals of the same variety to the nutrient environment is an interesting and important one. This question has been studied both for seedlings under more or less controlled conditions and also for older trees in bearing which were originally all from buds of a single tree but on seedling stock. The high variation in reaction of the seedlings suggests a probable underlying reason for the variability of older trees. The endeavor has been to evaluate for the trees in the field as far as possible the extent to which various environmental factors have con-

tributed to the variability in performance of the different individuals. It has been shown that soil variation is in part responsible but by no means entirely so. The work with the French crab seedling has strongly suggested another cause of this variability.

FERTILIZERS IN NURSERIES

This work was begun before the special investigations in nursery problems of all kinds were initiated at this Station. The trees in this experiment will be calipered and other data taken and the work on the problem terminated, so far as this Division is concerned.

SOIL MAINTENANCE IN ORCHARDS

The work under this heading deals with the relations of orchards and orchard soils to various kinds of fertilizer treatments. Effects of commercial materials on tree performance, especially with various nutrient carriers at present, and the fate of such materials in soil are being dealt with. The effects of such materials are checked by growth, yield, and other performance records, while more obscure possible effects on the economy of the tree are checked by laboratory work on tree and soil.

At present, five orchards are under experiments of this type. In three of these located near Geneva all of the above suggested relations are being studied, while one orchard in the Hudson River Valley is being fertilized with various newer commercial materials more for the demonstrative effects under the conditions existing on some of the poorer hill soils of the Valley.

During the past few years many new types of fertilizing materials have been placed on the market. In many cases the cost per unit of plant food in these new materials is less than in older and better known ones. Altho on theoretical grounds there is no cause for discrimination, nevertheless it is very necessary practically to know the value of these newer fertilizers for tree crops, especially the newer nitrogen carriers. In this connection it is not only important to know if they have an equivalent effect on production, but also how they react under varying conditions of variety, soil, and weather conditions.

Another important point is to know when to apply fertilizers. Many methods of application are being tried out and their effects on the tree noted.

BIOCHEMISTRY OF SOIL ORGANIC MATTER

Some preliminary work in this field has been started by this Division in cooperation with the Division of Soil Bacteriology. The present project deals with the relation of certain soil organisms to the character of the nitrogen and carbon in certain soil types which are suspected to differ widely in their nitrogen-carbon relations. Already certain organisms have been isolated and their reactions to nitrogen and carbon sources determined with a view to using them as indicators of the carbon and nitrogen relations in soils. It is hoped that such study will not only throw some light on the organic matter relations of some soils in which these relations are at present very puzzling, but will also ultimately constitute a ready and comparatively simple means of detecting in any soil the general character and availability of its organic nitrogen and carbon.

DIVISION OF BACTERIOLOGY

ORGANISMS COMMONLY FOUND IN MILK AND DAIRY PRODUCTS

Inasmuch as farmers are constantly being asked to eliminate various types of organisms from milk either because such organisms are harmful from a health standpoint or because they affect the keeping quality, flavors, etc., of the milk, members of this Division have been interested in studying in detail the bacteria normally found in milk. The dairymen of New York State should have information as to the exact nature of these organisms in milk and their economic and public health significance. Such studies obviously involve more or less technical and detailed investigation. During the year special attention has been given to studies of the streptococci. Studies have again shown the close relationship between the human pathogenic types and harmless or even beneficial dairy types. The chemical investigations in connection with this group of organisms have shown that the streptococci which produce the characteristic flavors in starters, butter, etc., are easily distinguished from the non-flavor producing varieties. Technical Bulletin No. 142 gives the results of these studies in detail.

The quality of milk from the standpoint of cheese production depends largely upon the type of organisms contained in the

milk when it is delivered to the cheesemaker. Members of this Division have been studying the physiology of these bacteria which may give some indication as to their importance in milk and in cheese-making. Some of the more common types, such as the streptococci, have been found not to attack casein when it is furnished in pure form, altho they are able to attack this substance as it occurs in milk accompanied by other nitrogenous compounds. These findings offer a possible solution of the controversy that has existed over the question whether the streptococci have a part in the ripening of cheese. (Technical Bulletin No. 141.)

Several organisms which have the power to break down the curd in milk have been studied. In attacking the casein they give the cheese or the milk, if it is allowed to stand for a great length of time, a disagreeable, bitter taste. These organisms may come from the udder and may be important in the ripening of certain semi-soft cheese. New York State dairymen producing milk for cheddar or American cheese factories should avoid allowing them to develop if possible. They can be reduced to a minimum by keeping the milk properly cooled during the period between milking and delivery at the cheese factory. Technical Bulletin No. 144 includes a study of this type of organism.

This Division plans to continue studies of this type in order that dairymen may know which of the organisms in milk are important for them to control or entirely eliminate and which may be innocuous or even beneficial in a safe milk supply.

BACTERIA THAT SURVIVE AND GROW DURING COMMERCIAL PASTEURIZATION OF MILK

During the past few years it has become increasingly evident that commercial pasteurization of milk, especially in large milk plants, does not always bring about a normal percentage reduction in the number of bacteria present. In fact, in many cases it has been shown that the number of bacteria present increased during the heating of the milk. Bacteria capable of growth at pasteurizing temperatures (thermophilic bacteria) produce very tiny colonies on the agar plates used in routine bacteriological control work. These tiny colonies have been described as "pin-point" colonies. Reports of these investigations during the year have been published as Technical Bulletin No. 147 and as Bulletin

No. 559. Two additional bulletins have been submitted for publication, one discussing the sources of thermophilic bacteria on the farm and the other discussing the control of these organisms in pasteurizing plants.

The investigations have shown that the following heat-resistant or heat-loving species of bacteria may occur in abundance in pasteurized milk: *Micrococcus conglomeratus* Migula, *Sarcina lutea* Schröter, *Sarcina rosea* Schröter, *Streptococcus thermophilus* Orla-Jensen, *Streptococcus faecium* Orla-Jensen, *Microbacterium lacticum* Orla-Jensen (probably identical with *Lactobacillus thermophilus* Ayers and Johnson), *Bacillus subtilis* Cohn, *B. calidus* Blau, *B. thermoalimentophilus* Weinzirl, *B. thermoin-differens* Weinzirl, *B. aerothermophilus* Weinzirl, *B. nondiastaticus* Bergey, *B. thermoliquefaciens* Bergey, *B. calidolactis* Hussong and Hammer, *B. michaelisii* Prickett, *B. kaustophilus* Prickett, and a thermophilic variety of *B. terminalis* Migula. In addition to these bacteria, several types of thermophilic *Actinomyces* and a heat-resistant yeast have been found.

The larger part of these organisms, if not all, are introduced with dust and dirt in small numbers into the milk before it leaves the farm. They may also occur in milk cans. During the pasteurization process, the non-spore-forming, heat-resistant types largely survive, making it difficult to secure a satisfactory percentage reduction in the number of living bacteria present in the milk.

The heat-loving bacteria, on the other hand, find pasteurization temperatures favorable for their growth and rapidly increase in numbers. While 30 minutes is not long enough to permit small numbers of these thermophilic bacteria to increase noticeably, yet they find opportunity to grow in foam, milk-stone, dead ends, about gaskets, etc., until they may occur by the millions per cc in the pasteurized milk where equipment is continuously operated for three hours or more. Moreover, the milk introduced into the pasteurizer may be heavily inoculated with them in case drainings from the heater, holder, or bottler are added to the milk. The same condition may hold in case returned milk is repasteurized. Delays of whatever nature that cause the milk to be held hot longer than 30 minutes likewise give a greater opportunity for the growth of truly thermophilic bacteria.

Where bacteria of the spore-forming types grow to millions per cc, they may produce a noticeable increase or decrease in acidity and may produce disagreeable flavors in the milk. There is no evidence that connects any of the species named with pathogenic conditions in man. Obligate thermophiles cannot grow in the human body, as the temperature of the body is not high enough.

Studies are being continued on thermophilic bacteria and their relation to the production of acid and flavors in pasteurized milk, their natural habitat, and their relation to particular types of pasteurizing equipment.

SANITARY MILK CONTROL

Two general bulletins (Nos. 567 and 568) have been issued during the year which discuss two phases of the sanitary control of milk. One discusses the significance of unusual increases in the number of white blood corpuscles in milk. The other is a report on the uses that are being made of the bacterial counts from milk as a means of controlling the quality of public milk supplies in the State.

MICROSCOPIC APPEARANCE OF RAW MILK

There has been a persistent demand for copies of Technical Bulletin No. 120, which is an atlas showing 16 micro-photographs of market milk and cream and for Circular No. 93 entitled "Clean and Cold Milk," that has caused the editions of both of these publications to become exhausted. Technical Bulletin No. 120 has been revised and reprinted as Bulletin No. 566. The number of micro-photographs has been increased to 20 and they have been limited to photographs of unpasteurized milk and cream. It is proposed to issue a bulletin during the coming year giving similar micro-photographs illustrating the bacteriology of pasteurized milk and cream. Circular No. 93 has been reprinted in a large edition and widely distributed in the State.

STUDIES ON POWDERED INFANT FOODS

The increasing use of commercially prepared infant foods has attracted the attention of control officials who are becoming interested in the sanitary quality of such foods as they appear

on the market. This interest has been stimulated, due to the fact that many of these commercially prepared foods are in direct competition with cow's milk or make use of cow's milk as a basis for the manufacture of such special foods. In those cases in which infant foods are in competition with cow's milk, the concerns producing these foods should be expected to meet the same sanitary standards as the fluid milk industry that is placing cow's milk on the market for infant consumption. On the other hand, the producers of commercially prepared infant foods who are using cow's milk as a basis for their products should not be allowed to place on the market processed cow's milk of sanitary quality inferior to that delivered by the fluid milk industry. The majority of the manufacturers of these commercially prepared products have realized this responsibility and have made every effort to place their products on a sanitary basis equal to that maintained in the fluid milk industry.

This Division has been interested during the past year in aiding the industries producing powdered milk and infant foods to establish definite standards for their products which would be fair to the farmer as well as to the manufacturer of such commercially prepared foods. Standards have been suggested and if adopted by the industry producing infant foods will materially aid in placing the industry on a firmer basis from the standpoint of improving the quality of its product. This will also have a definite beneficial influence on that part of the dairy industry that is producing milk to be made into commercially prepared infant foods.

STUDIES ON THE GRINDROD IMPACT STERILIZER

During the past few years there has appeared upon the market a special sterilizer known as the "Impact Process Sterilizer." This sterilizer has been designed to replace in certain instances the modern methods of pasteurization. Thru funds made available by the sponsors of this apparatus, this Division has been able to make a study of its efficiency.

The results of this investigation have shown that this new sterilizing process is capable of being adapted to the sterilization of milk destined to be used in manufactured dairy products. Its use in sterilizing fluid milk no doubt will be limited, as the

sterilization process involves the destruction of the cream lime and imparts a definite cooked flavor to the milk. On the other hand, it was noted that this method of sterilization is very efficient from the standpoint of practically eliminating bacteria, even those capable of growth at high temperatures, providing sufficiently high temperatures are used during the sterilizing process. The results of this investigation will be published thru the bulletin series of the Station.

ORGANISMS FOUND IN NORMAL UDDER

This Division has been interested for some years in the organisms commonly encountered in the normal cow's udder. This interest has been aroused during the last year because of concrete problems which constantly confront New York State dairymen. These problems include principally the control of excessive numbers of bacteria from the udder, the spread of garget or mastitis in the herd, and the source of the organisms which may cause epidemics of septic sore throat. The members of the Division have been aided in this project by a visiting Fellow of the International Education Board.

BEHAVIOR OF BACTERIA IN CERTAIN SOILS OF LOW PRODUCTIVITY

In the last annual report attention was called to a certain type of bacteria very abundant in the ordinary "good" soils of this locality, but scarce or entirely lacking in soils of low productivity. A study is now being made of this organism and others very similar to learn why they are unable to grow well in the latter type of soil.

