

Record of Research Work
Of Individual Members of the Staff
1923-28

N.Y. Agricultural Experiment Station
Geneva, N.Y.

Division of Agronomy

E. C. Collison, Chief

J. D. Harlan

J. E. Mensching

REPORT ON THE ACCOMPLISHMENTS,
PRESENT WORK AND NEEDS OF THE AGRONOMY DEPARTMENT.

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For some years a rotation project was in operation, in which potatoes, wheat and alfalfa two years were grown. There was an application of fertilizers made to potatoes and the wheat. The project has been temporarily abandoned because of the presence of an infestation of quack grass. This quack grass has been completely eradicated by the following method. The field was allowed to remain fallow for one year, the quack being kept down by frequent cultivation. The next year to prevent the loss of a whole years' crop the land was planted to corn, (checked), cultivated both ways, and by one or two hoeings, thoroughly, the quack eradicated. The following year the land was seeded to a mixture of oats and barley, which resulted in a yield of about seventy bushels of threshed grain per acre. No fertilizer or manure of any kind was used upon these crops and excellent yields were obtained. After removal of the oats and barley the land was seeded to wheat, no fertilizer being used. This resulted in a fair yield of wheat. The yield would have been increased had fertilizer been used, but it was considered desirable to add no additional fertility to this land as it is to be used for further studies. It has been demonstrated that quack can be completely eradicated by one year of fallow and one year of clean cultivation. It is further believed that two years of clean cultivation would serve the same purpose and not have the loss of a crop, with one year of fallow. It has further been demonstrated that alfalfa can be grown successfully in rotation, seeding it with the wheat crop instead of growing clover as is commonly practiced, thus insuring the increased benefits derived from growing alfalfa, both for

feed and for soil improvement. While this is true on land adapted to alfalfa growing, it is not to be recommended, from our present knowledge on soils to which alfalfa is not well adapted, by drainage and natural fertility.

About ten years work, using fertilizer on bearing apple orchards throughout the State indicated little benefit in the way of increased yields from such fertilizers, except where nitrogen was used. It is felt that the results were not satisfactory and new methods of attack are now being used. A new series of orchards has been put under a system of fertilizer treatment. One of these was started last year (1927) in which Nitrogen is used in the form of Nitrate of Soda and also as Ammonium Sulphate, and in amounts of five and ten pounds of material per tree. These Nitrogen materials are used both with and without the other fertilizing materials commonly used, namely phosphorous and potassium. The results last year on the McIntosh apple orchard of Wilson and Jones, indicated excellent returns from the expenditure of nitrogen. This year three additional orchards which give indication of needing nitrogen are being placed under treatment and observation. On these three orchards, together with two experimental orchards, to be established in the Hudson Valley by Mr. Anderson, the value of the newer sources of nitrogen are being placed in direct comparison with the older and more common nitrogenous fertilizers. Four or five years of intensive work will be required to demonstrate their ultimate usefulness.

In orchard soil management studies it is also very desirable to know whether it is possible or desirable to substitute a growing legume crop, for the common practice of clean cultivation. This is essential because of the high cost of labore associated with clean cultivation. Such an orchard is now under experiment near Phelps. If

time and expense would permit, it is very desirable that this work be extended to cover a larger number of commercial orchards.

While the commercial farmer's orchards are giving us much useful information, there is much in a fundamental way to be learned, in the nutrition of fruit trees. Were it possible to go into an orchard and diagnose the condition of the trees and soil from observation of the trees and their behavior, a valuable advanced step would be made. It is believed that studies of this kind can only be made under very closely controlled conditions such as are possible by green house and lysimeter culture. A start in this has been made in the greenhouse where apple seedlings have been grown in sand culture. It has been established here that trees do better under controlled conditions, with very dilute solutions, than with more concentrated solution. Much more intensive work should be done along these lines and under controlled lysimeter experiments where trees can be grown for several years, possibly to bearing age, and where accurate records can be obtained of physiological processes of the fruit trees. Are the nutritional requirements of the young fruit tree different and if so how and to what extent are they different from the mature or bearing tree? For results in such studies complete meteorological records should be obtained, and equipment should be provided for obtaining them.

From records of yields on the Rome Beauty orchard correlation studies have been made and some of these results published. The published results show that for this orchard the yield of apples is correlated with the rain fall of the current year, occurring between July 16 to September 1st. About twenty per cent of these trees have given yields which are not correlated with the rainfall as are the other eighty per cent. The problem still exists as to why these few trees are erratic in their behavior, but to date no satisfactory

reason has been found, and no explanation can be given.

Much work has been done to secure and maintain a high nicotine tobacco for insecticidal purposes. Selections have been made, and high yielding strains isolated. It has been determined that complete topping is essential for high nicotine content, and that the removal of "suckers" is necessary to obtain a high leaf yield. The leaf contains the nicotine in much larger quantities than the stalks and stem. Some attempt has been made to secure good grinding to a very fine condition, and a hammer mill is now used for that purpose. This mill will grind the material so that it is suitable for extraction. In a comparison of broadcast tobacco with transplanted tobacco it was found that the transplanted tobacco was higher in nicotine content and that the yield of broadcast was inferior to the transplanted.

On a two acre area of cropped land uniformly treated it has been found that there is great variation in the yields obtained from the various small areas into which it has been sub-divided. The areas are approximately eighteen feet square. It is certain that these variations in yield are due to the inherent condition and composition of the soils. Just what these differences are and how they influence crop yields is of prime importance for further advances in soil studies. By statistical methods, chiefly correlation, it should be possible to sift out the important factors in the soil, such as the colloids, clays, loams, sands, or organic matter, or mineral content and assign to each its individual importance in the crop producing power of the soil. Two hundred and fifty six carefully taken samples have been removed from this two acre tract, brought to the laboratory, and are now in the process of having certain determinations made from them. Equipment is already in our possession for such determinations

as colloids, sands and loams but the necessary apparatus is not in the laboratory for determining the replacable bases in these samples. Considerable labor is required each year to secure the yield records and it should be provided to the fullest extent.

From work done in cooperation with the Department of Soil Bacteriology, it has been shown that there is an apparent harmful effect upon a growing crop produced by the presence of fresh straw. This effect disappears after a time and is explained as follows. When fresh straw is added to a sand or soil culture, the decomposition of the straw takes place. This is brought about by the presence and the activities of certain cellulose decomposing bacteria. These organisms, during their period of activity require relatively large quantities of available nitrogen. As there is no other source of supply which they can attack, they utilize that present in the soil, with resultant starvation to the growing plants, unless liberal quantities of nitrogen are supplied to the soil as needed. It was also demonstrated in connection with the straw work that certain decomposition products, in the breaking down of the straw, are injurious to certain crops. Under normal conditions this effect is eventually dissipated, but is of much importance in studying the effect of one crop upon succeeding crops.

During the past few years much discussion has been aroused by the appearance of a patented material for the manufacture of artificial manure from straw. It has been shown that for those who care to do so, the same results may be obtained by the use of simple chemical compounds which when applied to the straw will produce the same effect as the patented material at a much lower cost. The process in either case is limited in the operation by the supply of water. Where the warm season is short as in New York and no water supplied except by natural rainfall, the rate of decomposition is very slow so that a long period

is required for the process, and is not considered very practical, except under special conditions, and where the artificial manure so produced has a very high value.

In cooperation with the Agronomy Department at Cornell this department is conducting an experiment on the value of the newer varieties of oats and barley alone and in combination, for the production of feed. This work is done here to secure results on land and under climatic conditions not found at Ithaca. Another experiment is under way to study the effect of time of cutting of alfalfa, on a soil adapted to alfalfa growing, upon (1) total acre yields (2) disease control and (3) survival of winter conditions. A good stand of alfalfa is now established and during the coming year, data will begin to accumulate. Practically all the work excepting fitting the land for these two experiments is done by the people of Cornell.

Approximately one thousand letters of inquiry are answered yearly on such subjects as the use of lime, its sources and comparative values. Within the past few days a sample of material was received. This is a high grade marl, discovered by accident, and insofar as the supply lasts can be substituted for equal quantities of more expensive limestone. Its discovery and use will undoubtedly save money for the nearby farmers, and result in increased yields obtained by the benefits of lime.

Many inquiries are received and answered concerning the form of commercial fertilizers to use and the amount of same to be applied per acre, for various crops. Over one hundred samples of soil per year are received from farmers and city residents asking for recommendations for increased production. Many of these have specific problems for which they wish assistance and advice.

An average of two or three farmers come to the laboratories every week with their problems. These are usually from nearby communities, and during the course of a year their numbers are quite large. It is very gratifying to know that frequently those interested come again and again, as new problems arise.

Considerable time and thought is devoted each year to the preparation of material for the exhibit at Syracuse during the State Fair. By attendance, many valuable contacts are made and much valuable information regarding the farmers problems is obtained from the farmers themselves.

In a general way, many of the more simple and elementary facts pertaining to agronomic science have been worked out. There are from time to time new problems appearing, however. At the present, many new fertilizers are coming on the markets and their merits should be determined. As examples of these, compare Nitrate of Soda with Urea. The latter carries three times the nitrogen of the former. In recent years a 5-10-5 fertilizer was considered a high analysis fertilizer. This is a mixture of various materials. There are now on the market materials known as Nitrophoska, having an analysis of 15-30-15. It is not a mixture but is said to be a definite chemical compound. The merits of such materials as indicated above should be investigated, and their value established for the farmer.

For further advance in agronomic work it is essential that laboratory methods be taken to the field. This necessitates detailed study of the makeup of the soil, productivity of the soil as measured by the growth and yields of crops and trees, and the behavior of the soil, moisture, and rainfall. This must of necessity be done by using very small plats, and with larger numbers so that the results can be well controlled and where necessary interrupted by statistical methods. Much valuable work can be done by the study of the effect of various fertilizer materials upon the equilibrium of the soil solution and the liberation of plant food already present in the soil in a more or less unavailable condition.

RECENT PUBLICATIONS OF AGRONOMY DEPARTMENT

Bulletins

- No. 477 1920 Progress Report of Fertilizer Experiments
with Fruits.
R. C. Collison.
- No. 478 1920 Sources of Agricultural Lime.
R. C. Collison.
- No. 494 1922 Fermentation and Preservation of Manure.
R. C. Collison & H. J. Conn.
- No. 503 1923 Final Report on the Cooperative Fertilizer
Experiments on Orchards.
R. C. Collison & J. D. Harlan.

Technical Bulletins

- No. 85 1921 Composition of Soils from the Chautauqua
County Grape Belt.
R. C. Collison.
- No. 94 1924 Statistical Study of Some Field Plots
Yields.
R. C. Collison & J. D. Harlan.
- No. 114 1926 Effect of Straw on Plant Growth.
R. C. Collison & H. J. Conn.
- No. 126 1927 Annual Variation in Apple Yields. A
Possible Cause.
R. C. Collison & J. D. Harlan.

Circulars

- No. 95 1928 Artificial Manure from Straw
R. C. Collison & H. J. Conn.

Supplementary statement.

The common practice of the nurserymen, result in the rapid depletion of organic matter from their soils. Formerly the supply was maintained by the addition of manure. In recent years the supply is diminished to such an extent that its use is limited. A study is now in progress, on lands of the Stuart Nurseries just north of Seneca Castle, where various crops are used for green manure, as a source of organic matter for nursery lands. This work is being done upon two areas of very infertile land, on which nursery trees have been grown but, which would not now grow satisfactory trees. Two years have been devoted to growing these green manure crops, and the plans call for two more years before the lands are again cropped to nursery trees.

During the past two years commercail fertilizers have been used upon a block of Wealthy apples on the lands of the Stuart Nurseries. The fertilizer is used in combinations and as single elements of large and small amounts. As yet no effects are apparent. Definite growth data will be obtained when the trees are dug after this season's growth. It is believed that in order to secure benefits from the use of fertilizer on trees, a good supply of organic matter must be present in the soil. In many cases this supply is not present.

The Station pasture is well seeded to pasture grasses, but the carrying capacity of the land is not as great as it should be. This year an experiment is in progress to make the pasture more productive by a seeding of white clover and the use of commercial fertilizers.

REPORT ON THE WORK OF J. D. HARLAN

The major portion of my time is devoted to the conduction and supervision of the field experiments of the Agronomy Department. This work includes the fitting of the land, the fertilization, the planting and harvesting of the crops.

These projects are as follows:

1. Soil fertility investigations.
2. Orchard fertilization studies.
3. Studies on the nutrition of trees in sand culture.
4. Cover crops for orchards.
5. Fertilizers on nursery trees.
6. Green manures for improving nursery lands.
7. Production of high nicotine tobacco.
8. Pasture improvement.
9. Growing grain crops in mixture (cooperative with Cornell).
10. Time of cutting alfalfa (cooperative with Cornell).
11. Time of seeding wheat for control of Hessian fly. (Cooperative with U. S. Dept. of Agri.).
12. State Fair activities.
13. Horticultural Society meeting activities.

1. Soil fertility investigations.- For a number of years a series of 104 one-tenth acre plats was under a rotation system, in which alfalfa was grown in rotation with potatoes and wheat. It was demonstrated that the alfalfa can be grown satisfactorily under such conditions on land adapted to alfalfa production.

This investigation showed yield variations present in the field. These variations are due to the character and variation of the soil. A portion of this field is now used for the study of these variations. The work is done on small plats. Plats are 18 feet square. Yields have been secured during the past three years as follows, 1925- corn, 1926- oats and barley, 1927- wheat. The field is now in alfalfa and yields of this crop will be obtained this year. Carefully taken soil samples consisting of thirty six cores taken

to a depth of eight inches, were made of each plat last year, and as time permits are being investigated in the laboratory. With the accumulation of yield data and the physical and chemical data on the soil samples, it is expected that by statistical methods, it will be possible to determine the relative value of the various factors in the composition of the soil, and their effect upon maintaining and increasing yields.

2. Orchard fertilization studies.- This work consists of the application of commercial fertilizers to commercial orchards, most of which are nearby. The object is to study the relative value of the different forms and amounts of nitrogen which can be used on fruit trees. This work is essential owing to the appearance of many new sources of nitrogen on the fertilizer markets.

3. Studies on the nutrition of trees in sand cultures.- A beginning in this work has been made during the past three years. Seedlings have been grown in the green house, in pure sand and chemical nutrients in solution. It has been demonstrated that trees do best in the more dilute solutions. It has also been found that there is a large coefficient of variation in the seedlings used. To eliminate this variation in the trees grown, attempts have been made to propagate trees on their own roots but without success to date.

4. Cover crops in orchards.- This project is in time to become a study of the comparative value of legumes versus a grass sod in orchards. The work was started in 1927 as a cooperative experiment on the orchard of Louis Salisbury near Phelps.

5. Fertilizers for nursery trees.- In 1926 a block of wealthy apple trees on the Stuart nurseries near Seneca Castle, was put under

a series of fertilizer treatments. During the past two years no effect has been apparent upon the growth of the trees. The trees are receiving fertilizer this year, and when they are dug, measurements will be made to determine, what effect if any, the treatments have had.

6. Green manures for nursery land improvement. It is becoming more difficult for the nursery men to secure manure for their lands. Since the organic matter must be maintained, the only source of it is through the use of green manures. Such an experiment is in progress on lands of the Stuart nursery near Seneca Castle.

7. Production of high nicotine tobacco.- It has been demonstrated that a high nicotine tobacco for insecticide purposes can be grown. The problem still remains, to further increase the nicotine content, increase the yield per acre of leaf, reduce the labor of caring for the growing and curing of the crop, and to develop a method of using to the best advantage.

8. Pasture improvement.- This project started in 1928 has for its purpose the determination of the most judicious use of commercial fertilizers for improving station pastures.

9. Growing grain crops in mixtures (Cooperative with Cornell). The purpose is to study the yields of oats, barley and peas alone and in combination, when grown for feed. 1928 is the third year. The work is done here because of the advantage of the soils not found at Ithaca.

10. Time of cutting alfalfa.- (Cooperative with Cornell). The object is to study, on a soil adapted to alfalfa growing, the effect of time of cutting, and the number of cuttings, upon the yield, stand and winter killing of alfalfa. Suitable soils are not available at Ithaca. Yields will be obtained for the first time this year.

11. Time of seeding wheat for the control of Hessian fly.-
(Cooperative with U. S. Dept. of Agri.) This project just started last fall. Earlier seedings give signs of heavy infestation.

12. State Fair and Horticultural meeting activities.- Much time and thought is given to the preparation of material and for attendance at these events. Attendance is found of value, not alone for the information given to farmers, but also because they serve as a source of obtaining a more intimate knowledge of the farmers' problems.

The following are a list of recent publications:

Bulletin No. 503, 1923. Final report on the cooperative fertilizer experiments on orchards, by R. C. Collison and J. D. Harlan.

Technical Bulletin No. 94, 1924. A statistical study of some field plat yields, by R. C. Collison and J. D. Harlan.

Technical Bulletin No. 126, 1927. Annual variations in apple yields. A possible cause. R. C. Collison and J. D. Harlan.

Respectfully submitted

JDH-H.

J. D. Harlan.

My work is largely in connection with a battery of 20 lysimeters, 16 of which are 4 feet deep, 2 are 2 feet deep, and 2 are 8 feet deep. Each tank is 56½ inches in diameter. In filling the tanks, soil was taken up in three layers, 0-8 inches, 8-16 inches, and 16-36 inches. The last depth formed the lower 2 feet in the bottom of the 4 foot tanks and 6 feet in the case of the 8 foot tanks, the second depth the next foot, and the surface 8 inches formed about the surface 9 inches in the tanks. Tanks 1-8 are filled with volusia silt loam from Burdette, N. Y., an acid soil of low productivity. The remaining 12 tanks are filled with soil from the Station farm (Ontario loam).

The problems of study are:

1.- The relation of legumes to the nitrogen problem as affecting soil fertility and plant nutrition.

2.- The relation of mineral constituents to crops in rotation and the effect of soil depth on such relation.

The crop rotation:

Two years grass (timothy) or legume (part alfalfa, part clover), two years cereal (barley, wheat), two of the tanks remain in fallow while the others are in cereal.

Fertilizer treatment:

Nos. 1-14 inclusive receive twice per rotation 560 lbs. per acre, of a mixture of mono-calcium phosphate and calcium sulfate in the approximate proportions as found in commercial acid phosphate, 280 lbs. per acre potassium chloride. Nos. 7 and 8 in addition to the above receive 700 lbs. per acre of dried blood to each alfalfa crop. Nos. 15-20 inclusive receive

700 lbs. per acre of dried blood to each crop. Nos. 1-8 inclusive receive 5 tons per acre precipitated calcium carbonate per rotation.

The composition of all seeds, fertilizers and the precipitation which is added to the tanks is determinal. Also a practically complete analysis is made of all crops removed and upon the drainage water from the tanks.

The following are a few of the results obtained.

Effect of one crop on another.

Barley following two years alfalfa on the volusia soil has yielded nearly three times as much dry matter as barley following two year timothy. While on the Ontario loam barley following two years alfalfa has yielded nearly twice as much dry matter as barley following two years timothy. The residual effect is noticeable on the wheat crop following barley only to a less extent; on the volusia soil 1-15 times and on the Ontario soil 1-17 times as much dry matter. On the Ontario loam the alfalfa rotation has yielded more dry matter in the case of barley and wheat following two years alfalfa than following two years alsike clover plus heavy nitrogen fertilization.

The two tanks on the volusia soil receiving the nitrogen fertilization has but slightly increased the yield of alfalfa, however, a slightly greater increase is noticeable on the cereal crops.

Composition of drainage water.

On the volusia soil the alfalfa rotation has drained six times as much nitrate nitrogen as the timothy rotation (69 lbs. and 11 lbs. per acre per rotation). Comparing the

fallow tanks with those planted to cereal I find the fallow tank has drained nearly five times as much nitrate nitrogen as the alfalfa rotation (307 lbs. and 69 lbs. per acre per rotation). The tanks receiving nitrogen fertilization drained only about 20 lbs. more nitrogen per acre per rotation than those not receiving nitrogen, even though the tank received 184 lbs. nitrogen per rotation. On the Ontario loam the alfalfa rotation has drained nearly twice as much nitrate nitrogen as the timothy rotation (56 lbs. and 36 lbs. per acre per rotation). The clover rotation which receives nitrogen fertilization has drained twice as much nitrate nitrogen as the alfalfa rotation, while the eight foot tanks drained twice as much nitrogen as the four foot tanks. The amount of nitrogen drained from each soil is about the same when alfalfa is grown in the rotation, however, when timothy is grown in the rotation the Ontario loam drained about three times as much nitrogen as the volusia silt loam even though the original nitrogen of the two soils carried as follows:

Volusia	0.114%	N.	or	2280	lbs.	on	2000000	lb.	acre	basis.
Ontario	0.182%	"	"	3640	"	"	"	"	"	"

Practically speaking, all nitrogen is drained as nitrate nitrogen, as the amount of ammonia nitrogen is small and there is only a trace of nitrite nitrogen.

The concentration of the leachings for any period of the year from duplicate tanks is almost a constant regardless of the volume, e.g., one month (March) duplicate tanks drained 286 and 486 liters and yet the concentration of all elements were nearly the same from each tank.

On the volusia soil the timothy rotation drained approximately 100 lbs. per acre per rotation more calcium than the alfalfa

rotation, while the fallow tanks drained approximately 200 lbs. per acre per rotation more calcium than the alfalfa, cereal rotation. On the volusia soil those receiving nitrogen fertilization drained slightly less calcium than those not receiving nitrogen. While on the Ontario soil the timothy rotation drained approximately 150 lbs. per acre per rotation more calcium than the alfalfa rotation. The clover rotation had a greater loss of calcium than the alfalfa rotation. Each rotation on the Ontario soil had approximately 100 lbs. per acre per rotation greater loss of calcium than the corresponding rotation on the volusia soil.

The original calcium content of the soils were:

<u>Volusia silt loam</u> surface	0.32%
sub- "	0.30%
sub-soil	0.30%
<u>Ontario loam</u> surface	0.69%
sub- "	0.68%
sub-soil	2.50%

There is very little difference in the amount of sodium, potassium or chlorine as to crops grown in rotation or fertilizer treatment, while sulfates and bicarbonates are in the same proportions as calcium. Carbonates are found in leachings from Ontario loam only, however, bicarbonates are found in the leachings from both soils, a greater amount is from the Ontario loam.

As previously stated the chemical examination of crops, leachings, seeds, fertilizers, and precipitation require considerable time. In addition during the growing season there is the culture of crops, also collecting and preparing for chemical analysis. Then there is the measuring and sampling of leachings for chemical analysis.

Besides the above there are frequent inquiries from

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farmers and samples of soil to make an acid test or other recommendations.

The following are some of the needs to facilitate in the prosecution of my work.

Full or part time of a man for taking care of crops and leachings from lysimeters, washing apparatus, aiding in chemical work, etc., etc.

Standard weights for chemical balance (50 mg. to 50 gms.)

Freeze vacuum oven.

Electric hot plates.

Ultra microscope for the determination of the size of particles of soil colloids.

J. E. Munsching

Division of Bacteriology

R. S. Breed, Chief

H. J. Conn

G. J. Hucker

C. S. Pederson

P. S. Prickett

DIVISION OF BACTERIOLOGY

Work of R. S. Breed.

Sources and numbers of Bacteria in market milk.

About 1910 the Department of Bacteriology began a survey of the sources of bacteria in market milk before it left the farm. This included studies on the number of bacteria in milk as drawn from the udder (Technical bulletins Nos. 27 and 132), the number derived from dust (Bulletin No. 409) and from the dirt that appears in milk as visible sediment, the number derived from milk pails, milk cans (Technical bulletin No. 99), milking machines, etc. (Bulletins Nos. 450 and 492). The latter part of this work was carried out in cooperation with the Illinois Station after Dr. H. A. Harding took charge of the work there. While this work was technical in nature, it resulted in securing ~~an~~ the very practical information summarized in the four-page circular No. 67, published in 1924 and reprinted as circular 93 in 1927.

There is general agreement among practical men connected with the dairy industry that this circular contains the most satisfactory information of the type, that has ever been presented to practical dairymen and there is such a continuous demand for large quantities of the circular for distribution to dairymen that the circular should be reprinted this summer.

The greatest change in dairy sanitation that has been brought about by this work is a lessened emphasis on dust and dirt as a source of bacteria in milk and an increased emphasis on moist utensils such as milk cans and milking machines as sources of bacteria. It has also resulted in a sharper differentiation between bacterial contamination of milk, and dirt and dust contamination.

Division of Bacteriology

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Identification of Types of Bacteria.

Milk control in America has been based largely on a count of the number of bacteria present. No really rational milk control work can be based on a knowledge of the numbers alone, inasmuch as many types of bacteria are not only harmless but ^{even} beneficial. Public health control work should primarily concern itself with keeping disease germs out of milk. The future will see a great advance in public health control of milk, when knowledge of the nature of the bacteria present is adequate, together with the knowledge of their natural habitat and life history.

Bacteriology

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A large part of the work of the ^A Division during the past ~~five~~ years has had for its object the securing of definite information regarding the nature of bacteria that play a part in connection with agriculture, including the dairy field. This type of work requires a long continued program and the results of this line of investigation are only just beginning to become evident in the publications of the Division.

These studies have included the following groups of organisms:

~~Dr. Conn has specialized in the group of Actinomyces, and spore-forming and non-spore-forming bacteria that are of importance in soil;~~
~~Dr. Hueker has specialized in a study of the micrococci and streptococci;~~
~~Dr. W. A. Whiting and Dr. A. H. Robertson have made habitat studies of~~
the organisms found in
~~milk cans, and milking machines, organisms and Miss Alice Breed has made a habitat study of the udder micrococci;~~
~~Mr. Pederson has taken up the study of the lactic acid rods especially concerned in fermentation of vegetable products such as tomato pulp and cabbage, and has given such attention as he could to plant pathogens of the colon typhoid types.~~
~~Dr. Robertson and Mr. Prickett have covered the field of heat resistant~~
the

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and heat loving bacteria that are important in connection with pasteurization; ^{and} Mrs. Breed and myself have given our attention to the group of red organisms that have many practical relations especially to food spoilage, reddening of fish eggs, ^{and the} spotting of rubber and copra.

Accuracy of Bacterial Counts.

Milk

Inasmuch as American milk control work has been based primarily on the idea that the reduction of the number of bacteria to a minimum will result in safe and sanitary milk, the difficulties connected with determining the number of bacteria in milk accurately has given rise to continuous criticism of the methods of counting bacteria. Because the Division of Bacteriology has been interested in the development of laboratory methods for controlling the sanitary quality of milk, particularly the application of the microscope to the determination of numbers, this situation has caused us to give a good bit of attention to the determination of the accuracy of these counts (Technical Bulls. No. 75 and 86); and methods of controlling errors by a standardization of routine laboratory control methods. This standardization work has been carried out by the laboratory section of the American Public Health Association and the Chief of the Division has been called upon for active work on the Standard Methods of Milk Analysis Report since 1914, having acted for a number of years as a member of the Milk Committee and later when all of the Standard Methods Committees were merged, having acted as Referee for the Bacteriological Section of this report. The last three editions of this report have been prepared at Geneva and much of the development of the report has been based upon our work. The Report is accepted as standard by Courts and by all Public Health Authorities of

the United States, and has been recognized internationally.

Inasmuch as this Standard Methods of Milk Analysis Report has been held strictly to the standardization of official routine milk control methods useful in public health work, there has come to be an insistent demand for a report covering laboratory methods useful in milk dealers and other dairy laboratories in maintaining the quality of all types of dairy products. This has led the American Dairy Science Association to establish a series of five sub-committees to draw up reports on laboratory methods useful in analyzing market milk, butter, ice cream, cheese, condensed milk, milk powders, etc., and the Chief of the Division has been called upon to act as General Chairman of all of these sub-committees, Dr. Hucker serving as chairman of the Committee on cheese laboratory methods. The ice cream report is already in print and the butter report is ready for presentation at the June 1928 meeting of the Association.

Milking Machine Work.

The work on methods of sterilizing milking machines in a simple and practical manner was almost completed before 1923. One bulletin has been issued since that time (No. 524) which was written primarily to study the application of methods of sterilization on a new and simple type of milking machine, the Surge Milker. The general directions for sterilization of milking machines drawn up as a result of our work are still regarded as the standard directions for meeting this practical problem and New York State dairymen and milk inspectors generally agree that results secured with these recommendations are excellent.

City Milk Control Work.

Since 1914 the Chief of the Division has carried the responsi-

bility for the milk control work for the City of Geneva. The City in return for his services has allowed us free access to all records and materials which would be useful in carrying out research problems in the city milk control field. The Station has provided laboratory facilities for doing this work while the City has paid the necessary expenses, including the salary of an Assistant Bacteriologist. The application of the direct microscopic technic to City milk control work was first worked out in a practical way in connection with this City work and has come into extensive use thruout the United States and other parts of the world. A report of this work is to be given before the International Dairy Congress to be held in London, England, this June (1928).

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International Committee of Bacteriological Nomenclature,

and Standard Methods

All studies of the types of bacteria are seriously handicapped by the fact that bacteriologists have been little interested in arranging their knowledge of bacterial species in a systematic way and in conformity with the rules and customs observed by other biologists.

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There is much confusion in scientific names of bacteriological species,

and American bacteriologists have become interested in an attempt to bring about international uniformity by a better application of International Rules of Nomenclature. Because the Chief of the Division was

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called upon to act as chairman of the Bacteriological Section of the International Botanical Congress held in Ithaca in 1925, he has been

asked
called upon to take an active part in organizing an International

Committee on Bacteriological Nomenclature, whose work is to be reported at the International Botanical Congress to be held in Cambridge, England in 1930. This work will assist very materially in making our investigation

of types of bacteria practical and useful. Definite knowledge of the types and habitat of bacteria promises to be as useful to bacteriologists in making recommendations of practical value to agriculture as a knowledge of the life histories of insects has been to entomologists in giving specific directions for the control of injurious insects.

Bovine Tuberculosis Work.

The Bacteriological Division has cooperated throughout its history with the Dairy Division in maintaining the Station herd free from tuberculosis and, until the accredited herd plan was put into effect, did all of the testing of the animals in the herd collecting data, which, it was hoped, would aid in explaining the non-lesion cases found in the herd.

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The introduction of the tuberculin test ordinance in the City of Geneva has also brought the Division into close cooperation with the Farm Bureaus and County Veterinarians of Seneca and Ontario Counties in their efforts to eradicate tuberculosis in the herds in these counties. The number of non-lesion cases found in these herds and the opposition to the work that developed caused us to suggest the development of a research program by the State in connection with the eradication work. Through funds provided by the State Department of Agriculture and Markets, this work is being started in a modest way at the State Veterinary College during the coming year.

This program should be developed so far as we are concerned into fundamental studies that will give us a better understanding of the nature of the organisms causing tuberculosis and the somewhat similar lumpy jaw (actinomycosis). These pathogenic organisms find their closest relatives in the little known group of Actinomyces, which Dr. Conn discovered some

years ago to be one of the most important groups of soil organisms. While the tuberculosis and lumpy jaw organisms have been studied extensively, little is known in regard to their close relatives whose activities are evidently important. A better knowledge of their biochemical activities might reasonably be expected to throw light on possible methods of controlling the two cattle diseases mentioned above.

Tomato Products Investigation.

Because of the work done at this Station on the accuracy of methods of counting bacteria in milk, the National Glass Container Association gave \$1500 in 1920 for investigating the accuracy of the Howard technique used in counting bacteria in tomato pulp and catsup. A report on this subject was prepared by Dr. C. A. Darling in 1922. This work brought us into intimate contact with the important catsup industry of New York State and caused one of our leading catsup firms to apply to us for help regarding a gaseous spoilage of their catsup. Mr. F. L. Mickle was employed to make the investigation which resulted in the publication of Technical Bulletin 110 (Mickle and Breed) in which the causal organism was described. Later Mr. Pederson and Dr. Breed carried this work to a very practical conclusion (Bulletin 538) which is having an influence in driving poor quality commercial catsup off of the market throughout the United States, and also in Canada.

Publications.

A list of bulletins and scientific papers published during the past five years is appended. In addition, time has been given each year in connection with the State Fair exhibit and in judging the milk and cream exhibit at the State Fair. One or more scientific addresses have

been given each year before the National and Local Branch Meetings of the Society of American Bacteriologists, American Public Health Association, American Dairy Science Association, and for the past three years before the International Milk Dealers' Association. Addressee have also been given before the State Dairymen's Association, State Association of Laboratory Workers, State Milk Inspectors' Association, Farmers' Week audiences, and other meetings of dairymen, and scientists.

Correspondence.

Correspondence amounts to approximately one hundred and fifty letters a month, though, because of the technical nature of the work, the larger part of this correspondence is with scientific and technical men, rather than with farmers. At the present time the most frequent request is for information regarding the application of the direct microscopic method to milk control work or the application of related laboratory methods in this particular field. There are also numerous requests for information regarding methods of producing high grade milk, and methods for the sterilization of milking machines. Miscellaneous requests vary from queries regarding methods of pasteurizing grape juice to those asking where to purchase reliable legume cultures.

Visitors and Requests for Laboratory Aid.

There are frequent visitors who come for specific information. Mr. Eglinton and Mr. Prickett have helped materially with the group that comes most frequently and demands the most time when they come. These are dairy inspectors or laboratory workers who wish instructions in laboratory methods of analysing market milk. In the last three months

this group has included six inspectors from the New York City force, one from the Sheffield Farms Co., one from Bordens, two from the Dairy-mens League, two from Mead, Johnson Co., one from the Watkins, one from the Monroe County and one from the Penn Yan public health laboratories. Dr. Tamoh Ikeda from the Imperial Home office, Japan, spent several months in the fall of 1927 in the laboratory on a similar mission. Dr. Nebel is working in the laboratory at the present time.