The "poor" soil to which most attention has so far been given is the so-called Volusia silt loam, a common hill soil in western and central New York of a distinctly acid character and well-known to be difficult to manage in such a way as to secure good crops. It has been found that this soil contains sufficient carbon to support the growth of the organisms being studied, but that the nitrogen is not readily available to them. This fact is interesting because the soil is very high in nitrogen and in organic matter. It has already been learned that it is not difficult in the laboratory

to render this nitrogen available to the bacteria under study, but it has not yet been learned why it is ordinarily unavailable and just what changes are necessary to make it become available.

This point is regarded as important because the bacteria under investigation are not unlike green plants in their nitrogen requirements, and it is thought that any treatment of this soil making the nitrogen available to them will make it also available to crops. The brief period in which the growth of bacteria in soil can be observed makes it much easier to carry on investigations of this nature with them than with larger plants. It is hoped, therefore, that the results of this investigation will shed some light on the practical problems presented by some of these New York State soils of low productivity.

STANDARDIZATION OF BIOLOGICAL STAINS

The work is being continued on the standardization of biological stains as previously reported. An illustration of the value of such work is its bearing on the study of bacteria in soils. The investigations of soil bacteria mentioned above require the microscopic examination of bacteria in the soil. To do this it is necessary to stain them with a certain dye. It has been realized for several years that the dye employed in this work is rather erratic in its action, some lots giving good results, others poor. Thanks to the cooperation brought about in connection with the standardization of stains, it has proved possible to investigate the cause of this erratic behavior. The results of this investigation have been published during the past year and have shown a simple method by which the user of the technic can control the situation, even tho he happens to have at hand a batch of dye not giving as good results as might be desired.

The study is mentioned merely to illustrate the value of the cooperative work on stains. Several other staining problems of value to other institutions have also been solved.

STUDY OF LEGUME NODULE BACTERIA

It has frequently been called to the attention of the Station that New York State makes no effort to control the quality of commercial cultures put on the market for the inoculation of legumes. A control of this sort is maintained in several other states.

Whether or not such an undertaking is advisable in New York State depends on two factors, viz., first, whether the cultures now on the market are frequently unreliable; and second, whether there is enough demand for these cultures in this State to justify the official control of such preparations. A study of the matter is now being made with these two points in mind.

SPOILAGE OF TOMATO PRODUCTS

Studies on the spoilage of tomato products have been completed during the year and three bulletins prepared for publication. Technical Bulletin No. 150 reports a study of the cultural characters of 266 cultures obtained from 83 samples of various types of canned or bottled tomato products which have been studied and the organisms classified. Eleven were found to be strains of *Lactobacillus lycopersici* Mickle; 27 strains of *Lactobacillus gayoni* (Müller-Thurgau and Osterwalder) Pederson; 69 strains of *Leuconostoc pleofructi* (Savage and Hunwicke) Pederson; 45 strains of *Lactobacillus pentoaceticus* Fred, Peterson, and Davenport; 33 strains of *Lactobacillus mannitopeum* (Müller-Thurgau and Osterwalder) Pederson; and 68 strains of *Lactobacillus plantarum* (Orla-Jensen) Bergey. The remaining 13 cultures were miscellaneous yeasts or spore-forming bacteria and were not identified.

Technical Bulletin No. 151 discusses the fermentation products produced by these organisms. The lactic acid bacteria ferment the sugars present and produce lactic and acetic acid, carbon dioxide, alcohol, and mannitol. None of these products are poisonous, but they produce disagreeable flat and sour flavors in most cases. In some cases the product may be slimy, but this sliminess is also not poisonous. Bulletin No. 570 discusses the practical control of the spoilage produced by these bacteria. With few exceptions the organisms are not resistant to the heat ordinarily used in canning. Losses are caused by carelessness in cleaning and sorting tomatoes, and by improper methods of operating machinery used in canning and bottling, especially where hot products are placed in containers that are not resterilized afterwards. Careless methods of handling and storing 5-gallon cans and the use of wooden vats and barrels contribute to a total loss from spoilage that is still much too large.

Work has been continued during the year on sauerkraut fermentation and on the spoilage of grape juice, pimiento cheese, and mayonnaise dressings.

DIVISION OF BOTANY

SPROUTING TESTS OF SEED POTATOES

It is known that the manner in which a potato tuber sprouts often indicates the character of the plant which it will produce. For example, tubers with spindling or slender sprouts almost invariably produce weak or diseased plants. During the past year one member of this Division has devoted much time to a study of the sprouting of potatoes with two objects in mind, viz., (1) to determine to what extent tubers affected with leafroll can be detected by means of sprouting tests, and (2) to devise methods for making sprouting tests which are practicable under farm conditions.

Since a preliminary report on this work will be published soon, it is unnecessary to give a detailed account of the results here. It has been found that sprouting tests are easily made, but their interpretation is often difficult. In general, tubers affected with leafroll produce mostly spindling or slender sprouts, but the exceptions are so numerous (at least under some conditions) that errors of diagnosis are frequent. The varieties used in the tests are Rural New Yorker No. 2, Green Mountain, and Irish Cobbler.

RASPBERRY DISEASES

A study of the symptoms and field history of several virus diseases of black raspberries has been in progress for two seasons. The two most destructive of these diseases are red raspberry mosaic and yellow mosaic. The growing season of 1928, owing to prevailing weather conditions, brought out many unusual variations in symptoms. Red raspberry mosaic in black varieties was masked and outgrown. In red raspberries the symptoms of yellow mosaic were emphasized up to midsummer, and red raspberry mosaic was largely suppressed. These unusual reactions made inspection and roguing difficult. Red raspberry mosaic is found more prevalent in black raspberry plantings in western New York than previously, yellow mosaic is appearing in numerous Columbian purple plantings, and yellow mosaic is very abundant in most Cuthbert plantings. Many promising seedling red raspberries

are being tested for susceptibility to mosaic. Active cooperation is maintained with the Department of Agriculture and Markets in the inspection and certification of raspberry plantings from which plants are sold.

INJURY CAUSED BY SULFUR FUNGICIDES

A cooperative project with the Chemistry Division on the relation of sulfur when used as a fungicide to the health and productiveness of orchard trees was begun during the year. A series of experiments was conducted under controlled conditions of temperature and humidity. Raspberry plants and apple trees were used. Elemental sulfur in various physical states, hydrated lime, and chemically inert dusts were included in the treatments. While the work has not progressed to the point where conclusions are justified, definite conditions were found which lead to injury of the foliage. These conditions make it appear that the physiological activities of the plant determine its susceptibility to injury and that the injury may be preventable within certain limits.

PREMATURE DEFOLIATION OF CHERRY TREES

In 1928, New York experienced a severe early defoliation of sour cherry trees comparable to that which occurred in 1916. The causes of this defoliation have been discussed in Bulletin No. 555.

It was found that the leaf-spot fungus (*Coccomyces hiemalis*) was not the only cause of defoliation. Some of the yellowing and dropping of the leaves was induced by a physiological disturbance within the tree, brought about by prolonged early spring rains. Because the primary leaf-spot infection took place early in June, satisfactory control of this disease required at least one spray application besides the two necessary for the control of the cherry fruit fly.

The relation of the vigor of the tree to the degree of defoliation was evident in many orchards. The degree of vigor was determined by measuring the yearly growth of the branches. Such measurements, checked by the condition of the roots, showed that some of the cherry trees have been suffering from weak roots caused by winter freezing. On some trees it was evident that the root injury occurred in 1927, while in other cases it could be traced to the winter of 1921-22.

The experience of 1928 indicates that winter injury or lack of proper growth may increase the premature defoliation of cherry trees. On the other hand, winter injury of the branches has been known to follow severe cases of defoliation. Due to the comparatively dry autumn of 1928 there was no growth produced in August or September, the branches matured well, and no twig injury was observed in the spring of 1929. In one orchard trees located in poorly drained soil produced a terminal growth of only 3 or 4 inches. Such growth was found winter killed the following spring.

DISEASES OF CANNING CROPS

Relation of environment to pea root-rot.—When pea roots rot in the field the grower wishes to know if the weather is not at fault. Most frequently his trouble is caused by fungi as influenced by weather. To elucidate the effect of weather, it is necessary to isolate the component factors and regulate them independently of each other. For this purpose three special chambers have been constructed and installed in one of the Station greenhouses. In these chambers the two most important weather factors, temperature and soil moisture, may be controlled accurately. Each chamber is a 4-foot cube well insulated on three sides and the bottom with cork. The top and one side are of two layers of glass separated by a dead air space. Each is cooled with a Frigidaire unit somewhat below the desired point to buffer the effect of varying external temperature, and then heated thermostatically to that point. By operating each chamber at a different temperature the effect of this factor upon root-rot may be measured. The effect of soil moisture will be studied by means of apparatus, in the process of development, by which the water content of the soil may be regulated automatically. This effect will be measured by maintaining plants in soils of several degrees of wetness in each temperature chamber.

Tomato spraying experiments.—Altho the premature defoliation of tomato plants by leaf-spot diseases often reduces the yield considerably and is preventable by spraying with bordeaux mixture, it is an open question whether the spraying of tomatoes is profitable in New York.

It is necessary to take into account not only the expense of spraying and the uncertainty concerning the extent of defoliation

that may occur, but also the fact that thoro spraying may delay the ripening of the fruit until a portion of the crop is destroyed by frost.

Possibly a moderate amount of spraying at the right time may be profitable. From a series of spraying experiments begun during the past year, an attempt will be made to learn the number of applications of bordeaux mixture most likely to be profitable and the best times for making them. It is expected that the experiments will be continued for four years and perhaps longer.

FRUIT DISEASE INVESTIGATIONS IN THE HUDSON RIVER VALLEY

Removal of spray residue from apples and pears.—Recently, attention has been directed to the fact that fruit sprayed with arsenical compounds for the control of insect pests may retain an amount of arsenic greater than the world tolerance of 0.01 grain per pound of fruit. Already, fruit growers in the northwestern United States have been compelled to devise methods for the removal of spray residue in order to market their fruit.

Altho chemical analyses indicate that Hudson River Valley fruit does not often carry an excess of arsenic at picking time, the presence of visible spray residue is liable to arouse the suspicions of buyers and may affect the sale of sprayed fruit.

Accordingly, it has seemed advisable to have methods of removing spray residue, applicable to eastern conditions, carefully worked out so that safe recommendations may be made whenever they are needed. The subject has been under investigation by the Divisions of Botany and Chemistry since the fall of 1926. (See report of Division of Chemistry, page 46.) Briefly stated, it has been found that spray residues may be successfully removed from apples by passing them thru a bath of dilute hydrochloric acid. Properly managed, the treatment should be simple, rapid, and cheap, and without injury to the keeping quality of the fruit in storage. A full account of this study will appear in a forthcoming bulletin.

Root diseases of fruit trees.—Another year's observation has failed to furnish convincing proof of the value of bridge-grafting or in-arching young trees into the trunks of apple trees suffering from crown or root injury. Treated trees have shown nearly 100 per cent survival, while an almost equal percentage of untreated trees have died. However, recovery to the point of profitable

bearing has taken so long that it is doubtful if the treatment is really profitable. It is planned to assemble the results of this work for publication during the coming year.

Fruit-spot diseases of apples.—After a period of several years during which the Brooks fruit-spot of apples caused no commercial loss, the disease reappeared in the Hudson Valley in severe form in 1928. Unfortunately, no field experiments had been planned so the opportunity to obtain data on control measures was lost. In storage experiments with affected fruit there was no apparent increase in the amount of disease during storage. This agrees with the results of experiments conducted during the winter of 1923–24.

PLANT DISEASE INVESTIGATIONS ON LONG ISLAND

Spraying experiments with bush lima beans.—A report on this project has been published in Bulletin No. 558. The experiments covered a period of six years. Downy mildew and bacterial spot were the diseases under study. Spraying with 4–6–50 bordeaux mixture both before and after blossoming gave excellent disease control and increased yields. Also, the appearance and keeping qualities of the beans was improved.

Potato seed treatment experiments.—Bulletin No. 554, published during the year, contains an account of experiments in which organic mercury compounds (Semesan Bel and Bayer Dipdust) were compared with mercuric chloride in the treatment of seed potatoes. The organic mercurials controlled seed-borne scab infection about as well as mercuric chloride, but were less effective against black scurf. They increased yields slightly as compared with no treatment and mercuric chloride treatment. However, as tested out with many farmers under actual growing conditions, neither the organic mercury instant dip nor the mercuric chloride soak treatment have been profitable enough to justify the added expense and bother of treatment.

Breeding cucumbers resistant to mosaic disease.—On Long Island cucumber mosaic is regular in its occurrence and attempts to control it by the eradication of susceptible weeds have failed completely. During the past four years an attempt has been made to select, out of the standard pickling and slicing varieties, strains that are mosaic resistant. Inbreeding did not reduce plant vigor

but did bring out many abnormalities. The desirable lines obtained were tested for resistance to downy mildew and bacterial wilt as well as to mosaic. Lines showing distinct mosaic resistance were secured. The development of mosaic-resistant varieties similar in type to varieties now in commercial use appears entirely practicable. This investigation is to be continued.

Toxicity of mercury and copper compounds used in seed treatment and spraying.—Many recommendations for spraying and seed treatment involve the use of copper and mercury compounds in concentrations likely to be toxic to plants. The effects are complicated and often not at once evident. For example, lima bean seed dusted with a mercury compound may germinate well, but the plants produced are smaller and yield less than those from untreated seed. Species vary in susceptibility to injury, and closely related forms may react quite differently. Thus, while lima beans are mercury sensitive, strings beans are not. It is believed that more fundamental knowledge of copper and mercury as plant poisons will make possible safer and more effective use of control measures. An investigation of this subject is in progress.

Hot water treatment of cauliflower seed.—The method of testing and treating cauliflower seed for black-rot described in Bulletin No. 550 has been successfully used on a large scale by the county agricultural agent of Suffolk County. About 80 per cent of the entire amount of cauliflower seed planted in the county last spring passed thru his hands. In carefully conducted experiments treated seed planted in healthy seedbeds gave crops free from black-rot last season when the disease was general and severe.

WORK OF THE SEED TESTING LABORATORY

Official seed testing.—During the year, 337 officially collected samples of field seeds were received from the Commissioner of Agriculture and Markets, 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. It would seem that now it is simply a matter of the buyer taking advantage of the protection afforded by the seed law.

In addition to the official samples above mentioned, there were received and tested 22 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.

Routine or service work.—The number of seed samples of all kinds received for the regular routine analysis was 5,306. This is larger than the number received during any previous year. In all, 7,544 tests were made during the year. The increase is largely due to a demand for analyses in order that the seed stocks can be properly labeled to comply with the law, and to the growing interest in the matter of freedom from disease of seed stocks used for the production of special canning crops.

Besides the regular official and routine analyses enumerated above, many special determinations have been made during the year. These have included the extent to which lots of imported seeds have been stained, identity as to kind and variety, examination to determine the possible origin of clover and alfalfa, and analyses for export shipment. Some fifty or more certificates have been issued for export shipment in which the new international certificate was used to accompany the seed stock going into export to other countries. All of these legitimate demands upon the seed laboratory are each year increasing in volume and becoming more exacting to meet the needs of better seed merchandizing.

Seed studies.—The large volume and variety of seed material received has presented an excellent opportunity for study. A better knowledge of the basic scientific facts, particularly as regards germination, is needed for the improvement of laboratory practice. Several special studies were undertaken during the year looking to a better understanding of methods of testing and seed evaluation. (See journal articles cited on page 76.)

Seed-borne diseases.—During the season 2,338 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 most conclusively that there is a great opportunity for the routine seed laboratory to put into practice the findings of plant disease specialists in the important matter of seed-borne diseases.

Drill survey.—A drill survey undertaken in cooperation with farm bureau managers by means of which samples of seed wheat were actually taken from grain drills in the field last fall showed the great importance of taking special care in properly cleaning and treating seed wheat used for seeding. Many of the samples taken from the drills showed that the seed being used was unfit and even seriously objectionable for planting purposes.

Field trials or "trial ground" work.—Recent legal enactments providing for trial grounds in connection with the seed laboratory were taken advantage of during the past season. In all, 112 lots of seed corn were planted in comparative tests in the field. The results showed that many of the descriptive names used for the varieties were utterly meaningless, often confusing, and sometimes misleading. 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.

Trial grounds were also utilized for planting out all of the kinds of vegetables which mature from seeds planted directly in the garden as found among the 537 commission packets collected by the Commissioner of Agriculture and Markets. The crops are grown to maturity and notations made upon trueness to type and uniformity of stock as well as a comparison of field versus laboratory germination.

Vegetable seed packets.—Bulletin No. 565, showing the findings of 964 sealed packets of vegetable seeds, was published during the year. The results show plainly that the older, better-known, and well established "commission-box" or "packetting" seedsmen place a fair to good grade of seed in their packets. However, there is still opportunity for improvement in this type of seed merchandizing. The contents of 9 per cent of the packets collected were utterly useless for planting purposes.

DIVISION OF CHEMISTRY

THE CHEMISTRY OF CASEIN

Investigations on the chemistry of casein were continued during the past year under a grant from the International Education Board in the laboratory of Professor T. Svedberg at the University

of Upsala, Sweden. The particular investigation attempted during this period was an examination of the homogeneity of casein made from milk by various methods described in the literature and also to find the molecular weight of this substance.

Certain experiments carried out in this laboratory within the last few year have indicated that casein prepared either by the method of Hammarsten or by that of Van Slyke and Baker was a mixture of substances and not a homogeneous chemical individual. By the centrifugal method developed by Professor Svedberg we are able to examine the ultimate particles of any given thing and find the weight of each particle and its size and shape. In this past year's study we have used the ultra centrifuge as the criterion by which to judge the purity of a given sample of casein.

Incident to this work it was necessary to find the absorption spectrum in the ultra-violet region and the partial specific volume of casein. There was found to be an absorption band at wave length 2760 Å which is a common characteristic of several proteins thus far investigated. It appears that the absorption band in this region is due to the presence of tryptophane in the protein. The partial specific volume was found to be 0.750, a value very similar to that found for egg albumen and several other proteins.

Results of our centrifugal studies showed conclusively that casein prepared by the methods of Hammarsten or Van Slyke and Baker were not pure substances, but were mixtures. Investigation further showed that the preparations of Van Slyke and Baker differed from each other.

In order to separate the above-mentioned mixtures of proteins into their respective component parts, we have used two methods of fractionation. The separation is based on the hypothesis that actually different chemical individuals will possess certain differences in molecular structure whereby they can undergo different reactions from one another.

By extracting crude casein with hot acidified 70 per cent alcohol, we have dissolved out from the mixture of proteins one distinct chemical individual, which by studies in the centrifuge, we have found to have a molecular weight of 376,000, a specific sedimentation velocity of 11.72×10^{-13} cm, and a diffusion constant of 3.56×10^{-7} cm.

By fractionation with certain mineral salts we are able to separate the residue of the mixture of proteins in crude casein still further. From these studies we were able to show that we were dealing with two other proteins of molecular weights 95,000 and 188,000, respectively, each with a characteristic sedimentation value.

Summing up briefly the outstanding results of our investigation, we have shown that neither of the old standard methods of preparing casein yield a chemically individual substance.

Crude casein was shown to contain and be separable into three proteins of molecular weights 95,000, 188,000, and 376,000, respectively. It will be noted that the two species of higher molecular weights are very nearly exact whole multiples (two and four) of the simpler species. This indicates quite forcefully that the more complex species may be chemically related to the simpler one and possibly formed from it thru the process of polymerization or association.

Two publications dealing with the above research will appear shortly in the *Journal of the American Chemical Society*.

FERTILIZER AND FEEDING STUFFS INSPECTION

During 1928, there were received for analysis 794 samples of fertilizers and 2,265 samples of feeding stuffs. Of the total number of samples received, 747 samples of fertilizers and 1,260 samples of feeding stuffs were received during the period of January 1 to July 1, 1928.

The general results in relation to complete fertilizers may be summarized as follows: The complete fertilizers contained the highest average total amount of plant food ever found in the fertilizers of New York State. This is due to a marked increase in the number of high-analysis or concentrated fertilizers. The average analysis of all complete fertilizers showed the following composition: Nitrogen, 2.91 per cent; available phosphoric acid, 9.64 per cent; and potash, 5.80 per cent. The average plant food in 100 pounds was 18.35 pounds.

The general quality of the feeding stuffs sold in this State compares favorably with those sold in other states. The material deficiencies in protein and fat content averages about 5 in every 100 samples. The percentage of deficiencies is much higher in

some of the high-protein concentrates, particularly cottonseed meal and animal by-product feeds than in compounded feeds.

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.

A more detailed account of the trend in the composition of fertilizers for the past 14 years is given in Bulletin No. 557.

CHEMISTRY OF INSECTICIDES AND FUNGICIDES

Nicotine content of tobacco grown for use as an insecticide.—This study has been concluded and the results published in Bulletin No. 562. (See report of the Division of Agronomy.)

Toxic residues on fruit.—Samples of apples were obtained from several fruit growing sections of the State and the amount of arsenic in the adhering residue determined. The amount of arsenic found was in all cases considerably less than the world tolerance of 0.01 grain of arsenious oxide per pound of fruit. The arsenic content found in residues on commercial apples varied from 0.001 to 0.0075 grain per pound of fruit.

These results indicate that objectionable residues are apt to occur only in cases where excessive or late applications of arsenicals have been used. The results further indicate that in any normal year it should be possible to produce clean marketable apples practically free from toxic residues.

Studies on dusting sulfur.—A study of the physical states of sulfur dust is being made in cooperation with the Division of Botany in connection with a project on sulfur injury to orchard crops. The fineness of particle size in commercial dusting sulfur is subject to no regulations. Samples of different brands show wide variability in this respect. The large fraction of coarse particles in some brands amounts to "adulteration" because it will not adhere to foliage. Methods of fractionating sulfur dusts and definitely measuring the particle sizes have been devised. Correlated to these studies, these fractions will be tested for adherence to foliage. In this way it is expected to standardize more definitely the physical properties of dusting sulfur so that it will better serve the purposes expected of it.

Physical properties of insecticides.—The results of analysis of arsenicals and other insecticides sold in this State indicate a need

for more definite standards by which to evaluate such insecticides. It may be said that many of the brands are uniform, within the limitations of the methods employed, but there do exist on the market materials of inferior physical quality.

DIVISION OF DAIRYING

DAIRY HERD MANAGEMENT

Some attention has been given to the securing of information on the causes of reacting animals which show no lesions on post-mortem examination. Commencing with the tuberculin testing of the herd in 1900 and the segregation of the disease-free cattle, the Station has maintained a herd free from this disease. Records have been kept of all tuberculin tests, reactors, and the post-mortem data. Until 1927 reactors in the disease-free herd have been too small to be of any significance. In 1927 the test failed to give clear cut results in many cases and left us with the difficult problem of interpretation. On account of the unique history of the herd and the irregularities of the test in 1927, an ideal opportunity was given for a study of non-lesion cases or of irregular results by the tuberculin test. The Veterinary College at Ithaca is making certain blood tests to determine the possibility of animals being sensitized to tuberculin and the Division of Bacteriology at this Station is cooperating in the study of acid-fast organisms related to the organisms causing tuberculosis. The blood tests and avian tuberculin tests made this year show no relationship to irregularities in the regular tuberculin test. The slight irregularities in the test this year were not considered by the veterinarians to indicate the presence of any tuberculosis in the herd and it was again passed as an accredited herd.