Altho the laboratory does not undertake the sanitary analysis of water, the laboratory worker for the Seneca Falls waterworks has been in for advice twice within the past two months, advice has been given in connection with the drilling of a well at the Geneva Milk Co. and numerous similar requests have been made. Many letters have been written explaining to people who ask for the sanitary analysis of water how to obtain the information they wish. Similar attention has been given to fairly frequent requests for information regarding sewage disposal on farms, at summer cottages, etc.

Immediate Needs.

The most pressing need is for a student assistant, or a media maker who is capable of caring for 1300 stock cultures, making media, etc. (partially provided for during the coming year). The need for additional clerical and stenographic help during certain seasons of the year is equally important (partially provided for). Additional room is needed also. It is unfair to expect full return from laboratory workers who work under the crowded conditions existing in the present laboratory. Mr. Prickett and Mr. Eglinton have been working under particularly unfortunate conditions. It is impossible to do research work in a room where several people are working, and interruptions are necessarily frequent.

Needs for the Future.

I - Dairy problems. An assistant bacteriologist is needed to carry on the work in market milk problems of primary interest to the producer that has formed a major and most successful part of the work of the Division for many years. Mr. Prickett should continue his work in the field of milk transportation, effect of temperatures on bacterial growth, and pasteurization. These problems are of great importance to the industry and have never been adequately investigated. Dr. Hucker should continue his work on cheese problems if assistance can be provided for him so as to take advantage of the offer of funds from the International Education Board. He should also be encouraged to continue his work with Mrs. Hucker on the baby food and other dried milk products problems.

II - Bacterial plant disease problems. An additional assistant, or better, an Associate Bacteriologist is needed, who is capable of working on the bacteriological aspects of tomato canker and other bacterial plant diseases in an effort to apply knowledge gained in other fields of bacteriology to the problem of controlling these, at present practically uncontrollable and occasionally highly destructive diseases. This work should be planned in such a way as to support the canning crops investigations at a place where help is needed.

III - Soil fertility problems. Green house space with a sufficiently well trained assistant to care for experiments that are in progress.



Robert S. Breed.

Appendix - Publications, 1923-1928.

1. The Milk Problem in Cities, Robert S. Breed. N.Y. State Dept. Health, Health News, 18, 84-90, April, 1923.
2. The Hygienic and Economic Control of Market Milk Production in New York State, Robert S. Breed. Proc. Worlds' Dairy Congress, 2, 1306-1311, October, 1923. Syracuse, N. Y.
3. Sterilization of Milking Machines, Robert S. Breed. Proc. Worlds' Dairy Congress, 2, 1324-1328, October, 1923. Syracuse, N. Y.
4. Manual of Determinative Bacteriology, 1st ed., David H. Bergey, assisted by Robert S. Breed et al, Williams and Wilkins Co., 461 pp. 1923.
5. Agricultural bacteriology in Italy, France and England as seen by a tourist, Robert S. Breed. Journal of Dairy Science, 7, 205-207, March, 1924.
6. Abnormal Milk as a Cause of Gastro-intestinal Disturbances Among Children, Robert S. Breed. Monthly Bulletin of the Certified Milk Producers' Ass'n of America, 3, Oct.-Nov., 1924.
7. Clean and Cold Milk, Circ. 69, N.Y. Agr. Exp. Sta., Robert S. Breed. Pages 4, pl. 1., September, 1924.
8. The type species of the genus Serratia, commonly known as Bacillus prodigiosus, Robert S. Breed and Margaret E. Breed. Jour. Bact., 8, 598, 1924.
9. Report of Rare Scientific Pamphlet obtained by Department Library, Robert S. Breed. U. S. Department Agri. Official Record, June 17, 1925.
10. Manual of Determinative Bacteriology, 2nd ed., David H. Bergey, assisted by Robert S. Breed et al, Williams and Wilkins Co., 462 pp., 1925.
11. A gaseous fermentation of tomato pulp and related products, Friend Lee Mickle and Robert S. Breed. Tech. Bull. 110, N.Y. Agr. Exp. Sta., 27 pps, 1925.
12. The validity of names applied to general and subgenera of the Coccaceae. G. J. Hucker and Robert S. Breed. Centralbl. f. Bakteriologie, II Abt., 64, 321-328. 1925.
13. Report of referee for the Committee on Standards Methods for the Examination of milk, Robert S. Breed. Amer. Jour. Public Health, 15, 207, 1925.
14. The terms "Germs," "Bacteria", and "Dirt", by Robert S. Breed. American Speech, 1, 107-110, fig. 1. 1925.
15. Methods of Counting Bacteria in Milk, by Robert S. Breed. The Milk Dealer, 15, No. 6, 50-56, March, 1926.

16. Non-thermophilic, spore-forming bacteria associated with pasteurizing equipment, by A. H. Robertson, M.W. Yale and Robert S. Breed. Tech. Bull. 120, N.Y. Agr. Exp. Sta., 7 pp. 1926. Also in Centralbl. f. Bakteriolog., II Abt., 68, 17-22, 1926.
17. What significance should be placed on leucocytes in milk? Robert S. Breed. Proc. 19th Ann. Convention Internat. Assoc. Milk Dealers, Detroit, Mich., 1926. Also in 1st Ann. Rep. N.Y. State Ass'n of Dairy and Milk Inspectors, 51-58, Albany, N.Y. 1927.
Robert S. Breed.
18. The microscopic appearance of market milk and cream, / Tech. Bull. 120 N.Y. Agr. Exp. Sta., 7 pp., 16 pl., 1926.
19. Standard methods of milk analysis: Bacteriological methods, by Robert S. Breed, Referee. Amer. Jour. Public Health, 16, 811-818. 1926.
20. Serratia indica Bergey, the red chromogenic bacterium originally isolated by Koch in India, by Robert S. Breed and Margaret E. Breed. Jour. Bact., 11, 76-77, 1926.
21. The accuracy of bacterial counts from milk, by Robert S. Breed. Amer. Jour. Pub. Health, 17, 604-606, 1927. Also in The Medical Officer, 119-120, London, September, 1927.
22. Use of the microscope in detecting various kinds of contamination in milk, by Robert S. Breed. Proc. 20th Ann. Conv. Internat'l Ass'n of Milk Dealers, 28-56, October, 1927.
23. Bacteriological Methods of examining ice cream, by Robert S. Breed, A. C. Fay, F. W. Fabian, B. W. Hammer. Journal of Dairy Science 10, 460-478, September, 1927.
24. The Genus Serratia Bizio, by Robert S. Breed and Margaret E. Breed, Centralbl. f. Bakteriolog., II Abt., 71, 435-440, 1927.
25. The preservative action in catsup of salt, sugar, benzoate and acid, by C. S. Pederson and Robert S. Breed, N.Y. Agr. Exp. Sta. Bull. 538, 16 pp., 1927. Popular edition, 8 pp., 1927.
26. The number of cells in cream, skimmilk, and separator and centrifuge slimes, by Robert S. Breed, Cir. 88, N.Y. Agr. Exp. Sta. 8 pp., 1927.
27. Clean and Cold milk, by Robert S. Breed, Cir. 93, N.Y. Agr. Exp. Sta. 4 pp. figs. 4. 1927.
28. The present status of systematic bacteriology, by Robert S. Breed. Jour. of Bacteriology, 15, 143-163, March, 1928.
29. Bacteria in milk, by Robert S. Breed. The Newer Knowledge of Bacteriology and Immunology, edited by E. O. Jordan and I.S. Falk, Chap. 30, 378-394, 1928.
30. The fermentation of glucose by organisms of the genus Serratia, by C. S. Pederson and Robert S. Breed. Jour. Bact. 15, 1928 (in press).

MSS. practically ready for publication.

The control of the sanitary quality of market milk, by Robert S. Breed.
Proc. Worlds' Dairy Congress, London, 1928.

Colored Coregonus (white fish) eggs. Will be submitted to the Jour.
Bact.

Classification of the Streptococci

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II. PRESENT PROGRAM OF WORK.

~~A. Investigations dealing with studies on the Coccaceae.~~

~~Classification of the streptococci.~~

Following the classification of the micrococci, the work on this group was continued with another genus viz., Streptococcus. The members of this genus are more important from the standpoint of agriculture, ^{and related industries} etc. than is true of the micrococci. They form the basis of dairy starters, and many of the species are involved in the production of pure food products as well as important from the standpoint of public health.

In order to arrive at results which will serve as a broad basis upon which practical applications can later be formed, the entire genus is being studied. This embraces species of a varied source, altho their cultural reactions are many times very similar. A large part of the genus is taken up by the so called "aroma" organisms, which no doubt are responsible for the production of flavor in butter and cheese and are also present in certain fermenting vegetables. It has been found that these types prefer levulose to glucose as a source of carbon, and without exception they produce levo-rotatory lactic acid. This is in contrast to the remaining streptococci which form dextro-lactic acid and prefer glucose as a carbon source. Most of these so called aroma types produce carbon dioxide from sugar and form only small amounts of acid from carbohydrates. On the other hand, if traces of yeast extract are present in the medium the amount of acid is materially increased. It is evident that these types form a distinct group from the other streptococci and have been overlooked in much of the earlier work dealing with floral studies of various agricultural products.

The studies on the relationships of the various species of this group are indicating certain similarities between various cultures

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being investigated

~~understudy~~ by other workers. The results are serving to clarify much of the confusion in regard to the relationships of important strains and is aiding to correlate the results of earlier investigators. This has been especially true in respect to the types of streptococci which survive pasteurization. It has been found that the type surviving pasteurization is entirely different from the streptococcus associated with normally souring milk. Many earlier investigators have added to the present confusion by initiating their investigation on the basis that the lactic acid streptococcus surviving pasteurization temperatures is identical with S. lactis, the streptococcus normally souring milk.

Heretofore bacteriologists have tabulated observations in terms of numbers of bacteria, but it is becoming evident that more important, both from a market control as well as from the standpoint of public health, is a knowledge of the kinds of organisms present. This is true when the fact is considered that a wide range exists in the pathogenicity, physiology, etc. of the various types which may be present. In order to ascertain the type present, a satisfactory basis of identification must be established and information must be available as to the physiology and other characters of the organisms being studied.

~~B. Investigations dealing with special problems.~~

Studies on special powdered baby foods.

Antithead

During the last year funds have been made available ^{by a commercial concern} for the study of the sanitary

quality of prepared baby foods. It is felt that if the dairyman is asked to make special efforts to produce milk containing a minimum of bacteria, the industrial concerns preparing various modifiers for baby milk should be required to meet the same standards. Samples of various baby foods are under study and their bacteria content is being determined. Pure

I PAST ACCOMPLISHMENTS

Soil Flora Studies

When work in this field was begun in 1911, the chief problem was to compare the types of bacteria in certain soils of low productivity with those in soils of normal fertility. Of the former class of soils, chief interest centered in the Volusia type, a group of "poor" soils quite widely distributed thru this state and Ohio. In particular, it was desired to make a study of this type of soil, to determine the influence of liming upon the kinds of bacteria.

It was quickly discovered that our knowledge of the types of bacteria in soil was too meager to allow any progress in such an investigation. The only kinds of microorganisms in soil that could be recognized were some of those concerned in the nitrogen changes (organisms, which are not very numerous in soil), and the spore-formers (which altho more numerous were upon investigation found to exist in normal soils only in inactive form. See Tech. Buls. 51 and 97). As a result it was decided to make a systematic study of the general soil flora and to learn to recognize the most predominant forms; then by studying the places and times of their greatest abundance, to get an idea of their significance, and to follow this with a study of their functions.

Learning to recognize these types that had never before been studied proved difficult, and it was necessary to work out new methods for their identification. It is only within the last few years that real progress has been made.

To study the activities of these bacteria has also required new methods. Recent work in various other laboratories has discredited the use of ordinary laboratory media for making such a study, because the organisms behave abnormally under such artificial conditions. Studying them in soil is not easy, both because of the impossibility of watching their growth and the difficulty in making chemical determinations to learn their activity. It was largely to meet this difficulty that a method was devised for examining bacteria in soil directly under the microscope, (Tech. Bul. 64) a technic which has recently been taken up by Winogradski and is now quite generally agreed to be one of the most promising methods in soil microbiology.

The study of the soil flora has brought out many interesting points, but two in particular that was of more than theoretical interest: first, that the group known as Actinomycetes are more abundant in sod than in cultivated soil (Tech. Bul. 52); and secondly, that a certain type of non-spore-forming bacteria, apparently not previously recognized, is very abundant in the ordinary "good" soils of this locality but is either scarce or entirely lacking in the soils of low productivity (work ready for publication).

The latter type of organism has been chosen for intensive study, largely because of its relation to the problem of the Volusia

soils. It seems to be entirely absent in such soils under natural conditions, and cannot even be made to grow in them by reinoculation after sterilization, unless furnished with the right food material. It also seems to be unable to grow in another group of soils, the Hessian type, which altho more productive than the Volusia soils require special handling to yield good crops. This type of bacteria proves to be more abundant in cultivated than in sod soils, another observation which correlates with the ability of the soil to produce crops.

It has proved possible to study the behavior of this type of organism in soil because of the microscopic technic already mentioned. Apparently its nutritive requirements are different in soil from what they are in laboratory media; and but for the microscopic method of study it would be difficult to investigate their activities in soil. As a result of the methods now at hand for studying this type of organism, it is planned to make a thoro investigation of its relation to the productivity of various soils.

Studies of Practical Problems.

At the same time that this work has been in progress an effort has been made to keep some projects of a more practical nature under way. This work has been handicapped by lack of greenhouse facilities and the assistance necessary to keep greenhouse work going. For this reason it has not been possible to do such work except when the cooperation of some department having greenhouse space at its disposal could be secured. As examples of such work may be mentioned the work on preservation and fermentation of manure, (Bul. 494), the investigation of the effect of straw (Tech. Bul. 114), and the present study of artificial manure, all carried on in cooperation with the Division of Agronomy; and the investigation of the effects of sod on plants, begun in cooperation with the Division of Horticulture. The latter piece of work was never finished nor carried far enough to justify publication, because the transfer of Mr. Tukey to other lines of work made it necessary to stop it; and neither the greenhouse space nor the assistance needed to pursue it further has been secured.

List of Bulletins dealing with Soil Bacteriology

- 1914: Tech. Bul. 35. Bacteria of frozen soil.
" " 38. Culture media for use in the plate method of counting soil bacteria.
- 1916: Tech. Bul. 51. Are spore-forming bacteria of any significance in soil under normal conditions,
" " 52. A possible function of Actinomycetes in soil.
" " 53. (pp 12-15). A comparison between agar and gelatin as media for the plate method of counting bacteria.

- 1917: Tech. Bul. 57)
 " " 58)
 " " 59)
 " " 60) Soil flora studies

- 1918: Tech. Bul. 64. The microscopic study of bacteria and fungi in soil.

- 1919: Tech. Bul. 67. Ammonification of manure in soil (Bright and Conn).

- 1921: Tech. Bul. 83. The use of various culture media in characterizing Actinomycetes.

- 1922. Bul. 494. Fermentation and preservation of manure. (Collison and Conn).

- 1923: Tech. Bul. 97. Factors influencing the activity of spore-forming bacteria in soil (Joffe and Conn).

- 1925: Tech. Bul. 114. The effect of straw on plant growth. (Collison and Conn.)
 " " 115. The punctiform-colony forming bacteria in soil.

- 1927: Tech. Bul. 129. The general soil flora. The bacterial flora of four soils compared by the direct microscopic method (Thatcher and Conn.)

- 1928: MSS has been submitted for a bulletin (by Collison and Conn) on the method of making artificial manure from straw. On the Director's advice it is being held up until the present season's work is completed. Meanwhile a circular on the same subject is being prepared.
 Material is at hand and almost ready for writing up on "A type of bacteria present in productive soils, but apparently lacking in soils of low productivity".

Standardization of Biological Stains.

After the method of staining bacteria for microscopic examination had been worked out it was found that in all lots of the dye used (rose bengal) were satisfactory. The matter was taken up with one of the supply houses and it was learned that the supplies of stains on the American market was then very undependable. It was found further that many other bacteriologists were faced with the same problem; and as the soil bacteriologist was chairman of the committee of bacteriological technic of the Society of American Bacteriologists, it seemed naturally to begin the necessary investigation of the subject at this Station. This has expanded into a cooperative investigation in which many other laboratories have taken part. It was organized at first under the National Research Council and is now affiliated with this body altho

organized separately under the name of the Commission on Standardization of Biological Stains.

This work is carried on due largely to the cooperation of the Chemical Foundation who are supporting it financially. It is therefore largely self-supporting; and so far as it takes time of a Station employee, this time is returned by the time of others paid for by the Stain Commission.

II PRESENT PROGRAM OF WORK.

The following projects are now receiving attention:

No. 2. Soil flora studies.

No. 7. An investigation on the effect of straw on plants (in cooperation with Agronomy).

No. 10. Studies of bacteriological technic.

No. 13. Standardization of biological stains.

No. 17. Comparison of the bacterial content of various soil types by the direct method.

Sub-project A. Correlation of the productivity of certain soils types with the ability of certain bacteria to grow therein.

Project No. 2 is not at the present time receiving much direct attention; but data on the subject are collecting in connection with the study of No. 17. The flora studies are of value for the reasons discussed above; namely that they lead to information as to the correlation of soil organisms with definite conditions of practice.

Project No. 7 is given attention at certain periods when called for. Present work on this matter consists of composting straw and utilizing it, after composting, as nutrient material for the growth of plants in greenhouse culture. It requires intensive work for a few days at a time at certain periods of the year. The project is important because it is realized that straw and other kinds of plant residue may be distinctly harmful if added immediately to soil; they can be converted into useful compost by permitting decomposition, but the most practical methods of doing so under New York state conditions have not yet been worked out.

Project No. 10 is being carried on with ^{other members of this division} ~~Dr. Hucker here~~ and in cooperation with various bacteriologists elsewhere. The chief outcome of it is the publication of a Manual of Methods for the Pure Culture Study of Bacteria. This publication is handled in the name of the Society of American Bacteriologists, and about 300 copies a year of it are sold. It is in loose-leaf form and sections of it are constantly undergoing revision to keep them up-to-date. These revised pages are distributed when issued to about 400 who subscribe for this service. This work is of value for two reasons: in the first place it keeps the Division of Bacteriology in touch with the latest developments in technic; and in the second place, it is of distinct service to bacteriologists elsewhere in bringing these methods to their attention.

Project No. 13 is also a cooperative project, the objects of which are discussed above. Much time is now being given to this, and the full time of Miss Haynes is devoted to the subject. Funds are received from the Chemical Foundation to finance the work. The need of dependable stains in bacteriological work or in other lines where a microscope is used makes this work valuable both to the Station and to others elsewhere. Very often some member of another division comes to us to get advice on some problem in which staining is involved. This has happened in connection with work in botany, horticulture, and the insecticides investigations.

Project No. 17, besides receiving a large part of Dr. Conn's attention, is at present taking more than half of Miss Darrow's time, and it is hoped to make arrangements shortly so that she can give nearly her whole time to it. Miss Darrow is not a Station employee, but is hired by outside funds and put on Station work in return for the time given by Dr. Conn to work of less direct value to the Station. This work is regarded at present as being the most useful line of soil bacteriological investigation that is being undertaken. It is showing differences between soils that have not been observed by any other bacteriological method, and these differences seem to correlate with differences in productivity. It is hoped that it may soon develop a method for rapidly obtaining information as to reasons for low productivity in certain soils.

As soil bacteriology has not yet had many practical applications and as work in it is largely technical, it does not bring one to any great extent into intimate contact with farmers. There may be perhaps twenty to thirty enquiries from farmers answered in the course of a year.

Active part is taken in the meetings of the Society of American Bacteriologists each year. The work on biological stains brings close contact with other societies, such as the Amer. Public Health Assn., and the Amer. Assn. for the Advancement of Science. This work is in active cooperation with the National Research Council.

III NEEDS FOR FUTURE DEVELOPMENT

The primary need in connection with this work is greenhouse space. Certain practical problems continually come up that are of much interest, but cannot be investigated without opportunities for greenhouse work. The only way such problems can now be handled is in cooperation with either the agronomy or the horticultural division so as to make use of their greenhouse facilities. Much more work of a practical nature in soil bacteriology could be handled if greenhouse investigations could be carried on without involving other divisions.

To make best use of greenhouse facilities, if they were available, might require an assistant familiar with greenhouse work. Greenhouse space could be used even with only the present amount of assistance; but much greater advantage could be taken of the opportunity for such work if an assistant were at hand who had the knack of handling greenhouse cultures.

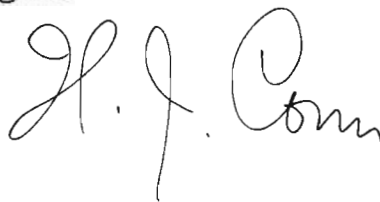
With greenhouse facilities available and assistance for handling such work it should be possible to undertake work on cultures for legume inoculation. There is at present no adequate inspection of such cultures in this state and we understand that there are difficulties in the way of undertaking it at Ithaca. There is coming to be demand for work of this kind, and with the increased facilities indicated, it could well be handled here. The work falls more logically under the jurisdiction of this Station, as it is similar in character to the seed inspection work, and is closely related to the canning crops investigations.

Development of work along all these lines could be accomplished to much greater advantage if the Division of Bacteriology had technical laboratory assistance available. Such assistance, by relieving staff members of the routine of making media and so forth, releases their time for work requiring greater skill.

More laboratory space could well be used at present and will be a necessity in connection with the increased program of soil bacteriological work just mentioned. It is to be hoped that this will be provided when better housing for the horticultural and related divisions is secured.

Lastly it should be remarked that fundamental scientific work in soil bacteriology, altho handicapped here, is much more so at other experiment stations. It has been largely stopped at many such institutions, and it is important that New York State continue in the future, as in the past, to encourage some research of this type.

Signed:

A handwritten signature in cursive script, appearing to read "H. J. Conn". The signature is written in dark ink on a light-colored background.

List of Journal Articles Published
during Last Five Years.

- American eosins, H.J.Conn, Chairman Committee on Standardization of Biological Stains, National Research Council. Science, 56, 689-690. 1922.
- The preparation of staining solutions, H.J.Conn, Chairman Commission on Standardization of Biological Stains, Science 57, 15-16. 1923.
- The standardization of biological stains, H.J.Conn, Chairman Commission on Standardization of Biological Stains. Science, 57, 24-25. 1923.
- Safranin and methyl green, H.J.Conn, Chairman, Commission on Standardization of Biological Stains. Science, 57, 304-305. 1923.
- Thionin, H.J.Conn, Chairman, Commission on Standardization of Biological Stains. Jour. Dairy Science 6, 135-136. 1923,
- Standardized nomenclatures of biological stains, H.J.Conn, Chairman Commission on Standardization of Biological Stains. Science, 57, 743-746. 1923.
- Dye solubility in relation to staining solutions, H.J.Conn, Chairman Commission on Standardization of Biological Stains. Science, 57, 638-639. 1923.
- Certified methylene blue, H.J.Conn, Chairman, Commission on Standardization of Biological Stains. Science, 58, 41-42. 1923.
- Progress in the certification of biological stains, H.J.Conn, Chairman, Commission on Standardization of Biological Stains. Science, 59, 18. 1924.
- Certified safranin, H.J.Conn, Chairman, Commission on Standardization of Biological Stains. Science 59, 556-557. 1924.
- Investigations concerning imported biological stains, H.J.Conn, Chairman, Commission on Standardization of Biological Stains. Science, 59, 328-331. 1924.
- The utilization of glucose in mineral media by bacteria with reference to acid fermentation, J.S.Joffe and H.J.Conn. Abs. Bact., 8, 10-11. 1924.
- A report on basic fuchsin, H.J.Conn. Science, 60, 387-388. 1924.
- Certified stains - what they are and how to obtain them, H.J.Conn. Jour. Lab. and Clinical Med., 10, 321-322. 1925.
- New applications of biological stains, H.J.Conn, Jour. Chem. Education, 2, 184-185. 1925.
- History of the Commission on Standardization of Biological Stains, by H.J.Conn. Stain Technology 1, 1-3. 1926.

- Progress in the standardization of stains: I. Methods of standardization. II. Grades of gentian violet. III. Recent information concerning basic fuchsin, by H.J. Conn. Stain Technology, 1, 49-59. 1926.
- Progress in the standardization of stains: The standardization of eosin and related dyes, by H.J. Conn. Stain Technology, 2, 81-86. 1926.
- Fluorescein dyes as bacterial stains, with special reference to their use for soil preparations, by H.J. Conn and W.C. Holmes. Stain Technology, 1, 87-95. 1926.
- Progress in the standardization of stains: The haematoxylin problem, by H.J. Conn. Stain Technology, 2, 1-3 1927.
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Periodical Edited

- Stain Technology. A quarterly published by Commission on Standardization of Biological Stains, Geneva N.Y. H.J. Conn editor and business manager.

Outline of the work of G. J. Hucker.

SUMMARY.

Two lines of investigation have been underway for sometime. One deals with improving the quality of cheddar cheese by proper grading of the milk to be made into cheese. As an outgrowth of this investigation a study has been initiated concerning the classification and identification of a certain group of bacteria which may be largely responsible for the ripening changes in cheese as well as being associated with other milk products, udder infections, etc.

Recently the work dealing with the study of this particular group of organisms has been expanded and an additional line of effort has been developed viz., a study of the sanitary quality of certain prepared baby foods. This latter project has been supported by funds received from ^{var} industrial concerns interested in the manufacture of baby foods.

I. WORK COMPLETED.

A. Investigations dealing with cheese.

For a number of years New York State has held an enviable reputation as a cheese producing State. The Station is anxious to aid in maintaining this standing and has planned work in this field with the thought of accumulating more information of immediate value to the cheese maker and cheese milk producer. Work of a bacteriological nature dealing with cheese ripening was resumed in 1919 and since that time the principal effort has been centered upon a study of the organisms in cheese and their relation to the ripening process.

The relation of the kinds of bacteria found in cheese to its quality.

After a general survey of the field it was found that little was

known in regard to the relationship of the types of organism occurring in cheddar cheese and the commercial quality of the cheese. However, a detailed examination of a large number of cheese purchased on the open market revealed that certain organisms were definitely associated with the poorer grades of cheese while others were always found in the cheese of a better quality. This latter observation led to a detailed study of these particular types of bacteria with the hope that information would become available in aiding the dairyman to so handle his milk that it would contain the proper bacteria for high grade cheese production. From these results we are now able to give more valuable suggestions to cheese milk producers in order that they can eliminate as far as possible the undesirable types which are generally found in low quality cheese.

Numbers of bacteria in milk in relation to the quality of cheese.

Upon a study of the economic conditions common to our cheese districts,

it was found that the return upon the investment by the cheese milk producer was below that of the dairyman in the market milk regions. However, the market milk producer had far more stringent standards to meet with respect to the quality of his milk. Many have believed that the raising of the standard of the quality of the milk in the market milk districts has been one factor which created better economic conditions for this type of dairyman. For this reason it was agreed that the quality of the milk in the cheese factory districts should be raised with the hope that a better quality of cheese would

subsequently increase the price as well as the total consumption of cheese, thereby reflecting upon the returns to the individual dairyman. With this in mind, investigations were immediately begun to study standards whereby cheese milk could be graded and the farmer reimbursed upon the basis of quality. As the numbers of bacteria occurring^m milk serve as an index to its sanitary quality in the production of market milk, it was thought advisable to learn if the same standards could be applied to cheese districts. Considerable time was spent in the northern New York cheese district gathering data at a typical cheese plant. The results of the work indicated that the numbers of bacteria in milk, altho significant from a market milk standpoint, were not important in determining the quality of milk for cheese making. It was found in some instances that the best quality cheese could be made from milk containing the largest number of bacteria while in other cases milk containing only a limited number of organisms produced a cheese which did not develop a desirable or typical flavor.

It was concluded from these investigations that the types of bacteria in the milk, as it arrived at the cheese factory, was a more important factor contributory to cheese quality than the total numbers of bacteria found in the milk. On the other hand large numbers of certain types were to be desired, but information is not at hand on which we could advise the farmer so to handle his milk to enhance the growth of the desirable types of bacteria previous to its arrival at the cheese plant.

While in Denmark during the past year, a special study was made of the methods in vogue of grading milk for cheese factories with the hope that some acceptable standards other than those based

upon numbers of bacteria in the milk could be found which were applicable to conditions in our own state.

The use of pasteurized milk for cheese making.

However, it was realized that studies

on the types of bacteria and their identification would consume considerable time if information upon this problem were secured which would serve as a basis upon which to control the production of satisfactory milk for cheese making. In order to study methods of improving the quality of the milk for cheese making which would have immediate application to the industry, a cooperative project was initiated with the Dairy Division to study the use of pasteurized milk for cheese making. The results of this investigation showed that milk could be pasteurized and made into cheese, and that this procedure was very effective in controlling the undesirable organisms which may occur in milk produced in cheese districts. It was found that a fair quality of cheese could be produced from milk which previous to pasteurization contained large numbers of undesirable bacteria. The method of pasteurizing the milk was practical and did not involve the addition of foreign acid to aid in curdling the milk with rennet. These results have received favorable comment from several European laboratories and were republished in Danish for distribution to the dairymen of Denmark. Work done previously at Cornell and published simultaneously gave similar results.

The bacteria used in cheese starters.

When the milk was pasteurized or even

in the use of raw milk, the question has arisen as to the proper type of organism which should be included in the "starter". A study of the organisms found in starters and their

relation to the quality of cheese was undertaken to learn their effects upon the production of cheese flavor. Many different types of streptococci were isolated from dairy starters and used as the basis of new starters for making cheddar cheese. It was found that certain types had a very beneficial effect upon the resulting cheese. A particular group of streptococci were noted which would impart a characteristic flavor to cheddar cheese made from pasteurized milk. While the uninoculated controls failed to develop the flavor characteristic of this type of cheese, the results of this investigation were recognized by the Hansen Laboratories in Copenhagen, Denmark, which produces a large percentage of the commercial cheese starters used in the United States, and these flavor producing streptococci were added to the complement of organisms already present in their starters.

Methods for examination of cheese. Certain difficulties have arisen from time to time in relation to the study and discovery of the organisms in the cheese. In order to facilitate this work, methods were perfected whereby the cheese could be so sectioned and stained and the organisms as they were found in the cheese could be studied. A study of the sections so prepared revealed that certain types were actively growing in the cheese while others were not increasing as the cheese became older during the ripening period. This same group of streptococci which were found to be important in the study of starters and their relation to cheese flavor, were found in large colonies in the cheese mass while certain other organisms which heretofore have been considered to be important factors, were found singly and in pairs, indicating that no growth had taken place.

Special studies on
Package cheese.

The cheese industry during the last few years has turned its attention to various methods of popularizing its product and meeting the demand of the public for a uniform grade of cheese in a convenient package. Many of the industrial concerns have succeeded in putting on the market a cheddar cheese package which has met with favor from the consumer. However certain difficulties have arisen with reference to spoilage. The Station has been called upon in several instances to offer advice in such cases and in one instance considerable work has been done to determine the organisms causing hydrogen sulphide production in packaged cheddar cheese. The results have been very encouraging and altho the work is temporarily terminated it is hoped that it will be resumed as soon as facilities are available.

B. Investigations with dealing with bacteriological technic.

Methods of interest
to the industry.

In the pursuit of the various problems difficulties arise as to methods of procedure which necessitates the improvisation of new methods. Such methods are not only adaptable to the case in question, but, in many instances, to other lines of investigation. As mentioned above a method has been improved whereby cheese can be sectioned and the bacteria in the cheese can be directly studied and some speculation made as to their growth and action upon the cheese. This method has been adopted in some circles and has lent aid in studying certain problems connected with the ripening of various types of cheese.

Methods of interest to
Bacteriologists.

In collaboration with Dr. Conn a detailed study has been made of the Gram stain

which is widely used in differentiating and characterizing bacteria. As an outgrowth of this investigation a new staining procedure has been suggested which is being used in many laboratories and which has solved some of the difficulties of the older methods in which the staining solutions were not stable and fresh materials were of necessity, prepared before use. A comparison of all the known methods of Gram staining was made involving some several thousand preparations and the results clearly indicated that workers in the field of Bacteriology were reporting irregular results due not to the inability of the organism to take the stain properly but rather to the inefficiency of the staining solution. Recommendations were made in regard to Gram staining procedures, which have been subsequently substantiated by other workers. The edition of this bulletin has become exhausted and a second and revised edition has been prepared.

A quick method of detecting acid production by bacteria from various test substances has been improved and media containing the suggested indicators have been prepared on a large scale by a supply house dealing in materials for the use of Bacteriologists. This method has been adopted for the qualitative determination of acid production by a number of laboratories. A similar procedure for the detection of ammonia has also been developed which has served the use of Bacteriologists in those cases where ammonia must be determined in the presence of proteins or aldehydes.

C. Investigations dealing with the studies on the Coccaceae.

In connection with the studies on cheese which were initiated with the thought of placing the cheese industry on a firmer basis, a line of work has been developed which has to do with the classification and

identification of the organisms involved in the ripening of cheese and commonly found associated with cheese and other dairy products. In order to arrive at conclusions which would be of value not only to the dairy industry and agriculture as a whole, the entire group of closely related organisms was studied, in order that more information would be available as to the significance of the various kinds of bacteria found in agricultural products. This group of bacteria which are one of the most commonly encountered in such sources and may be responsible for certain changes in various products, are the organisms grouped under the family name, Coccaceae. These bacteria are all spherical in morphology and predominate in dairy starters, udder flora, utensil contamination of milk, as well as being the etiological factor involved in certain diseases as mastitis, secondary infections of various kinds, etc.

One of the genera viz., Micrococcus, was studied intensively and after a comparison of several hundred strains collected from various sources a system of classification was suggested. This classification has served as a basis for other workers and been responsible for a clearer understanding and more definite identification of the strains of this type generally encountered. The classification of such a group of organisms opens up many new avenues of approach to long existing problems, Once the identity of an organism is established by such a classification the sources of contamination in milk can be more definitely traced.

The nitrogen metabolism of the micrococci was studied in detail with hope that once knowing the availability of various proteins to this group of organisms some conclusions could be drawn as to their possible action upon the casein in ripening cheese. It was found that

pure amino acids will not serve as sources of either carbon or nitrogen. Pure simple proteins are not available sources of nitrogen if washed cells of the micrococci were inoculated into solutions containing such proteins as the nitrogen source. However if unwashed cells were inoculated into such solutions, growth generally followed. On the other hand if washed cells were inoculated into a medium containing simple proteins to which traces of digested protein were also added, growth was noted in 24 hours. It was concluded from these investigations that simple proteins will not serve as a source of nitrogen to initiate growth but once growth is started the micrococci will attack and break down such types of protein. Chemically pure amino acids however are rarely available even if growth has been initiated.

It was also found that various carbohydrates have a protein sparing action upon bacteria with respect to metabolism. Micrococci will not split a simple protein molecule to obtain carbon but will utilize the loosely attached amino groups if carbon is available from other sources.

Further work in cooperation with Dr. Carpenter has shown that bacteria find a greater amount of available nitrogen in the earlier as well as the later stages of protein digestion than during an intermediate stage of the digestion.

D. Publications.

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- The flora of American commercial cheddar cheese and its relation to quality. Presented before the Worlds Dairy Congress, Syracuse, 1923.
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- Methods of Gram staining. (With Dr. Conn) N.Y. Agric. Exp. Station, Tech. Bull., 93.
- Studies on the Coccaceae. I. Previous taxonomic studies concerning the genera of the Coccaceae. N.Y. State Agric. Exp. Station, Tech. Bull., 99.
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- Studies on the Coccaceae. IV. The classification of the genus Micrococcus Cohn. N.Y. State Agric. Exp. Station, Tech. Bull., 102.
- Studies on the Coccaceae. V. Serological studies of the micrococci. N.Y. State Agric. Exp. Station, Tech. Bull. 103.
- A study of the characters of primary importance in the differentiation of the micrococci. Centralbl. f. Bakteriol., etc., Orig., 95, 109.
- Studies on the serological relationships of the species of micrococci. Centralbl. f. Bakteriol., etc., Orig. 95, 123.
- The validity of names applied to genera and sub-genera of the Coccaceae. (With Dr. Breed) Centralbl. f. Bakteriol., etc., 11 Abt., 64, 321.
- The Gram staining properties of the micrococci. Centralbl. f. Bakteriol., etc., Orig., 95, 446.

The species of the genus, *Micrococcus*. Centralbl. f. Bakteriol. etc. 11 Abt., 64, 481. (Abstract of N.Y. State Agric. Exp. Station Tech. Bull., 102).

The utilization of protein and non-protein sources of nitrogen by the micrococci. (With Dr. Rettger of Yale University). Centralbl. f. Bakteriol., etc., 11 Abt., 65, 272.

The utilization of the hydrolytic decomposition products of protein by micrococci. (With Dr. Rettger of Yale University). Centralbl. f. Bakteriol., 11 Abt., 65, 118.

Effect of pasteurization and cooling of milk upon the quality of cheddar cheese. (With Mr. Marquardt). N.Y. State Agric. Exp. Station, Bull. 534.

The effect of certain lactic acid producing streptococci upon the flavor of cheddar cheese. (With Mr. Marquardt). N.Y. State Agric. Exp. Station, Tech. Bull., 117.

Om Ostmaelkens Afkøling og Pasteurisering. Mejeri-Posten, 9, 41.

Der. Einflutz des Kuhlens der Milch auf die Qualität des Cheddar-Kases. (With Mr. Marquardt) Milchwirt. Forschungen, 3, 359.

Effect of certain streptococques d'acide sur l'arome du fromage de cheddar. (With Mr. Marquardt) Le Lait, 6, 845.

Further studies on the methods of Gram staining. (With Dr. Conn). N.Y. State Agric. Exp. Station, Tech. Bull., 128.

The relation of hydrolytic decomposition products of proteins to bacterial growth. (With Dr. Carpenter) Jour. Inf. Dis., 40, 485.

The agglutinability of strains of micrococci isolated from similiar habitats. (With Dr. Robertson) Centralbl. f. Bakteriol., etc., 11 Abt., 68, 1.

The agglutination reaction as a test for differentiating the micrococci. Centralbl. f. Bakteriol., etc., 11 Abt., 68, 7. (Also in N.Y. State Agric. Exp. Station, Tech. Bull., 118.)

Serological methods for the Pure culture study of bacteria. (With Dr. Bayne-Jones) Manual of Methods for Pure Culture Study of Bacteria.

Results in manuscript form.

Studies on the Coccaceae. VIII. A study of the cocci resisting pasteurization temperatures. (In press)

Studies on the Coccaceae. IX. Further studies on the classification of the micrococci. (In press)

Studies on the Coccaceae. X. The motility of certain cocci. (With Miss Thatcher). (In MSS)

Studies on the Coccaceae. XI. The effect of the medium on the chain forming characteristics of the streptococci. (In MSS)

Studies on the Coccaceae XII. Certain biochemical reactions of the streptococci. (In MSS)

Studies on the Coccaceae. XIII. Action of the streptococci upon casein. (In MSS).

Studies on the Coccaceae. XIV. Carbon dioxide production of the streptococci. (In MSS)

Studies on the Coccaceae. XV. The relationships of the acid proteolytic cocci. (In MSS)

III NEEDS FOR ADDITIONAL FACILITIES.

Sympathetic
consideration.

Continued Sympathetic consideration and counsel from the administration and friendly cooperation between the various members of the Department are essential for the completion of satisfactory work.

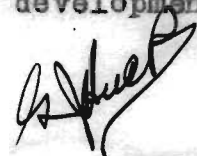
Funds

There is urgent and great need for funds whereby additional technical assistance can be secured to care for the large amount of routine work always involved when bacteriological work is to be done. At present a cooperative project with the Universities of Stockholm and British Columbia, dealing with the important cheese problems, awaits assistance to care for the extra work involved. The other two institutions have made arrangements for such help but this Station has been compelled to temporarily withdraw until aid is forthcoming. By such a withdrawal the dairymen of the New York State are daily losing the the advantage of the experience of two other large institutions as well as the use of results which may have a far reaching practical significance.

There is also immediate need for more clerical assistance to aid in caring for manuscripts as well as other routine duties.

More space is
necessary.

The quarters in which the work must be carried on are inadequate. This need is emphasized even in light of the fact that all similar institutions are perennially requesting more room. Our quarters are too meagre for proper continuance of the work without regard to the development of any new lines of effort.



Tomato Products Investigation.

Several years ago because of an outbreak of spoilage in catsup, our attention was called to the problem of preventing spoilage in all tomato products.

A causal organism was identified and its heat resistance and other characters determined by Mr. Mickle. The results of this investigation were published in Tech. Bull. 110 by F. A. Mickle and R. S. Breed. This was followed up by further investigations of spoilage in catsup, canned tomatoes, pulp and similar products, and it has been found that there are several types of bacterial spoilage which occur. The loss from such spoilage can hardly be estimated. It occurs both in home canned goods and in factory canned goods. In a recent study of the conditions, one factory reported that thousands of cases of catsup had been returned to them.

Several hundred cans, jars or bottles of these materials have been opened, the causal organisms isolated and classified. Classification although apparently of scientific interest only, is of extreme practical importance in that other bacteriologists and chemists are enabled to compare any organisms found by them in spoilage with these organisms, and if they happen to be the same, learn the characteristics of their own organisms without going into a detailed study. The heat resistance of these organisms as well as their resistance to ingredients normally present in catsup, have been determined. From these studies it has been found possible to prepare a catsup in which spoilage organisms will not grow readily. The results of this work are found in Bulletin 538, and the popular edition of Bulletin 538. From heat resistance studies, we have

learned the temperature necessary to kill the bacteria which are most often found in tomatoes or pulp.

It is of great importance in the canning of such products to know how much heat is necessary, especially since catsup loses its bright red color and the pectin is destroyed by overheating. Tomatoes also lose their color and continued heating causes the fruit to lose its firmness. Pulp is affected in the same way.

This work is now being prepared for publication, one bulletin to be presented from the scientific standpoint for the use of the chemist and bacteriologist in the industry, while a second will be presented from a practical standpoint. The results of the catsup studies have been presented from a scientific standpoint to the Society of American Bacteriologists. It has been exhibited from a practical standpoint at the State Fair, where many questions relative to the making of good catsup were answered. Several trips have been made among the canners of the State for conferences, particularly with their chemists. Two news items have also been published relative to this work.

Although the actual laboratory work is considered practically complete, we will continue to advise the canners as well as the housewives.

If the problem were to be continued, it would be to determine the heat necessary to kill bacteria in canning tomatoes using various concentrations of sugar and salt, the ingredients ordinarily present. We are not equipped at present, nor have we room enough to carry out a project of this nature.

Biochemical Studies of Bacteria.

It has always been of scientific interest and very often of practical value to know the type of products produced by bacteria. Some bacteria produce poisonous products, others produce materials which spoil the product in which they grow, while others are extremely beneficial in that the end products of their fermentation are desirable either as foods, in preventing undesirable spoilage, in producing certain helpful effects as in tanning, or on producing by products which can be recovered and used.

A study has been completed on the fermentation of glucose by certain red pigment producing bacteria of the genus Serratia. The paper is of interest from the standpoint of classification, particularly in pointing out the relationship of this group to the colon and aerogenes groups.

The results have been presented at the recent meeting of the Society of American Bacteriologists and will be published in the Journal of Bacteriology.

Further studies are being made with the organisms of sauerkraut and spoiled tomatoes.

Studies on Bacterial Canker of Tomatoes.

Bacterial canker of tomatoes was noted in Erie and Niagara Counties during the seasons of 1926 and 1927. The loss to the tomato growing industry in Niagara County was estimated at \$50,000 in 1926. Since the disease is caused by a bacterium, we are cooperating with Dr. ^{H.H.} Jones in this study. We find its isolation complicated by growth

of secondary organisms which apparently help kill the plant.

Methods of control especially in selection of seed from healthy plants, in destruction of refuse, and in treatment of seed are being worked out. These will be continued in a study of plots and in farmers' fields thruout the state, in an attempt to determine the relation of the source of seed to the disease.

Cornell Extension Bulletin 170 described the disease very briefly and in it control measures are advised.

Sauerkraut Investigations.

The production of a high grade uniform sauerkraut in a comparatively short time is a problem of interest to the kraut packer. Geneva is in the center of one of the largest sauerkraut producing regions in the world.

Sauerkraut is a product of very complicated fermentation. Ordinarily the sugars are broken down to produce desirable end products such as lactic acid. Often in actual practice undesirable organisms grow and produce soft, yellow, pink, or red kraut, and may actually destroy the acid produced. At other times fermentation starts so very slowly that it may require months to obtain the correct acidity. These conditions can not be corrected until we have a thorough understanding of the fermentation.

It has been shown that the fermentation can be changed greatly by the use of starters, such as a pure culture or mixed cultures of organisms, obtained from kraut or juices from other vats. Some of the effects produced are very poor but others are desirable. As yet

no decided improvement has been affected over naturally fermented kraut produced by a good fermentation. A study has also been made of the bacteria present in sauerkraut, and the change in types of organisms during the fermentation such as the killing of undesirable types, the growth of new desirable types and the reappearance of undesirable types.

The problem will be continued during the coming fall and winter. At present no publications have been presented. The kraut packers of the vicinity have been addressed at a meeting at Syracuse and the kraut men in the vicinity have been consulted with and assisted during the past three years.

To be carried out effectively this problem requires a great amount of routine work of a type which could be done by a laboratory assistant if one were available.

Carl S. Pederson

I - Bacteria that survive pasteurization.

One of the most popular and prosperous agricultural activity of the farmers of New York is the production of milk. 4,693,200,000 pounds of milk of \$175,550,000 value to the farmers were produced in 1926. When it is remembered that about 75% of the milk produced in New York is consumed as fluid milk or cream, the larger part of which is pasteurized, investigation of this subject is seen to be important to the dairy industry of the State. This question is also of very great interest to the various public and private milk control laboratories of the State due to their duty in maintaining milk quality standards, as well as to those industries manufacturing dairy products, condensed or powdered milks for example, in which the milk is subjected to heat treatments.

The present investigation is a continuation of this problem undertaken in this laboratory several years ago shortly after a few investigators in the dairy industry had noted unusual results obtained by plating pasteurized milk and at almost the same time that in certain cases the usual percentage reduction of bacteria by pasteurization was not being obtained. The problem, first studied in this laboratory by Dr. A. H. Robertson, falls into two natural divisions; the one dealing with the non-spore forming group of bacteria which was investigated by him, and the other dealing with the spore forming group with which the present investigation is concerned.

In his study, the results of which are given in Technical Bulletins Nos. 130 and 131 of this Station and Bulletins Nos. 274 and 275 of the Vermont Agricultural Experiment Station in cooperation with this Station, Dr. Robertson found five species of organisms, 90% of whose

numbers were able to survive the pasteurizing process.

Two of these types were found to be important. After establishing their identity he studied some of their important relations to the dairy industry. Among other things he investigated the changes they produce in the milk in which they are growing and the conditions which favor their survival during pasteurization. Of special interest is his study of the relationship of the age of the bacteria to their heat resistance from which he points out how the efficiency of pasteurization depends much on the history of the raw milk.

The present phase of the study deals with the identification of the thermophilic spore forming bacteria found in milk and the frequent occurrence of tiny colonies, commonly known as "pin-point" colonies, on agar plates poured from pasteurized milk.

(1) The heat-resistant types of bacteria, which term includes the organisms isolated by Robertson as well as those in this study, are very largely responsible for this type of colony and its appearance is usually indicative of their presence in the milk. In the present study seven types of organisms have been isolated from such colonies. Of these, three types have been found to be the most important. These colonies are the cause of much trouble to the milk control laboratories and the milk plant operators in securing desirable, low-count, pasteurized milk. The control laboratories are troubled because this type of colony frequently is difficult to see and hard to count, thus increasing the difficulties of securing accurate bacterial analysis of milk on which sanitary control is so largely based. Also these colonies appear sporadically and irregularly, creating difficulties in securing comparable counts in the same laboratory or between different laboratories.

Some municipal milk control laboratories have regarded these "pin-point" colonies as indicating unsanitary practices in the pasteurizing plants which handled milk giving such colonies, and have threatened to revoke the plants' licenses thus closing them. Such action creates disturbance in the milk industry. This study has shown the pasteurizing plants are usually not at fault, but that the trouble frequently is due to the presence of the heat-resistant organisms in the raw milk. Their numbers in the raw milk can be controlled in part by practices on the farm. This throws the responsibility in part back on the farmer, for he is the one responsible for the cleanliness of the milk produced. Here is a problem which he needs help in solving. What economical procedure is he to follow that will keep down the number of heat-resistant bacteria in the milk he produces? Fundamental and detailed study on the identity, nature and habitat of these organisms will probably answer the question. This study has indicated some suggestive possibilities.

Measures for better understanding of the organisms have been indicated to the dairy industry and milk control laboratories by the use made in this investigation of the Breed microscopic technique and counts of agar plates poured from milk incubated at 55° C.

(2) At present an effort is being made to identify the thermophilic spore-forming rods isolated from milk with previously named and described species. Also certain of their relationships important to the dairy industry is under investigation. Finally, the evidence as to their probable source will be given. This should help in their control.

A preliminary note on this work was given at the 1927 Christmas

meeting of the Society of American Bacteriologists. A popular article based on this study was published in "Glass Lining" which is issued by the Plaudler Co.

This investigation is nearly completed and the manuscript is in process of preparation.

II - Certain factors involved in controlling the quality of raw milk.

A. Securing fair samples for bacterial analysis.

(1) The larger part of the fluid milk and cream sold in New York is subjected to some sort of sanitary control.

The sanitary control of milk is based very largely on its bacterial content. The bacterial counts may be noticeably affected by the methods used in obtaining samples for bacterial analysis. Besides this very important public health activity additional interest is given to this question by the practice of the largest milk companies of the state in paying premiums for milk which bacterial analysis indicate to be of a certain purity from the standpoint of bacteriological content.

This study has shown it is practicable to use the composite butter fat samples for bacterial examination by the Breed microscopic technique as a means of quickly gaining an indication of the bacteriological quality of the milk delivered by each patron. This is of very real advantage when it is important to diagnose and clean up quickly the sanitary conditions of a milk plant, especially if it is not subject to regular sanitary control. Practically all milk plants have composite butter fat samples from which such samples may

be secured. The influence of the preservatives used in these samples on the staining reactions of the bacteria has been studied for their effect on the desirability of these samples as specimens for bacterial examination. An extended application of this same principle is the practicability of sending preserved milk samples to a central laboratory for examination, thus aiding the health officers in communities that have no laboratory facilities for sanitary control. This may prove of much value when the revised N.Y. State Milk Code goes into effect, since it requires a much stricter laboratory control of the sanitary quality of the milk, than prevails at present.

Another phase of the problem studied is advisability of securing samples more rapidly of the raw milk as delivered for examination by the Breed microscopic technique so that one inspector can extend his activities and still remain effective. Milk companies already use it and the New York City Milk Inspectors are adopting this method as an aid in their use of the Breed microscopic technique to control the sanitary quality of milk delivered to New York City.

(2) This investigation is now being concluded and the manuscript is under preparation.

B. Milk Sediment Testers.

(1) The revised New York State Milk Code that goes into effect this year provides that each producer's milk shall be tested for sediment at least once each month. In order to be able to advise with milk plant operators intelligently concerning the merits of different types of sediment testers available a comparison of them has been made and their performance studied. A questionnaire has been used in securing information from private and municipal milk control laboratories, concerning their preferences of types and the reasons therefor, and

any recommendations. Some study has also been given to the preparation of standard discs for comparison and grading purposes. A photographic reproduction of a set of standard discs prepared in this laboratory appears in the Fifth Edition, Standard Methods of Milk Analysis, American Public Health Association.

(2) This investigation is now being completed and the manuscript is being prepared.

(3) Work on these problems has been handicapped by the crowded working conditions of the laboratory. Thru lack of space this laboratory has to serve in part as a stock room and preparation room for the rest of the Division of Bacteriology as well as a general passageway with the consequent unavoidable interruptions and inconveniences.

Another pressing need is a laboratory helper that can assume some of the routine work in the laboratory and assist in some of the more difficult work. The value of such assistance has been strikingly shown in the valuable help given by Mr. Harkness, a Hobart College student, who has been working part time in this division.

Since coming to the Station a little over a year and a half ago several outside activities have been engaged in. Among these has been that of Assistant Judge of milk and cream at the N.Y. State Fair in Syracuse. Another was in cooperation with the N.Y. State Department of Agriculture and Markets in inspecting commercial bacteriological laboratories. Assistance in demonstration of and instruction in bacteriological technique, especially the Breed microscopic technique, for certain visiting technicians and laboratory workers visiting this Division for that purpose has been done. The duties of the office of Secretary-Treasurer of the N.Y. Central State Branch, Society of American Bacteriologists, also have been handled in this laboratory.

Assistance has also been given to the work of the City Bacteriologist from time to time. That work was handled for a month during a vacancy in that position and training was given to the present incumbent. Cooperative efforts have also been made since then from time to time as the occasions warranted.

P. J. Prickett

Division of Botany

F. C. Stewart, Chief

W. O. Gloyer

W. H. Rankin

L. K. Jones

Seed Laboratory

M. T. Munn

M. E. Woodbridge

O. M. Hoefle

REPORT ON WORK FROM 1923 TO 1928

By F. C. Stewart, Chief in Research

General Statement

As Chief of the Division of Botany, the writer has general supervision of six Associates and two Assistants. Such work occupies perhaps one-third of his time. A small proportion of time is devoted to answering inquiries, estimated at between 600 and 900 per year, on miscellaneous botanical subjects, most of which relate to potatoes, popcorn, mushrooms, and plant diseases not in the province of other members of the Division. The remainder of his time, approximately two thirds, is devoted to research, which, during the past five years, has been chiefly on projects relating to popcorn, potatoes, and mushrooms (wild and cultivated).

Some Practical Results of Research

I. With popcorn

It was proven conclusively that the popping of popcorn is very largely dependent upon the moisture content of the corn; that a moisture content of 13 to 15 per cent is the most favorable; and that during the greater part of the year, in New York, approximately this moisture content is found in corn stored where it has free access to the outside air, but corn stored in a heated building soon becomes too dry to pop well. This knowledge is of much practical importance in the handling and storing of popcorn.

A simple home method of rejuvenating over-dry popcorn was devised, and the best methods of home popping determined. (See Bulletin No. 505.)

II. With potatoes

1. By means of field experiments conducted during four seasons it was determined that bordeaux spray is considerably more efficient than the Sander's copper-lime dust in the control of potato pests, particularly the leafhopper, which causes the destructive disease known as hopperburn. Since both dust and spray are extensively used on potatoes in New York we believed, at the time, that we had definitely answered a question of much importance to potato growers. However, recent experiments in Ohio have given different results and we are considering further experimentation on the subject. (Bul. No. 518.)

The above work was done in collaboration with Mr. Parrott.

2. From the results of a four-year experiment with leaf-roll at Geneva and a three-year experiment with mosaic at Malone, the following conclusion was reached: "It appears that isolation and roguing of the seed plat cannot be depended upon to control satisfactorily either mosaic or leaf-roll, or even to prevent potatoes from running out with the latter disease under certain conditions. Nevertheless, the practice is to be recommended, as it is certainly helpful." (Bul. No. 522.)

Mosaic and leaf-roll are destructive diseases for which no method of control is known except the use of disease-free seed. Our aim is to find a method of producing seed potatoes free from leaf-roll and mosaic. A further experiment on mosaic by improved methods is in progress at Malone.

III. With mushrooms

1. During two winters experiments were conducted with mushrooms in flat beds under the benches in the Station greenhouse. The outstanding result of these experiments was the beneficial effect of cottonseed meal added to the manure during fermentation. In one experiment six beds containing cottonseed meal

yielded at the rate of 1.08 pounds per square foot, while the yield of the other six beds was at the rate of only 0.17 pound per square foot. All other conditions in the two series of beds were as nearly equal as it was possible to make them. The cause of the low yield on the untreated beds is not known, but whatever it may have been it was overcome by the use of cottonseed meal. (Bul. No. 546.)

Mushrooms are notoriously uncertain. It is our opinion that cottonseed meal may have an important place in mushroom culture.

2. In Bulletin No. 535 we have given an account of experiments and studies on the mica ink-cap, a common edible wild mushroom growing about stumps in lawns, pastures, etc. This is an edible fungus which everybody should know. Accordingly, special effort was made to describe and illustrate it so well that it may be identified with certainty. It was shown that there are eight or ten successive crops of the fungus between May 1 and October 1. Thirty-eight pounds were gathered about a single large elm stump in one season.

Research Results Chiefly of Scientific Interest

I. With popcorn

1. Owing to the lack of standard experimental methods for investigations of popping quality it was necessary to devise some, viz., (1) a volumetric method for the measurement of popping quality; (2) a method of regulating the temperature of the popper by means of the time consumed in popping; and (3) a simple method of determining the moisture content of corn. (Bul. 505)

II. With potatoes

1. The three-row plots used in the dusting and spraying experiments of 1922 and 1923 (reported in Bul. 518) were utilized in a study of row competition and "border effect". By comparing the yields of the middle rows with those of the outside rows it was shown that in the wet season of 1922 the latter definitely

outyielded the former; while in the dry season of 1923 there was only an insignificant difference in favor of the middle rows. Furthermore, in 1922 the south outside rows outyielded the north outside rows, owing, it is believed, to the better illumination of the former. The conclusion reached is that weather conditions have an important relation to row competition and "border effect" in potato plats. (Bul. 518, pp. 30-36.) This information is of use in the conduct of potato plat experiments.

III. With mushrooms

1. Observations on two species of fungi occurring in our mushroom beds, one a fawn-colored mold (Oedocephalum fimetarium), the other a large cup fungus (Peziza vesicubosa var. saccata), led to the conclusion that the former is a conidial form of the latter. (Mycologia 19, pp. 184-187. 1927.)

2. In our mushroom experiment of 1925-26 (reported in Bul 546) the mushrooms were of an unusual kind. They were identified by Dr. C. Kauffman, an expert on agarics, as belonging to Psalliota brunnescens, a rare wild species not known to mycologists to be under cultivation. A short paper giving an account of this discovery and a technical description of the fungus prepared by us has been accepted for publication in Mycologia.

Present Program of Work

Project No. 6. - The popping of popcorn. Present work on this project is along three lines: (1) The relation of age and viability to popping quality; (2) tests to determine the relative popping quality of about 32 varieties of popcorn; and (3) the length of time that popcorn will retain its poppability in air-tight containers.

No. 1 has been in progress six years and will be continued until the lower limit of poppability is reached. We have sufficient corn to carry the experiment

nine years longer if necessary. Mr. Munn makes the viability tests.

No. 2 is carried on in collaboration with Mr. Hall as a part of his study of the varieties of popcorn. It has been running two years.

No. 3 is intended to carry to a conclusion preliminary work reported in Bul. 505. It is to be commenced this spring.

No. 1 is of scientific interest chiefly. The practical bearing of No. 2 is obvious. For No. 3 it may be said that storage in fruit jars is a convenient home method for preventing corn from becoming too dry. Hence, it is desirable to know how long it can be safely stored in this manner. Also, fancy popcorn is now frequently sold in sealed cartons to retain moisture. Both the seller and the buyer of such corn are interested in knowing how long the corn will keep in such packages. We have previously shown (Bul. 505) that it keeps perfectly in sealed jars for at least three months.

Project No. 2. - Control of mosaic in the potato seed plat conducted at Malone in cooperation with L. L. Foote, a grower of seed potatoes. This is a continuation of work reported in Bul. 522. It has been running four seasons. By starting with healthy seed, by planting in tuber units, by destroying rose bushes in the vicinity of the seed plat, and by removing diseased plants as early as possible we are obtaining excellent results. However, previous experience warns us not to be over enthusiastic. The experiment will be continued a few years longer.

Project No. 32. - Studies on the sprouting of potatoes. This was begun in February, 1928. It has two objects: (1) To determine how accurately the health and vigor of potato plants can be predicted by means of sprouting tests of the tubers and the best and most practicable method of making such sprouting tests; (2) to determine the causes of poor stands and devise methods for preventing them.

Certain investigators claim that the character of the sprouts is a good index of the health and vigor of the future plant. Tubers affected with leafroll are said to produce slender sprouts. Tubers which are slow in sprouting usually produce weak, unproductive plants. There are also other sprout indications.

If by means of a sprouting test a grower could determine before planting time the health and vigor of his seed potatoes, it would be very useful. A simple method adapted to farm conditions is much needed. It would be particularly useful to growers of seed potatoes.

Imperfect stands are a frequent cause of low yields. Several factors are involved. Sometimes one thing, sometimes another is responsible. Some of the causes are pretty well understood, while others are little known. It is believed that a critical study of the problem would yield worth-while results.

Project No. 5. - Mushrooms and toad-stools. This project is in two parts: (1) A study of about a dozen of the wild mushrooms and toadstools; and (2) a survey of the larger fungi growing in the vicinity of Seventh Lake in the Adirondack Mountains. The former is a regular Station project, the latter a vacation project carried on chiefly during the writer's vacations. Both have been in progress several years.

The woods, pastures, and lawns of New York produce large quantities of edible fungi, most of which goes to waste. There is widespread interest in them, but the difficulty of distinguishing edible from poisonous species deters many people from using them. It is our aim to help out here by furnishing full, plain descriptions accompanied by color plates. Also, if possible, find simple methods of encouraging their growth where desired. On the latter subject we have already conducted numerous experiments without much success.

Bulletins have been published on two species, the velvet-stemmed *Collybia* (Bul. 448) and the mica ink-cap (Bul. 535). A bulletin on the uncertain *Hypholoma*

is well under way and this will be followed by a bulletin on puffballs which is expected to appear before July 1, 1929.

In this mushroom work we have the able assistance of Mr. Lawson, the Museum Preparator, who makes the paintings for the color plates. Mr. Lawson has also made excellent wax models of 16 edible and 4 poisonous fungi for our museum.

Project No. 5. Subproject No. 1. Cultural experiments with mushrooms. This has to do with cultivated mushrooms and is conducted under benches in the Station greenhouse. From the results of experiments in the winter of 1926-27 we suspected that a large quantity of straw in the manure has a harmful effect on the crop. (See Bul. 546, p. 37). The experiment of the past winter was designed to throw light on this matter. For some unknown reason the crop was a complete failure and nothing was learned. Probably, another attempt will be made next winter unless projected alterations in the greenhouse prevent.

Outline of Activities During the Year

In the selection of projects we take into consideration the way they fit into the season's program, but do the best we can there is some conflict at certain times. November 1 to March 1 is the slackest so far as experimental work is concerned. The greenhouse experiments with mushrooms fit in here nicely. Also, we aim to do as much as possible of our writing during this period, tho it is absolutely impossible to adhere closely to this program. This period is also used for odd jobs such as herbarium work in connection with the Adirondack mycological studies. The popcorn experiments should be made during March or April. Altho they take, altogether, only seven to nine days, we are finding it hard to fit them in this year with the potato sprouting tests in the greenhouse which require much and constant attention between March 1 and May 1. The field work on the potato sprouting project must have a good deal of attention from June 1 to

to July 10. During this same period the uncertain Hypholoma is at its best. About July 15 a trip must be made to Malone to look after the potato mosaic experiment there. Our usual time for vacation is the month of August. Puff-balls come on in September and should have our full time this year if the season is a good one. We have under consideration another experiment on dusting versus spraying for potatoes. If this is undertaken it will occupy a considerable portion of our time between May 25 and October 15 and necessitate some changes in the summer program.

Membership and Work in Scientific Societies

The writer has been a member of the American Association for the Advancement of Science since 1896 and a fellow since 1901. He has also been a member of the American Phytopathological Society since its organization in 1909. Formerly, he was active in this Society serving as President in 1913.

His chief activity in the Phytopathological Society during the past five years has had to do with an effort to bring about more rational methods and regulations in the nursery inspection for crown-gall. Realizing that the inspection regulations in several states were unjust and prejudicial to the interests of New York nurserymen he brought about an investigation of the matter by a committee of which he was made chairman. This committee reported at the Cincinnati meeting in 1923. Its recommendations were adopted by the Society and also by the American Association of Entomologists. (See report in Phytopathology 14, pp.172-173. 1924). The report of this committee stimulated research on crown-gall which has resulted in a better understanding of the disease and more rational inspection regulations.

Additional Facilities Needed

An urgent need in our line of work is more money for labor. The writer believes thorely that it is important to give careful attention to details in plat and greenhouse experiments. This cannot be done with the labor now available. Portions of the farm are so overrun with quackgrass that they cannot be used for plat experiments with potatoes or other small plants. Lack of labor at the proper time may ruin an experiment. At times, the writer has been compelled to use a hoe himself to prevent potato plants in his experiments from being strangled by quackgrass. Because of this unsatisfactory labor situation we have sometimes avoided taking on desirable potato projects involving plat work.

Another need is more and better greenhouse facilities. Many experiments can be more successfully carried out in a greenhouse than in the field. For example, in our study of the sprouting of potatoes much useful work can be done with potatoes in pots in a greenhouse. But we need a greenhouse in which the temperature of the air can be controlled well, and for certain investigations means for controlling the moisture content and temperature of the soil are necessary. It is impossible to conduct successfully experiments with beans, potatoes, tomatoes and roses all in the same house as we are now forced to do. We should have separate sections for the several crops and means of furnishing the special conditions required by our particular experiments. The greenhouse the Division of Botany now uses is unfit and wholly inadequate for our needs.

We also need more laboratory space, but the writer does not feel this need so much as other members of the Division who are doing more work in plant pathology. Our present laboratory designed for two men is required to serve four.

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RESULTS OBTAINED FROM 1923-1928 AND FUTURE PLANS

W. O. Gloyer

In the past the investigation of fruit tree diseases has been of such a long term nature that ample opportunity was afforded to take up minor problems which appeared of agricultural value. The study is also of a perennial nature, and usually the period over which the work can be performed is limited from a few days to a month in duration. To obtain results repeatedly under the same conditions requires years of experimentation, whereas in a vegetable or grain crop similar results on parasitism may be obtained in a few days. This is well illustrated in the case of the investigation of winter injury. The work was begun in 1916, and in 1923 injury was obtained. No injury has appeared since due to the inability of the natural conditions to so dovetail with each other as to favor the killing of tissue by low temperatures.

Investigations Completed

Cabbage seedbed diseases. - In 1924, Bulletin 513 was published jointly with Dr. Glasgow as an outgrowth of his work on the treatment of the cabbage maggot. Both the maggot and the damping off of the cabbage in seedbeds was a serious matter in the large kraut sections of this state. It was found that the mercuric chloride utilized to control the maggot readily controlled the soil fungi causing the damping off, so that in many places the liquid treatment has superceded the screen method. For the first time an adequate method was devised for the control of the club-root disease in cabbage seedbeds. The liquid method is now generally used thruout the country, and since the publication of Bulletin 513 other uses have been made of mercuric compounds for the control of soil diseases.