The average production of 23 cows which finished test in 1928 was 7,364 pounds of milk and 424 pounds of butter fat. This is an increase of 324 pounds of milk and 22 pounds of butter fat over the average yield of 23 cows which finished test in 1927. It has been necessary to exercise great care in the selection of herd sires to develop a herd of such high average production.

The present herd sires of the Station are proving their worth. The senior herd sire, Owlrest, has been entered in the Register of Merit of the American Jersey Cattle Club. His first six daughters on their first 305-day test yielded an average of 373 pounds

of butter fat. The heifer records of the dams of these daughters average 345 pounds of butter fat. They made an average increase of 28 pounds of butter fat over the first records of their dams. Owlrest Select, one of these daughters, qualified for a silver medal. She produced in the 305-day test period 458 pounds of butter fat. She is making a considerably better record up to the present time in her second lactation period. In the first month of this period she produced 76 pounds of butter fat and for the four following months she has produced a little better than 55 pounds of butter fat.

The junior herd sire, Superb Owlrest, has one daughter which has finished her first test. She yielded in 305 days 6,794 pounds of milk and 417 pounds of butter fat. A large number of Register of Merit tests, besides the two mentioned, were completed. Five cows made records of over 500 pounds of butter fat, the highest yield being 544 pounds. Owl Interest Sheba qualified as the junior three-year-old champion of the State with a record of 540 pounds of butter fat in 12 months.

DAIRY PRODUCTS

Ice cream investigations.—Much attention has been given thruout the year to the effect of aging on the properties of ice cream mixtures. The effect of the time of aging on the properties of the principal ingredients of the ice cream mix has been studied for each principal ingredient and for combinations of these ingredients. Tests have been made of the original mixture without homogenization and after homogenization when the product is fresh and after 2, 4, and 18 hours aging. These tests consist of the viscosity of the mix, ease of whipping, texture, and body of the frozen product, etc. More data are necessary before definite conclusions can be drawn on this problem.

Some time was devoted to a study of preparing chocolate sherbet. Different percentages of chocolate and sugar were combined with milk in order to obtain a satisfactory combination of these ingredients. Tests were made to determine the advisability of homogenizing this mixture. A formula was devised which made a very satisfactory chocolate sherbet. It was found to be desirable to homogenize the mixture.

A number of commercial stabilizers for water ices and sherbets have been compared. One or two of these appear to give promising results. However, none of them are as satisfactory as the formula devised by this Division, using agar and gelatin as stabilizers.

A study of the effect of pasteurization temperature upon the properties of the mix and the resulting ice cream have been published in the *Ice Cream Trade Journal*. The ice cream mixes were prepared and processed in the same manner, except that they were pasteurized in 145°, 155°, and 165° F for one-half hour and at 180° F for ten minutes. It was found that as the temperature of pasteurization increased there was a gradual decrease in viscosity and size of fat globule clumps in the homogenized mixes and an improvement in their whipping quality. The flavor, texture, and body of the ice cream mix were not materially affected by the temperature of pasteurization with the exception of 180° F. A cooked flavor accompanied this temperature.

A study of the effect of certain salts on the ease of whipping ice cream mixtures published recently has been in the *Journal of Dairy Science*. A study of methods of flavoring ice cream with cocoa and chocolate was published in the *Ice Cream Trade Journal*. A preliminary report of results in these two problems was given in last year's annual report.

Cheese investigations.—Further attempts have been made to develop a method of packaging small amounts of natural cheese. It has been found desirable to package cured cheese rather than the green cheese. Trials during the past year have favored the use of a treated edible coating to prevent mold growth and loss of moisture. The edible coatings are being developed further with the purpose of obtaining a preparation which will prevent mold growth and evaporation at room temperature for a period of 30 days.

Further experiments have been conducted in the manufacture of cream cheese of the Neufchatel type by the new method developed at this Station. These experiments have established the desirability of using ground agar rather than other types of agar or gelatin. The use of cream directly from the separator or cream which has been standardized in order to increase its fat content has been found to produce slight defects in the texture of this cheese. Cream separated to contain the proper amount of

fat and aged for a period ranging from 4 to 24 hours at cold storage temperatures produced a cheese of excellent quality. It was demonstrated further that the use of skim milk powder improved the quality of cream and cottage cheese.

Market milk investigations.—The effects of cooling, agitation, and other physical influences on the creaming capabilities of milk have been studied further. The results have been summarized and the material is ready for publication.

The study of mechanical refrigeration for dairy farm purposes has been continued. Data have been gathered relating to the temperature obtainable under average farm conditions and also upon the cost of operation. Data have been gathered relating to the influence on the bacterial flora of normal milk of temperatures ranging from 35° to 60° F. Sufficient data have not been gathered on this subject to warrant definite conclusions.

A study of cleaning solutions has been made. The stability of chlorine in various salt solutions has been investigated. The cleaning and sterilizing properties of silicates, carbonates, phosphates, and combinations of these have been studied. Additional data are required before conclusions are possible on this subject.

Experiments with frozen milk have shown that the creaming capabilities of frozen Holstein or mixed milk are slightly reduced. Freezing does not appreciably alter the creaming capabilities of Jersey milk. It has been shown that all samples of frozen milk can be restored to their normal creaming power after being pasteurized.

During the past year work has been started, but not completed, relating to the establishment of a sediment standard for milk. These studies have been made in cooperation with members of a milk sediment standardization committee of the American Association of Agricultural Chemists.

Tests with strainers and strainer cloths are being continued.

INSPECTION OF BABCOCK AND BACTERIOLOGICAL GLASSWARE

This work has been continued at the Station as in previous years and the tests may be summarized as follows:

SUMMARY OF ALL GLASSWARE TESTED FROM JUNE 1, 1928, TO JUNE 1, 1929.

TYPE OF GLASSWARE	NUMBER RECEIVED	NUMBER INAC- CURATE	NUMBER BROKEN
Babcock:			
Milk bottles, 8 per cent.	26,068	31	55
Cream bottles, 50 per cent, 9-gram, 6-inch.	2,698	1	4
Cream bottles, 50 per cent, 9-gram, 9-inch.	179	.....	2
Cream bottles, 50 per cent, 18-gram, 9-inch.	132	.....	.....
Pipettes, plain 17.6 cc.	5,088	339	56
Miscellaneous, not marked S. B.	35	.....	.....
Total Babcock.	34,200	371	117
Gerber:			
Milk bottles (butyrometers)	400	.....	1
Bacteriological:			
Pipettes, 1.0 cc.	16,116	488	27
Pipettes, 0.01 cc.	440	1	1
Pipettes, miscellaneous.	18	.....	.....
Total bacteriological.	16,574	489	28
Total glassware, all kinds.	51,174	860	146

Further advances have been made in perfecting the technic involved in testing large amount of Babcock and bacteriological glassware. Special studies of pipette construction and delivery have been made in cooperation with members of the American Dairy Science Association in an effort to standardize further the amount and rate of delivery of pipettes used for milk analyses.

DIVISION OF ENTOMOLOGY

STUDIES ON APPLE INSECTS

The investigations relative to the efficiency of certain insecticides in combating injurious insects and the effect of various spray materials on the quality of fruit and productiveness of apple trees have been continued.

On account of the destructiveness of the bud moth (*Spilonota ocellana* Schiff.) this insect is receiving particular attention, the efforts being directed largely to ascertain its susceptibility to standard spray practices as well as to special treatments with new insecticides. In view of the high rate of infestation of many orchards it is gratifying to record that the experiments conducted in the vicinity of Holley show that the pest is amenable to treatment and that apparently there is little need of apprehension relative to the work of the insect on the part of growers who treat their trees systematically according to the standard measures recommended by the spray service. The chief value of the aforementioned procedures lies in the fact that the pest is held constantly to unimportant numbers, thus being rendered impotent to produce serious damage during any single season. In view of the demand for information relative to the control of the pest, Circular No. 109 was prepared and distributed among growers in the areas showing heavy infestation.

The efforts with oil sprays deal principally with the insecticidal efficiency of different types of oils against the eggs of the leaf roller and the accumulative effects on the health of the trees from an annual application of sprays containing 6 to 8 per cent lubricating oil. This treatment is designed for the protection of orchards where it is clear that the arsenical sprays as customarily employed do not afford adequate security. The possibility of enhancing the insecticidal efficiency of arsenical mixtures by means of such materials as fish oil, linseed oil, and iron sulfate is receiving consideration. The results of the leaf roller investigation to date were published in Bulletin No. 561; and to guide growers in their spray practices Circular No. 111, which deals largely with the selection and use of spray materials, was prepared.

With respect to the rosy aphid, the major aspects of this problem are the comparative susceptibility of the eggs and newly-hatched nymphs to treatment and the insecticidal efficiency of various oil and sulfide sprays used alone or in combination with nicotine sulfate or free nicotine or finely ground tobacco dust. The effect of these various mixtures on the red mite is also being noted.

In connection with the studies relative to the codling moth, the major problems are to determine methods for preventing "stings" on the apples and the possibility of controlling the pest by treatments directed exclusively against the first generation of the caterpillars. In this latter effort, in addition to securing adequate protection with fewer applications of insecticides, there is also involved the prospect of avoiding objectionable spray deposits. While the influence of chemical treatments in removing the coating of insecticides from the surfaces of apples and on the finish and keeping qualities of apples are being considered, the primary object of the efforts at present is to determine if washing of apples is a necessity considering the climatic conditions and spray practices that prevail in western New York.

STUDIES ON PEAR INSECTS

Continuing the investigations of the pear psylla along lines followed during the past three years, various oils were applied during the early spring to kill the hibernating adults of the pear psylla and to prevent deposition of eggs by individuals that chanced to survive the treatment. All lubricating oils tested in cold-mix emulsions and the various commercial oil preparations proved very efficacious in reducing the number of adults and in rendering the trees uncongenial to them. However, when treatments were repeated over several years, a marked difference in toxicity to pear trees was noted with the different oil preparations, some grades of oil causing marked injury. The results were especially noticeable with the weaker trees. For this reason, the use of oil sprays in most orchards is recommended for not more than two successive seasons, after which recourse should be had for a season or two to nicotine sprays as given in the regular schedule. If desired, the oil treatment may again be used with comparative safety for one or two years.

A noteworthy feature of the oil treatment is the residual effects of oils on the eggs and the young nymphs, the vast majority being killed, many of them succumbing one or two months after the treatment.

Recently, a study has been made of the effects of an activator added to nicotine sprays. Present indications are that by the use of such materials the amount of nicotine can be reduced in the spray at a considerable saving in cost.

Environmental studies of pear orchards indicate that a considerable decrease in infestation can be secured by setting the orchard in proper relation to surroundings. Orchards have been repeatedly observed where freedom from the pests is directly related to the environment. A rather extensive survey is in progress to determine and measure the environmental factors responsible for lessened infestation.

INSECT PESTS OF CANNING CROPS

The cherry fruit fly, the carrot rust fly, the seed corn maggot, and the spinach leaf-miner are being studied from the point of view of the canner and the grower of canning crops with the primary object of developing practical measures for their control. Since growers of canning crops are frequently engaged in the culture of onions on a large scale and since the maggot often causes large losses, much attention has also been devoted to this problem.

As previously reported, investigations of the cherry maggot have shown that infestation of cherry fruits may be markedly reduced by timely applications of arsenical sprays and dust mixtures. While most of the growers with whom we have worked are succeeding in producing crops that pass inspection at the canning factory, it sometimes happens that occasional orchardists following the standard system of treatment do not meet with the same degree of success in their efforts. In attempts to find an explanation for these seemingly anomalous results, which obviously are not due to the character of the materials applied, it was discovered that the time of the spring emergence of the flies may vary greatly in different orchards due, apparently, to type of orchard soil and orchard exposure. For this reason observation cages are maintained in a number of orchards in different localities

to determine the period of first emergence, maximum emergence, and last appearance of flies in the hope that the data secured may shed light relative to the influence of various environmental factors. The facts secured by these efforts should also prove of great value in checking the observations of the spray specialists in the different cherry sections and thus making possible a more accurate timing of the applications by orchardists generally. Aside from the life history studies, much attention is being given to other phases of the problem, such as the predacious and parasitic enemies of the maggot, influence of certain cultural practices, efficiency of small arsenical dosages, and influence of canning processes in eliminating maggots.