Small cherry. - In 1926, Bulletin 540 was published on the dwarfing, shriveling, and dropping of cherries and prunes. The constant association of the fungus Coniothyrium olivaceum to the shriveled Morello cherry indicated that this fungus was the possible cause of the injury. Attempts were made to control the fungus by means of applications of sprays and it was noted that the more spray applied the more injury was found present. It was observed that the fungus was secondary and the real causal agent was the use of lead arsenate, which produced an injury on the pedicels and thus cut off the sap flow, which resulted in shriveling of the fruit. Farmers were advised not to use excessive amounts of the insecticide and not to spray on hot, humid days in summer. The least injury was observed where the dry-mix or wettable sulfur was used as a spray.

Diseases of gladiolus corms. - In 1926, the gladiolus growers were at a loss to know the exact method for control of the hard rot of the corms, caused by Septoria gladioli. Heretofore no method of treatment had proved successful. Tests made at the Station proved that the fungus can be controlled and the results were published in 1927 with D. C. Carpenter as the junior author. The title of the paper is: "Comparison of fungicides for the control of the hard rot of gladiolus corms." (Bull. Amer. Gladiolus Soc. 4:20. Apr. 1927.) In the spring of 1927, similar tests were repeated on the hard rot and on a new disease called black-rot, caused by the fungus Penicillium gladioli. It was found that similar results were obtained as in the previous year and that both diseases were controlled by the use of warm mercuric chloride solutions. It was also found that at 120° F. the fungi were controlled without the use of a fungicide. The final recommendation now is to treat the corms for one-half hour at a temperature of 120° F. in water or a solution of 1-1000 of mercuric chloride. The results have been submitted to the Bull. American Gladiolus Society for publication and no doubt will soon be available.

Investigation Completed but not Published

Beans. - Formerly the production of dry beans was mostly in New York, but now other states have taken the lead so that New York is lagging in this important crop that goes hand in hand with the production of fruit. When the beans were originally planted in the orchard to note possible effect on winter injury, mosaic was the determining factor in bean production. This disease seems depressed at present and the bacterial blights now appear a menace to this important industry. Fortunately, the investigation of the bacterial blights has been of sufficient duration to enable us to make proper recommendations as to the best cultural methods necessary for the escapement of the blights. Where farmers readily produced 20 to 30 bushels of beans thirty years ago they are now producing six to seven bushels per acre. Some successful farmers have learned how to solve the problem by proper rotation of crops so that they are maintaining high production. In the minds of many farmers there is the fallacy that beans receive all their nitrogen from the air, and hence can be grown repeatedly on the same soil. This has led to a nitrogen deficiency of the soil so that the bean plants do not have sufficient nutrients to produce a vigorous growth and thus escape the bacterial blights.

Geneva and York two new varieties of beans. The Wells Red Kidney, which is usually grown in this state, appears to be resistant to the alpha and beta strains of anthracnose. It has been found to be susceptible to the gamma strain of anthracnose and to the bacterial blights. By crossing the White Kidney and the Wells Red Kidney, selections have been made that are now pure and in the F 8 generation. Both varieties are much superior to the standard varieties now grown. They are more vigorous, higher yielders, show less blight, are more palatable, free from hardshell and do not possess the tough seed coat as found in the Wells. It is believed that the new varieties will supercede the Wells in this state.

The Geneva variety had been distributed to thirty farmers in various parts of the state. Each was given a two-pound sample of similar seed. Some farmers produced as low as twelve pounds, while, on the other hand, the highest amount produced was 100 pounds. In the former case beans were badly blighted, while in the latter they remained free from disease. Apparently, in considering the yields from various farms it is necessary to note the conditions under which the beans are grown. Incidentally, it was shown that many farmers are not aware that the red kidney is a ravenous feeder and that many farms lack sufficient nitrogen in the soil to enable the plants to make a vigorous growth. The breeding results and comparative tests have been brought together and will soon be ready for publication.

Hardshell of beans. - The subject of impervious seed-coats, or hardshell of legumes, has been a matter of much importance to farmers and canners. In the case of the Robust pea bean which is used in canning, about ten per cent of the beans have to be discarded and cannot go into the packed product. Heretofore the causes of hardshell were unknown, and in the case of bean the factors involved have been determined. It has been found that the relative humidity of the atmosphere at which the beans are stored or harvested is the determining factor. By breeding and selection the hardshell factor has been eliminated in the Geneva and York varieties. Hardshell is not present under ordinary conditions of storage. Attempts are now under way to eliminate this factor in the Robust pea bean. Two preliminary papers have been published on this subject: "Sclerema and Hardshell: Two Types of Hardness of Beans." Proc. 12 & 13 Meet. Assoc. Off. Seed Analysts p. 60. 1921. "Hardshell of Beans: Its Production and Prevention Under Storage Conditions." Proc. 19 & 20 Ann. Meet. Assoc. Off. Seed Analysts pp. 52-55. 1928. The material and data of this subject has been compiled and partly written and will be submitted for publication after the bulletin on the Geneva and York varieties has been presented.

Time of planting and its relation to bacterial blights. - As has been already stated, it may be said that the blights have been the causal agent in making the farmer abandon the culture of dry and canning-crop beans. Besides the relation of soil nutrients to disease, it has been found that the time of planting also is a factor. Under fair soil conditions, beans have been planted at weekly intervals in parallel rows. The rows sowed early may be badly infected while those planted late are free from disease. Infection takes place at a certain period of growth, the time between June 15 to 20 being the most favorable time for planting. Other reasons for planting late are as follows:

1. Produces a uniform stand and uniform ripening
2. Produces large seed.
3. Avoids seed-corn maggot
4. Avoids bean weevil
5. Avoids hot weather and the dropping of blossoms.
6. Avoids hardshell and tough seed coat
7. Produces maximum yields
8. Produces the most palatable beans for family and canning use.

Most of the work has been finished and this will be compiled and written after the other two subjects on beans has been completed. Farmers have received the above information thru the press and by addressing them at Farmers' Week.

Aster diseases. - The subject of the diseases of the aster has been considered as a side issue rather than a major project. The aster seed industry formerly was a great one about Rochester and other places in the state. Many people now have about an acre of plants and ship the flowers in large quantities as far as St. Louis. It was found that instead of two diseases we have about eight present. The life cycles of four new diseases caused by fungi have been ascertained and their methods of control established. Heretofore the treatment of aster seed was not practised, but now all seed is being treated, due to the investigations at this Station. A grower at Baldwinsville has cooperated with me and is now the only successful aster-seed grower in the East.

An abstract of the work has been published in *Phytopathology* 14:64. 1924.
As soon as possible this work should be published in bulletin form.

Present Investigations

Beans. - There are a few things left in the investigation of bean diseases that should be continued as a matter of routine. They are here enumerated:

(1) The continuation of Robust and white pea bean crosses in order to test the purity of the selections as to hardshell. The production of such a strain is highly desired by our canners. If such a strain could be developed and produced in New York it would tend to swing the pea-bean industry back to this state. At present we cannot compete with Michigan because the Robust has been introduced and grown there so long that buyers look to that state for their supply of pea beans.

(2) I now have a cross between the Station selections and Mahogany red kidney which are now in the F_3 generation. It has been determined that the non-hardshell factor of the Geneva selections can be transmitted to other crosses and appears to dominate. Here is an illustration of a dominant factor (hardshell), when once eliminated, reacting as a recessive character. I have several selections which show the required color but have not been produced in sufficient quantity to determine the cooking quality. Should such a variety be produced it would help the New York farmers to regain the lost bean markets.

(3) The Geneva and York red kidney varieties ought to be continued a few years so as to supply farmers with small amounts of these varieties. Also attempts should be made, if possible, to increase the standard of production by selection of high yielding plants.

Winter injury. - The winter killing of fruit trees has been an important problem in all fruit-growing sections. In some states fruit raising has been abandoned due to continuous killing of newly planted orchards. For many years this subject has been investigated by former members of this Station. I believed that

detailed records kept of an individual orchard would throw some light on the relation of orchard culture to winter injury. In 1916, the Ben Davis orchard was planted to determine the effect of various factors on winter injury. The orchard was divided into three parts. One received manure in spring and a cover crop in the fall. Another received manure in the fall, and the third, or check, received only an oat cover crop in the fall.

Only in 1923 were results obtained. Attempts were made to duplicate the conditions under which injury was produced, but so far attempts have not been successful. It has been found by elimination that there were several factors which, when acting in unison, produced the injury. On several occasions two of the factors have been operative, but no injury was observed. Some of the results obtained are as follows:

1. The addition of manure in itself did not induce winter injury.
2. The addition of manure in the fall was highly beneficial in all respects and was much superior to the additions made in the spring.
3. Additions of manure in the spring may not show any improvement over the check. This holds true in dry seasons, especially.
4. Land deficient in nutrients may not show any beneficial effects of yearly applications of stable manure until five to six years have passed.
5. The checks were not as productive as the manured plats.
6. Interplanting orchards with beans was not injurious.
7. High headed or low headed trees were not a factor.
8. Plowing away from the trees favored winter injury to the roots.
9. Applications of white or black non-injurious paints showed that absorption of the heat rays alone was not a factor in the production of winter injury.
10. Analysis of the water content of branches taken thruout the year was illuminating, but showed no measurable differences that would play any part in the subject of winter injury. The water content may be a contributory factor under certain conditions.

The observations made in the Ben Davis orchard should be continued until the factors so dovetail with each other that injury is induced. Tests made in the laboratory are of little significance. Results have been given at the Horticultural Society meetings, but it was thought unwise to publish until the results of 1923 are duplicated under natural conditions in a control orchard.

Crown gall. - Each year thousands of dollars of nursery stock is destroyed because it shows enlargements which may be overgrowths or crown-gall. In contrast with the West, New York buds most of the nursery stock and less crown-gall is produced. Under these conditions, if enlargements are found on the roots there is little doubt that it is a disease formation. In New York, only, a fraction of one per cent of the budded stock is diseased. On western grafts crown-gall and overgrowths are very common. The question is raised as to whether or not such enlargements are injurious.

In 1926, a crown-gall orchard was established to determine the effect of the overgrowths on the future growth of Baldwin, Wealthy, and McIntosh trees. These are the three main varieties grown in different parts of the state, and all subject to overgrowths.

After five years of growth it is planned to remove some of the trees and make careful examination. A few trees were examined after two years and in some cases new galls were formed on the side roots while in other cases the overgrowths disappeared. In a few cases decay had set in at the region of the overgrowth.

Inoculations have been made on mature trees and some ^{galls} are now two inches in diameter. As these are above ground, it is easy to follow their future development. As yet, no relation has been found between the true galls and the formation of burr knots.

It is unknown just what results will be found in these studies, but that fact was considered at the outset when the project was undertaken.

Routine Duties

There is more or less routine work to be done each day which often upsets plans for the day's work. At some periods of the year the visitation of farmers is most numerous when a little-known disease becomes epidemic. It is believed that from two to three letters are answered each day on inquiries from bean growers,

fruitgrowers, and florists. With the center of the State Nursery Inspection Service located at Geneva, some of the time is taken in diagnosing diseases and verifying the conclusions of inspectors. In some cases visits have been made to the packing sheds to observe and pass judgment on shipments received. This contact with the Inspection Service is desirable since it keeps one informed of new diseases that are being shipped into the state.

Each year attendance is desired at the State Horticultural Meetings, where questions are answered on plant diseases. In some years special reports are made as chairman on fruit diseases. The contacts made at the State Fair are not beneficial from a research standpoint. Formerly, when the Pathology and Entomology Departments were the only ones to exhibit at the Fair, more than two weeks' time was consumed. This came at a critical period when observations in the field were very important. These duties are now undertaken by Mr. Lockett. In 1928 a special bean exhibit will be made which will be a summary of the culture, breeding, and cooking tests conducted at the Station.

Seasonal duties. - In the research of plant diseases I have found that no two similar seasons have been alike as to the division of time. Thruout the year the time has been divided between routine duties, actual time taken in conducting experiments, the compilation and recording of data accumulated, and the preparation of reports for publication.

In the spring and summer, the time has been devoted to orchard studies, and bean diseases and their reaction to the environment.

In the autumn, the recording and harvesting of small experimental bean plots and the harvesting of fruit in the Ben Davis orchard is undertaken.

The winter has been found best for intensive laboratory tests with fungi, seeds, and the action of fungicides on seeds and soils. At the proper time inoculations and spraying tests have been made, depending upon the problems under consideration.

In 1928, much of the time will be devoted to the writing of the bean investigations that have been completed in 1927.

Future Needs

For future progress it is highly desirable to have efficient equipment for the control and regulation of temperature and humidity. Heretofore, large jars have been utilized, but such methods are not satisfactory where large objects or plants are used. Had the new building been obtained, control chambers would have been provided. Similar chambers would be highly desirable in the greenhouse, altho it appears that they would not reach their highest efficiency unless installed in a house where steam heat is automatically controlled. Without new equipment and buildings to install such material, the character of the research can only be of a mediocre nature and not up to the standards maintained by other institutions in the state, such as Cornell and the Boyce Thompson Institute.

RASPBERRY DISEASE INVESTIGATIONS

Investigations begun July, 1922, under special appropriation, to determine the cause and control of the running-out of red raspberry varieties which had become the limiting factor in red raspberry culture. A virus, later named "red raspberry mosaic" was found to be the cause of the low yields and inferior quality in red raspberry fields thruout the state. My entire attention for about three years was devoted to the practical aspects of the red raspberry mosaic problem, and as time permitted other virus diseases of the raspberry group were taken up. The results obtained in the past five years are reported in Complete Bulletin 543.

1 a Practical results include:

1. The cause of the general abandonment of red raspberry culture was identified as mosaic.
2. By publications, talks, correspondence and Farm Bureau cooperation growers have been taught generally to recognize the symptoms of mosaic.
3. The manner of spread of raspberry mosaic was determined to be due to a single species of aphid and observations on the life history and habits of this aphid have suggested practical means of reducing the rate of spread of mosaic.
4. The average rate of spread of mosaic has been determined for different sections of New York, giving growers an estimate of the depreciation rate of plantings in their section.
5. The susceptibility of a large number of varieties has been determined, thus giving growers a chance to intelligently choose varieties for various locations according to the rate of depreciation in yield and quality that may be expected.

6. The fact that mosaic spreads very slowly in some varieties and rapidly in others under identical field conditions was determined for a large number of varieties, thus giving growers a chance to choose the mosaic-escaping varieties for sections that demand this type of control measure.

7. Mosaic-free strains of a large number of varieties were developed as foundation stock, and this stock was used to demonstrate that mosaic losses could be thus avoided in sections where the average rate of spread of mosaic was low.

8. Mosaic-free stock and roguing the first and second year after planting were demonstrated as successful control measures for central and western New York.

9. Such measures for the lower Hudson River valley failed due to the higher rate of spread there, and the only measure of control indicated for that region is the use of resistant and mosaic-escaping varieties.

10. Mosaic losses in black raspberries have been shown to be avoidable by keeping red and purple varieties at a distance from black plantings.

Ib. Fundamental and non-practical results:

The raspberry virus disease project has been conducted entirely with practical results under field conditions as the object in view, therefore only few fundamental results have been possible.

1. It was determined that mosaic-escaping and relative susceptibility are two distinct and uncorrelated factors. The new term "klescidity" was coined for use in designating this factor of escaping infection. An article on the use of this new term is in preparation.

2. A biologic relation between the single species of aphid and the virus is indicated by the fact that the younger instars are far more efficient carriers.

3. The Station collection of named varieties, seedlings resulting from breeding and newly named varieties being multiplied have been rogued annually.

thus keeping the foundation stock for horticultural characters free from mosaic.

4. Records have been kept on susceptibility and klandusity of all varieties and seedlings.

Ic. Cooperation on raspberry disease problems.

1. The nursery stock certification law was amended in 1923 to include raspberry virus diseases. Encouragement and assistance was given annually to the Department of Agriculture and Markets in reducing the amount of mosaic in raspberry nursery stock.

2. Close cooperation with several County Farm Bureaus has been maintained where such assistance was desired; the best permanent results being secured in Monroe and Erie counties.

3. A system of inspection and certification for a brand of high grade mosaic-free raspberry nursery stock is in operation thru the New York State Seed Improvement Association, with Farm Bureau, Geneva Station, and College of Agriculture cooperating.

Id. Publications.

- Rankin, W. H. Raspberry mosaic and mosaic-free planting stock.
Proc. 68th Ann. Meeting New York State Hort. Soc., 1923,
272-280. 1923.
- _____ Running-out of raspberries. New York State Agr. Exp. Sta.
Circ. No. 67, 1-12. 1923.
- _____ Raspberry diseases. Proc. 69th Ann. Meet., New York
State Hort. Soc., 1924, 139-145. 1924.
- _____ Raspberry mosaic and bluestem. New York State Agr. Exp.
Sta. Circ. No. 75, 1-4. 1924.
- _____ Raspberry mosaic control in the Hudson River Valley.
Proc. 71st Ann. Meet., New York State Hort. Soc., 1926,
173-178. 1926.

Rankin, W. H. and Hickey, J. F. Mosaic and leaf-curl (yellows) of the cultivated red raspberry. *Phytopath.*, 12, 253-264. 1922.

_____, _____ and McGurry, J. B. Leaf-curl and mosaic of the cultivated red raspberry. *Phytopath.*, 12, 58. 1922.

IIa. Present program.

1. Inheritance of mosaic susceptibility in red raspberries. In cooperation with the Division of Horticulture, the several hundred seedling red raspberries developed by breeding are being inoculated to determine their susceptibility. The practical aim is to develop a high quality mosaic-resistant variety.

2. Virus diseases of black raspberries. Five virus diseases of black raspberries have been described by various writers, but they are incompletely understood. In a planting of about 1500 Plum Farmer plants progressive symptom and inoculation studies are being made. These studies are fundamental to the working out of practical control measures.

3. Mild mosaic of raspberries. This is one of the described virus diseases of black, purple and red raspberries. Two states, Michigan and Wisconsin, include it in their nursery stock certification regulations. It is a puzzling, low temperature, mosaic-like trouble of doubtful economic importance in New York. More information on it is important from the nursery inspection standpoint.

4. Strawberry root-rot. This is probably the most important strawberry disease in New York and other northern states. Field and greenhouse studies are planned to determine the effect of soil conditions as predisposing agents leading to root-rot. The progress of this study will depend upon suitable greenhouse chambers for controlling temperature and moisture relations.

IIB. Activities during the year.

April 1 to November 1, spent in field work at Geneva and elsewhere. Winter months spent on miscellaneous activities such as occasional meetings, library work, summarizing field notes, etc. No progress on projects is made due to lack of laboratory and suitable greenhouse facilities. Correspondence probably averages about four letters a day in winter months. Including all types of meetings for discussion of raspberry diseases there are about ten annually. Usually attend the annual meetings of the botanical societies. Am member of committee in charge of the 1928 Summer Meeting of the American Phytopathological Society to be held in New York City in August. Subject of the Field Conference this year is "Diseases of Ornamental Plants." Time secured by special and vacation leave is largely spent on tree-disease investigations.

III. Additional facilities needed.

At present and for six years past, have had practically no facilities in the way of laboratory or greenhouse space to supplement the field problems under investigation. I have desk space only. A well equipped plant pathology laboratory and greenhouse with modern facilities is needed before the winter months may be used to supplement field problems.

W. H. Rankin, Associate in Research.

April 9, 1928.

D I V I S I O N O F B O T A N Y

Leon K. Jones
Associate in Research

The work on canning crop diseases was initiated July 1, 1925. Since this date I have been working on three major projects as follows:

1. A study of diseases transmitted in pea seed.
2. A survey of canning crop diseases
3. A study of a new bacterial stem-rot disease of tomatoes.

The results of investigations of the diseases transmitted in pea seed are recorded in Bulletin No. 547. These investigations were started because of the extreme damage to the pea industry caused by *Ascochyta* blight in 1925. A conservative estimate of the losses caused by this disease in 1925 can be placed close to \$1,000,000 in a \$7,500,000 industry. It had been shown previously that the organism causing *ascochyta* blight was often carried in the seed.

Practical Results

(1) Devising a reliable method of testing pea seed to determine the presence of *Ascochyta* blight organisms in the seed.

(2) Standardizing the above method so that it can be used by seed testing laboratories.

(3) Showing where healthy seed can be produced: practically all of the seed grown in the semi-arid western part of the United States is free from these organisms, while a large percentage of the seed produced east of the Mississippi river is more or less infected.

(4) Field and greenhouse experiments showed that diseased seed usually gives a reduced stand of plants, compared with the stand from healthy seed. Also that the use of diseased seed introduces the organisms into the pea fields in a position very favorable for causing extreme damage during the growing season.

(5) Reducing the amount of diseased seed used by New York farmers. The investigations have resulted in the return of diseased lots of seed to seedsmen to such an extent that they are very careful to send only healthy seed into New York. This is illustrated by the results of the seed-testing work. During 1925-26, 828 samples of seed sent in by 24 canning companies were tested. Forty-nine of these samples were found to be diseased, and 20 of the lots were returned to the seedsmen. During 1926-27, the tests were made on 693 samples of seed from 26 canning companies. Of these 693 samples, only 10 were found to carry the *Ascochyta* organisms, and 5 of these lots of seed were returned to the seedsmen. During the present season some 500 samples of seed have been tested and no diseased samples from seedsmen have been noted.

(6) The treatment of pea seed with organic mercury compounds has quite consistently given increased stands of plants, especially when seed was planted in cold, wet soil adverse to rapid germination.

(7) It has been shown that the disease-producing organisms live over the winter on pea refuse and in the soil and that crop rotation and destruction of pea refuse aid materially in reducing losses.

(8) It has been shown that such varieties as Horsford, Advancer, Perfection, and certain new varieties are considerably more resistant to injury from these organisms than such commonly used varieties as Alaska, Admiral, Surprise, etc.

Scientific Contributions

1. Showing that three *Ascochyta* organisms have been confused in previous studies of this disease.
2. Clearing up the above confusion and naming a new species of *Ascochyta*.
3. Contributing to our knowledge of the period of incubation of these three organisms on the host.
4. Noting that mature ascospores of *M. pinodes* are commonly produced on the host during the growing season. This is contrary to the usual production of ascospores by a pathogenic organism. Usually ascospores (wind-carried spores) are produced on overwintering host material only.

The second project (a survey of canning crop diseases) has been conducted primarily to become acquainted with the disease problems in the state. This is necessary in order to know the major problems, so that special research work may be initiated on the major problems as they appear. Some results of this survey work may be noted in Circular No. 99.

Practical Results

- (1) Obtaining a practical knowledge of the disease problems.
- (2) Disseminating practical information to canners and farmers while visiting the various canning areas.
- (3) Developing good will and cooperation among farmers and canners towards the work done at the Experiment Station.
- (4) Obtaining a better knowledge of the Farmers' problems in order to better adapt scientific research to practical control measures.
- (5) Reports to meetings of canners and farmers relative to their major disease problems and the best known control measures to follow in combating them.

The third project (a study of a new bacterial stem-rot disease of tomatoes) was initiated May 25, 1927. The project was started due to the observations made while carrying out the survey work. This disease of tomato plants was very damaging in one locality during 1926. It is estimated that in the state it caused a loss close to \$50,000 that season to a crop with a value of \$750,000 to \$1,000,000. The investigations were initiated to ascertain the nature of the causal organism in relation to control measures. Some of the results of these investigations are given in Circular No. 99. and Cornell Extension Bulletin No. 170. This work is being carried on in cooperation with Carl S. Pederson of the Division of Bacteriology.

Practical Results

- (1) Determined the nature of the causal organism
- (2) Showed that the disease may be carried in the seed.
- (3) Cooperated with the plant growers in selecting seed free from the disease. Obtained disease-free seed of one variety in this way in 1927.
- (4) Initiated a control program in the tomato-growing areas to reduce or possibly eliminate the disease.
- (5) Addressed seven meetings of canners and farmers in the affected area on the nature and control of the disease.

(There was average attendance of 55 at these meetings)
- (6) Treated most of the seed to be used in the affected area with mercuric chloride and initiated the treatment of practically all the rest of the seed to be used.
- (7) Carrying on experiments to determine extent to which the disease is seed-borne.
- (8) Conducting experiments to determine the value of seed treatments in control of the disease.

Scientific Results

1. Showing that the disease, altho initiated by the bacterial canker organism, may become complicated by the presence of other organisms to such an extent that it is impossible to isolate the causal organism.
2. Inoculation experiments to show the relation of the causal organism, Aplanobacter michiganense, to the other organisms present.

During the winters of 1925-26 and 1926-27 the summer field work was supplemented by experimental work on pea diseases in the greenhouse. During the winter of 1927-28 greenhouse work has been attempted on the tomato disease. Due to the lack of favorable temperature in the greenhouse, these experiments have been greatly curtailed, especially with tomatoes. The greater portion of the time during the past winter has been given to a study of literature and writing bulletins.

During the years 1925-27 correspondence on seed testing and inquiries for information required an average of about five letters a day. During the present year, since the seed testing work has been turned over to the Seed Testing Laboratory, an average of possibly two letters a day has been required.

Requests that I visit fields showing an unhealthy condition average between five and ten a month during the summer. These fields are scattered across the state from Utica to Fredonia.

I have spoken at from seven to ten meetings of canners and farmers per year on canning crop disease problems.

List of Publications

- Jones, Leon K.
1926 Pea disease investigations. The Canner 62 (2): 127-128.
- Jones, Leon K.
1926 Recent developments in the control of apple scab.
Proc. N. Y. State Hort. Soc. 1926: 132-135.
- Keitt, G. W., & Leon K. Jones
1926 Studies of the epidemiology and control of apple scab.
Wis. Agr. Exp. Sta. Res. Bul. 73:1-104.
- Jones, Leon K.
1927 The relation of Mycosphaerella pinodes to Ascochyta blight of peas. Phytopath. 17:44

- Jones, Leon K.
1927 Studies of the nature and control of blight, leaf and pod spot, and footrot of peas caused by species of *Ascochyta*.
N. Y. Agr. Exp. Sta. Bul. 547: 1-46.
- Jones, Leon K.
1928 Diseases of canning crops in 1927.
N. Y. Agr. Exp. Sta. Circ. 99:1-5
- Jones, Leon K.
1928 *Ascochyta* blight, leaf and pod spot and footrot of peas.
The Canner 66 (15):21-22.
- Jones, Leon K., and Carl S. Pederson
1928 Bacterial canker of tomatoes.
Cornell Agr. Exp. Sta. Extension Bul. 170:1-4.

Present Investigations

(1) Treatment of pea seed with organic mercury compounds. This work is being conducted in cooperation with the Geneva Preserving Company and four other canning companies. The practical value of these experiments is to determine more definitely the value of seed treatment in relation to stand of plants, yield, and root-rot control. The experiments are being conducted on 55 acres at Geneva and 15 acres in each of four other localities in order to have various soil and environmental conditions.

(2) Relation of varietal resistance to rootrot. These experiments are carried on in fields known to harbor rootrot organisms, in an attempt to ascertain whether any of the commonly used varieties are less susceptible to injury than others.

(3) Relation of soil moisture and temperature during and following planting of pea and bean seed to rapid and slow germination, poor and good vigor of plants, and rootrot. Also the relation of these soil conditions to percentage stand of plants. A better knowledge of these factors is necessary in order to advise as to time of planting and character of soil to be used for these various crops. It is necessary to have controlled temperature chambers in the greenhouse

in order to attack the fundamentals of these problems.

(4) Further investigations on the bacterial canker disease of tomatoes in order to determine:

- (a) The extent to which the disease is carried in the seed.
- (b) The value of seed treatment as a control measure.
- (c) The practicability of selecting healthy seed.
- (d) The value of crop rotation and destruction of tomato refuse in the control of the disease.

Further studies on the causal organism in relation to other organisms isolated from the diseased tomato plants will be made. These studies have an added practical significance in that the other organisms appear to be common soil organisms, and they appear to be able to cause further destruction of the plants once the bacterial canker organism initiates the trouble. Also there is some reason to believe that these soil organisms are capable of causing a diseased condition of tomato plants under some environmental conditions without the aid of the bacterial canker organism.

(5) The survey work will be continued to note outstanding disease problems and to disseminate information directly to farmers on their problems.

Equipment Needed

There is urgent need of three or four controlled temperature chambers in the greenhouse. This should be supplemented as soon as possible by a better greenhouse with various temperature rooms and a pathological laboratory in conjunction with the greenhouse.

Report from Seed Testing Laboratory.

Prepared by H.T. Munn, Associate in Research, in charge of lab.

- 1.- During the past five years not less than 16,477 seed samples have been tested for purity or germination, or both in the laboratory. Probably (a) one-third of these reports have gone directly to the planters of the seed stock or were used by vendors in making sales under the seed law. In either case the results were ostensibly the same to the ultimate user of the seed. The remaining third of the reports were for the Commissioner of Agriculture in seed law enforcement and in this connection it may be pointed out that New York is often pointed out as one of the two States with the uniform seed law which enforces its law. We feel that this policy of public project service followed by reasonable law enforcement is particularly effective and valuable. Most marked changes have been noted in the quality and the manner of vending seeds during the past five years. The survey of the pocket vegetable seed situation during the past three years has done much to clear up the general tone of the business and apparently has driven a few rather questionable firms from operation in this State. We consider this service as of great value not alone to farmers but to house-holders, gardeners, and truck crop growers.
(b). Out of the work as outlined above there have come opportunities to the following formal publications in addition to many news notes to supplement the bulletins and to provide timely advice to buyers of reasonable seeds, Bulletins No. 504, 507, 528, 533, and Circular 73
- 2.- It has been found that the service which the laboratory is called upon to (a) render has increased markedly each year and far in excess of the assistance which has been provided to meet such increase. Particularly during the past three years there has been no so-called "dull-season" in the laboratory, but rather there has been the continual pressure of routine work, in other words, the yearly program has been defined by the work at hand. This situation has not permitted of what may be called investigational work and has prevented the carrying on of projects outlined in project reports, however it has been possible to salvage or rather bring out isolated pieces of research or observation from the great bulk of routine material as it has passed thru the laboratory. The present status of each investigation at the present time is practically at a standstill for want of opportunity to get at the work in proper manner. These projects now unfinished require a consecutive period of days or weeks to finish them rather than a few minutes day by day or at opportune times. We hope to finish off two or three of these lines of work during the coming summer months. It is very important that investigational work on certain phases of seed testing be carried along with the routine work, indeed that is one of the cogent reasons why the laboratory is connected with a research institution. It seems necessary to carry on some fundamental research work on germination upon which to base practical method of testing.
(b)- As outlined in (a) above, there is no longer a seasonal period of work except in the sense that during the spring months there is the "peak load" or over-load of seasonal rush work when everything must give way to the bare necessities of the work at hand. Voluntary samples and fee-test samples come during the earlier spring months to be followed by the usual crop of official samples as soon as buying begins just previous to spring planting. It has been impossible to give prompt attention to the official samples but to carry many of them on into the summer and fall as we could get to them.

2. Seed Laboratory.

- (c)- Probably not more than 20 addresses have been given during the past five years at meetings of various kinds. Meetings of informal nature and dealing with seed law enforcement of allied phases have been attended each year. Probably the most frequent type of extension effort in connection with our work has been the answering of definite inquiries in connection with a seed sample submitted by grower or buyer. Very often this inquiry can be answered in connection with and either upon the report submitted or in the form of an additional letter. There have been probably 900 to 1000 such inquiries each year. In addition there have been many separate inquiries regarding seeds or seeding problems with which no samples were submitted. Surely there have been 200 such inquiries each year. It would seem that each working day brings at least one such separate inquiry.
- (d)- AS contributions to scientific meetings at least three papers have gone from the laboratory to the Official Seed Analysts Associations meetings. Last year there were six such contributions. In addition to separate contributions there have been opportunities to carry out cooperative research work or comparative tests with or thru some committee of the Association mentioned, and also, with the International Association. As example of the latter there may be mentioned the international seed testing rules. In the form of cooperative effort with State and National agencies it is reasonable to feel that the laboratory has contributed fully its share in many ways. We like to feel that the seed program carried forward in this State is abreast of the times and a progressive one. It cannot maintain that position in the future unless provisions are made to meet the increase in volume in routine work.

5.- The needs in the way of equipment are probably being met as fast as funds will permit. Our greatest handicap at present is the lack of satisfactory germinator equipment and that problem is partly one of more floor space. The greatest need of the laboratory is satisfactory clerical assistance of special type. It is not stenographers to take dictation and write letters that are specially needed but rather a combination stenographer-seed analyst, or in reality a competent clerk who can number samples properly, route them to the laboratory where they should properly go, prepare reports to go with the samples and then when the test is completed to get the report correctly filled out and off to the sender of the sample, and to properly file the carbon copy of the report in the laboratory. Also, there is the work of preparing the final reports of all analyses to the Commissioner of Agriculture and to assist in keeping such records correct and in proper condition. This work can be done under direction by any competent person with a proper attention to details. It seems unwise to require the time of highly paid technical workers to do this more or less clerical work. It has been our experience that this work cannot be satisfactorily done by a stenographer who may come in from one-half to one hour every other day. Perhaps the greatest need in this connection can be satisfactorily met by utilizing seed test fee income to hire clerical assistance during that part of the year when most needed. Such temporary assistance would at least relieve the situation during the rush spring season and permit of the carrying on of any investigational work thruout the entire year. The other alternative and the one which we may be forced to accept in the near future is to provide for at least one additional member to the department of the grade of Assistant. This latter provision will need to be made if the volume of work continues to increase at the same rate as it has during the past three years.

REPORT OF MARY E. WOODBRIDGE, ASSISTANT IN RESEARCH

DIVISION OF BOTANY

1. (a) Routine analyses on 4249 samples of seed during the year 1926-27.
Routine analyses on 3550 samples of seed during 1927-28 to date.
(April 11, 1928)
- (b) See Report for Seed Laboratory.

2. (a) Practically the entire year is taken up with routine analyses and attendant phases of work on official and unofficial samples. No opportunity has been afforded for carrying on investigational work this year because of the routine work being very heavy and not seasonal.
- (b) During the time in which I have been on the Station staff the work has been largely routine work on official and unofficial samples with the peak of work coming during the months of January, February and March. In the spring of 1927 some experimental work on the germination of carpet grass was carried on in addition to my regular routine work. For report of this, see 2 (d).
- (c) Answers to inquiries of farmers or additional information regarding seed samples are given directly on or in connection with the laboratory reports sent to them. Three-fourths of the farmers sending in samples request some additional information which can usually be supplied at the time the report of analysis is sent.
- (d) Contribution, - Paper. "Germination of Carpet Grass," prepared for the Annual Meeting of the National Association of Official Seed

2. (d) continued

Analysts. See "Proceedings of Nineteenth and Twentieth Annual Meetings of the Association of Official Seed Analysts of North America." Feb. 1928.

3. The greatest personal need which I feel in my work is that of a better condition of light for purity work. North light is recommended to prevent eye strain. Evidently this condition cannot be remedied in our present location.
- There is great need of special clerical assistance for the seed laboratory during the rush season particularly.

Report of Olive M. Hoefle
Assistant in Research and Inst. in Botany.

1. Important results accomplished.
 - a. Routine analysis made on 4340 samples of seed to date.
 - b. See report of Seed Dept.

2. A. Practically the entire year is taken up by routine analyses and attendant phases on official and unofficial samples.
B. No opportunity has been afforded for investigational work.
C. During the time that I have been at the Station, activities of the Seed Dept. have been confined quite largely to continual work of purely routine nature on seed samples with the peak of activities, the rush season, during January, February, and March. It has been necessary to hold over a number of official lawn grass samples until time would permit to handle them.
D. Numerous inquiries for information concerning seed samples submitted by farmers are covered by the regular report sheets sent out at the time the sample is analyzed, or in additional letters. No definite number of such inquiries can be set down, but roughly speaking, it is estimated that about three fourths request additional information aside from the regular report, which can be answered at the time the analysis is made.

3. There is great need at the present time for special clerical assistance, particularly during the rush season.

Division of Chemistry

L. L. Van Slyke, Chief

D. C. Carpenter (Airy Chemistry)

L. R. Streeter
(Insecticides and Fungicides)

A. W. Clark
(Inspection Department)

REPORT OF DIVISION OF CHEMISTRY

L. L. Van Slyke, Chief in Research.

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The work of the Division of Chemistry is given under the following heads: (1) Dairy Chemistry, (2) Plant Chemistry, (3) Special Research, (4) Inspection of fertilizers, feeding-stuffs, insecticides and fungicides, (5) Research work in chemistry of insecticides and fungicides.

Mr. Streeter has prepared a special report on research work in chemistry of insecticides and fungicides and Mr. Clark has furnished a report on a portion of the inspection work. In the absence of Mr. Anderson and Mr. Carpenter, a brief statement has been prepared, giving an outline of the work which has occupied their time during the past five years.

The Chief of the Division of Chemistry has included among his duties (1) general charge of the chemical laboratory (2) correspondence, made up of official correspondence regarding inspection of fertilizers and of replies to farmers and others making inquiries about various materials relating to agriculture, and seeking chemical information regarding fertilizers, vinegar, dairy chemistry, etc., (3) supervision of inspection of fertilizers, and (4) research work in dairy chemistry.

This ^{portion of the} report is limited to two general subjects, inspection of fertilizers and research work in dairy chemistry.

1. Inspection of fertilizers. A brief review of the history of fertilizer inspection will not be out of place here. In 1878 the first law was passed providing for fertilizer inspection in New York State, but no provision was made for its enforcement.

Nothing further was done until 1890 when the discovery of extensive fraud in fertilizers resulted in the passage of a law, the execution of which was placed in charge of this Station. The law was amended from time to time to make it more efficient. Beginning in 1890, there have been analyzed an average of nearly 800 samples of commercial fertilizers each year, the results of which have been published in bulletins for distribution among the farmers of the State. Since 1910 special bulletins have been issued in addition, giving desired information based on the analytical results, relating to the composition and cost of mixed commercial fertilizers and unmixed materials.

The beneficial effects of fertilizer inspection may be briefly summarized: (1) Dishonest fertilizer manufacturers in this State have been driven out of existence. (2) There has been direct protection to farmers against fraud by placing in their hands specific and reliable information about the composition of fertilizers in the market. (3) Farmers have been led to a more judicious selection and economical use of plant-foods. (4) The general standard of composition of commercial fertilizers has been made not only more uniform but of higher grade. These results have been accomplished practically without any cost to the State.

2. Research work in dairy chemistry. This work has been devoted to two general lines of study, with practical applications, - (a) the composition of milk and its products, and (b) the chemistry of cheese-making. Both lines of work have been so extensive that they cannot be briefly described, but a few of the practical results may be stated.

(1) The relation of the composition of milk to the yield, composition and quality of cheese.

(2) The conditions of the manufacture of cheese in

relation to yield and quality of cheese, including causes and methods of prevention of loss of fat in cheese-making.

(3) The work of this Station was the first to call attention to the methods of paying for milk on the basis of its fat content.

(4) Curing of Cheddar cheese.

Among the later research studies may be mentioned the following:

(1) Chemical changes in the souring of milk, with practical applications to the manufacture of cottage cheese.

(2) A method for the preliminary detection of abnormal milk.

(3) Determination of the keeping quality of milk.

(4) A method for distinguishing heated from unheated milk.

II. PLANT CHEMISTRY

R. J. Anderson and R. L. Shriner.

1. Composition of vegetable oils, - corn oil, cottonseed oil, linseed oil, rice-bran oil, wheat-germ oil, grape-seed oil, etc. The work was to ascertain what particular compounds in vegetable oils are affected when exposed to ultra-violet light so that such oils acquire the property of preventing or curing the disease of rickets in children. It was known that the special compounds thus affected are known chemically as sterols, of which there are several different ones. The specific purposes of this work have been to isolate these different sterols and ascertain their value as antirachitic agents. The work has shown that certain sterols are of value and others are not.

2. Coloring-matters in grapes. This work has for its object to ascertain the composition of the different pigments in grapes to be used as a basis for studies in the relations of different varieties of grapes. Work is not completed.

3. Composition of grape stems. Work has been done to determine the kinds and amounts of carbohydrates, especially sugars, stored in different varieties of grapes during the dormant period. The purpose is to discover some fundamental reason for observed differences in the winter hardiness of different varieties of grapes.

III. SPECIAL RESEARCH

D. C. Carpenter

1. Casein. Work has been given to the preparation of chemically pure casein from milk for the purpose of studying its properties. The important relation of casein to cheese-making has been shown by extensive work done at this Station in former years. It has seemed desirable to add to our knowledge about the chemical properties of casein.

2. Gelatin. In cooperation with the Division of Dairying, work has been done to study the chemical properties of pure gelatin to furnish a basis for determining the value of gelatin of different grades for use in making ice-cream.

3. Products from proteins in relation to bacteria. In cooperation with the Division of Bacteriology, work has been carried on to learn the relation of the decomposition products of certain proteins to the growth of bacteria.

Report of D. C. Carpenter 1927 - 1928

Through the use of the ultracentrifuge in the laboratory of Prof. T. Svedberg at the University of Upsala, Sweden, and by means of a grant from the International Education Board, the molecular weight of casein prepared by various methods is being studied. The direct object of this study is not only to determine the molecular weight, but to ascertain a method of preparing casein which frees it from foreign matter and does not decompose the protein during the process of preparation and subsequent purification. Experimental methods in the past have been unable to ascertain quantitatively what is pure casein. With this new tool for science we are able to look within the protein solutions and make observations of this character.

The extinction coefficient of casein solutions for ultra-violet light shows a sharp absorption band at wave length 276m μ , consequently light of this wave length is used in the photographic recording of the rate of sedimentation and diffusion of the casein particles under applied centrifugal force. The rate of diffusion and the specific sedimentation velocity and the partial specific volume of the protein, are each being studied by the most dependable methods yet devised, and also the influence of protein concentration, salt concentration, and of pH on each of the above properties. These data are required for the mathematical solution of the equation yielding the value of the molecular weight. The results so far show that we are encountering the phenomenon of polymerization or aggregation of protein molecules in solution, which decidedly complicates matters and makes necessary the extrapolation of data to infinite dilution for calculations as to the ultimate weight of the individual molecule. These matters necessitate the accumulation of more extensive data than we had foreseen, for the immediate solution of the question of molecular weight of casein. These necessary data never the less have a wide application to colloidal solutions in general and to protein solutions in particular and give us our first fundamental information on this subject.

Publications during the year July 1927 - June 1928.

1. Influence of Neutral Salts on the Optical Rotation of Gelatin. I
D. C. Carpenter J. Phys. Chem. 31, 1873. (1927).
2. The Grading of Commercial Gelatin and its Use in the Manufacture of Ice Cream. I. D. C. Carpenter, A. C. Dahlberg, J. C. Hening,
J. Ind. Eng. Chem. April. (1928).
3. The Grading of Commercial Gelatin and its Use in the Manufacture of Ice Cream. II. A. C. Dahlberg, D. C. Carpenter, J. C. Hening.
J. Ind. Eng. Chem. May. (1928).

(Signed) D. C. Carpenter
May 28, 1928.

D I V I S I O N O F C H E M I S T R Y

C h e m i s t r y o f I n s e c t i c i d e s a n d F u n g i c i d e s .

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Contributions in the above field of investigation are as follows:

Chemical studies of nicotine dusts placed in storage for definite periods of time showed that certain commercial dusts undergo chemical changes and lose nicotine, the active principal of the dust, unless stored under proper conditions.

The above led to a more general chemical study of nicotine dusts, e.g., the rate of volatility of nicotine from such dusts giving an indication of their probable insecticidal efficiency. Also a classification of the common dust carriers used in compounding nicotine dusts as a basis for selecting the most suitable ones to use from the standpoint of efficiency and economy.

The results of the above investigations were published as bulletin No. 501 of this Station.

In cooperation with the Division of Agronomy, investigations have been carried on for several years on the growing of tobacco of high nicotine content for insecticidal purposes. This work was undertaken to put methods in the hands of fruit growers for producing their own supply of nicotine or as a basis for a separate agricultural enterprise by which the supply of nicotine might be increased to such an extent as to make its use less expensive. The writer has made chemical analyses essential to the success of the above investigations. These investigations are still in progress. One paper has been published as a progress report. "Factors which Influence the Nicotine Content of Tobacco Grown for Use as an Insecticide", Journal of the American

Society of Agronomy, 16, 7, 1924.

Other investigations on nicotine are studies of methods by which finely ground tobacco may be used as a substitute for commercially prepared nicotine dusts and methods for extracting nicotine to make home-made nicotine concoctions for spraying. Some phases of these problems are being further investigated. Two preliminary papers have been published in the Journal of Economic Entomology, vol. 17, No. 6, 1924, and vol. 18, No. 4, 1926.

The work as outlined above has been a contributing factor toward the more efficient and practical use of nicotine as an insecticide.

Reactions between inorganic materials used as insecticides and fungicides when mixed to form combination sprays or dusts.- A study of the reactions which take place when acid arsenate of lead and lime-sulfur solutions are mixed and the influence of casein preparations or skim milk as a protective agent against the undesirable changes which take place in such mixtures. The results were published as New York State Agricultural Experiment Station Bulletin No. 521.

Adherence of sprays and dusts to foliage.- A two year study of the comparative adherence of fungicidal sulfur to apple tree foliage when applied both as a dust and as a lime-sulfur spray. At the time of these investigation it was concluded that the adherence of sulfur sprays was superior to sulfur dusts, and might be expected to give better protection against fungi. The results were published as New York State Agricultural Experiment Station Technical Bulletin No. 115.

Physical properties of commercial dusting and spraying materials.- An investigation of the possibility of determination of degree of fineness of insecticidal dusts by sifting thru a series of standard sieves developed the fact that such fine particles take on

an electric charge when in contact with the metal sieves and so fail to pass thru the meshes of the sieves. A method of overcoming this difficulty by mixing materials which take on charges of opposite sign and so become neutral was worked out and a series of determinations of the fineness of several commercial dusts of various kinds was made. This method gives a basis for comparing commercial dusts as to fineness, one of the physical properties related to their efficiency when used as insecticides and fungicides. The results of this work were published as Technical Bulletin No. 125.

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3. "Lead Arsenate Lime-Sulfur, and Tobacco Dust as a Triple Spray Mixture" by L. R. Streeter, Jour. of Economic Entomology, vol. 17, No. 6, 1924.
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7. "Combination Sprays" by R. W. Thatcher and L. R. Streeter. Proc. Sec. 69th Annual Meeting, N. Y. State Hort. Soc. pp. 50-56, 1924.
8. "The Adherence of Foliage of Sulfur in Fungicidal Dusts and Sprays" by R. W. Thatcher and L. R. Streeter, Tech. Bul. No. 116, 1925. N. Y. State Agri. Exp. Sta.
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PRESENT PROGRAM OF WORK

Growing of Tobacco of High Nicotine Content.

Work on this project is being continued in cooperation with the Division of Agronomy. It seems desirable to continue this work in order that we may have available more accurate yield data on nicotine produced per acre. It is also planned to make analysis of tobacco plants at different stages of development to determine at what stage the maximum nicotine content is reached. It is also desirable to make chemical analysis of individual plant in connection with breeding experiments to develop pure strains of tobacco yielding high nicotine content. Chemical analyses essential to the success of this work are to be made by the Division of Chemistry.

Chemical Studies of Tobacco Dust and Nicotine.

A continuation of previous investigations on nicotine and tobacco dusts to determine the chemical and physical factors involved in effective and practical use of tobacco dusts of high nicotine content. The nicotine occurring in tobacco is for the most part in combination with organic acids and is not available in its most effective form until liberated from these acids and made free to volatilize, in which form it is very toxic to insects. Certain chemical compounds, such as hydroxides and carbonates, have been found to be good activators for this purpose and in order to have a better understanding of the principles involved and definite knowledge in regard to the best activators to use it is proposed that these investigations be continued. Studies are in progress to determine the lethal dosage to various species of insects of nicotine evolved from tobacco in known quantities.

The other phase of the nicotine project has to do with grinding of tobacco and extracting the nicotine by methods that may be practical for fruit growers to follow in making their own nicotine concoctions.

tions. We now have data on laboratory methods of extracting nicotine from tobacco leaves and from tobacco dust. The results indicate that some of these methods give promise of being applicable as methods of extracting nicotine on a scale useable by fruit growers. The development of such methods are essential to the practical application of the several nicotine projects under way at this Station. Work on this project should be concluded this year.

Spray Residue on Fruit.

The desirability of being able to comply with the international tolerance of .01 of a grain of arsenic (As_2O_3) per pound of fruit has led to a general study of the amount of arsenic found on fruit produced in this country.

Work on this project has been under way for two years, to determine the quantity of arsenic on fruit sprayed according to our own spray schedule. The work has been chiefly centered on cherries. This last year apples sprayed on the Station farm were included and results indicate that the above fruits sprayed according to our schedule often contain more arsenic than the amount allowable by the tolerance. This project includes work on methods that may be used to remove arsenic from fruit in order that it may pass as arsenic free.

Work is to be continued this year to obtain data as to the actual conditions that exist relative to quantity of arsenic found, using any fruit from commercial orchards that have been sprayed in a manner representative of orchard practice in this State. And second to develop methods that may be recommended for removal of arsenic in cases where it is present in excessive amounts. At the same time, it is essential to the general solution of the problem to keep in mind the desirability of a substitute for lead arsenate and to use every effort to develop such a substitute.

Investigations were started last fall in cooperation with the Department of Chemistry at Cornell to develop methods for detecting lead on fruit spectroscopically. Work on this project has progressed to the stage where we are ready to prepare a paper on this subject.

PHYSICAL PROPERTIES OF DUSTING AND SPRAYING MATERIALS

Importance of the Problem

At present no very definite physical standards are recognized. Preliminary studies and practical experience have indicated that there is a very marked difference in physical properties of materials now on the market. Many failures to control insects and plant diseases have been attributed to poor physical quality of the material used. When farmers buy insecticides and fungicides they are protected by law and official chemical analyses against inferior chemical quality. Shouldn't they have the same protection against inferior physical quality ?

Methods of Attack

The suggested methods of attack are by sieving tests, optical methods of measuring particle sizes, suspension tests, bulk density or dry volume measurement, spreading and adherence, and choice of fillers and spreaders that improve the physical quality of dusts and sprays. For oil sprays, viscosity, surface tension, refraction index, flash point, specific gravity and type of emulsion are important factors in the efficiency of oil sprays.

Value of Proposed Investigation

A study of physical properties would give a better understanding of the importance of physical properties and their relation to the efficiency of the dust or spray, should lead to some standardization of these materials and develop laboratory tests that may be

applied to protect the purchaser of these materials against inferior physical quality. Sufficient improvement of dust that would permit their more general use, might contribute toward the elimination of the spray residue problem and toward the reduction of foliage injury due to burning. Experimentation alone can determine whether sufficient improvement can be made to justify this assumption. It is the writer's opinion that work of this nature would yield results of considerable value.

Correlation Research Problems

Finely divided particles are known to possess or acquire an electric charge under certain conditions such as friction, absorbed ions, etc. The theory has been advanced that the sign and quantity of charge are factors in the adherence of a dust or spray to foliage and the fluffiness of dust and the ease with which they form dust clouds. Work along this line is offered as a suggestion for a research problem which has not been very extensively investigated relative to its application to insecticides and fungicides.

Not all of the work suggested under the heading of "physical properties of dusting and spraying material" can be undertaken this year. It is hoped that the following studies on sulfur dust can become a part of this years program.

At the present time sulfur offered for sale as a fungicide may be anywhere from 200 mesh to 1 micron in average particle size. It is possible that a fallacy exists in the supposition that fungicidal efficiency is directly proportional to increased fineness. It is conceivable that such a dust can be so finely divided that a large proportion of the material will drift away from the tree, when applied as a dust. In other words, how fine should a material be to give the most practical and economical control ? At present there are no definite

accepted standards of fineness for such materials.

Experiments planned to determine the quantity and distribution of sulfur on foliage using dusts of varying degrees of fineness, also determine if possible any existing relationship between particle size and distribution on foliage, quantity adhering to foliage and efficiency. Determine, if possible, relationship between evenness of coating on foliage and persistence of toxicity.

These experiments should also take into consideration a study of the effect of inert materials used in conjunction with sulfur and their effect on physical properties of sulfur dust.

The above work should give us a better understanding of the importance of physical properties of dusts and possibly yield a basis for adopting some standards of physical quality of sulfur to be used as a fungicidal dust.

Investigations as outlined above will lead to chemical studies of sulfur and its toxic properties and to cause for foliage injury.

That the oxidation products of sulfur are the important factors contributing to its toxicity seems to be the general accepted theory. The rate of oxidation is probably related to particle size of sulfur. What are the natural factors that cause oxidation? Are the oxidation products responsible for foliage injury? What are the effects of alkaline materials such as $\text{Ca}(\text{OH})_2$ on the fungicidal properties of sulfur? Can fungicidal efficiency of sulfur be increased by adding oxidizing agents? Can the fungicidal properties of sulfur be controlled? These are some of the questions to which an answer supported by chemical data is needed. It is hoped that many of these problems can become a part of the active program soon.

OUTLINE OF ACTIVITIES DURING THE YEAR

From the present date until July 15, work on the various tobacco projects will be continued. About July 15th work on spray residues will be resumed. Also during the months of July and August work suggested on physical properties of sulfur dusts and their relation to disease control should be under way. During the fall and early winter months project on spray residues on apples should be continued. No definite time need be set for this work as the apples can be held in storage. It has been the custom in the past to make chemical analysis on tobacco samples grown for high nicotine content during the early winter months. Measurements in physical properties of dusts can be made in the laboratory at such times not definitely assigned to seasonal work.

During the year considerable miscellaneous work is done as special analysis for Fruit Growers Co-op, etc. Such work in the past has been done gratis.

The estimated number of inquiries answered for farmers is set at 100 per annum.

Frequently papers are presented at scientific meetings, as A. C. S. and State Horticultural Society meetings.

Facilities needed for the most effective prosecution of my work are a laboratory definitely assigned to insecticide and fungicide investigations, and an assistant chemist.

L. R. Streeter.

REPORT OF INSPECTION WORK OF THE DIVISION OF CHEMISTRY

UNDER THE DIRECT SUPERVISION OF

A. W. CLARK, ASSOCIATE IN RESEARCH (CHEMISTRY).

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(1) During the past five years we have analyzed over 15,000 samples of commercial fertilizers, feeding stuffs and insecticides. In addition to the service rendered to the farmers of the State and the protection afforded farmers and honest manufacturers from fraud and deception, there is turned into the State Treasury yearly about \$100,000 in license fees from feeding stuffs and fertilizers, and from \$20,000 to \$30,000 in fines and penalties.

During the year 1927 there was an attempt on the part of a manufacturer in a neighboring state to ship an adulterated product into this state. Due to vigilance on our part this adulteration was detected and as a result this one manufacturer alone paid about \$5,000 in fines and paid a rebate of \$5.00 per ton to the feed dealers. As a result of this experience, this manufacturer has decided that "honesty is the best policy" and has discontinued adulteration.

Twenty years ago, adulteration was quite common but it is now an exception rather than the rule. The case above mentioned simply shows what would undoubtedly happen if we were to relax our vigilance in the examination of feeding stuffs.

The results of our inspection work are published in the bulletins of the Department of Agriculture and Markets to which Department credit is due for fine cooperation and efficient administration of our agricultural law.

We have published two bulletins of general interest to consumers of feeding stuffs entitled "Composition and Cost of Feeding Stuff".

These are Station bulletins 515 and 545.

(2) Our present program, owing to the nature of our work is necessarily a continuation of the work done in the past. We believe that more work should be done in regard to the inspection of insecticides and fungicides. According to the plan followed in the past, this work has been done in alternate years. With the present rapid development along these lines, a yearly inspection in the future will doubtless be advisable.

As we have no additional funds for doing this work, we have been rather handicapped in attempting to carry out this work with the same amount of help with which we are carrying on our feed and fertilizer inspection work. On this account, it has been necessary to hold up this insecticide and fungicide work until after the fertilizer work is completed.

This Division has for several years placed an exhibit at the New York State Fair at Syracuse showing our inspection work.

The number of letters written in connection with our inspection work and answering inquiries of farmers was 248 during the past four months, with an estimate of 3,600 letters written during the past five years.

I have served as Secretary and Treasurer of the Association of Feed Control Officials of the United States for about ten years but retired during the past year. The estimate of correspondence above mentioned does not include any letters written in connection with my work as Secretary of the Association.

(3) To make the insecticide and fungicide inspection more effective, it is our opinion that samples should be collected in the spring and summer and that sufficient help should be provided to make such analyses at once as certain kinds of materials undergo changes in composition in storage.

Insecticides and fungicides have developed commercially much faster than official methods have been worked out for the analysis of such products. Frequently methods of analysis have to be worked out for new products.

Division of Dairying

A. C. Dahlberg, Chief

J. C. Hening

J. C. Marquardt

My Past and Present Work at the Experiment Station

A. C. Dahlberg

The presentation of the results of the past five years of investigations at this Station might more properly start in November, 1921 when I came to the Station. The staff of the Dairy Department consisted of an Associate in Research. There were no experimental projects under investigation, none had been planned, and no data suitable for future consideration was available.

My time was devoted, in 1922, rather exclusively in becoming acquainted with certain of the dairy interests of the State, with the details of reorganizing the routine work of the Department to make my own time more available for research, and in securing two assistants who were appointed in 1923.

RESULTS OF INVESTIGATIONS DURING THE PAST FIVE YEARS

Ice Cream

The scientific and practical results presented in publications can most effectively be given by subjects rather than chronologically. No Experiment Station was extensively studying the manufacture of ice cream in 1922 and since this branch of the dairy industry had been neglected by scientists I hoped to be able to become recognized in this particular field.

The study of the texture of ice cream was planned to furnish the physical-chemical background for more extended scienti-

fic and practical investigations. The microscopic appearance of smooth and coarse ice cream was clearly shown for the first time. The concentration of sugar in ice cream into a very heavy sirup was demonstrated thus giving a clear understanding of the way that increased percentages of sugar make ice cream smooth and soft by reducing the quantity of ice. This work also demonstrated that milk fat and serum solids have an associative action in preventing the growth of large ice crystals, probably thru the physical holding of water by the proteins adsorbed on the fat. The action of gelatin in ice cream was clearly shown to be unrelated to its protective colloid action as was generally assumed to be true but it was related to gel strength. The foundation for the correct evaluation of gelatin for ice cream purposes was presented since a gel was required in the finished ice cream to give the desired effects. This investigation has been used as the basis of many recent researches and it was the only work of any Experiment Station to be presented before the National Ice Cream Association in 1925.

Ice cream manufacturers were seriously troubled with a greenish-black discoloration of chocolate ice cream which seriously threatened the business of some plants. The problem had been presented to at least three Experiment Stations and one commercial laboratory before I was requested to undertake its solution. The discoloration was found to be caused by the tannins in alkaline cocoas or chocolates combining chemically with the iron in the ice cream cans. I recommended that the discoloration should be prevented by using paraffined cardboard liners for cans holding chocolate ice cream. This practice is now almost universal and is generally recommended by all as a positive prevention

of the discoloration.

In the study of water ices and sherbets new facts were discovered. The hardness of these products can be made to correspond with that of ice cream at a given temperature by controlling the percentage of air in the product and, to some extent, variations in the sugar content have an influence on hardness. Water ices and sherbets usually became so hard on the surface after a few days aging that the product could not be cut with a spoon. The surface hardening was caused by crystallization of sucrose and was prevented by replacing about 20 per cent of the sucrose with glucose. The use of corn sugar as recommended from these studies has been checked by other stations and is now a standard practice in the manufacture of these products. Unfrozen sirup usually drained out of water ices and sherbets. It was found that this bleeding could be prevented by suitable stabilizers such as gelatin, gum, and agar. Agar was particularly effective and was recommended. The use of agar has been approved by several other institutions and thousands of gallons of water ices and sherbets are now made with this stabilizer. The formula for orange ice given in the publication of these results was used by the Corn Products Refining Company for making a water ice exhibited at the last dairy show which received favorable attention.

An extended study of gelatin was made in cooperation with D. G. Carpenter and J. C. Hening. In addition to securing much valuable and new data on the chemistry of gelatin this study demonstrated errors in existing methods of grading gelatin but clearly showed gel strength was the proper basis for grading gelatins. My proposed method

Of testing gelatin was improved and was presented at the last convention of the National Ice Cream Association. The method has been received with much favor and two investigators have already published work showing its accuracy and simplicity.

At the present time Mr. Hening and I have just completed a study of chocolate ice cream in which we show that cocoa when homogenized in the mix will replace some of the milk solids and that the excessive viscosity and difficult whipping sometimes obtained with cocoa can be eliminated thru the use of baking soda. Certain flavors such as caramel, coffee, and malt blend well with chocolate and may improve the flavor.

Further studies are under way to give additional information on altering the characteristics of water ices with various stabilizers to show the causes of some defects which are often encountered. Attention is now being given to determine the effects of certain gums upon ice cream since these products are being commercially used to a limited extent.

The practical success of these studies on the manufacture of ice cream is demonstrated by the fact that I have presented our results at the last three consecutive meetings of the National Association of Ice Cream Manufacturers, that I have been invited to consider the research program of the Association, and that I have been requested to review research work of the current year for the past three consecutive years for the leading ice cream Journal.

Market Milk

The first study of fluid milk and cream was undertaken with J. C. Hening to show the relationship of viscosity, surface tension, and whipping properties of cream. It was shown that the viscosity of cream was influenced not only by its fat content but to a large extent by the extent of fat clumping. Fat clumping could be brought about by separating milk when the fat was in a churnable condition. By controlling the condition of the fat at the time of separation it was possible to clearly demonstrate that the increase in viscosity of cream due to aging is largely dependent upon fat clumping. It was possible to produce a very viscous pasteurized cream and very thin raw cream with similar fat contents. This study also showed that the stiffness of cream due to whipping was caused by fat clumping and an excellent photo-micrograph of whipped cream was secured. Altho increased viscosity and decreased surface tension were related to improved whipping qualities in a general way, this relationship would not hold definitely enough to pre-determine the whipping qualities of cream by these conditions.

A comparison was made of milk filtration and clarification as a method of removing sediment from milk. This study was conducted in cooperation with J. C. Marquardt. The results of this investigation demonstrated for the first time that milk filters using cotton pads or loosely woven cloth with a long nap would satisfactorily remove all visible sediment from milk without altering the properties of the milk in any other way. The clarifier removed a large portion of invisible sediment in addition to the visible sediment which was normally removed by filtration. The length of the cream layer was decreased when milk was

clarified at the generally recommended temperature of 90°F. We found that clarification at a cold temperature approximating 40 to 50°F. successfully removed the sediment and did not injure the creaming properties of the milk. This information was apparently new and since the publication of these results a new clarifier has appeared on the market which eliminates all foam from milk and thereby permits clarification at a cold temperature. The cold clarification of milk is a new and generally recommended practice. Incidentally, these results on filtration and clarification of milk have been verified by two other Experiment Stations.

A study has also been made in cooperation with J. C. Marquardt on various practices that influence the normal creaming properties of milk. It has been shown that the breed of cattle has no influence upon the creaming properties of milk excepting thru variations in the percentage of fat. Results of other investigators which have shown a difference were caused by errors introduced thru the methods used in standardizing the milk to a uniform fat content. There is some change occurring in skimmilk when it is aged cold which noticeably reduces the creaming properties of milk. Milk held at relative warm temperatures of about 60°F. give normal cream layers but the short cream layers which form on milk that have been previously held cold are due to the temperature rather than agitation as was formerly supposed. Normal creaming properties of milk are restored in full by heating the milk to a temperature of 110° to 135°F. With this information available the influence of temperature upon the creaming properties of milk is being studied because the problem is so important commercially and previous investi-

gators have not had sufficient facts before them.

For several years I have collected various milk strainer devices and have watched the development of the modern single service strainer. The difficulty with these strainers has always been that milk would not flow thru them at a sufficient speed. This study has progressed far enough so that the conditions necessary for proper milk straining are clearly established. In the case of single service cloths it is essential that the cloth should not be thicker than outing flannel and that the cloth must hang freely in the strainer. In the case of single service cotton pads it is essential that the top of the pad must be protected against the washing by the milk and that the bottom must be supported by a very coarse wire screen having about four wires to the inch. The cotton must be protected against packing by the use of a conical disc.

An electrical refrigerating unit has just been installed for an investigation of the practicability of such units for use on dairy farms. It is planned that J. C. Marquardt will work upon this particular study. The first problem concerned with this study was the construction of an insulated tank that would be adaptable to dairy farms. The refrigerating plant itself will be studied to determine the reliability of the machine as well as the capacity required to cool specified amounts of milk. A comparison will be made of tubular surface cooling with the cooling of milk by placing the filled cans in cold water. It is hoped that the latter method will prove entirely satisfactory which will be determined by various tests upon the quality of the milk.

This problem as it will be studied will be of value not only to show the practicability of mechanical refrigeration but the results will be applicable to ice cooling on any dairy farm with the exception of the studies on the mechanical refrigerator itself.

Dairy Herd Management

The Experiment Station herd of registered Jerseys was found to be badly infected with tuberculosis in 1900. It was freed from tuberculosis by the bang method and since 1905 has been maintained as a disease free herd. In this manner the herd has been a demonstration that tuberculosis could be successfully kept out of the herd for a long period of time. It has now been 23 years since there was an established case of tuberculosis in this herd.

In the fall of 1923 the herd was divided into two groups to study the influence of three milkings and feedings per day upon the development of the cows during their normal life time. The cows have not responded entirely uniform to the treatment yet in practically all cases increased production has resulted from the extra milking each day. The data have not been compiled but it is probable that the production of the cows will increase on an average approximately 20 per cent due to the extra feeding and milking. It is evident that such a practice could be used to increase the fluid milk supply of the New York milk shed in case of an acute shortage. The results will also make it possible to compare the records made on official test by cows milked two or three times a day.

There have been a number of experiments conducted to compare machine and hand milking but most of them are at fault because of the shortness of the test. The Station herd is now being used for such an investigation. Altho enough data have not been secured to draw conclusions, it seems probable that under the carefully controlled conditions of this experiment that a difference will be shown in the production ability of cows milked by machine and by hand.

In cooperation with the Bureau of Dairy Industry, U. S. Department of Agriculture and the Animal Industry Division at Cornell University Mr. Hening and I have assisted with the slaughter of several cows to study the relationship of their type to milk production. The production records of the cows are known thruout their life and detailed ante-mortem and post-mortem measurements and weights are secured on all cows that are slaughtered. It is hoped that thru information of this character that the essential points of conformation which are indicative of milk production will be definitely established.

Cheese Making

As a consequence of securing information causing fat clumping in ice cream mixes, I conceived the idea that the fat in cream might be agglutinated to such an extent that the finished product would have the consistency and characteristics of cream cheese. The idea proved to be sound and a new method of manufacturing cheese of the neufchatel type has been devised and patented to safe guard the method for general use should it prove especially advantageous. In this method

the cream is standardized to the desirable composition and after pasteurization and cooling starter and salt are then added. The body of the cheese is produced thru homogenization thus eliminating the need of producing and draining a rennet curd. The method saves much labor and floor space as well as insuring a uniform product. One company has already placed upon the market a cheese probably made by this method and another large dairy concern has recently advised me that they intend to begin manufacturing cheese by this method in the near future.