The carrot rust fly continues to take a large toll from growers who disregard approved control measures. This is a pity in view of the high prices paid in recent years for a superior product, coupled with the fact that experience is showing conclusively that injuries by the pest may be avoided to a large degree. It has been found that carrots planted after the first of June ordinarily escape damage, and if such late-planted carrots are harvested by the first to the middle of September they should be exempt from serious injury. Tests with insecticides are being carried on with the object of finding a direct means of control.

The efforts with respect to the spinach leaf-miner are largely concerned with testing insecticides to repel the flies and thus prevent egg deposition or to destroy the young maggots as they commence to tunnel the leaves.

The studies of the seed-corn maggot are largely directed to determining the insecticidal efficiency of various chemicals against the maggot and the influence of the various treatments on the germination of peas, beans, and corn.

Extensive experiments during the past three years in cooperation with growers at Williamson and Elba point to the conclusion that lubricating oil emulsion is an efficient and economical treatment for combating the onion maggot. Another important development from these efforts has been the construction of spray machines adapted to onion culture. Aside from the protection afforded onion plants against the pest by the treatment is the destruction of weeds, thus greatly simplifying cultural operations. An early publication of the data derived from these studies is planned.

STUDIES ON GRAPE INSECTS

For a number of years grape growers in the Keuka Lake Valley have been seriously troubled with cutworms which climb the vines during the spring and "cut" the young grape shoots. Several species have been found to develop the climbing habit, which apparently is brought about by the lack of food. This may be due to the death of annual plants and to early cultivation which destroys certain favored perennials. The growing of a cover crop of Dwarf Essex rape and allowing this to remain under the vines in the spring until the cutworms have pupated offers considerable promise as a cheap method of luring the cutworms from the vines. The experiments are being continued.

STUDIES ON THE ORIENTAL PEACH MOTH

The oriental peach moth (*Laspeyresia molesta*) is now firmly established in Niagara and Chautauqua Counties in western New York. The heaviest infestation is found along the Niagara River and is spreading eastward thru the peach and quince area at a rapid rate. The occurrence of the insect in these two counties is of primary concern to the peach industry in western New York. Since there is no satisfactory method of protecting peach orchards by means of insecticides, the most promising recourse to combat the insect is the utilization of parasites.

Thru the cooperation of the United States Bureau of Entomology and the State Department of Agriculture and Markets, importation from New Jersey of the larval parasite (*Macrocentrus ancylihora*) was made possible last season. Parasites were liberated at two points in the area of heaviest infestation along the Niagara River. Twig collections made at weekly intervals until peach harvest showed that the parasite had become established. Its ability to pass the winter in this area remains to be determined by twig collections of first brood larvae this spring. The egg parasite (*Trichogramma minutum*) is being bred in the laboratory and liberations will be made thruout the season. A brief account of the situation is given in Circular No. 106.

THE EUROPEAN CORN BORER

In view of the increasing importance of the corn borer in relation to the sweet corn industry in New York, investigations were under-

taken in Erie and Chautauqua Counties in the fall of 1927. This project was continued thru the season of 1928 and embraced various phases of the activities of the insect, such as the life history, effectiveness of plowing, the date of planting in relation to the rate of infestation, the use of insecticides against the young caterpillars, and a study of the infestation in weeds and other host plants. The studies so far have been confined entirely to sweet corn, since this crop has apparently suffered more loss in New York than field corn.

The points which have been most emphasized in the plowing experiments are the comparative value of spring and fall plowing, the difference in effectiveness when infested stalks are plowed under at different depths, and the difference in effectiveness when plowed under in a light gravel soil and a heavy clay soil. Studies have also been made upon the activities of the caterpillars which regain the surface of the soil after being plowed under. In general, it has been found from our experiments conducted over one season that plowing under infested corn stalks and other plant refuse is the most effective way of reducing the numbers of the insect known to the present time. There was little difference in the rate of effectiveness when infested material was plowed under at different depths, but there was a decidedly higher percentage of mortality among the caterpillars when the plowing was done in the fall rather than in the spring. It has been found that in order for the plowing operation to be effective in the control of the insect it is necessary to gather up and destroy all corn refuse left on the field after the plowing is completed.

A number of insecticides were tried out against corn borer caterpillars during 1928, but the experiments were too limited to say anything definite with reference to any of the materials. There is evidence, however, that some of the materials will effect a considerable reduction in the caterpillar population. Oil emulsions, arsenate of lead, and nicotine sulfate all appeared to have value in reducing the numbers of the insect, but it will require more work to be able to say whether this method of attacking the insect is practical.

Experiments to determine the difference in the rate of infestation of corn planted at different dates have shown that the earliest

plantings are usually heavily infested and that there is a gradual reduction in infestation in later plantings. In 1928, Golden Bantam planted the first week in June escaped with a comparatively light infestation. Planting as late as this is not practicable in most cases where the corn is being grown for the market.

Circular No. 107 deals briefly with the life history, habits, and control of the borer in sweet corn with special reference to conditions in Erie and Chautauqua Counties.

STUDIES ON CUCUMBER INSECTS

In field experiments for the control of cucumber beetles trap squash seedlings were again used to advantage for the segregation of beetles "driven" off the main crop by dusting. Instead of using nicotine dust to destroy the beetles on the traps, trials were made with the flame from a blow torch with good success. The new method, altho perhaps taking slightly longer to operate, had the advantage over dusting in that the efficiency of the seedlings was not interrupted by the presence of dust and it eliminated the possibility of recovery by beetles such as took place under certain conditions when nicotine dust was used. Very few seedlings were destroyed by the flame when judiciously employed.

In comparative tests of dust mixtures in plant protection, gypsum dust mixtures were again superior to hydrated lime mixtures as indicated by growth and yield. Plants dusted with a mixture containing calcium arsenate 1 pound and gypsum 15 pounds gave the highest yield.

STUDIES ON POTATO INSECTS

The problem of foliage protection on potatoes by dusting and spraying during 1928 was chiefly concerned in the maintenance of healthy foliage under climatic conditions that were particularly favorable for thrifty growth and, at the same time, were largely instrumental in suppressing the development of aphids and leafhoppers to insignificant numbers.

The Colorado potato beetle and second brood of flea beetles were limiting factors in production, but fortunately these two pests are the easiest to control with the means available.

In mid-July many fields were subjected to a short but severe attack of late blight. The injury to the foliage was very evident where copper applications had been suspended in preference for nicotine dusts applied in anticipation of aphid injury. On the other hand, the epidemic was held in check where the normal weekly copper applications had been made. As a result, plants regularly treated with copper applications gave the highest yield, those sprayed averaging higher yields than those dusted. On the other hand, plants receiving a special alternative application of nicotine dust for aphids in place of the normal copper spray treatment had their yields invariably reduced. There was no advantage gained in using three nozzles per row instead of two when spraying.

Preliminary experiments in planting dates indicated by their results that significant increases in yield were to be obtained by early planting, the importance of which is of considerable practical value since it may enable the farmer to cut losses that would otherwise occur due to the limitations of spray and dust practices, especially in controlling leafhoppers, injury from which occurs during the last month of foliage development.

STUDIES ON CAULIFLOWER INSECTS

The cabbage maggot (*Hylemyia brassicae* Bouché) was the most destructive insect in the cauliflower seedbed. Owing to the cool, wet weather during May and June, oviposition extended over a period of six weeks, necessitating additional applications in order to avoid injury. Of the materials tested for preventing injury by the maggots, mercuric bichloride solutions 1-1,200 gave the best results. A dry application of Bayer Special No. 190 and sand in proportions by weight of 1 to 10 gave the second best results.

Aphids and thrips were not a factor in growth during the season. Aphids (*Myzus persicae* Sulz.) were destroyed by disease on potatoes at the stage in development when migration to the seedbed might have been expected. It is evident from the results of observations during the past six years that infestation of the seedbed by aphids (and coincidentally by thrips) follows that on potatoes if conditions are favorable, the cauliflower seedbed furnishing a fresh breeding ground for immigrants leaving overcrowded conditions on potato foliage.

STUDIES ON FRUIT INSECTS IN THE HUDSON RIVER VALLEY

Commonly regarded as a localized species, the pear midge has, during the last two years, devastated many orchards in the Hudson River Valley where, in certain sections, it reached the status of a pest of primary importance. In previous experimental work facts were obtained concerning its life history and some experiments were undertaken to determine its susceptibility to certain insecticides. This year special efforts were made to ascertain the most critical time for treatment and the value of various spray practices, the field experiments being conducted in commercial orchards at Plattykill, Germantown, and Hudson. Tho the set of pears is very small thruout the Hudson River Valley on account of poor pollination, the data obtained indicate that lime-sulfur-nicotine spray is effective when applied twice during the period after the cluster buds have been separated, a trace of pink shows, and before the white of the petals can be easily seen. Along with this work some experiments have been started in the hope of finding parasites which may prove of value in controlling the midge.

The apple maggot is still a serious pest with fruit growers in certain localities, and a study of the insect was continued this year to secure further facts concerning its habits and control. From the data gathered it appears that two arsenical sprays, the first applied just previous to the peak of emergence and the second a week or ten days later, will afford protection in average years.

Since many growers favor the use of oils for their delayed dormant sprays, tests were made with bordeaux oil with and without nicotine sulfate to determine their value in combating the rosy aphid. Lime-sulfur with nicotine sulfate proved the more efficient spray, while bordeaux oils containing extract ranked second in effectiveness.

DIVISION OF HORTICULTURE

TESTS OF FRUIT VARIETIES

The varietal collection of fruits has been continued as in the past, new kinds being added and worthless sorts eliminated. The collection of European grapes and nuts was greatly increased, as 114 varieties of grapes obtained from Russia, France, and Northern Africa and 47 kinds of filberts, hickories, pecans, black

walnuts, butternuts, and Persian walnuts were planted for fruiting. In selecting the grape varieties, hardiness and early maturity were given first consideration, since such types may grow in the grape districts of New York and at least should have value for breeding work.

During the past season Kahalili, a very early white European grape, Rivers Orange, a yellow-fleshed nectarine, Viking raspberry originated by the Horticultural Experiment Station at Vineland, Canada, the Ewart pear, Lloyd George, an English raspberry, Wyona, a late-ripening strawberry, and Marigold, an early free-stone peach, originated by the New Jersey State Agricultural Experiment Station, were noted as having special merit.

FRUIT BREEDING EXPERIMENTS

The fruit breeding work has been continued as extensively as during the past years. Approximately 2,700 trees of apple, pear, cherry, peach, nectarine, and plum crosses were set out for fruiting. With strawberries 1,200 F¹ generation seedlings were described and 116 selections made for further test. In addition, further selections were made in noteworthy strawberry seedlings that had fruited for the third time. Plants and fruit were also described of 4,500 raspberry seedlings and 4,000 more were set out for fruiting. Descriptions and selections were likewise made of many grape seedlings and a few apple, pear, cherry, plum, and nectarine seedlings.

Two grape, two pear, and two apple seedlings were selected as worthy of naming and introducing and many other seedlings were noted as deserving another trial. The recommended and named kinds will be propagated and distributed as during the past ten years by the New York State Fruit Testing Association of Geneva, New York.

POLLINATION EXPERIMENTS

In connection with the breeding work, data have been accumulating for many years in regard to fruit development or setting when varieties are self-pollinated and inter-crossed. During the past year many additional selfs and crosses were made to obtain more extensive information on this subject, and especially in regard to the behavior of the new fruits. The results of this work have been compiled and will be published shortly in bulletin form.