Testing Dairy Products

Several years ago a general committee on chemical methods of dairy products was created by the American Dairy Science Association and I have acted as chairman of this committee. It is the intention of this committee to formulate and plan methods of testing milk and its products which will be acceptable to the dairy industry. As an example of the type of work carried on thru this Association it might be mentioned that the Babcock test universally used in this country has been standardized to a considerable extent thru the activities of the sub-committee on the Babcock test. The recommendations of the committee have been adopted by the U. S. Bureau of Standards, the American Association of Official Agricultural Chemists and by more than a dozen States of the Union.

As chairman of the sub-committee on the Gerber test an investigation of this method was conducted in cooperation with H. C. Troy of Cornell University and George E. Hoym of the U. S. Bureau of Dairy Industry. It was shown by this investigation that the Gerber test

was as accurate and probably as practical as the Babcock test but that it has no special advantages. The committee recommended that the Association should recognize only one practical fat test for milk and cream.

At the present time the sub-committee on the Babcock test is studying the specifications of the milk pipette and the type of mineral oil to be used for eliminating the meniscus on cream tests. The Babcock test has been subjected to criticism for giving high results and it is rather probable that those investigators who secured high results used a pipette that delivered slightly too much milk.

ACTIVITIES OTHER THAN RESEARCH

Standardizing Babcock and Bacteriological Glassware

In accordance with the provisions of the State laws the dairy division has tested for accuracy all Babcock and bacteriological glassware used in the testing of milk or cream wherever such tests are used as a basis for payment. At the present time approximately 75,000 pieces of glassware are tested and marked each year. The Babcock glassware is now very accurate but the bacteriological glassware was exceedingly inaccurate when the work was first undertaken and is still too inaccurate. A large amount of bacteriological glassware has been rejected and during the first year of testing many of the 1 ml pipettes delivered from .5 to 1.5 ml. Until a few months ago I supervised the testing and marking of this glassware but recently these duties have been undertaken by J. C. Marquardt.

Dairy Herd Management

Since this institution has no member of the staff trained in dairy cattle work who could devote his time to the management of the herd and investigational work it has been necessary for me to assume these duties. A large amount of time is needed for this work since it is necessary to watch the details of work in the handling of the herd and in the barn, of entering and recording all feed and production records, and in recording pedigrees, etc. In recent months a portion of this work has been given to J. C. Hening.

Hardly a week passes in which someone does not come to see the herd and practically every day someone comes in to discuss problems of dairy herd management. Very few addresses have been given on this phase of the dairy work altho much time is taken in giving individual advice and in answering correspondence. Each year from five to ten groups of students, cattle club workers ect. visit the herd for experience in judging. Each of these visits requires about a half day of time.

Association Activities

For several years I have taken an active part in the affairs of the New York State Dairymen's Association and the New York State Jersey Cattle Club. This is evidence by the fact that for the last two years I have served as President of both organizations and continue to serve at the present time as a director.

Rather intimate contact has been maintained with the New York State Ice Cream Manufacturers Association by attendance and addresses at their annual conventions and by personal contact with

various members of the Association.

In addition to having served as chairman of the former sub-committee on the Gerber test, I have been chairman of the general committee on chemical methods for the American Dairy Science Association. This year I was elected editor of the Journal of Dairy Science which is the official publication of this Association. This Journal published each year approximately 600 pages of new material on dairy science.

The International Association of Ice Cream Manufacturers began an abstracting service for members about a year ago. All current and back literature of interest and value to manufacturers of ice cream will eventually appear in the ice cream abstracts of this Association. Members subscribe for this service and volumes are mailed to them each year. The general management of this service is handled thru the secretary of the International Association and I serve in the capacity of abstracting editor.

RECOGNITION OF PUBLISHED INVESTIGATIONS

It is often difficult for one to justly interpret the value of contributions made to an industry. Fortunately we can occasionally secure the opinions of others on this question. Two points which bear on the recognition of my published investigations are of special interest. In the book entitled "Fundamentals of Dairy Science" written by 28 authors who have been employed by the U. S. Bureau of Dairying considerable recognition has been given to three publications from this department. There have been 15 direct references made to these

publications, three direct quotations have been made, and three illustrations have been reproduced in this book.

Two years ago the graduate students of Penn. State College voted to determine those who had made the most valuable contributions to our dairy literature. It was especially gratifying that out of the 150 to 200 names mentioned by the students that my name was included with the 20 who received the greatest number of votes, as a result of publications made since I have been at this institution.

ADDITIONAL FACILITIES NEEDED

There can be no doubt that the outstanding need of the dairy division is additional floor space. This is emphasized by the fact that there is no room for additional equipment and most of the work is now carried on in too crowded conditions.

There is also urgent need for someone in the department capable of managing the dairy herd and conducting investigations to the capacity of the facilities which are available. This fact is especially emphasized to me since my time is so divided that it is almost impossible to give enough time to investigational work to maintain a satisfactory standard by a sufficient amount of good work.

There is also need for Holstein cattle, not from the standpoint of using the cattle for breeding purposes, but to furnish milk for the investigations on milk and its products. It is exceedingly inconvenient and undesirable for us to be compelled to continuously secure Holstein milk from neighboring herds of cattle. It is obvious

that we cannot publish results on market milk or cheese without first checking the results which we secure with Jersey milk on milk produced by Holstein cattle.

PUBLICATIONS

- 1923
- Twenty-two Years of Tuberculin Testing in the Same Herd.
A. C. Dahlberg, N. Y. Agric. Exp. Sta. Bul. 496
- A Greenish-Black Discoloration of Chocolate Ice Cream.
A. C. Dahlberg, Jour. Dairy Science, Vol. 6, pp 455-460
- Ice Cream Included in Proposed Geneva Program.
A. C. Dahlberg, Ice Cream Trade Jour. Vol. 19, p 69
-
- 1924
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- New York Experiment Station Jerseys.
A. C. Dahlberg, Hoard's Dairyman, Aug. 1, Aug. 22, Aug. 29, Oct. 24
- How Ice Cream Appears Under the Microscope.
A. C. Dahlberg, Ice Cream Trade Jour. Vol. 20, pp 68-70
- The Causes of Leaky Butter.
A. C. Dahlberg and J. C. Marquardt, New York Produce Review, Jan. 6, 1924
-
- 1925
- Viscosity, Surface Tension, and Whipping Properties of Milk and Cream.
A. C. Dahlberg and J. C. Hening, N. Y. Agric. Exp. Sta. Bul. 113
- The Texture of Ice Cream.
A. C. Dahlberg, N. Y. Agric. Exp. Sta. Tech. Bul. 111
- The American Food Jour. Vol. 20, pp 505-507
- Annual Report of National Association of Ice cream Manufacturers

1926

A Study of the Manufacture of Water Ices and Sherbets.

A. C. Dahlberg, N. Y. Agric. Exp. Sta. Bul. 536

Annual Report of National Association of Ice Cream Manufacturers

A Comparison of the Babcock, Gerber, and Roesse-Gottlieb Methods
for Determining the Percentage of Fat in Milk and Cream.

A. C. Dahlberg, Geo. E. Holm, H. C. Troy, N. Y. Agric.
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The Equity of Register of Merit and Medal Standards.

A. C. Dahlberg, The Jersey Bulletin and Dairy World,
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1927

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A. C. Dahlberg, Jour. Dairy Science, Vol. 10, pp 106-116

New Facts About Gelatin and Its Use in Ice Cream.

A. C. Dahlberg, Annual Report of International Association
Of Ice Cream Manufacturers

1928

Grading of Commercial Gelatin and Its Use in the Manufacture
of Ice Cream.

I. D. C. Carpenter, A. C. Dahlberg, and J. C. Hening, Ind. and
Eng. Chem. Vol. 20, pp 397-406

II. A. C. Dahlberg, D. C. Carpenter, and J. C. Hening, Ind. and
Eng. Chem. Vol. 20, pp -

I. IMPORTANT RESULTS ACCOMPLISHED DURING THE PAST FOUR AND ONE-HALF YEARS

Milk and Cream Studies

The viscosity and whipping properties of cream are not only of interest from a scientific standpoint but are of very great practical importance.

A thorough study was made of the viscosity, surface tension and whipping properties of skim milk, milk and cream both raw and pasteurized and fresh and aged from Holstein and Jersey cows.

A significant and important difference was found between the viscosity of the aged raw cream from Jerseys and Holsteins. The viscosity of milk and cream was found to increase with aging and increased percentages of fat, but both effects were variable. The effect of fat was most noticeable when the percentage was 20 or above. Pasteurization slightly reduced the viscosity of milk and greatly reduced the viscosity of cream. The effect of aging on viscosity was inhibited to a large extent by pasteurization.

A new and important result was obtained showing that tremendous variations could be brought about in the viscosity of cream separated from the same milk and containing the same percentage of fat.

Cream from milk separated immediately after milking or pasteurization showed very little clumping of fat globules and was thin while cream from milk either raw or pasteurized held cold (35° to 45°F) from 3 to 24 hours and then slowly warmed to 80°F. and separated showed a large amount of fat globule clumping and the cream on aging became very thick.

The surface tension of milk and cream was found to decrease with an increased fat content and it usually decreased with aging. Pasteurization usually increased the surface tension and aging would not reduce it to normal.

The cream whipping experiments carried on in conjunction with these experiments agree with results found by other experimenters and furnish valuable practical information.

Good whipping cream gave a reduced volume of whipped cream when compared to poor whipping cream. Well whipped cream stored at cold temperatures remained whipped permanently with little or no drainage. Cold skimmilk could be whipped to the consistency of egg white but retained the air for only a few minutes.

In a general way increased viscosity and decreased surface tension were associated with good whipping qualities. It was found that the viscosity of normal cream could be altered to upset its relationship to cream whipping. Abnormally viscous cream whipped well but not better than normal cream of the same fat content.

Due to the difficulty of holding the temperature of the milk and cream constant for viscosity and surface tension determinations and because a slight change in temperature greatly effects these determinations they were made in a room at a temperature of 40°F. The milk and cream on which the determinations were made were held in this room.

These results are reported in Technical Bulletin No. 113 of this Station. Viscosity, Surface Tension, and Whipping Properties of Milk and Cream by A. C. Dahlberg and J. C. Hening. The major portion

of this data was secured by the junior author. Counsel and advice were received from the senior author and the write up of the results was altered some by him.

The bulletin has been used by several institutions for classroom instruction.

Some of the results have aroused interest from a commercial standpoint.

Three plates and two charts taken from this bulletin have been used in a recent book on Fundamentals of Dairy Science by Associates of Rogers.

An article was prepared from Technical Bulletin 113 for the Creamery and Milk Plant Monthly.

A cream whipping circular was prepared and distributed at a cream whipping exhibit at the State Fair. Circular No. 77 of this Station. Successful Cream Whipping.

Studies on Homogenization

Experiments on homogenization and its special application to ice cream making were carried on.

The clumping of the fat globules following homogenization appear to have an important influence upon viscosity and ease of whipping of ice cream mixes.

An extensive study was made to endeavor to determine the cause of this fat globule clumping following homogenization. Purified butter oil was homogenized with various solutions of gum tragacanth, sodium oleate, skimmilk powder, skim milk, dialized skimmilk, dialized whey etc. Certain salts were added to portions of these mixes before they

were homogenized. Cream and cream and water and cream and various salts were homogenized. Ice cream mixes were homogenized at a wide range of temperatures. Viscosity determinations of the resulting mixtures were made and approximately three thousand fat globules and fat globule clusters were measured. No reason has been found for the clumping of the fat globules of cream or ice cream mixes when homogenized. The problem is a difficult one and of course physical properties of ice cream mixes cannot be studied under a pressure of 2000 pounds or more such as are given the mix during homogenization. The present physical chemical knowledge available may not be sufficient to make possible the solution of the problem.

However, problems of practical value have been worked out from data secured in this study.

Results of practical value were derived from this work relative to the influence of adding gelatin or sugar to the mix prior to pasteurization and homogenization as compared with the addition of these ingredients immediately after homogenization. This study also included the effect of the homogenization of ice cream mixes before and after condensing.

The two stage valve, a recent development for homogenizers was tested in some of these experiments.

In these experiments approximately 5000 individual fat globules and 10,000 fat globule clusters were measured. Viscosity determinations of the ice cream mixes were made. Melting resistance and hardness determinations were made on the ice cream. It was necessary to make the hardness determinations in the hardening room at a temperature of 0° to -10°F.

The data on the increased viscosity of the mix and on the improved texture of ice cream due to adding the gelatin after homogenization warrant the conclusion that the action of gelatin is slightly greater when added at this time. It is doubtful that this difference is enough to be of commercial importance to the ice cream manufacturer.

The addition of sugar prior to homogenization greatly increased the extent of fat clumping, the viscosity of the mix, and the difficulty of securing the desired overrun. This is new information and can be of considerable help to a manufacturer who is having difficulty in whipping his mixes.

The two stage valve was found to reduce the size of fat clusters, the viscosity of the mix, and permitted an easier incorporation of air.

The mixes homogenized before condensing contained smaller fat globule clumps, were easier to whip, and produced an ice cream slightly better in texture and quality than a similar mix homogenized after condensing.

The work on the Effect of Homogenizing Ice Cream Mixes Before and After the Addition of Gelatin or Sugar and Before and After Condensing was reported at the Dairy Science Association meetings held at East Lansing, Michigan, June 1927 and has been sent to the Journal of Dairy Science for publication.

Gelatin Work

Following this experiments have been carried out with Mr. Dahlberg and Dr. Carpenter on gelatin problems.

A large number of very careful tests were made of the

jelly strengths of twenty different samples of gelatin of varying gelatin strength by a test devised by Mr. Dahlberg.

These tests were made with varying percentages of gelatin in distilled water, in conductivity water and in skim milk. The pH of some of the samples of gelatin varied considerably and the pH of the gelatin solutions in the conductivity water was adjusted to a certain standard with an N/20 KOH solution. Skim milk proved to be most satisfactory in which to dissolve the gelatin for the tests because the variation in the pH of the different gelatins was made uniform by the buffering action of the skim milk.

Some work was done with other gelatin tests and also on viscosity determinations of gelatin solutions.

Twenty different batches of ice cream mixes were prepared and frozen using the twenty different kinds of gelatin. Five different percentages of one kind of gelatin varying in amounts by five hundredths of one per cent were used in five lots of one batch of ice cream. The correct amount as shown by the test used in one lot and quantities less and more than the required amount were used in the other lots. Without knowing the identity of the bricks at the time of judging a variation of five hundredths of one per cent gelatin could be readily detected and the samples of ice cream could be arranged in the order of their gelatin content.

Then the correct amount of twenty different kinds of gelatin as shown by the test were used in twenty different lots of one batch of ice cream mix. No difference could be detected in the twenty samples of ice cream containing the twenty different kinds of

gelatin. This showed the accuracy of the test.

This work is being published in a series of two articles in the Journal of Industrial and Engineering Chemistry.

Just the portion of the work which I was connected with is mentioned in this report. The senior authors will point out new discoveries and the scientific and fundamental importance of this work.

The gelatin test for determining the correct amount of gelatin in ice cream has been much needed and has met with great approval with ice cream manufacturers.

Experiments with chocolate ice cream in cooperation with Mr. Dahlberg have been sandwiched in with other experiments. This work is to be published as a popular article in the Ice Cream Trade Journal.

2.

Present Program of Work

Study of the Effect of Certain Salts on Ice Cream Mixes

In my present work a study of the effect of certain salts on the ease of whipping of ice cream mixture is being made.

It is recognized that the properties of ice cream mixes are not uniform from day to day even tho the mixes appear to be prepared in the same manner. This study should show one reason for these variations. This phase of the work is practically completed.

Since Sept. 1, 1927 I have been given charge of keeping the records of the Jersey herd, the purchase of feed and sale of young stock.

I gave a talk at Farm and Home Week at Ithaca Feb. 1928.

I answer inquiries from farmers, ice cream makers and milk dealers, on an average of approximately twenty-five a year. I also make analyses of 10-12 ice cream samples from commercial plants each year.

3. Needs for Additional Facilities for Most Effective
Prosecution of Work

We could use more floor space to advantage.

Division of Entomology

P. J. Parrott, Chief

H. Glasgow

F. Z. Hartzell

S. W. Harman

F. L. Gambrell

D. M. Daniel

THE DEPARTMENT OF ENTOMOLOGY

P. J. Parrott, Chief in Research

The efforts of the Chief of the Department of Entomology are directed primarily to administrative work in connection with the research activities of the staff under his direction and to various investigations dealing with the control of injurious insect pests that attack orchard, farm and garden crops. Relative to the latter, the major problems receiving his personal attention are as follows:

1. The comparative utility of various insecticides for the treatment of different orchard fruits.
2. The insecticidal properties of tobacco dust.
3. Economical and efficient methods of combating apple aphids.
4. The production of cherries for the canning industry which conform to State and Federal regulations with respect to immunity from maggot infestation.

Experiments with insecticides.

The orchard interests of the state sustain large losses as a result of the ravages of injurious insects. The codling moth alone is estimated to damage the apple crop to the extent of \$5,000,000 annually. The pear industry could not long prosper if orchardists had no recourse to insecticide treatment. Other commercial fruits are attacked by equally important pests. Growers of potatoes, spinach, carrots, corn and celery are confronted with similar serious problems.

The need of protection from injurious insects has created a demand for chemicals adapted to the control of injurious insects. The leading chemical

concerns now maintain departments devoted exclusively to the manufacture of insecticides. New preparations appear on the market each year. The sale of insecticides is constantly increasing.

One of the important functions of the Department is to determine the efficiency, safeness and economy of the new products in comparison with standard materials. This activity calls for the supervision of 26 plats, involving approximately 3000 apple trees, as well as several small plantings of other kinds of fruit trees. Chemical concerns and farmers alike seek information derived from this effort. The results of these activities also constitute the basis of the official spray schedules which serve to guide fruitgrowers in their spray practices. There is probably no single effort undertaken by the Station which is more heartily supported by fruitgrowers. The principal accomplishments from these efforts are as follows:

1. From the standpoint of general utility and economy there is no spray better adapted to the needs of apple growers than lime-sulfur and lead arsenate, to which should be added nicotine sulfate if control of aphids is desired.
2. Of a number of arsenical compounds tested, none proved as safe or as efficient as lead arsenate.
3. That dust sulfur and wettable sulfur were not as dependable as lime-sulfur unless growers make thoro and heavy applications and treat their trees according to seasonal developments of the different pests.
4. That dust sulfur and wettable sulfur are more safe to apple foliage for midsummer treatments and that wettable sulfur and dust sulfur usually produce a better finish on apples than lime-sulfur solution.

5. That there is no satisfactory dust for scale insects.
6. That red bugs are as susceptible to nicotine dusts as to sprays containing nicotine.

Tobacco dust studies.

Pests such as aphids, red bugs, and psylla impose a heavy burden on fruitgrowers since repeated treatments are necessary and the cost of spray materials is high. The heavy expense is largely due to the fact that nicotine sulfate is the only reliable insecticide and one concern has practically a monopoly in the manufacture of the product. The cost of nicotine sulfate is \$11.75 per gallon, which makes the material almost prohibitive. There is a demand for a cheap substitute, not only to reduce the expense of treatment but in order that growers may be able to make the number of applications needed for the production of fruit of high quality. The Department believes that one possible solution of the problem is the employment of tobacco dust in combination with the usual lime-sulfur solution. Nicotine derived by this means seems to be as efficient as nicotine evolved from nicotine sulfate. However, clogging of nozzles and suction intake has been encountered, but it is believed that this difficulty may be overcome by proper grinding of the tobacco and the use of special screens to remove the coarser particles.

Present activities contemplate the development of practical methods of overcoming these obstacles as well as the securing of additional experimental data relative to the killing efficiency of free nicotine evolved from tobacco dust in the manner described.

Apple aphid investigations.

Until the Department investigated the apple aphids there was no means of distinguishing the newly-hatched nymphs of the different species. Moreover, there

To Director F. B. Morrison:

In accordance with your request presented on April 6, 1928 I am submitting the following report of my activities in the Dairy Department for a five year period.

Upon my arrival at the Station on May 1, 1923 my first duties were to assist in the organization of the department library, and to assist Mr. A. C. Dahlberg with an ice cream study. This work continued for a period of three months after which we were prepared to undertake a comprehensive study of the clarification and filtration of milk. The results of this study were available in bulletin form on July 1, 1924. The results of these studies have been incorporated into the dairy teaching program at Cornell, the University of Wisconsin, the University of California, and the University of Missouri. The De Laval and the Burrell Manufacturing Companies according to their head offices regard this work as the most comprehensive, and up-to-date study of clarification and filtration made.

It is gratifying to know that the results have been verified at the Michigan, Idaho, and Washington Stations, and in commercial milk plants. This brief report does not allow for a detailed enumeration of the milk plant operations advantageously changed as a result of this work.

My second major project at this Station dealt with the manufacture of cheddar cheese. This study was undertaken with Dr. G. J. Hucker of the Bacteriological Department. The results were published in two bulletins. A bulletin of a practical nature relating to the cooling

and pasteurization of milk for cheddar cheese making has been adopted the dairy field men of the Department of Agriculture and Markets in this State. The technical bulletin resulting from the studies of the bacteria concerned with cheese making is a valuable contribution to the science of cheese making. According to a statement by Dr. G. J. Hacker both of these publications have met with favor among European Investigators interested in Dairy Research. The findings of these studies have been translated into three foreign languages, and it is safe to assume that the information has reached men in all parts of the world, who have an interest in the science and practice of cheese making.

My third major project at the Station related to the manufacture of cream cheese. An exhaustive study of the influences of homogenization, rennet and culture action, and pasteurization was made. The results were published in the Journal of Dairy Science. The material was also presented as a thesis for an advanced degree at Cornell University. As a result of these studies there is available an abundance of data to assist manufacturers of cream cheese in solving some of the problems of detail which confront them.

The cream cheese studies have been reported in the Dairy Trade Journals; and requests for information relating to manufacturing methods have been received by this department. Also to my knowledge the results of this study have been used for instruction and extension purposes at the University of California, and at the University of Missouri.

At present the writer is working with Mr. A. C. Dahlberg in a study of the physical properties of milk. The results of the pre-

liminary and first parts of this project are ready for publication. A complete study of the creaming power of normal Jersey and Holstein milk has been made. Physical and chemical factors related to the creaming power of milk have been investigated. Pasteurization influences upon fat rising have also been studied.

During Farm and Home Week at Cornell this winter a brief outline of this work was presented. Dr. Otto Rahn and Dr. Paul Sharp commented very favorably on the scope, importance, and progress of this work. A number of milk producers and distributors who were not able to attend the Ithaca meeting have requested reports of these studies as soon as they are published.

Effective Sept. 1, 1927 several changes were made in the Dairy Department. Since that date the writer has had charge of the Inspection of Babcock and Bacteriological Glassware. It is also my duty to take charge of the samples submitted to the department for analysis. Altho we do not encourage this work approximately 400 samples are tested each year. These requests range from a fat in milk determination to a complete analysis of a series of dairy products. Besides this I have the responsibility of keeping the department Library up-to-date.

I have during the past five years appeared as a speaker on the program of the following: American Bacteriological Society, Dairy Science Association, Western New York Butter and Cheese Society, New York State Dairymen's Association, and at the Farm and Home Week Program at Ithaca.

During the first semester of 1926 I completed the

requirements for the Degree of Master of Science at Cornell University. My major study was Dairying, and my minor study was Chemistry.

It has been my pleasure at the Station during the past five years to assist certain staff members in the translation of German Scientific Reports into English. Altho most of this work has been done after regular office hours, I feel that this work has and will continue to be a real service to some of the men at the Station.

In answering question 3 of your request I wish to be very conservative in my reply. Our main handicap is lack of space. This limits our equipment and raw material which in turn places a very definite limit upon the amount and type of work which we can do.

I trust that this report is in accordance with your request. I am attaching a list of my publications, and also a list of the Dairy Organizations in which I hold an honorary or active membership.

SIGNED

J. Marguerite

TECHNICAL BULLETINS

- No. 104 Filtration and Clarification of Milk
 A.C. Dahlberg and J.C. Marquardt
 Pages 27
 Distributed Aug. 1, 1924
-

- No. 117 The effect of certain lactic acid producing streptococci
 upon the flavor of cheddar cheese
 G. J. Hucker and J. C. Marquardt
 Pages 13
 Distributed June 1, 1926
-

COMPLETE BULLETIN

- No. 534 Effect of pasteurization and cooling of milk upon
 the quality of cheddar cheese
 J.C. Marquardt and G.J. Hucker
 Pages 28
 Distributed June 1, 1926
-

JOURNAL ARTICLES

- Die Einflüsse der Filter und Kläumaschinen auf die Milch
 J. C. Marquardt
 Milchwirtschaftliche Forsch., Bd. II, Heft 1, 1925
-

Studien über die Textur von Gefrorenem

A.C. Dahlberg and J.C. Marquardt

Milchwirtschaftliche Forsch., Bd. III, Heft 1, 1926

Der Einfluss des Kühlens der Milch auf die Qualität des
Cheddar-Käses

J. C. Marquardt

Milchwirtschaftliche Forsch., Bd. III, Heft 4, 1926

Om Ostemaalkens Afkling og Pasteurisering

J.C. Marquardt and G.J. Hucker

Mejeri-Posten, 9 Aargang, Nr. 10, 1926

Effect de certains Streptocoques Producteurs d'acidi lactique
sur l'aroma du fromage de Cheddar

G. J. Hucker and J. C. Marquardt

Le Lait, 6 Anne (Seme VI) No. 60. 1926

Soft Cheese Investigations

J. C. Marquardt

Jour. Dairy Science, 10, 309-330. 1927

Observations on the Salting of Sweet Butter

J. C. Marquardt

Pacific Dairy Review, July 23, 1923

The Causes of Leaky Butter

A.C. Dahlberg and J.C. Marquardt

New York Produce Review, Jan. 16, 1924.

DAIRY ORGANIZATIONS

American Association Creamery Butter Manufacturers

American Dairy Science Association

California Creamery Operator's Association

California Dairy Association

California Dairy Industry Association

California State Dairy Council

National Dairy Association

Western Dairy Instructors Association

Western New York Butter and Cheese Association

Editorial Division

J. D. Lockett, Editor

WORK AND NEEDS OF THE EDITORIAL OFFICE

The activities of the Editorial Office of the New York State Agricultural Experiment Station group themselves largely under one of the following heads, each of which will be discussed briefly below:

1. Editing and supervising the publication of the numerous bulletins, reports, and circulars issued by the Station.
2. The preparation of "copy" for the syndicated press service maintained by the Station, and the writing of occasional special or feature articles for the newspapers and magazines.
3. General supervision of Station exhibits at the State Fair and at the winter meetings of the State Horticultural Society.
4. Consultation with members of the Staff on the preparation of material for publication in scientific journals.
5. The writing of "The Station NEWS", a weekly mimeographed sheet of a house organ nature for distribution to members of the Staff and a few others.
6. Supervision of miscellaneous printing.

1. EDITING THE STATION PUBLICATIONS.

Without question, the primary function of the Editor at this Station is the preparation of manuscripts for publication in the formal series of "bulletins" and circulars maintained by the Station, and the supervision of the various steps involved in their printing and distribution.

The editing of the Station bulletins involves more than simply marking the copy for the printer as to headings, type, etc. The Editor is expected to read the manuscript critically, as a disinterested party, and either clarify vague passages or call them to the author's attention for correction. Considerable time is spent in checking calculations and references from the text to tabular material, with profitable results in many cases, both to the Station and to the author. No attempt is made by the Editor to evaluate the

scientific worth of the contribution offered for publication, but the exposition must be sufficiently clear to make the contribution readily understood by all those who read the printed report.

In view of the fact that this Station does not publish material containing general information, with the exception of an occasional circular, but confines its formal publications to reports of results of experimental projects, the number and character of the Station publications vary quite materially from year to year. The following summary shows the number of each type of publication issued during each of the past five years, together with the total number of pages.

Year	Technical		Type of Publication				Circulars		Totals	
	Num- ber	Total pages	Num- ber	Total pages	Num- ber	Total pages	Num- bers	Total pages	Num- ber	Pages
1923	7	236	11	315	3	15	9	83	30	649
1924	11	633	22	563	4	23	6	46	43	1,365
1925	7	214	8	333	5	24	8	79	28	650
1926	8	207	8	237	1	4	10	101	27	549
1927	7	274	11	378	4	32	5	36	27	720
	40	1,564	60	1,928	18	98	38	345	155	3,933

*Including the Annual Report for the year.

After the manuscript is prepared for the printer, considerable time is taken up with the reading of proof and other details pertaining to the publication of the report. For the past several years the Station has contracted with a local printer for the printing of its bulletins and circulars, and this arrangement has made possible a close working relationship with the printer which has proved quite advantageous.

2. THE NEWS SERVICE.

Equally as important as presenting the results of the experimental work underway at the Station in a formal manner is the interpretation of the results to the public, and the broadcasting of information as to the avail-

ability of publications dealing with the subjects on which the Station bulletins treat.

The practical application of the results reported in the bulletins is, of course, brought out in the bulletin itself. Such publications, however, must of necessity be published in limited quantities, and their distribution effected thru more or less restricted mailing lists. In order to reach the public more effectively, therefore, a syndicated press service was inaugurated at the Station in January, 1922, and has functioned continuously since that time.

The primary function of this "News Service" is to furnish the newspapers and farm papers with reliable and timely information about the work of this Station. At the start, a list of all the daily and weekly newspapers in the State was prepared and the mimeographed stories sent out once each week for a period of six months. At the same time subscriptions were entered with two clipping bureaus.

A careful record was kept of the clipping returns thru this first six-month period, and at the end of that time a list was prepared of those papers from which no returns had been obtained. These papers were queried as to whether or not they wished to have the service continued. A most satisfactory reply was secured, many of the papers stating that they were using the material regularly, others that they used occasional stories that seemed to fit their territory, while a few frankly stated that they did not care for the service. These last, together with those papers that failed to reply to the inquiry, were dropped from the mailing list, so that the present list represents a group of newspapers using all or part of the Station's News Service.

Clipping returns are still received from one clipping bureau and serve as a check on the use of the news material in the State. Perusal of a

number of farm papers also reveals that the material sent out in this way is well received by many of them.

An even more important check on the use of the news material is the daily correspondence received at the Station. A careful check of the requests received over a period of several months revealed that more than 25% of the requests for Station publications could be traced definitely to items appearing in the newspapers of this and other states.

The number of stories sent out from week to week varies somewhat with the season of the year, but a minimum output of four stories per week, two to the daily papers and two to the weekly and farm papers, has prevailed for sometime. During the past five years 956 stories have gone out thru the Station News Service.

The gathering of the material for use in these stories and the actual preparation of the copy necessarily requires a considerable amount of time each week.

In addition to the syndicated material described above, an occasional request is received for a feature article for some newspaper, and special articles are sometimes prepared for magazines or other publications.

3. SUPERVISIONS OF STATION EXHIBITS.

In line with the conception of the Editor's office as a clearing house for information about the Station and its work, the Editor has, since 1924, headed a Staff Committee on Exhibits. This Committee came into being primarily to rejuvenate the Station's exhibits at the State Fair and to work out a more or less definite policy governing the Station's activities in this contact with the public.

The Station makes only three exhibit a year -- at the State Fair, at the meeting of the State Horticultural Society at Rochester in January,

and at the eastern meeting of the State Horticultural Society at Poughkeepsie later in the winter.

At these exhibits each department at the Station is encouraged to work out the details of its own exhibit. The Committee on Exhibits then coordinates the whole display and supervises the general arrangement in order to obtain the most effective exhibit possible. The broad general policy which guides the Committee in this respect is the assumption that the Station exhibit represents the institution as a whole and that the several department exhibits shall so arrange their display matter as to harmonize with the entire exhibit.

As an indication of the magnitude of the Station's exhibits at the State Fair, the exhibits occupy approximately 5,000 square feet of floor space and over 200 feet of wall space. At the State Horticultural Society meeting in Rochester the exhibits occupy approximately 225 feet of wall space and 1,600 square feet of floor space. The space used at Poughkeepsie is much less than this.

The budget authorized by the State Fair officials for the 1928 exhibits of this Station amounts to \$2,000, an increase of \$600 over last year's item for this purpose. The State Fair exhibits have never cost the Station a penny in actual cash outlay, altho the time of the men on the exhibits is of course a charge against the Station.

Naturally, the time devoted to exhibit duties by the Editor is limited to brief periods preceding the exhibit dates and the exhibits themselves. Preparations for the State Fair particularly and for the Rochester exhibits to a less extent does, however, require some attention in advance and an appreciable amount of time is given over to committee meetings, conferences, correspondence, etc., much of the detailed arrangement of the

several exhibits being left to the Chairman of the Exhibits Committee.

4. CONSULTATION WITH STAFF MEMBERS.

Frequent requests are made by members of the Staff for editorial assistance in the preparation of manuscripts to be submitted to scientific journals. This assistance usual takes the form of a reading of the manuscript for general construction and clarity. Occasionally proof will be read for the author.

While these demands are never heavy, an appreciable amount of time is taken up each year with this type of service.

5. THE STATION NEWS.

With the establishment of field laboratories in the Hudson River Valley and on Long Island, in addition to the Vineyard Laboratory already in existence at Fredonia, the idea was conceived in 1923 of establishing a mimeographed sheet to serve as a house organ in order to keep members of the Staff at these outlying laboratories in touch with activities at the Station and to serve also as a semi-official news medium for the Staff at Geneva.

The NEWS appears each Tuesday, and the material contained therein is assembled by the Editor thru a number of Department "Correspondents". This enterprise occupies the Editor's attention for approximately half a day each week.

6. Miscellaneous Printing.

A considerable sum of money is spent each year by the Station on miscellaneous printing, such as letterheads, forms, etc. This material all passes thru the Editor's hands together with proof on the same, and while it is not a time-consuming item in the Editorial Office, it is an important function of that Office.

NEEDS OF THE EDITORIAL OFFICE

The Editorial Office at this Station as at present organized is a one-man office. This means that with the activities of the office outlined above any interruption in the physical presence of the Editor in the office works a serious curtailment to the efficient functioning of the Station's editorial machinery.

It is still possible for the Editor to anticipate absences from the office to the extent that the editorial activities of the Station do not come to a standstill with his absence from the office for brief periods. This is becoming increasingly difficult, however, and the time is not far removed when it will be an actual impossibility.

During the past five years, the Station Staff of technical workers has increased 50%. Many of these men are now reaching a point where they are becoming productive in the way of published reports of their work. This is reflected immediately in an increase in the editorial activities of the Station.

Lacking even ordinary stenographic assistance, the Editor is finding a steadily increasing demand on his time for attention to routine matters that unduly crowd the more important duties of the Office. For example, it is becoming more and more difficult to give the proper amount of time to the editing of Station manuscripts and to keep the other duties of the Editorial office going. It is the opinion of the Editor that he should be able to give undivided attention to the editing of these manuscripts when occasional demands. As it is now this important phase of the work must give way frequently to the editorial obligations with a consequent showing^{up} of publication.

The chief need in the Editorial office, therefore, is for a competent assistant who could take over much of the proof reading, correspondence, including other routine items and some of the news writing, so that the Editor could devote more of his time and energies to the primary function of his office.

The possibilities in developing further the News Service of the Station are tremendous. In fact, the present dissemination of information by this means is in an exceedingly elementary stages when compared with the advances made by similar institutions in other states.

Any further expansion under the existing limitations of the office is out of the question, except possibly in one or two minor details. The assistant mentioned above should be a person of sufficient training and experience, therefore, to aid in the further development of this phase of the Station's editorial activities. The qualifications desired would be a college education, preferably with an agricultural background and some definite training or experience in journalism, adequate knowledge of stenography to meet the needs of the office, and ability to master the office style in order to become proficient in proof reading. The position should pay \$1,800 in order to attract and hold the type of person desired.

Editor.

May 1, 1928.

was no satisfactory method of combating aphids in commercial orchards. In developing a satisfactory system of combating the rosy aphid, the Station also demonstrated the importance of the delayed-dormant application in combating early infections of apple scab. Our recommendations relative to the value of the delayed-dormant treatment for these two pests have been approved by the Spray Service.

In the experiments with dust mixtures it was demonstrated that the aphids are immune to applications of nicotine dusts during the period when buds are dormant or as buds display leaf tips. On the other hand, the insects proved highly susceptible to nicotine dusts when treatments were made as blossoms were opening. Apparently with nicotine dusts of ordinary concentrations a canopy of foliage is required in order to retain nicotine in sufficient amounts to kill the aphids.

The experiments with lubricating oil emulsions indicate that while dilutions containing 3 per cent oil reduce the amount of injury by the rosy aphid, the protection afforded the trees has not been as satisfactory as that usually obtained with either lime-sulfur and nicotine or the bordeaux-oil spray with nicotine. To secure a high degree of control it is necessary to increase the ratio of oil, 4 per cent being the minimum we would care to suggest as being calculated to secure an appreciable reduction in the number of the rosy aphid without incurring too great a risk of injury to the buds.

The cherry maggot in relation to pure food regulations.

Sweet and sour cherries are subject to infestation with maggots. However, the actual condition of cherries with respect to these pests was not revealed until federal food inspectors notified canners that they should take steps to eliminate maggots from their products. The canners appealed to the Station for assistance.

Arrangements were effected whereby examinations were made by this Department of canned cherries from the different factories in this state and of orchards in the different cherry-growing sections supplying fruit to canning companies. These surveys revealed a grave situation in view of the condition of commercial orchards with respect to these pests, the seizure of interstate shipments of canned goods by federal inspectors, and the threatened danger that jobbers would prefer canned cherries from Wisconsin and Michigan in preference to canned cherries from New York.

Obviously, the key to the solution of the problem was the adoption by cherry growers of more efficient spray practices. Experiments conducted by the Station demonstrated that by means of certain spray practices infestation of cherries could be reduced considerably below the tolerance permitted by the federal food inspectors. Moreover, it was demonstrated that the accumulative benefits from proper spraying are high. A study of canning methods also revealed that by means of certain modifications of factory processes the condition of cherries could be greatly improved. The Station recommendations have been adopted by both canners and cherry growers.

With the development of a section of the Department devoting its exclusive attention to canning crop problems further studies along these lines have been undertaken by Dr. Glasgow who has assumed direction of the project.

PUBLICATIONS

1923

Insect problems of the Hudson River Valley, P. J. Parrott. Proc. 68th Ann. Meeting N. Y. State Hort. Soc., 283-297. 1923.

The insecticidal properties of tobacco dust, P. J. Parrott and Hugh Glasgow. Jour. Econ. Ent. 16, 1923.

Influence of dust and spray mixtures upon apple production, P. J. Parrott. Crop Protection Institute, News Letter No. 6. March, 1923.

1924

- Circular No. 70. Dec. Spraying and dusting experiments with apples in 1923.
P. J. Parrott, F. C. Stewart, and Hugh Glasgow.
- Some side lights on spray injuries to apple fruits and foliage, P. J. Parrott.
Jour. Econ. Ent., 17, 267-274. 1924.
- Tobacco dust as an insecticide, P. J. Parrott and G. F. MacLeod. Jour.
Econ. Ent., 16, 424-429. 1923.
- The utility of dust and spray mixtures for orchard treatment, P. J. Parrott.
Proc. Penn. State Hort. Assoc., 1924, 3-23.
- Some side lights on dusting and spraying practices, P. J. Parrott.
Proc. 69th Ann. Meet. N. Y. State Hort. Soc., 118-134. 1924.
- The spray schedule in relation to pear psylla and pear thrips control,
P. J. Parrott. Proc. 69th Ann. Meet. N. Y. State Hort. Soc., 204. 1924.

1925

- Bull. 517. Comparative efficiency of dust and spray mixtures in controlling
the currant aphid, by P. J. Parrott and S. W. Harman.
- Cir. 78. Spraying and dusting experiments with apples in 1924, by
P. J. Parrott, Hugh Glasgow, F. C. Stewart.
- The efficiency of various spray and dust mixtures in controlling rosy
aphid. P. J. Parrott and Hugh Glasgow. Jour. Econ. Ent., 18, 214-218. 1925.
- Some practical points relative to control of rosy aphid. P. J. Parrott.
Proc. 70th Ann. Meet. N. Y. State Hort. Soc., 17-22. 1925.

1926

- Cir. 84. Jan. Spraying and dusting experiments with apples in 1925, by
P. J. Parrott, Hugh Glasgow, and F. C. Stewart.
- Controlling fruit flies in cherry orchards, by P. J. Parrott. The Canner,
61, 23-27, 1925.

1926 continued

The peach cottony scale (Pulvinaria amygdali. Chll.) by P. J. Parrott. Proc. 71st Ann. Meet. N. Y. State Hort. Soc., 23-29. 1926.

Fruit flies in cherry orchards, by P. J. Parrott. Proc. 71st Ann. Meet. N. Y. State Hort. Soc. 130-131. 1926.

The range of utility of oil sprays. P. J. Parrott. Proc. 71st Ann. Meet. N. Y. State Hort. Soc., 166-169. 1926.

Controlling fruit flies in cherry orchards. P. J. Parrott. Fruits and Gardens 5, 6, and 29. 1926.

Controlling fruit flies in cherry orchards. P. J. Parrott. The Canner, 62, 140-143. 1926.

1927

Cir. 89 Nov. The peach cottony scale. P. J. Parrott and S. W. Harman. A survey of important insects and spray developments. P. J. Parrott. Proc. 72nd Ann. Meet. N. Y. State Hort. Soc., 4-13. 1927.

The peach cottony scale. P. J. Parrott and S. W. Harman. Jour. Econ. Ent., 20, 146-150. 1927.

A perspective of the oil spray situation. P. J. Parrott. The American Fruit Grower Magazine, Vol. 47, No. 2, 1927. pp. 1, 39 and 45.

MISCELLANEOUS ACTIVITIES

Answering inquiries from farmers. The number of letters dictated varies with the season, running from 7 to 20 letters per day. The number runs on an average from 1600 or over per year.

Addresses to farm organizations. Constant demands are made on the Department for addresses. Lack of time and official duties compel non-acceptance of many such requests, especially from organizations in other states. We usually respond to invitations from farm organizations within the state, delivering each year addresses before the State Horticultural Society at the time of the summer

and winter meetings, the Hudson Valley Fruitgrowers' Association, county fruit growers' societies, and various Farm Bureau meetings.

Telephone calls from farmers. Many requests from farmers for information are received by telephone. During the spraying season of late spring and early summer, especially, the calls of this character are frequently so numerous as to occupy practically the entire attention of one member of the staff. At this period telephone calls may run as high as 15 to 25 per day.

Seasonal activities. From late fall to early spring my entire time is practically all spent in preparing addresses, reports, scientific papers, and in attendance at scientific societies, conferences relative to insect control and spray service, and at meetings of various farm organizations. Any available time is used for the preparation of experimental data for publication in Station bulletins. From late spring to autumn attention is devoted largely to experimental activities, field surveys, and in consultation with workers in the different field laboratories.

Other activities that demand some of my time are as follows:

Association of Economic Entomologists (Vice Pres. 1927, 1909-10, Pres. 1913-14).
Chairman of the Northeastern Branch of Entomologists.
Member of Board of Trustees of the Crop Protection Institute.
Representative of Entomological Association to Division of Biology and Agriculture, National Research Council.
Chairman of the State Entomological Commission on European Corn Borer.
Member of National Committee on Codling Moth Investigations.
Chairman, Conference of Entomologists and Phytopathologists of New York State.
Conference on Research of Cannery Problems.
School of Cannery
Corn Borer Conferences at Washington, D. C., Detroit, Michigan, and Buffalo, N. Y.

NEEDS OF DEPARTMENT

The most serious need of the Department is an assistant to Dr. Glasgow. The truck crops of this state suffer extensive losses from destructive insects, and practically little is known relative to the life histories, habits and control of these pests. The carrot industry is in a serious condition owing to the ravages of the carrot rust fly, and this same pest threatens the culture of celery. Unless economical and efficient methods of combating the pests are developed, sections devoted to extensive production of these crops will have to abandon both celery and carrots. Some growers have already abandoned the growing of carrots and are trying to produce potatoes. In making this shift they have run into other difficulties. The situation with the spinach leaf miner, onion maggot, wire worms and white grubs is quite similar.

Dr. Glasgow is very much handicapped in that he is trying to handle all of these problems single handed. He is, of course, making progress; but his efforts would be very much more productive if he had some assistance. The reason is that he is attempting to carry on experiments in four or five localities that are widely separated. No one experiment receives the attention that is required to do really satisfactory work. With planting, application of insecticides, harvesting of his crops, and securing data he is constantly on the move. If adverse weather, breaking of machinery and delays occur because of the inability of cooperating farmers to conform to his schedule develop, his program is upset and as a consequence certain of the experiments suffer. His productive capacity would be greatly increased if he had at his command an active, intelligent workman. He does not ask for a trained assistant.

Dr. Glasgow also needs a small truck which could be used to convey him and his assistants, spray supplies and machinery to the different localities where his

experiments are located. As things stand now he is often compelled to use his own car and the customary mileage does not really compensate him for the rough usage to which it is subjected. He makes no serious complaints, but I can see from his comments that the present situation with reference to the conditions under which he is working are not to his liking. Personally, I believe he has real reasons for being dissatisfied.

A situation that needs to be considered when the time is opportune is that concerning Mr. Harman's work in Niagara and Orleans counties. The growers are making greater demands on the Station, and I feel certain that the sentiment in this general area favors a more effective and larger program of activities than present conditions of the Station permit. Mr. Harman should have more funds for experimental activities as well as the assistance of a workman of the type which Dr. Glasgow desires.

Mr. Munding is handicapped by the lack of funds to buy necessary insecticides and, here again, if it were possible for him to employ a laborer during the busy months his efforts would be very much more productive.

With respect to equipment, the Station may be compelled to buy a new spray machine to take the place of the one now used to spray the Station orchards. It is not certain that it can be depended on for another season.

A spraying machine adapted to treating truck crops may be needed, especially if the Mexican bean beetle develops to destructive numbers.

With respect to the house, it needs outside repairs as well as a coat of paint. Drainage should be attended to as the cellar has been wet all winter. Two bedrooms, bathroom and hallways should be papered and painted. The furnace is also defective and there is a possibility of its giving out at any moment. Two of the houses equipped at the same time as ours with this type of boiler have had new boilers. Two years ago funds were set aside for the purchase of a new

boiler, but because of unusual emergencies the money was spent for other purposes.

If it is a legitimate request, the floor of the garage needs strengthening and the garage equipped with double doors. I believe the Station carpenter could make these repairs in a couple of days.

DEPARTMENT OF ENTOMOLOGY

Report of Work for Years 1923 - 1928

Hugh Glasgow, Associate in Research

During the seasons of 1923 and 1924 the bulk of my time was devoted to certain phases of the orchard dusting-spraying program that were being carried out on a large scale at the Station during this period and for the two or three years preceding. In addition to this work a smaller amount of time was spent in an attempt to work out improved methods for the control of the cabbage maggot particularly as it affected the production of cabbage and cauliflower seedlings.

This unit of the general dusting and spraying program referred to above was conducted mainly in a large commercial orchard of 240 bearing trees located near Hall, N. Y., belonging to Wilson and Jones. The primary object of the experiments in this orchard was to establish the comparative merits of insecticides and fungicides when used in the form of dusts and liquid sprays. The various applications to follow the established spray schedule were designed for the control of all the common insects affecting the apple. Particular attention was given to rosy aphid control in this orchard.

Extensive tests to determine the comparative value of dust and liquid insecticides for the control of the San Jose scale were also carried out in a large, badly infested orchard near Geneva belonging to the Rice Nursery Company.

A summary of the results of the work in the Wilson and Jones orchard is given in Circulars 76, 78 and 84. The results of the work in the Maxwell orchard have not yet been published.

The general conclusions drawn from the work in the Wilson orchard and from other similar experiments were that dusting may often be used to advantage in

special cases, or as an emergency measure, and can often be used with success in the control of specific pests such as the rosy aphid, codling moth, red bug, and apple scab. The cost in general is considerably greater, however, and the results much less certain than where liquid sprays are used. In general, dusts do not appear well adapted to take care of the general spray program in a commercial apple orchard. When used against scale insects dust preparations proved uniformly less effective than the same insecticides applied in liquid form.

The results of the cabbage maggot work have been published in Bulletins 512, 513, and in Circular 76. In this work it was found that, in addition to screening, the seedbed may be protected from the ravages of the maggot by applications of either tobacco dust or solutions of mercuric chloride. In addition to its value in maggot control it also developed in the course of these studies that the mercuric chloride method possessed great possibilities for the control of certain troublesome seedbed diseases, such as *Rhizoctonia* and club-root, and promised to be of almost as great value in this respect as for the control of the maggot, against which the method was primarily directed. The mercuric chloride method has now become well established in the cabbage-growing sections of the state and is giving uniformly satisfactory results in maggot control as well as in preventing losses from various seedbed diseases.

In 1925 my work was transferred to the canning-crops investigations with the understanding that problems well under way in other lines should be completed. At this time the cherry fruit fly was perhaps the most acute problem before the canners of the state. As a result of the activities of the federal pure food authorities large shipments of canned cherries were being seized and destroyed at this time because they frequently contained maggots of the cherry fruit fly. This situation involved the canners in the loss of thousands of dollars, disorganized one important phase of the canning industry, and threatened the growers

with the loss of the most important outlet for their sour cherry crops. On account of this situation and the insistent demand for information on the maggot, practically all my time during the season of 1925 and a considerable proportion of my time during the two succeeding seasons had to be spent on this problem, in which I have had the assistance of Mr. F. L. Gambrell. A report of progress has already been published as Circular 87, and we have now nearly completed the cherry maggot study. This should be rounded out during the coming season provided nothing happens to the cherry crop.

As the maggot situation now stands a number of orchard operations have been found that will materially reduce the maggot population in a cherry orchard, such as repeated shallow cultivation, the use of contact insecticides, or the destruction of crop remnants. Such operations may be important supplementary measures, but the main dependence of the grower must be placed in the use of properly timed arsenical applications, either in the form of dusts or sprays. This method of control as it is now being practised by the leading cherry growers of the state appears to be a specific for the cherry fruit fly. The practicability of this method of control has been so thoroughly demonstrated by practical growers thruout the state that it leaves little to be desired from the standpoint of control. Aside from some very unusual situation there appears to be no valid excuse for a grower failing to secure a crop of cherries practically 100 per cent free from the maggot, and there is also no longer any excuse for the canner who persists in accepting maggoty fruit from the grower.

Since the consumer has no alternative but to eat canned cherries entire, together with anything adhering to the skins, it seemed that the practice of coating such a food product with arsenic, as must be done for maggot control, might result in serious criticism. To meet such possible criticism a great deal of time was spent in determining the actual danger resulting from such a

practice as well as means for meeting the situation if it should arise. It has been found that, if necessary, the amount of arsenic commonly used for maggot control in the orchard can be materially reduced and still give good commercial control of the pest. It was also shown that the bulk of any arsenic still adhering to the fruit at harvesting time can readily be removed at the plant with small expense.

During the past two seasons the spinach leaf-miner, carrot rust fly, and the general wireworm situation have received considerable attention as canning crop problems. These are all serious canning crop pests and are of equal or even greater importance in their destruction to other crops not grown primarily for canning.

The spinach leaf-miner is the chief limiting factor in this state in the production of spinach for canning as well as when this crop is grown for the general market. Owing to the wide distribution of the pest, its large number of generations, and the rapidity with which the maggot develops in the leaves after the infestation starts, it makes the growing of spinach in this state extremely hazardous. It is capable of destroying the commercial value of an entire planting in a very short time.

The carrot rust fly is a pest that is steadily becoming an increasingly greater menace to carrot growing in this state. In some important sections where carrots in the past have been one of the major crops the rust fly has forced the practical abandonment of this crop by commercial growers, and is threatening to do the same with celery, another major crop.

Wireworms have always been troublesome pests that are exceedingly difficult to control. Altho wireworms have received a great deal of attention from entomologists in different parts of the country for many years, there is at present no established means for their control that will apply under general field conditions in New York state.

The situation as it now stands in regard to these three pests is very unsatisfactory, for altho considerable work has been done on them during the past two seasons, the problem of their successful control is by no means settled. A vast amount of work will doubtless have to be done before their control is in anything approaching as satisfactory a position as that of most of our common fruit tree pests. It is safe to say that we are little farther ahead in the solution of truck crop problems of this character, or in our methods of attack, than we were twenty years ago with some of our common fruit insect problems.

In working on problems of this sort it is obvious that the bulk of the studies bearing on control, if they are to have any weight with the grower, should be carried out in those localities where the particular pest involved is most abundant and destructive. This will naturally require a great deal of travel in planning and following up the different problems, and unless this can be done with the least possible loss of time during critical periods there is bound to be a serious overlapping of the various projects with resulting confusion and possibly sacrifice of much of the work under way. The same situation is bound to come up unless there is sufficient labor available to help out at critical periods. Progress can be made in all these problems as the work is now being carried on, but working single handed the results cannot be secured as rapidly as the growers wish and expect.

Needs

The following are some of the things that are most essential in prosecuting this work to the best advantage:

1. Some sure and rapid means of transportation that can be depended on thruout the season.
2. One intelligent laborer who can be counted on for help whenever needed.

3. Labor to be available at certain critical periods, possibly three or four times during the course of the season.
4. Facilities for the construction of occasional simple, inexpensive pieces of machinery that may be needed in the work.

Activities during year.

Planning and carrying out entomological investigations during the growing season, normally from the latter part of March until November. The winter months are occupied in assembling data so that the results of the summer's work will be in available form, in examining and working up material collected during the growing season, and in preparing reports and talks for various meetings.

Meetings attended during year, five.
Letters answered approximately 200.
Visitors during year approximately 100.

During the coming season the following insects are to receive attention so far as the facilities available will permit:

Cherry fruit fly
Spinach maggot
Carrot rust fly
Wireworms
Onion maggot
Rosy apple aphid

The rosy apple aphid problem is one that has carried over from former years and should be completed this season if the insect develops in sufficient numbers to make the tests planned significant.

Station Publications
Last Five Years

- Bulletin 512 Control of the cabbage maggot in the seedbed
- Bulletin 513 Cabbage seedbed diseases in relation to certain methods of cabbage maggot control. (With W. O. Gloyer)
- Circular 70 Spraying and dusting experiments with apples in 1923, with P. J. Parrott and F. C. Stewart.
- Circular 76 The cabbage maggot: its control in the seedbed.
- Circular 78 Spraying and dusting experiments with apples in 1924) With
Circular 84 Spraying and dusting experiments with apples in 1925) P. J. Parrott and
F. C. Stewart
- Circular 87 The cherry fruit fly, with F. L. Gambrell
- Circular 100 100 insect pests of canning crops in 1927.

Journal Articles

- Journal of Economic Entomology Vol. 16, 1923, p. 68.
Control of the root maggot in cabbage seedbeds.
- Journal of Economic Entomology Vol. 16, 1923, p. 90 (With P. J. Parrott)
The insecticidal properties of tobacco dust.
- Journal of Economic Entomology Vol. 17, 1924, p. 95.
The mercuric chloride treatment for cabbage maggot control
in its relation to certain seedbed diseases.
- Journal of Economic Entomology Vol. 18, 1925, p. 214. (With P. J. Parrott)
The effect of various dust and spray mixtures in controlling
rosy aphis.
- Science Vol. 59, p. 338, 1924. (With W. O. Gloyer)
Mercuric chloride as a preventive of certain damping-off fungi.
- Phytopathology Vol. 14, p. 25, 1924. (With W. O. Gloyer)
Effect of mercuric chloride treatment for maggot control on
Rhizoctonia and club-root of cabbage.

DEPARTMENT OF ENTOMOLOGY

F. Z. Hartzell, Associate in Research

1. Accomplishments during the years 1923-27.

Pear Psylla

Investigations of the life history and control measures, in which nicotine sprays and dusts were used, were conducted in Niagara, Orleans and Monroe counties from 1920 to 1923, during which time over 80 acres of pears were under experimentation. The results were published in Bulletin No. 527 in July 1925. During 1926 and 1927 investigation of oil sprays for the control of pear psylla were in progress in the neighborhood of Geneva, and additional studies of the spray residue problem were made in Oswego county in 1927. During 1927, and at present, Mr. F. L. Gambrell is assisting in the investigation. The results with oil sprays have not been published, but two circulars (Nos. 98 and 102) have been published for the guidance of pear growers.

The results of the pear psylla investigations to date may be summarized as follows:

(a) Studies were made of the life history of the insect with special reference to the egg-laying period of the hibernating adults. These results have an important bearing on the efficiency of control measures during the early spring, especially in the region bordering Lake Ontario, and thereby assist in making the proper spray recommendations.

(b) Efficient control of the pest was secured by means of nicotine sprays. The results of these investigations have assisted in laying the foundation for present recommendations for the control of the pest.

(c) Lime-sulfur and nicotine when used at the summer strength of the former was found to have a deleterious effect on the foliage, at least during certain

seasons, so the use of the heavy lime-bordeaux and nicotine spray was substituted and has been found very effective without injurious effects to the foliage or fruit.

(d) A thorough investigation of nicotine dusts revealed the fact that sulfur-nicotine dust is not as efficient as lime-nicotine dust because it is more difficult to envelope the trees with the former material.

(e) It was learned that the stages of the insect present, temperature, humidity, wind velocity, size of trees and dosage play an important part in the efficiency of nicotine dusts. In Bulletin No. 527 is given an extensive biometrical study of these factors.

(f) By showing the conditions under which nicotine dust can be used successfully, as well as the factors that cause failure, it is believed that the pear growers of the state have been saved thousands of dollars annually since they need not waste material by making improper applications.

(g) A spray consisting of soap and nicotine was found effective against the psylla nymphs during the late summer, and since it leaves no spray residue can be recommended for use late in the season without danger of spotting the fruit.

(h) Tests of dormant oil sprays have shown that they are very effective in controlling pear psylla at a greatly reduced cost per tree for labor and materials. The indications are that during certain seasons a single application, properly made, will control the pest for an entire season when the orchard is isolated from infested pear trees. This should make the growing of pears very profitable, at least as far as psylla control is concerned.

(i) Tests of summer oil sprays have not proven effective against pear psylla, but further experimentation with the materials are in progress.

(j) Studies of the migration of pear psylla have shown that infestation of an orchard occurs in the fall and that the susceptibility to psylla is closely related to the amount of shelter from the wind that is afforded to the trees by

topography, woodland and other orchards. These observations form the basis for present studies, with the aim of modifying the environment to such an extent as to greatly reduce the psylla menace; thereby bringing about economy in labor and material to keep the plantings free from the pest.

(k) The regular spray schedule costs about 20 cents per tree for materials to control psylla alone, while the cost of the oil treatment costs from 3 to 5 cents per tree for materials. The cost of the additional treatments for labor when the regular schedule is followed is largely avoided by the use of oil. Since there are some 2,000,000 pear trees in the state, yielding annually about 1,500,000 bushels of pears, the industry is of sufficient size to warrant the statement that if the cost of psylla control can be reduced by as small an amount as 10 cents per tree the saving to pear growers of the state will amount to not less than \$200,000 annually.

Codling Moth

During the years 1922 and 1923 in Niagara county, and during 1924 and 1925 in Chautauqua county, investigations were made on the seasonal history of the codling moth, and a considerable reduction in wormy apples was made by properly timing the spray applications. The results of these experiments apply to the principal apple sections of the state; namely, the Ontario and Erie plains. In the counties on the south shores of Lakes Erie and Ontario there are approximately 4,000,000 bearing apple trees yielding in the neighborhood of 12,000,000 bushels annually. The application of the results of these experiments would mean a saving of at least 5 per cent more fruit or about 600,000 bushels annually.

Grape Berry-moth.

The grape berry-moth is the cause of "wormy" grapes and much effort has been expended in developing efficient spraying practices. Certainly there is no insect

pest of the grape which is so difficult to control as this insect. While it does not usually infest the 30,000 acres of vineyards in the Chautauqua region, it was present in nearly half of this area in 1922. During ordinary years the pest is confined to a much smaller area and my studies have shown that it is definitely related to areas in which drifting of snow occurs in the vineyards, such as the east sides of woodland and buildings. These constitute foci of infestation from which, during favorable seasons, the pest spreads over larger areas of the grape belt. By removing such foci the pest could be largely eliminated because there would be few insects surviving to infest vineyards during favorable periods. The loss from this insect would easily reach five dollars per acre over 10,000 acres of vineyards during a year like 1922, especially since the new grape grading law is in effect. Therefore a loss of \$50,000 during such years would not be an extravagant claim. It is believed that most of this loss can be eliminated by modifying the environment to avoid drifting of snow in portions of the vineyards. We base this claim on results that have been secured with the grape-vine flea-beetle (See Ecological Investigations below). Even during years of lighter infestation, the loss would no doubt total several thousands of dollars in the Lake Erie region. The results of studies on this problem are being prepared for publication in a Station bulletin.

Ecological Studies

I am convinced that a number of problems in insect control which either at the present are attacked by means of insecticides or which have not been solved can be more economically met by modifying the environment than by any other means. This has carried us into the realm of surveying for the making of ecological maps and this has necessitated the developing of mapping methods applicable to the problems at hand. Systematic botany had to be mastered because it was necessary

for us to identify all the food plants of the different insects studied. It has also brought us in touch with the problem of winter shelter, temperature, humidity, shade, soil types and reactions, and ground cover. This problem has been under investigation thruout 15 years, the outstanding results being as follows:

Lessening the intensity of grape leafhopper attack (Results published in Bulletins 344 and 359, 1912 and 1913), the control of the grape berry-moth mentioned in the preceding chapter, the data secured for further studies on this phase of control of the pear psylla, but most striking of all the control of the grapevine flea beetle by destruction of wild grapes.

The grapevine flea beetle formerly was a pest of considerable importance in the Chautauqua region, and at the present time causes considerable damage in the vineyards of the Finger Lakes region. We have proven that this pest can be controlled; in fact, practically eliminated in every vineyard by destroying wild grape vines in the vicinity. The results will be given, altho the work was done previous to 1923 because they have not been published in bulletin form for the reason that it was desired to secure observations over a considerable period of years so as to make certain that the results were not due to a dearth of the insects caused by other factors. However, because the results have been very favorable recommendations have been given thru growers' meetings, local papers, and the Rochester Meeting of the State Horticultural Society so that growers could make use of the information.

In 1914, a vineyard near Sheridan suffered a loss in fruit, at present prices, of about \$400 because of the depredations of this insect. I recommended to the owner, after a careful study of the source of the infestation, that he destroy all the wild grapes in the woodland near his vineyard and he has not suffered any loss since that time - 13 years. In fact, I recommended these measures to all growers who had suffered from losses due to the grapevine flea beetle, with the result that the growers of Chautauqua county made such an

excellent clean-up of wild grapes that there has not been any reports of injury from this insect for the past 13 years. This very enthusiasm has prevented me from securing further observations on the pest in that region. It might be stated that it cost the owner of the Sheridan vineyard less than \$10 to destroy the wild grapes near his vines. The reason why the insect is still destructive in the Finger Lakes region is because of failure to get rid of wild grapes near the vineyards. This may give me a chance to make further observations. The success of these measures was the starting point for further ecological studies and gives us confidence in the method when properly applied.

Biometrical Studies

The use of mathematics in the analysis of experimental data is no longer a mental plaything, but has become an important tool in the methodology of science. Since biometry has proven so useful in other biological sciences, I have made a pioneer effort to adapt them to the results of entomological research by using them in the analysis of data in three bulletins published previous to 1923, and used it extensively in a bulletin in 1924 and in a bulletin in 1925. Also, I published two papers in the Journal of Economic Entomology in 1924 in which I have endeavored to bring the methods before economic entomologists.

The past two winters I have devoted considerable time to the statistical analysis of data of the results of various insecticides in the station orchards. In a portion of this work I have used methods that have been employed in other sciences but, to my knowledge, have never been employed in any of the agricultural sciences. The results are being prepared for publication in station bulletins.

Publications

From 1924 to 1925 inclusive I published several timely articles on the control of grape insects in THE GRAPE BELT, a semi-weekly paper published in Dunkirk, N. Y.

- Bul. 519. Dusting and spraying to control grape root-worm. pp. 29, pls. 2, charts 2, July, 1924. (Experiments made in 1921 and 1922)
- Bul. 527. Susceptibility to dust and spray mixtures of pear psylla (*Psylla pyricola* Forster). pp. 123, plates 12, charts 8, figs. 2. July, 1925.
- Cir. 74. The rose chafer. pp. 4, pls. 2. March, 1924.
- Cir. 98. Lubricating oil emulsions for the control of pear psylla. pp. 4. March, 1928. F. L. Gambrell Junior Author.
- Cir. 102. The dormant oil spray and the pear spray schedule. pp. 4. April, 1928. F. L. Gambrell, Junior Author.

Contributions

Meeting, American Association of Economic Entomologists.

The use of biometrical methods in the interpretation of codling moth experiments. Jour. Econ. Ent. 17:183-1924.

The estimation of dosage for volatile dusts: An illustration of the value of correlation mathematics to entomology. Jour. Econ. Ent. 17:279-285. 1924.

Grape Insects. Proc. N. Y. State Hort. Soc., pp. 78-84, with answers to questions to page 89. 1924.

Answers to questions at grape round table. Proc. N. Y. Hort. Soc. pp. 170-176. 1925.

Use of oils for the control of pear psylla. Proc. N. Y. Hort. Soc. (in press) 1928.

Grape insects and their control. Address before Mich. Hort. Soc. Paw Paw, Mich. March 1, 1927.

Each year the answering of farmers' inquiries by mail has caused the writing of from 100 to 500 letters. A large number of farmers have been advised regarding the control of insects which, including those whose questions are answered at our exhibit for the Rochester meeting, must total at least 500 annually. At least a dozen addresses at farmers' meetings have been given annually the past five years.

2. Present program of work.

When an insect pest threatens any crop my first aim has always been to first find some practical method of control; generally the use of some insecticide, then, later, endeavor to discover more economical measures either by investigating other more promising insecticides or, even better, by searching for some means of natural control. Having first given the fruitgrowers a method of saving their crops the

investigator is entitled to devote a longer time to problems bordering on pure research, but having as his aim either more efficient or more economical methods of combating the pest. When the stress of field work is past investigations of general importance to the field of entomology are undertaken, such as adhesiveness of insecticides, histological studies for oil injury, and taxonomy of certain insects. Investigations that can be made entirely in the laboratory are usually conducted during the winter months.