STOCK, PRUNING, AND BUD SELECTION EXPERIMENTS

No new developments have occurred in the stock, pruning, and bud selection experiments. The plum trees propagated on Myrobalan roots are still far superior to those growing on St. Julien, peach, Americana, and Marianna stocks. Both the sweet and sour cherries continue to thrive better on Mazzard than on Mahaleb roots. The high and low yielding strains of the Rome apple which have been fruiting for about 10 years show no noticeable differences. The only bud selections that have shown any superiority are the so-called red sports, such as Red Duchess, Red Gravenstein, Red Spy, Red Rome and red sports of King, Twenty Ounce, and Delicious.

WORK AT THE CHAUTAUQUA VINEYARD STATION

The close of the year 1928 marked the twentieth consecutive season that the grape experimental work has been carried on in the Chautauqua grape belt. From time to time during this period several bulletins and circulars have been published by the Station giving the results of these researches. Two of these, Downy and Powdery Mildews of the Grape and their Control, and Grape Culture in New York, have gone out this spring. Five main experimental projects are still under way. These are the testing of new varieties of grapes, breeding new grapes, testing commercial fertilizers for grapes, pruning and training experiments with grape vines, and a test of commercial varieties of grapes grafted on vigorous, hardy stocks. From time to time other projects are added as the need for definite information about them arises. Two of the newer investigations have to do with the use of sulfur gas previous to shipment to market and after loading, and the effect on vine and fruit from the complete removal of blossom clusters from one or more canes. Both of these projects will be carried on for several years. A test of several synthetic forms of nitrogen has been under way for the past four years in comparison with Chilean nitrate of soda under field conditions.

HORTICULTURAL WORK IN THE HUDSON RIVER VALLEY

Horticultural experiments have been conducted in the Hudson River Valley since 1924. Projects ready for publication now

include a test of fertilizers for grapes and a test of fertilizers for apples. The latter project has been conducted in three different orchards, viz., one on a bearing Newtown orchard, one on a young bearing McIntosh orchard, and one on a McIntosh orchard planted in 1924. The tests of fertilizers for sour cherries and pruning sour cherries were concluded last season. The results of these two tests have already been published and as there is nothing new to report no further publications will be made.

Both experiments of fertilizers for McIntosh apples are being continued, as is the fertilizer experiment for Newtowns. This year a pruning experiment in the same Newtown orchard was started. The variety test of apples, pears, peaches, plums, grapes, and small fruits, tests of six different nitrogen carrying fertilizers started last year on McIntosh apples, and the cover crop test on apples started last year are being continued.

Three new experiments were started this year, viz., a test of nitrogen carrying fertilizers on apples and on currants, and a commercial fertilizer experiment for currants.

BOTANICAL WORK IN THE DIVISION

Descriptions are being prepared of original species of cultivated esculents and the synonymy of various groups is being straightened out in order that plant breeders may more readily determine the material with which they are working. During the past year a "Revision of the Unicorn Plants" has been published and a synopsis of the "Cultivated Beans and their Allies" has been prepared for publication. The herbarium of cultivated plants is being augmented as rapidly as conditions permit, about 500 species having been added in 1928. Systematic work on apples, cucurbits, and Alliums is being carried on, together with a cytological investigation of the last two groups.

VEGETABLE VARIETY TESTS

The work with vegetable varieties, for securing descriptions for the *Vegetables of New York*, has proceeded along the same lines as in previous years. Field notes have been completed on muskmelons, about 260 varieties, on sweet corn, 300 varieties, and on squashes, pie pumpkins, and vegetable marrows, about 160

varieties. First or second year records were also taken on all obtainable varieties of asparagus, carrots, parsnips, rhubarb, okra, martynia, leeks, red celery, peppers, and egg plants; and new plantings were made for 1929 of additional peppers and egg plants and of about 450 varieties or strains of tomatoes. The last three crops will be on exhibition in the Station fields during the late summer and fall.

The work on peas was completed, and after many unexpected but seemingly unavoidable delays, was received from the printer and distributed late in the year. This is Volume I, Part 1 of the three volumes to be issued. The part on beans is now about ready for the printer and should appear during the coming winter.

CANNING CROPS INVESTIGATIONS

This year will complete the fourth season of field experiments with canning crops. When this year's records have been compiled, it is planned to publish in separate bulletins the results obtained from the various experiments with the leading canning crops.

Experiments with tomatoes.—A new experiment started this year is a study of the physiological effect and economic value of fertilizing tomatoes in the transplanted seedling flat. It is expected that some interesting new facts in regard to tomato plant nutrition and physiology will be developed in this experiment. In the field fertilizer experiments with tomatoes, the most outstanding increases in yield were obtained where phosphorus was applied, indicating that this is the principal limiting element. The same results were secured with cabbage, applications of 1,200 pounds per acre of 4-16-4 fertilizer gave higher net returns than smaller amounts of fertilizer on tomatoes.

In the tomato breeding work, 18 hybrids are being carried on in the third generation, while 74 promising selections are being carefully studied in the tomato trials. In a comparison of tomato varieties for canning, the John Bear variety has consistently produced the best yields. Marglobe is of excellent quality but is lacking in yield.

Comparing yields of tomatoes from seed sown March 10, March 25, and April 10, the largest returns were secured from the plants that were seeded on March 25. Plants grown in a coldframe

without transplanting until they were set in the field were very inferior to plants that had been transplanted into flats in the seedling stage setting 108 plants per flat.

In comparing various distances of spacing tomato plants in the fields, the largest yields were secured by spacing the plants 3 feet apart each way; but the largest net return was obtained when the plants were set $3\frac{1}{2}$ by 4 feet apart.

Experiments with peas.—A new experiment was started this year with canning crop peas. This is a comparison of different potash fertilizers to determine the influence of the different forms of potash on the rate of growth and maturity and chemical composition of peas and the effect on the quality of the canned product.

In order to determine if the chloride radical affects the hardness of peas, some of the fertilizer treatments included ammonium chloride as the source of nitrogen. The results secured this year indicate that the form of potash made little, if any, difference; and that it is not the chloride radical in muriate of potash that causes premature ripening and hard peas.

The results of this year's test showed that all forms of potash tended to hasten maturity of peas and slightly reduced the proportion of small sizes. There was no increase in yield from any form of potash. This experience was conducted on Ontario loam soil which, with good farming practice, usually does not require potash fertilizer. There was some evidence that both muriate of potash and sulfate of potash tended to make hard peas in the canned product.

Approximately 100 strains of canning peas are being tested each year for varietal purity, trueness to type, vigor, and freedom from disease. This work is giving valuable information for the canners and growers in regard to the best sources of pea seed, and is tending to eliminate the less reliable sources.

Pea breeding work is being continued, 27 hybrids now being grown in the third generation.

Grading pea seed for size gave negative results in regard to differences in maturity, yield, and quality. To determine the best rate of seeding peas, seed of four leading canning varieties has been sown at the rate of 3, 4, 5, and 6 bushels per acre. Both early and late plantings have been made of each variety and at each rate of seeding. The yield records have consistently

indicated that 5 bushels of seed per acre produce the largest net returns.

Pea seed has been treated with various organic mercury compounds to determine the value of these treatments in disease control and to increase germination. In general, the germination of pea seed has been increased by seed treatment.

Inoculating pea seed with nitrogen-gathering bacteria has given negative results. Apparently there is abundant natural inoculation in this particular region, probably due to the wild vetch which is very common here.

The importance of early planting of all varieties of peas has been strikingly demonstrated in an experiment to determine the relation of time of planting to the development of peas and vines. It appears that all canning varieties may be planted as early as the ground can be worked; and that the later the planting after the ground is in good condition, the smaller the yield. This is particularly true with the late sweet varieties.

Striking results have been obtained showing that peas and beans are likely to be injured if the fertilizer is drilled in with the seed, and that yields can be increased by drilling in the fertilizer in a separate operation just before planting. With beans this likewise gave better returns than drilling in the fertilizer between the rows as the beans were being sown.

Rotation experiments.—The rotation and fertilizer experiments are yielding data of increasing importance each year. One of the rotations has been changed from a five-year rotation of tomatoes, beans, beets, wheat, and red clover to a four-year rotation of tomatoes, beans, beets, and peas with sweet clover seeded in the peas. This change shortens the rotation one year, adds another canning crop in place of a field crop, and gives an opportunity to determine the merits of sweet clover as a soil builder in a canning crops rotation.

Experiments with corn.—Sweet corn seed graded into two sizes, viz., large and small, gave differences in uniformity of maturity that should prove of considerable interest to growers and canners. From the grower's standpoint the graded seed can be planted more uniformly because the planter can be adjusted with greater accuracy. Another important advantage to the grower in using graded seed is that it results in greater uniformity of maturity

so that the crop from each grade of seed can be harvested in one picking and the field will not have to be gone over a second time. The crop from the large seed will mature about four to six days earlier than the crop from the small seed. The greater uniformity of maturity of the graded seed also results in a higher quality product for the canner.

In comparing various rates of planting Golden Bantam and Early Evergreen corn, the largest returns with the Golden Bantam were obtained from hills spaced 30 inches apart each way with four plants per hill. Many farmers do not seem to realize that this small-growing variety can be planted closer and seeded heavier than the larger-growing types, and that yields and net returns can be considerably increased in this way. With Early Evergreen corn the best returns were secured from hills spaced 3 feet apart each way with four plants per hill.

Treating sweet corn seed with organic mercury compounds gave noticeable differences in the early germination of the seedlings but no significant differences in yields. A new project has been started with corn including field and canning tests to try to find a higher yielding strain of Golden Bantam or a better yielding yellow variety of equally high quality. The present low yields from Golden Bantam are very unsatisfactory to farmers and canners alike.

NURSERY INVESTIGATIONS

Comparison of nursery seedling stocks.—To compare fruit and rose stocks from various seedling producing sections of the United States with the standard foreign grown stocks, in order to determine the best sources of domestic stock for New York conditions, and particularly to ascertain whether any of the domestic stocks now being produced meet the needs of New York nurserymen as satisfactorily as do foreign-grown stocks, 104 different lots from the principal seedling producing sections in the United States and Europe were grown on the Station grounds during the year. Measurements were made before growth began and again at the end of the season, and observations were made regarding time of starting, vigor, and insect and disease resistance. All stocks were budded to five representative varieties of their particular class to see the proportion of first-

class trees produced. The records served as a comparison between domestic and foreign-grown seedlings, at the hearing of the Federal Horticultural Board at Washington, D. C., in June, 1928, with reference to the advisability of placing a quarantine upon importations of fruit and rose stocks.

The imported stocks were uniformly superior to the general run of domestic stocks. On the other hand, there were limited numbers of domestic seedlings from certain classes of stock which were thoroly satisfactory and which gave a very encouraging view to the final solution of the domestic seedling supply. The differences in stocks observed this past season indicate that certain sections are better adapted to one type of stock than another. The matter of variability in domestic stock extends to grading and handling. The loose grading by American seedling growers is in marked contrast to the close grading of European stock.

Sources and varieties of seed for stocks.—Because of the restrictions upon importations of seedling fruit tree stocks likely to be imposed by Federal quarantine, the production of domestic stocks is of direct concern to American nurserymen. Most stocks in the past have been raised from seed which has been secured in Europe. Nurserymen have complained that seed secured from foreign sources is not always reliable and they are interested, therefore, in building up a domestic supply.

In the work done at this Station it has been observed that domestic supplies of seed are in general superior in viability to those from foreign sources because of practical considerations. It has been shown that certain apple varieties, such as Ben Davis, Rome Beauty, Winesap, Wealthy, McIntosh, Whitney, and Northern Spy, give desirable seedlings, and that Baldwin, Rhode Island Greening, and Tompkins King give inferior seedlings. For practical reasons, therefore, seed from such a region as western New York, where Baldwin and Rhode Island Greening predominate, is to be avoided in favor of that from a section like the Pacific Northwest where other varieties are interplanted commercially.

Among pears, Beurré d' Anjou, Bartlett, Burkett, Burré Hardy, and Winter Nelis have produced seedlings of desirable type. Carolina "natural" peach seed has given more vigorous seedlings and better stands than seed from some of the California yellow

canning peaches. Plum seed has been satisfactory in general, regardless of source. In the case of cherry seed, the best seed has come from the late-ripening kinds, such as Downer, Oswego, Black Republican, and Abundance, whereas seed from early ripening varieties, like Early Purple, Coe, Governor Wood, and Black Tartarian, has been worthless.

Methods of producing seedling fruit stocks.—Two types of roots are used by nurserymen, namely, straight roots and branch roots. For New York conditions, where trees are usually budded, the main interest is in the branch-root seedling. Four methods have been used in producing seedlings, first, growing in one year from seed; second, growing in two years from seed; third, digging at the end of the first year from seed and growing a second season; fourth, transplanting early during the first season of growth. The first method has given a high proportion of straight roots, especially with apples and pears. Cherry and plum seedlings produced by this method are not so satisfactory as by the transplanting method, but they are satisfactory. The second method is worthless for all classes of stock, because growing the second season merely accentuates the undesirable features of seedlings grown in one year from seed. The third method has proved desirable for apples and pears, which under New York conditions are difficult to grow to sufficiently large size the first year from seed. Stock raised by this method has been reasonably well branched and has been of good size. The fourth method has given the most desirable branch-root seedlings comparable to imported stock. Various methods have been tried and planting boards devised to expedite the work, but as yet the cost of transplanting is too high to warrant the operation. For a full discussion of seedling production, the reader is referred to Bulletin No. 569 on "Seedling Fruit Stocks."

Storage of nursery stocks.—Because of the size of most nursery enterprises and because of economic distribution of labor, nurserymen have been compelled to dig their stock in the fall of the year and store indoors during the winter. In cooperation with local nurserymen, records of humidity and temperature have been kept in five types of commercial storages, namely, (1) constant temperature cold storage, (2) modern concrete storage, (3) low

ceiling wood construction, (4) high ceiling concrete construction, and (5) dirt bank cellars.

In addition, stock of the principal classes has been dug at several times during the fall and stored in different cellars, and later planted out in the field to study behavior. Observations show that there is nothing to take the place of maturity. Well-ripened stock will withstand much more adverse conditions than stock not fully matured. Cellars may be too damp or too dry. If they are too dry, the immature stock shrivels. If they are too damp, the immature stock is attacked by fungi. A humidity of 75 to 85 per cent seems well adapted to practical nursery conditions.

Asexual propagation of seedling stocks.—Seedling stocks grown from the same sources of seed differ in character. Therefore, fruit trees propagated on seedling roots are not uniform and many trees are inferior individuals in consequence. One of the refinements in horticulture is to develop economical methods of propagating stocks asexually, similar to the method used in propagating the grape and raspberry. Such stocks would be identical one with the other and lend themselves to more uniform orchard plants.

The selected types of asexual stocks that have been produced in various parts of Europe and America have been collected and are being grown under New York conditions to determine their desirability. In addition, selections have been made from superior seedling stocks that have appeared by chance on the Station grounds and they are being multiplied by root cuttings and layers. Various methods of propagating by trenching, by layering, by mounding, and by root and stem cuttings are being tried.

Fertilizer and cover crops for nursery stocks.—Results of fertilizer applications upon apple, cherry, and rose stocks have shown no response in two seasons from applications of nitrate of soda, stable manure, urea, superphosphate, and muriate of potash, either alone or in combination. Cover crop tests that were begun a year ago are still in progress to determine the practicability of maintaining the fertility of nursery land by the use of cover and green manure crops without making it necessary to resort to new land for each planting.

PUBLICATIONS AND EXHIBITS

BULLETINS AND CIRCULARS

Reference to the list of bulletins and circulars issued by the Station during the year, which appears at the end of this report, will reveal a material increase in the number of pamphlets issued during the past twelve months over the previous year. In all, 12 Technical Bulletins, 15 General Bulletins, and 8 Circulars, in addition to the Forty-seventh Annual Report, were issued during the period covered by the present report. Also, five circulars issued at earlier dates were reprinted. Obviously, the major portion of the Editor's time has been occupied with the editorial supervision of these formal publications of the Station.

During the past fiscal year one important change in the publication policy of the Station was put into effect, *viz.*, the discontinuance of the so-called Popular Bulletin series. This step was taken after careful consideration of all of the aspects of the situation, particularly with respect to the present trends in popularizing the results of experiment station work. This Station was a pioneer in its efforts thru its "popular" bulletins, to interpret to its constituency the results of its investigations. With the rapid expansion of extension literature by the agricultural colleges of the country and with the development of a syndicated press service at this Station, it was felt that the field of the so-called popular bulletin had been largely usurped by these agencies. Consequently, the series has been discontinued, with certain modifications of the General Bulletins and the press service to be discussed later.

Coupled with the discontinuance of the Popular Bulletins has developed the policy of urging upon the author of a General Bulletin the necessity for presenting his material in the most effective manner possible for the audience for which it is intended—the New York State farmer, or, in some instances, industries utilizing agricultural products.

The Technical Bulletins published by the Station continue to deal with subjects of interest primarily to scientific workers, and are written for the scientist. The Circulars present information of a general nature gained either from the Station experiments or from other sources. They are intended primarily for use in

answering correspondence and are written in a non-technical style.

THE MAILING LISTS

The Station continues to distribute its bulletins to a mailing list classified into subject matter groups, such as Dairying, Entomology, Bacteriology, etc., according to the interests of those who ask to have their names placed on the mailing lists. The policy back of the Station mailing lists is a rather liberal one. It is intended to supply publications to all who ask for them as long as the supply lasts, whether residents of this State or not, altho naturally most of the bulletins go to New York farmers.

Abolishing the Popular Bulletin series made it necessary to transfer those who were on the mailing list for these bulletins to the General Bulletin mailing list. To accomplish this, return postcards were sent to all names on the Popular Bulletin list and an opportunity provided for a transfer to the General list. Work has practically been completed on this transfer, resulting, of course, in a material swelling of the numbers on the General list with a consequent increase in the size of editions of the General Bulletins.

THE NEWS SERVICE

The syndicated press service to daily and weekly newspapers and to farm papers has now been in operation for more than seven years. Reviews of the Station bulletins and circulars and timely information on various phases of the Station work form the chief items dealt with in the news stories. A total of 267 stories was sent out during the past year. Correspondence stimulated by the appearance of these stories in the papers, returns from a clipping bureau, and personal observation on the use of the material in papers seen regularly in the Editor's office indicate that the service is an effective means of putting before the public the results of Station research.

As part of the modified publication policy with reference to Popular Bulletins, discussed above, an expansion of the press service has been given a trial during the past several months and is to be further developed during the coming year. This new departure has to do with the inauguration of a so-called "picture service." Thru this service about forty daily papers in the State are supplied with a picture in "mat" form, together with a

mimeographed story to go with the picture. Thus far, this service has been offered only once a month, but it is proposed to increase the number of these articles and pictures materially during the coming year. The picture service has been well received by those papers that make a special effort to cover farm news, particularly where a farm page is provided for at regular intervals.

EXHIBITS

The Editor continued to serve during the past year as chairman of the staff committee on exhibits. The chief function of this committee is to coordinate the exhibits of the several research Divisions at the State Fair and at the winter meeting of the New York State Horticultural Society in Rochester, the two important exhibits attempted by the Station.

The Station has long operated under the policy that it is not properly the function of the institution to expend any considerable amount of its financial resources or of the time of the Staff in arranging and attending exhibits, the latter being regarded as primarily an extension activity. It is felt, however, that as a State institution the Station is under something of an obligation to its constituency to show at the New York State Fair important contributions being made to agricultural science thru its investigations. Also, the Station receives generous financial support for this exhibit from the Bureau of the State Fair and from special funds provided by the Legislature for State institution exhibits, hence relieving the Station of any considerable financial burden in this respect.

The numerous important lines of work under way at the Station having to do in one way or another with the fruit industry of the State renders the Station's exhibit at the winter meeting of the State Horticultural Society especially worthwhile. Not only is the Station able to put before several thousand fruit growers the latest results of its experiments, but the members of the Staff working along horticultural lines are afforded a splendid opportunity to meet those who are most interested in their work.

These two exhibits, therefore, together with a small display of fruit varieties at the Eastern meeting of the State Horticultural Society at Poughkeepsie, constituted the extent of the Station activities in these directions during the past year.

BULLETINS AND CIRCULARS

Bulletins and circulars issued by the Station during the year ended June 30, 1929, are listed below.

TECHNICAL BULLETINS

- No. 138. July. A type of bacteria abundant in productive soils, but apparently lacking in certain soils of low productivity, by H. J. Conn. Pages 28, figs. 4. Distributed November 25, 1928.
- No. 139. July. A summary of research studies relating to casein and some of the applications, by L. L. Van Slyke. Pages 41. Distributed November 25, 1928.
- No. 140. July. The chemistry of sour milk, by L. L. Van Slyke. Pages 14. Distributed November 25, 1928.
- No. 141. July. Studies on the Coccaceae: XII. Action of the streptococci upon casein, by G. J. Hacker. Pages 13. Distributed November 25, 1928.
- No. 142. July. Studies on the Coccaceae: XIII. Production of carbon dioxide by the streptococci, by G. J. Hacker. Pages 10. Distributed November 25, 1928.
- No. 143. July. Studies on the Coccaceae: XIV. Certain biochemical reactions produced by the streptococci, by G. J. Hacker. Pages 64. Distributed November 25, 1928.
- No. 144. July. Studies on the Coccaceae: XV. Relationships of the various acid-proteolytic cocci, by G. J. Hacker. Pages 20. Distributed November 25, 1928.
- No. 145. July. Two new varieties of red kidney bean: Geneva and York, by W. O. Gloyer. Pages 51, figs. 6. Distributed November 25, 1928.
- No. 146. July. Chemical studies of grape pigments: II. The anthocyanins in Clinton grapes, by R. J. Anderson and Fred P. Nabenhauer, pages 12; III. The anthocyanins in Seibel grapes, by R. J. Anderson. Pages 9. Distributed February 1, 1929.
- No. 147. October. Thermophilic and thermoduric micro-organisms with special reference to species isolated from milk: V. Description of spore-forming types, by Paul S. Prickett. Pages 58, chart 1. Distributed February 1, 1929.
- No. 148. March. Control measures for cucumber beetles, by H. C. Hockett. Pages 84. Distributed June 6, 1929.
- No. 149. March. A preliminary study of the unicorn plants (Martyniaceae), by G. P. Van Eseltine. Pages 41, figs. 15. Distributed June 6, 1929.

BULLETINS

- No. 555. August. Defoliation of cherry trees in relation to winter injury, by W. O. Gloyer and Hugh Glasgow. Pages 27, figs. 8. Distributed November 25, 1928.

- No. 556. August. Composition and cost of commercial feeding stuffs in 1927, by A. W. Clark assisted by W. F. Walsh, M. P. Sweeney, M. G. Moore, and F. J. Kokoski. Pages 39. Distributed November 25, 1928.
- No. 557. November. Commercial fertilizers: I. History of fertilizer-control work of this Station. II. Composition and cost of commercial fertilizers in New York State from 1913 to 1928, by L. L. Van Slyke. Pages 24. Distributed February 1, 1929.
- No. 558. November. Spraying experiment with bush lima beans, by E. E. Clayton. Pages 22, figs. 2. Distributed February 1, 1929.
- No. 559. November. Heat-resistant and heat-loving bacteria in their relation to the pasteurization of milk, by Robert S. Breed. Pages 19, figs. 6. Distributed February 1, 1929.
- No. 560. December. Downy and powdery mildews of the grape and their control, by F. E. Gladwin. Pages 14, figs. 3. Distributed February 1, 1929.
- No. 561. December. The fruit tree leaf roller in western New York, by S. W. Harman. Pages 31, figs. 6. Distributed February 1, 1929.
- No. 562. January. High-nicotine tobacco, by R. C. Collison, J. D. Harlan, and L. R. Streeter. Pages 19. Distributed May 15, 1929.
- No. 563. February. Fruit regions and varieties of eastern New York, by H. B. Tukey. Pages 82. Distributed May 15, 1929.
- No. 564. February. Potato seed treatment experiments on Long Island with special reference to the organic mercury instant dips, by E. E. Clayton. Pages 32, figs. 3. Distributed May 15, 1929.
- No. 565. March. The quality of packet vegetable seed on sale in New York in 1926, 1927, and 1928, by M. T. Munn, Olive M. Hoefle, and Mary E. Woodbridge. Pages 47. Distributed May 15, 1929.
- No. 566. March. I. The microscopic appearance of unpasteurized market milk and cream, by Robert S. Breed. Pages 28, figs. 20. Distributed June 6, 1929.
- No. 567. March. Bacterial counts in sanitary milk control, by Robert S. Breed. Pages 25, figs. 10. Distributed June 6, 1929.
- No. 568. April. The sanitary significance of leucocytes in milk, by Robert S. Breed. Pages 14, figs. 7. Distributed June 6, 1929.
- No. 569. April. Seedling fruit stocks, H. B. Tukey. Pages 34, figs. 11. Distributed June 6, 1929.

CIRCULARS

- No. 106. November. The oriental peach moth in New York, by Derrill M. Daniel. Pages 8, figs. 6.
- No. 107. December. Life history, habits, and control of the European corn borer in Erie and Chautauqua Counties, by G. E. R. Hervey. Pages 11, figs. 3.
- No. 108. December. Dusting and spraying experiments with potatoes on Long Island in 1928, by H. C. Hockett. Pages 12, figs. 4.

- No. 109. January. The bud moth, by P. J. Parrott and S. W. Harman. Pages 10, figs. 9.
- No. 110. February. Grape culture in New York, by F. E. Gladwin. Pages 10.
- No. 111. March. The fruit tree leaf roller in western New York, by S. W. Harman. Pages 11, figs. 6.
- No. 112. April. Red currants and gooseberries, by G. L. Slate. Pages 11.
- No. 113. May. Cucumber beetles, by H. C. Hockett. Pages 8, figs. 7.

JOURNAL ARTICLES

In addition to the publications listed above, the following technical papers, reporting on various phases of investigations under way at the Station, have appeared in scientific journals or trade papers during the past year.

- Breed, Robert S. Bacteria in milk. The Newer Knowledge of Bacteriology and Immunology, edited by E. O. Jordan and I. S. Falk, *Chicago; Univ. of Chicago Press. Pages 378-394. 1928.*
- Breed, Robert S. Heat-resistant and heat-loving bacteria in pasteurized milk. *Proc. 21st Ann. Conf., Intern. Assoc. Milk Dealers, 16-35. 1928.*
- Breed, Robert S. The control of the sanitary quality of market milk. *Proc. World's Dairy Congress, 666-673. 1928.*
- Breed, Robert S. The Newman combined fat extraction, fixing and staining solution for use in the direct microscopic technic for counting bacteria in milk. *Amer. Jour. Public Health, 19, 99-100. 1929.*
- Buchanan, R. E., Breed, R. S., and Rettger, L. F. A diagrammatic summary of various bacterial classifications. *Jour. Bact., 16, 389-396, 1928.*
- Clayton, E. E. Breeding for resistance to cucumber mosaic disease. *Phytopath., 19, 85. 1929.*
- Clayton, E. E. Toxicity of mercury and copper compounds in relation to their use for seed treatment and spraying. *Phytopath., 19, 186. 1929.*
- Conn, H. J., and Holmes, W. C. Certain factors influencing the staining properties of fluorescein derivatives. *Stain Technology, 3, 94. 1928.*
- Conn, H. J. Progress in the standardization of stains; Five years of stain standardization. *Stain Technology, 3, 105. 1928.*
- Conn, H. J., and Kornhauser, S. I. The history of staining; Cochineal dyes. *Stain Technology, 3, 110. 1928.*
- Conn, H. J. Progress in the standardization of stains; Stain specifications. *Stain Technology, 4, 1. 1929.*
- Conn, H. J. Notes on technic; Note on Loeffler's methylene blue. *Stain Technology, 4, 27. 1929.*
- Conn, H. J. Progress in the standardization of stains; Definiteness in staining formulae. *Stain Technology, 4, 33. 1929.*
- Conn, H. J. The history of staining; Logwood dyes. *Stain Technology, 4, 37, 1929.*
- Conn, H. J., Chairman. Report of Committee on Bacteriological Technic; Concerning the manual of methods published by the Society. *Jour. Bact., 16, 145. 1928.*

- Conn, H. J. On the microscopic method of studying bacteria in soil. *Soil Science*, **26**, 257. 1928.
- Conn, H. J. Certain abundant non-spore-forming bacteria in soil. *Centr. für Bakteriologie, Parasitenkunde und Infektionskrankheiten*, II. Abt., **76**, 65. 1928.
- Glasgow, Hugh, and Gaines, J. G. The carrot rust fly problem in New York. *Jour. Econ. Ent.*, **22**, 412-416. 1929.
- Glasgow, Hugh. Mercury salts as soil insecticides. *Jour. Econ. Ent.*, **22**, 335-340. 1929.
- Hartzell, F. Z. Relation of snow cover to infestation by the grape berry moth (*Polychrosis viteana* Clemens). *Jour. Econ. Ent.*, **22**, 126-132. 1929.
- Hartzell, F. Z. Application of one of Pearson's probability theorems and some special probability equations to entomological data. *Jour. Econ. Ent.*, **22**, 202-209, 1929.
- Hening, J. C. Effect of homogenizing ice cream mixes before and after the addition of gelatin or sugar and before and after condensing. *Jour. Dairy Sci.*, **11**, 229, 1928.
- Hening, J. C., and Dahlberg, A. C. The effects of certain salts on the properties of ice cream mixes. *Jour. Dairy Sci.*, **12**, 129, 1929.
- Hening, J. C. Temperature of pasteurization—how it affects the mix properties. *Ice Cream Trade Jour.*, **24**, No. 10. 1928.
- Hoefle, Olive M. Results of a study of *Daucus carota* seeds. *Proc. Assoc. Off. Seed Analysts, N. Amer.*, **1928**, 35-36. 1929.
- Hedrick, U. P. Fruit growing at the New York Agricultural Experiment Station. *Proc. 74th Ann. Meet., N. Y. State Hort. Soc.*, 114-124, 1929.
- Hucker, G. J. Action of the streptococci upon casein. *Centr. für Bakteriologie, Parasitenkunde und Infektionskrankheiten*, II. Abt., **76**, 321-328. 1928.
- Hucker, G. J. Further studies on the classification of the micrococci. *Centr. für Bakteriologie, Parasitenkunde und Infektionskrankheiten*, I. Abt., (Originale), **111**, 9-22. 1929.
- Hucker, G. J. A study of the motility of certain cocci. G. J. Hucker and Lida M. Thatcher. *Centr. für Bakteriologie, Parasitenkunde und Infektionskrankheiten*, I. Abt. (Originale), **111**, 166-171. 1929.
- Hucker, G. J. The effect of the medium upon the formation of chains by the streptococci. *Centr. für Bakteriologie, Parasitenkunde und Infektionskrankheiten*, I. Abt. (Originale), **111**, 161-166. 1929.
- Hucker, G. J. Lessons derived from the recent World's Dairy Congress. *Molkerei Posten*, 1929.
- Hucker, G. J. Production of carbon dioxide by the streptococci. *Centr. für Bakteriologie, Parasitenkunde und Infektionskrankheiten*, II. Abt., **77**, 145-150. 1929.
- Hucker, G. J. Methods of determining the sanitary quality of milk. *Molkerei Posten*, 1929.
- Hucker, G. J. Certain biochemical reactions produced by the streptococci. *Centr. für Bakteriologie, Parasitenkunde und Infektionskrankheiten*, I. Abt. (Originale), **111**, 31-64. 1929.

- Hucker, G. J. The relation of starters in cheese making to the subsequent breaking down of the casein during the curing process. *Molkerei Posten*, 1929.
- Hucker, G. J. Relationships of the various acid-proteolytic cocci. *Centr. für Bakteriologie, Parasitenkunde und Infektionskrankheiten*, II. Abt., **76**, 161-172. 1929.
- Hucker, G. J. A study of the cocci resisting pasteurization temperatures. *Centr. für Bakteriologie, Parasitenkunde und Infektionskrankheiten*, II. Abt., **76**, 17-27. 1929.
- Huckett, H. C. A contribution to the study of control measures for cucumber beetles, *Diabrotica duodecimpunctata* Oliv. and *vittata* Fabr. *Jour. Econ. Ent.*, **22**, 405-411. 1929.
- Huckett, H. C. New Canadian Anthomyids belonging to the genus *Hylemyia* Rob. Desv. (Muscidae, Diptera). *Can. Ent.*, **61**, 93-96. 1929.
- Marquardt, J. C., and Dahlberg, A. C. The volume of the cream layers forming on Holstein and Jersey milk. *Jour. Dairy Sci.*, **11**, 409-419, 1928.
- Mundinger, F. G. Report on some entomological investigations in the Hudson Valley. *Proc. 74th Ann. Meet. New York State Hort. Soc.*, 164-167. 1929.
- Parrott, P. J. Spray practices with reference to the bud moth and leaf roller. *Proc. 74th Ann. Meet. New York State Hort. Soc.* 27-39, 1929.
- Parrott, P. J. Dust and spray mixtures. *Rpt. 35th Ann. Meet. Mass. Fruit Growers' Assoc.*, 143-150, 1929.
- Parrott, P. J. Thirty years association with an apple orchard. *Rpt. 35th Ann. Meet. Mass. Fruit Growers' Assoc.*, 169-176, 1929.
- Prickett, Paul S., and Breed, Robert S. Thermophilic organisms found in culture media. *Jour. Bact.*, **16**, 247-249. 1928.
- Sayre, C. B. Fertilizing beans and peas. *Canner*, **68**, 1929.
- Sayre, C. B. Growing vegetables for the canning industry. *New York State Dept. Agr. and Markets Bul.* 1929.
- Shear, E. V. Experiments with apple scab. *Proc. 74th Ann. Meet. New York State Hort. Soc.*, 168-173. 1929.
- Stewart, F. C. Is *Psalliota brunnescens* under cultivation? *Mycologia*, **21**, 41-43. 1929.
- Streeter, L. R. Bentonite as a dust carrier for nicotine. *Jour. Econ. Ent.*, **22**, 234. 1929.
- Tukey, H. B. A preliminary report upon the production of seedling fruit stocks. *Proc. Amer. Soc. Hort. Sci.*, **25**, 158. 1929.
- Tukey, H. B. A gauge for rapid diameter measurements. *Science*, **68**, 406, 1928.
- Tukey, H. B. Variety in fruit. *New Hampshire State Hort. Soc. Rpt.* 1928.
- Wellington, Richard, and Hawthorn, L. R. A parthenocarpic hybrid derived from a cross between an English forcing cucumber and the Arlington White Spine. *Proc. Amer. Soc. Hort. Sci.*, **25**, 97-100. 1929.
- Woodbridge, Mary E. Problems encountered in the analyzing of orchard grass seed. *Proc. Assoc. Off. Seed Analysts N. Amer.*, 1928, 23. 1929.
- July 1, 1929. U. P. HEDRICK, Director.