Since insects vary enormously in numbers during the different years, some seasons are much more favorable than others for making investigations on certain species. For this reason an investigation of an insect may be in progress for a season or two and then held in abeyance until another favorable season occurs. This is especially true of grape insects and explains why some projects must be continued over a longer period than others. Our policy has been to adopt a conservative attitude and not to publish in station bulletins until we believe that the facts found and the remedies offered will apply for the majority of seasons. My tendency has been to make my bulletins more or less monographic in scope rather than to break the subject into a number of parts: For example, Bulletin No. 527.

Investigations Under Way

Grape insects. - A number of projects on grape insects have been passed on to Mr. D. M. Daniel since my transfer from Fredonia to Geneva in the autumn of 1925. However, I am assisting him in an advisory capacity, since my experience should result in saving him from misguided efforts, and further, I can assist by directing his efforts to the important problems.

Pear psylla. - The investigations with this insect, which are being prosecuted with the assistance of Mr. F. L. Gambrell, may be summarized as follows:

(a) Continuation of tests of dormant oil sprays for the control of the hibernating adults, extending the investigation to all the better known brands of oil emulsions and miscible oils, as well as testing the different kinds of oils in

home-made emulsions. The object is to determine what commercial preparations are safe and effective and also what properties in an oil make for effective control of the insect and, especially, affect the safety of the material on pear trees. It is necessary to learn how many consecutive seasons oil sprays can be applied without injuring the trees. Already, for 1928, some 25 acres of pear orchards are under treatment and it is intended to continue these for several years. Altho the material has already been applied, it will require a vast amount of observation and counting thruout the summer to secure the data upon which to determine the results.

(b) An investigation to determine how oil injures woody tissue as well as how leaf tissue is harmed by the same material. An extensive histological study has been made on this phase of the psylla problem. It was necessary to be able to locate the oil in the tissues, so a new histological technique was evolved, but further investigation is planned. By using oils of different properties it is hoped to be able to determine what properties in an oil favor or retard injurious effects. This study will have an important bearing not only on pears but on other trees that may receive oil treatment, as it will indicate what oils may be safe and it will be possible to say whether the oil or other factors have caused the injury if apparent damage is in evidence.

(c) A continuation of tests of oil sprays during the summer for the control of pear psylla nymphs. This investigation involves the effectiveness on the insects and safety to the foliage. Two seasons' work have been devoted to the problem, but the study should be continued for a number of seasons to determine the effect that meteorological factors play. The investigation has as its object the securing of a more economical insecticide than the costly nicotine.

(d) A continuation of the ecological investigations of pear psylla which have been in progress for several years, mention of which has been made under

"accomplishments". I regard this as a very important project in the interest of economical pear production. It is aimed to study a rather large number of orchards by mapping the same and also by repeated visits to representative areas. These surveys will enable us to study the problem from various angles both in the field and in the office.

(e) A further study of the migration of pear psylla in relation to ecological factors to determine just how environment affects the insect. This really is a continuation of (d) since it will be necessary to make counts and measurements to correlate the effects of environment on migration.

Apple leafhopper. - An investigation of this insect has been in progress for the past two years. The leafhopper is a very important enemy of apples, potatoes, roses, and especially nursery stock since it stunts the growth. The aims may be summarized as follows:

(a) The determination of the degree of injury to foliage. This involves studies of leaves to determine the degree of infestation and a quantitative determination of the amount of chlorophyll destroyed by varying degrees of feeding by the insects. A quick method for the making of these determinations has been adapted to this study, thru a conference with Dr. Lubimenko, a Russian plant physiologist, at the International Botanical Congress held at Ithaca in 1926, and further improvements are in progress.

(b) Determining the effects of the various sprays and dusts on the control of the insect. Some progress has been made on this point. It will be necessary to devise treatments that are more effective than the present ones.

(c) A study of ecological factors that favor or retard infestation. Our studies on grape leafhopper have shown the advantage of ecological studies. It seems advisable to investigate this phase of the apple leafhopper because, if the insect can be reduced by natural means, this may prove more economical than to rely entirely upon the use of insecticides. Ecological mapping may assist in the

problem. A study of predaceous and parasitic enemies is also included in the program.

(d) Effect of leafhopper feeding on growth is to be investigated with the aim of being able to determine the degree of infestation necessary to demand treatment or other remedial measures. Another problem to be studied is the relation of the period of growth when feeding produces the greatest degree of stunting.

(e) Life history studies to determine the factors favoring or retarding development of the number of broods during the season. Since control measures with insects generally depend upon attacking the pest at a vulnerable stage, studies of the seasonal history are planned to determine these stages in relation to vegetative growth.

Climbing out-worms on grapes. - Since 1925 there have been sporadic outbreaks of out-worms in vineyards. During 1925, observations were made on these insects at Fredonia and a new bait was devised in which mustard is used as the attractant. In 1926, as well as during 1925, observations revealed the fact that, in the Chautauqua county vineyards, the outworms prefer cruciferous plants to grapes. There was a serious outbreak of outworms in the vicinity of Penn Yan during 1927 and the following experiments in control are planned for that region:

- (a) The effect of allowing the ordinary herbaceous plants to remain under the vines until the outworm menace has passed.
- (b) The planting of Dwarf Essex rape under the vines to serve as food until all danger of the pest is gone.
- (c) Tests of the mustard bait in vineyards having clean culture.
- (d) A study of environmental influences on the infestation by outworms.
- (e) A study of parasitic and predaceous enemies of outworms.

Biometrical analysis. - Data on long-term experiments conducted by the Department awaits statistical analysis. It is planned to continue this during winters. Furthermore, most data in my experiments, or at least as far as possible, will be collected in such a manner that correlation and other mathematical studies can be made, the ultimate aim being to learn the significance of the data of

experiments and to study relationships of the various factors involved in field and laboratory tests. Some time will be devoted to the higher branches of biometry with the object of studying principles and methods; also to adapt appropriate computations and analyses to agricultural research.

Investigation of plat experimentation. - Several years ago two English biometricians devised what is known as the "chessboard" method of arranging experimental plats for testing farm crops as regards varietal differences in yield and effects of fertilizers. I do not know of this method being used in entomology so I have, this spring, in my psylla experiments placed two sets of plats according to the chessboard arrangement. However, the English workers use the method of chance in laying out the plats. I believe I have improved this method for long, rectangular plats by deliberately arranging them according to a definite plan, at the same time saving the valuable chessboard system.

The object is to compensate and if possible eliminate what is known as systematic error in the area under experimentation. This is especially important if the data is to be free from this source of error. It is planned to use this and other forms of chessboarding of plats on other experimental areas with various insects, the idea being to make a concrete biometrical study of plat arrangement. In this manner data for biometrical research can be secured without adding much labor to the regular experiments. The results will be valuable in all kinds of plat experimentation regardless of the branch of agricultural science involved.

Investigation of adhesiveness of insecticides. - This project is aimed at efforts to secure more efficient control of insects by securing mixtures of poisons that will remain on the foliage over a long period and not spot the fruit. In the past, poisons have been sold which did not have sufficient adherence to make them efficient. From time to time it may be found that materials are failing to control and a study of the adhesive properties may, as in the past, furnish the explanation. It is not intended that this project should involve continuous study of the general

problem of adhesiveness, but was outlined so that whenever needed the work could be carried out in the same systematic manner, thus making the results comparable with previous work.

Outline of Activities During the Year.

Spring, summer and autumn. - Much of the time is spent in making experiments in the field, taking observations and securing the data. Whenever possible, each batch of material is placed in suitable containers with preserving material, tagged, and counts made during inclement weather in the summer, or counts are made during the winter if there is no rush to secure the data. This allows the maximum amount of field work possible during the periods when the work can be done, and saves time and expense when traveling is necessary. The same is true of ecological mapping. The necessary correspondence and answers to farmers' questions are cared for together with attendance at summer field meetings, if found necessary to attend to answer questions. During the summer the experimental work is done in various parts of western New York on farms where the problems can best be studied. A considerable amount of photography in the investigations, both as a matter of record and for illustrations in publications, as well as for lantern slides, must be done during the summer.

Winter. - This season is used for activities that can be done in the office or laboratory. The following is a summary of the more important work:

Making counts and other determinations on material collected from field experiments.

Determining the amount of chlorophyll from dried leaves from experimental plats.

Completion of maps of ecological surveys.

Making drawings for illustrations in publications.

Making prints from negatives taken during the summer for use as records or for use in publications.

Making lantern slides for use at meetings.

Histological studies of insect injuries, oil injury and effects of insecticides.

Making adhesive experiments.

Developing new spray mixtures.

Compiling and analyzing data from experiments.

Biometrical studies and computations.

Preparing bulletins, circulars, scientific papers and reports.

Writing addresses for horticultural and farmers' meetings.

Planning new experimental activities and collecting the materials.

Answering correspondence.

Attending horticultural and farmers' meetings either for addresses or to answer questions.

3. Needs

Better office and laboratory facilities as regards space.

Laboratory glassware and reagents.

Transit for ecological surveys.

Portable anemometer for study of air currents in investigations of pear psylla migration.

Small balloons, rope and material to make sticky screens to study psylla migration in relation to environment. This includes compressed hydrogen to inflate the balloons.

Complete set of the journal BIOMETRIKA, together with some half dozen recent books on the subject.

There should be a complete set of recording meteorological instruments at the Station operating continuously so that the relation of meteorological conditions to insect activities and to spray injury might be more carefully correlated. Such equipment would furnish records for all departments having to do with the growth of plants, but would be especially valuable to this Department.

Ground for planting trees to test new insecticides and to use as host plants for insects in cages. This plot should be near the source of water supply to facilitate the mixing of small amounts (say a bucket full) of spray material and thus allow the greatest number of different applications in a short time.

Needs con.

Waterproof containers, young trees, and platform scales to study the effect of insects and insecticides on the growth of trees.

Interplanting the Rome Beauty apple orchard with the McIntosh variety to develop a system of spraying for this variety which is very susceptible to spray injury. Professor Parrott informs me that he discussed this question with you, and states that this planting would also afford me an opportunity to study the effects of the spray system on apple leafhopper. The planting should be made this spring.

DEPARTMENT OF ENTOMOLOGY

Report of S. W. Harman, Assistant in Research

The More Important Results of the
Past Five Years' Work

Upon assuming my duties at the Station five years ago I was assigned to a project at North Rose to determine the values of various spray and dust mixtures in combating orchard pests in general. A block of 250 twenty-five year old apple trees made up the main experimental block, and additional plats were used in adjoining plantings. The more important phases of the work were as follows:

Establishing a well tried system of orchard spraying for that locality.
Determining the value of dust mixtures for use in apple orchards.
Extensive tests with the dry-mix sprays.
Comparative value of lime-sulfur and bordeaux sprays.
Comparative value of sulfur and copper dusts.
Comparative value of nicotine sprays and dusts for the control of rosy aphis and red bugs.
Value of oil sprays for use against the rosy aphis, apple red bugs, and the fruit tree leafroller.

The work was summarized at the end of each season in Circulars 63, 70, 78, and 84 on pages 1-3, 2-4, 2-6, and 2-4 respectively. The data is now being assembled preparatory to publishing in bulletin form.

Several other projects to determine the merits of dusts in combating various injurious insects were delegated to the writer, which established the fact that certain preparations are effective against different species of insects.

The greenhouse aphid, Myzus persicae, which gives considerable trouble to the florist, was effectively controlled by dust mixtures containing nicotine. The results of the investigations are published in Bulletin 502.

The currant aphid, Myzus ribis, which oftentimes defoliates currants was controlled by the use of various nicotine sprays and dusts. Details of these studies were published in Bulletin 517.

Certain types of oil in the form of emulsions have proved to be excellent spray materials for the control of the more hardy and resistant insect pests. A large part of the writer's time has been devoted to tests with oil sprays. It was found that danger from oil injury to trees begins at the time green tissue shows on the opening buds and that oil sprays applied after this period are very liable to cause injury, the damage varying in proportion to the oil content.

One of our most difficult pests to combat is the fruit-tree leafroller. This insect at times injures over 50 percent of the crop in some orchards. In extensive tests at North Rose it was demonstrated that the insect can be effectively controlled with oil sprays. The results of this work are at present in manuscript form.

The peach cottony scale, a new pest for this section, was first discovered in western New York in 1925, and was so destructive to the peach-growing industry that many growers were absolutely discouraged. This insect was controlled by means of oil sprays. The results of the work are described in Bulletin 542 and Circular 89. An article giving a brief account of these experiments was published in the Journal of Economic Entomology 20, 146-150, 1927.

The use of highly refined white oil emulsions, which are apparently non-toxic to trees in foliage, has been recently developed. This material was tested to determine its safeness to peach leaves and efficiency against the peach cottony scale. Details of these experiments were published in Bulletin 552. The investigation not only demonstrated a new method of controlling the insect during the growing season, but it also suggested that this system of control is equally applicable to pests of a similar character on other plants.

The codling moth, the most important insect pest of the apple-growing industry, has been responsible during late years for a steadily increasing amount of injury to the apple crop in western New York. Repeated urging by growers and Farm Bureau workers made it desirable for the Station to undertake an investigation which began in 1924 under the immediate supervision of the writer. A systematic study of the life history and habits of the insect led to the discovery that the summer application of spray materials had been made with little regard to the egg-hatching period of the insect. A new schedule was devised by means of which growers have gradually reduced the amount of injury to the apple crop. The work has been reported each year in mimeograph form as the 1st, 2nd, 3rd, and 4th Reports on Codling Moth Investigations, and these reports have been distributed to interested growers.

In carrying out these studies it has been found that there is an enormous "carry over" of the larval stage of the insect in storage houses. This is a phase of the problem which requires further investigation.

Some attention has been given to baits as a supplementary means of control. The most promising attractants found to date are water solutions of molasses and "Diamalt" (a yeast product) which, after fermentation, are attractive to the adult insects. Large numbers of the moths have been destroyed by this means.

The use of the highly refined white oil emulsions, or the so-called summer oils, as ovicides for codling moth control have been thoroly tested during the past few seasons. These materials were found inferior to the standard practice of using poisons and in addition have the drawback of russeting the fruit.

A considerable number of new insecticides, mainly arsenical combinations, have been tested and to date none have been found superior to arsenate of lead.

Present Program of Work

1. Codling moth investigations

- a. Life history studies
- b. Control studies
- c. Investigation of "carry over" of larvae in storage plants
- d. Reduction of spray residue on fruit
- e. Elimination of burning of foliage from summer sprays

Because of the remoteness of the field of operations from the Station, the writer attempted to discontinue that part of the work conducted in western New York. However, pressure was brought to bear by the Farm Bureaus and growers which made it desirable to continue the investigation. Each year the scope of the work enlarges until now it demands the almost constant attention of the writer during the summer months. The nature of the work, dependent as it is upon seasonal conditions, must necessarily be repeated each year in order to properly forecast the spraying periods and keep in touch with seasonal conditions.

2. Life history and control of the European Fruit Lecanium

This scale insect is abundant in plum, peach and quince orchards thruout the state and the regular spray practices fail to hold it in check.

The project was undertaken a year ago and satisfactory results have been obtained with both dormant and summer oils to control the insect. Oil sprays are again being tested this spring, and the investigation should be completed by the end of the season.

Outline of Yearly Activities

Winter months

Writing up results of investigations carried on during the growing season.
 Continuation of such projects as can be carried on during the winter months.
 Computation and arrangement of data.
 Making illustrations for publications.
 Making and analyzing new and promising spray materials and mixtures.
 Preparation of exhibits for the State Fair and Rochester Meeting of the New York State Horticultural Society.
 Addresses at Farm Bureau Meetings, 4.
 Address at Spray Service School, 1.
 Answering letters, average 1 each day.
 Writing occasional articles for the Weekly News Letter of Department of Entomology and Plant Pathology of Cornell University.

Spring, summer, fall.

Work on projects in the field.
 Answering inquiries
 Personal interviews with growers, insecticide manufacturers, etc.
 Speaking at Farm Bureau tours.
 Testing out new spray materials, etc.

Needs for Future Work

If it is found necessary to continue the codling moth work in Monroe, Orleans, and Niagara counties it will be desirable to have funds sufficient to allow renting orchard land, to cover the expense of necessary spray materials, and to hire necessary labor.

DEPARTMENT OF ENTOMOLOGY

F. L. Gambrell, Assistant in Research

My work at the station began in 1924 in a cooperative way. Altho not working directly for the station, the problem receiving my attention was an investigation of calcium arsenate as an insecticide. This work was sponsored by the National Research Council and was under the direct supervision of Professor Parrott. This problem extended during the summer months only and was the continuation of an investigation begun the previous year.

Since lead is more expensive than calcium the problem was undertaken from the standpoint of a study of the efficiency and safety of calcium arsenate as a substitute for lead arsenate. The major part of the investigation was directed towards a study of the insecticide in relation to the orchard industry. More arsenates are used in this particular phase of agriculture than on all other crops combined, in this state; consequently, a saving of only a few cents per pound in the purchase of insecticides would result in a great saving to the farmers.

Calcium arsenate when used on vegetables affords good control against chewing insects and is safe to the plants. On the other hand, when it is used in combination with lime-sulfur for fruit tree pests, certain chemical changes take place which make it very unstable and unsafe to use on foliage. Similar effects are sometimes observed when lead arsenate is used, but these cases are less frequent and less serious than with calcium arsenate as a general rule.

In this work calcium arsenate of varying percentages were tested ranging from 20 to 40 per cent arsenic oxide, the latter being the content of the standard material manufactured for commercial purposes. These materials

were tested in combination with lime-sulfur and wettable sulfur on apple, plum, and cherry trees and their effects determined both as to varying percentages of the different calcium arsenates as well as their incorporation with different fungicides. A report of the results obtained were prepared and presented as a Master's Degree thesis at Ohio State University and a copy was also turned over to the Department of Entomology at this Station.

The results of this investigation may be briefly summarized as follows:

(1) Injury to foliage frequently attended applications of the different calcium arsenates, as well as lead arsenate in certain instances, when used in combination with lime-sulfur solution. Generally speaking, calcium arsenates with the lower arsenic oxide content produced less injury than the higher percentages and, considered in the aggregate, they were more destructive to foliage than lead arsenate.

(2) Browning of the leaves was most conspicuous during periods of high temperatures and heavy rainfall, indicating that this injury was in some way correlated with certain climatic factors.

(3) The addition of a sufficient amount of lime hydrate or calcium caseinate to the lime-sulfur-calcium-arsenate solution reduced somewhat, but did not entirely eliminate, serious burning of apple foliage. The degree of injury, of course, varied with the percentage of arsenic oxide used as well as with varying amounts of lime. Calcium caseinate, when incorporated into the lime-sulfur mixture, improved materially the physical properties of the spray. Foliage injury was greatly reduced when arsenates were used in combination with the wettable-sulfur spray consisting of lime hydrate 8 pounds, superfine sulfur 16 pounds, and calcium caseinate 1 pound in 100 gallons of water.

(4) Field experiments were designed to test the relative toxicity of calcium arsenates and lead arsenate against the cucumber beetle, potato beetle, and the codling moth. Lead arsenate and calcium arsenate both afforded good protection against the cucumber beetle on squash vines either as a dust or spray mixture. Relative to codling moth, calcium arsenate containing 40 per cent arsenic oxide was not as effective as lead arsenate used at the same time and in the same proportions. Experiments in another orchard showed noticeable reduction in the number of infested apples, but because of lack of uniformity of fruit yields and the variation in infestation, the results were not conclusive.

As a result of this investigation the following conclusion was reached. Calcium arsenate, as chemically constituted at present, has little promise of replacing lead arsenate as an insecticide for the control of orchard insects.

My work at the station, as a member of the staff, began in the spring of 1925, and the report following covers the period from 1925 to date. At the time I came to the station Dr. Hugh Glasgow had just been transferred to the Canning Crops Investigation with the idea in mind of making a study of the more important injurious insects affecting canning crops. One of the insects demanding special consideration was the cherry fruit fly. I was designated to work on this insect problem in conjunction with Dr. Glasgow.

Cherry Fruit Fly

At the time the study was initiated the fruit fly situation had already assumed serious proportions. The federal pure food authorities had found that large quantities of cherries were being packed which contained many maggots in the finished product and were considered undesirable for human consumption. Consequently, several large shipments were seized and destroyed. This activity was of sufficient importance to make almost imperative some solution of the problem.

Naturally, the situation of the canners resolved itself to the selection of one of two things; namely, curtailing the canning of cherries or else demanding a cleaner product from the growers. The latter idea seemed to be the more plausible and important aim.

Not a few orchards had been abandoned or else the growers were realizing only a minimum amount of salable cherries from their trees because of the ravages of this insect. In the season of 1924 quite a few orchards, bearing heavy crops of fruit, were not harvested because of the severe infestation of maggots. When one realizes that there are approximately 1,500,000 cherry trees in the state which yield around 200,000 bushels of fruit valued at approximately \$1,000,000, the loss of only a small proportion of this crop can be fully appreciated.

This situation involved the loss of thousands of dollars, both to the canners and fruitgrowers, and threatened one phase of the canning industry. Because of the frequent and insistent demand for information on this insect, as well as for a better solution of the problem, practically all of my time during 1925 and 1926 was devoted to a study of this insect. A good part of the time during 1927 was also devoted to this study.

As the fruit fly situation stands at present there are a number of things which may be done to materially reduce the population of flies in an orchard and decrease the infestation. They are the following: (a) use of contact insecticides such as nicotine sulfate or calcium cyanide; (b) destruction of crop remnants such as the cherries remaining on the trees after the crop has been harvested, (c) frequent cultivation — a certain number of puparia are destroyed by this method. While the above suggestions serve as supplementary control measures, main dependence for control must be placed upon the use of properly timed arsenical preparations, either in dust or spray form. It should be remembered that dusting is more expensive than spraying and that during periods

of adverse weather conditions more frequent applications are necessary. The practicability of properly timed applications of arsenicals as a primary and dependable control measure have been so thoroly demonstrated as a result of our studies that little feeling of doubt should remain in the minds of growers regarding the value of our recommendations, particularly as to the emphasis we place upon the correct timing of the treatment.

In our studies an effort has been made to link the seasonal appearance of the flies with some stage in the development of the cherry. Our work has brought out the fact that flies begin emerging from the soil when the cherries are quite small, but that the first treatment for the maggot should be made when Early Richmond cherries begin to show "blush" or red color on one side. The second application should be made at the time Montmorency cherries show the same stage of development. These points are quite important in timing the treatment properly and should be kept in mind by the growers. To determine this point it was necessary to construct large cages in the orchard and make daily observations as to the emergence of the flies. This phase of the problem alone required considerable time.

The consumer has no method of determining between clean and infested canned cherries at the time they are purchased, and the same holds true for any spray residue remaining on the fruit. During the past year or so the question has been raised as to the possible amount of arsenical residues on the skin of different fruits. In order to protect ourselves regarding this point certain modifications of the spray schedule have been studied. In some of our experimental work the amount of arsenate of lead has been decreased and the number of applications reduced with the idea of determining the effect these operations have on the amount of spray residue. We also wanted to determine if a reduction in the regular amount of arsenic would afford sufficient

control of the cherry fruit fly. We found that the amount of arsenate of lead can be materially reduced and still secure a good degree of commercial control. In all of our experiments it has been our policy to first determine whether or not insecticides, when used at maximum strengths, were safe and efficacious. Then if these products show promise the dilutions are reduced to the minimum.

Related Species of Fruit Flies

Owing to the phylogenetic relationship to the cherry fruit fly certain other species of fruit flies have been studied because of the bearing they have in contributing to a better analysis of data secured on the cherry fruit fly. These insects include: apple and blueberry maggot (Rhagoletis pomonella), current fruit fly (Epochra canadensis), and the walnut husk-maggot (Rhagoletis suavis). I have found that the habits and life histories of these species are very similar to those of the cherry fruit fly and that the principles regarding their control are essentially the same. It has been clearly demonstrated that the whole group of flies are generally susceptible to arsenical mixtures. Considerable time during the winter months has been devoted to a taxonomic study of the relation of the species, making drawings, illustrations and photographs for use in publications and for general reference.

While pursuing this study I have devised a simple method of making enlarged drawings of such structures as insect wings, legs, and general body outlines of small insects. These structures when mounted on slides in balsam, can be enlarged from twenty to thirty times and the image is projected directly on paper so that they can be traced in a very short time. This process is accomplished by using a large camera, such as the stationary one we have in the department, and a condensing lens, in the same way that enlarged photographs or lantern slides are made. Including the time necessary for setting up the camera, illustrations of

this type can be made from two to four times as quickly as when a camera lucida is used. This operation results in a great saving of time and insures a uniform symmetrical drawing, besides increasing the amount of work that can be accomplished.

The results of the work on cherry maggot has not been published in detail. However, the important points relative to the method and time of application have been published in Circular 87 in June 1926. This work should be completed this season and detailed results published as soon afterwards as possible, providing nothing happens to the cherry crop which will interfere with our experiments as presently planned.

Pear Psylla

This work has been under way for several years by Mr. F. Z. Hartzell, but in 1927 I began working with him on the problem. Investigations of oil sprays for the control of pear psylla were begun some time ago, but Mr. Hartzell took over this work in 1926 and it was continued last year by the two of us.

The efficiency of nicotine as a control measure has been thoroly demonstrated; however, the use of this material is recognized as being rather expensive. With this idea in mind, as well as the general interest exhibited in other materials, extensive experiments have been planned using different types of lubricating oil emulsions and miscible oils. The question of spray residues was also studied in a commercial orchard in Oswego county. While the results of these investigations have not been published in detail, Circulars 98 and 102 have been prepared and distributed to the growers. These two circulars set forth briefly the important points relative to the use and applications of dormant oil sprays and the part they occupy in the regular spray schedule.

Briefly the results to date may be summerized as follows:

(1) Efficient control was secured from the use of a bordeaux-lime-nicotine spray. This is the standard recommendation for summer applications. The results

obtained from the use of this material serve as satisfactory basis in comparing the results obtained where oil sprays were used.

(2) Studies were made relative to the life history of the insect with special reference to the egg-laying period of the hibernating adults. Observations were made as to the first appearance and the length of the oviposition period. This point has proved to be an important factor in securing efficient control with oil sprays, since the oils should be applied previous to the egg-laying period. Our experience has shown that oils, if commercial control is to be secured, must be applied at the proper time.

(3) Several standard lubricating oil emulsions and miscible oils were applied during the dormant season with the idea of determining relative efficiency, safety to trees, and the properties in an oil which are conducive to proper control.

(4) Tests with dormant oil sprays have shown that they are very effective in the control of pear psylla. The cost per tree, both for labor and material, are greatly reduced. At the present time, evidence seems to point to the fact that, during certain seasons at least, a single application of oil during the dormant season will take care of psylla for the entire summer. This means a great saving in labor and cost of material. These results should make the growing of pears a profitable business, at least as far as pear psylla is concerned.

Following this recommendation means that the cost of treatments for pear psylla are reduced from 20 cents to about 4 cents per tree. When we consider that there are about 2,000,000 bearing pear trees in the state, a large number of which are treated annually for pear psylla, we have a better idea of the saving this means to the pear grower.

(5) Summer applications of oils during 1927 did not prove a satisfactory control measure. Further experiments are planned to check the results obtained last season.

Investigations Under Way

1. Cherry fruit fly. - Studies by Dr. Glasgow and myself will be continued again this season. We are hoping to complete the study of this pest during 1928. There are several points relative to the life history that have not been thoroly worked out and, also, some points regarding modification of the regular spray schedule which should receive consideration, particularly as regards reduction of the quantity of lead arsenate used and the relation of this to the spray residue problem.

2. Related species of fruit flies. - This study will be continued in connection with the cherry fruit fly problem. Since the habits of these insects are so similar, their life histories and methods of control should be considered under one big group. This will help materially in correlating data accumulated on all the species in question. The general utility of arsenicals as a control measure will be given thoro consideration.

3. Pear psylla. - Investigations with this insect are being continued this season by Mr. Hartzell and myself. These studies will include: (a) continuation of tests of dormant oil sprays as a control measure, including home-made lubricating oil emulsions, miscible oils, and certain other proprietary mixtures; (b) determination of the relative efficiency of these materials; (c) the effect of these various oils on the growth of the trees; (d) studies of the properties of an oil which make them effective and safe to use on trees; (e) continuation of tests of summer oils for the control of psylla nymphs. About 25 acres of pears have already been treated this season with different types and kinds of oils which will serve as a basis for the study of the above points. (f) Studies relative to the question of spray residues on fruit at picking time. It has been generally conceded that certain types of insecticides cannot

be applied too near the harvesting because of spotting the fruit. (g) The effect of isolated orchards will be studied, particularly as to infestation and number of applications necessary. The same will be observed for orchards which are not remote from other plantings.

4. Red spiders. - I have just taken up a study of this pest, beginning in 1928. In certain areas they have proved serious pests on apples, peaches, prunes, and small fruits. One grower estimated a loss of \$600 from approximately 100 peachtrees in 1927. In the present program of work a number of materials have already been applied in commercial orchards on prunes and peaches to test the value of certain types of insecticides as a control for hibernating eggs. In the prosecution of this work the following points will be considered:

(1) Relative economic importance and abundance of this pest on apples, peaches, prunes, and small fruits.

(2) Determination of the several species present and the relative abundance and importance of each species.

(3) A study of the relative efficiency of dormant applications of home-made lubricating oil emulsions, miscible oils, and proprietary mixtures on the destruction of hibernating eggs. Also the influence these preparations have on summer infestation.

(4) Studies as to the strengths and properties of oils which make them safe and efficacious. Since there is a wide range in the cost of different types of oils this may have an important economic bearing in formulating spray recommendations. It is also very essential to know just how many seasons oil sprays can be applied to trees without producing deleterious results.

(5) Studies of the accumulative effects of repeated summer applications of lime-sulfur, wettable sulfur, and sulfur dusts on reducing the summer infestation of these spiders.

(6) Investigations on the use of summer oils in the control of young nymphs and adults.

(7) Investigations relative to the penetration of dormant oil sprays into cracks and crevices and the amount of control secured.

(8) Applications of varying percentages of oils on raspberries to determine strengths that are safe to the plants; also the number of seasons these oils may be applied without producing injurious effects.

Publications

Circular No. 87. The cherry fruit fly. fig. 3, H. Glasgow and F. L. Gambrell
June, 1926.

Circular 98. Lubricating oil emulsions for the control of pear psylla.
pp. 4, F. Z. Hartzell and F. L. Gambrell, March 1928.

Circular 102. The dormant oil spray and the pear spray schedule. pp. 4,
F. Z. Hartzell and F. L. Gambrell, April 1928.

Attendance at State Fair and Fruitgrowers' Meetings

I attended the State Fair in 1925, 1926, and 1927. During 1926 and 1927 I had charge of the exhibit for the Department of Entomology and spent the week there in discussing insect problems, explaining different types of injury, discussed practical applications of spray recommendations, etc. I also attended the summer and winter meetings of the New York State Horticultural Society during this period, assisted in setting up exhibits at the winter meetings, and conducted fruitgrowers and county agents on tours and explained the various experiments under way.

Letters of inquiry, approximating 50 to 200 annually, are answered which deal with certain specific insect problems.

Activities during the year:

The greater part of the time during the spring and summer months is spent in laying out and conducting field experiments, securing data, doing the necessary amount of photography, collecting, preserving, and storing such material as can be kept for study during inclement weather or the winter months. In this way the maximum amount of field work can be accomplished. During the winter months my time is devoted to compiling and analyzing data secured in the summer months; making counts and observations of material preserved for winter study; making photographic prints, illustrations, and lantern slides to be used in publications and for general reference; formulating plans of experiments to be conducted during the summer months; development of spray mixtures; answering correspondence, etc.

Needs:

- (1) Better office and laboratory facilities, with particular reference to space.
- (2) Usual amount of laboratory equipment such as glassware, chemicals, etc.
- (3) More ground space for the planting of small trees, berry plants, vegetables, etc. These should be set near the center of operations and near the main water supply, the object being to use these plants in carrying on experiments in a small way for various insects and for the application of insecticides whose merits and safety factors have not been determined. These plants and trees in question will be sprayed or dusted with hand machines and for this reason their proximity to our present ground at the spray shed is highly desirable. Such a location would greatly facilitate the matter of application and observation.

REPORT ON ENTOMOLOGICAL WORK AT THE VINEYARD LABORATORY

By Derrill M. Daniel, Assistant in Research

1. My efforts since coming to the Station in July, 1925, have been directed largely toward the control of grape pests in the Chautauqua Grape Region. There are some 30,000 acres of grapes in this area which suffer varying degrees of injury from the grape rootworm which kills the vines outright; from the grape berry moth which infests the berries and renders them unfit for human consumption; from the grape leafhopper which sucks the sap from the leaves, causing the fruit to have a low sugar content, remain a dull red color instead of a deep purple as it would be if ripened properly; from the grapevine flea beetle which feeds on the buds in the spring, destroying undeveloped leaves and fruit clusters; from the rose chafer which feeds on the blossom clusters; from the grape curculio which feeds within the berries causing them to drop; and from the grape blossom midge which emasculates the flowers.

All spray recommendations designed to protect this area are based on the work of this Station. Special attention has been directed toward testing dusts for control of the grape rootworm. Work with nicotine dusts for the control of the grape leafhopper has been continued. The tests on adhesiveness of insecticides are continued in connection with dusts for the grape rootworm and grape berry moth. Experiments for control of grape berry moth have been continued with the view of eliminating spray residue. Tests have been made with paradichlorobenzene for the control of grape rootworm. Heretofore no control of the blackberry leaf-miner has been secured. Experiments to date show promising results with a 4 per cent white oil emulsion. Continuation of the experiments is contemplated. For a full report on the investigations to date see Technical Bulletin 133.

I discovered in 1926 and reported the presence for the first time of the oriental fruit moth in western New York. This pest is ranked as of first importance in other infested areas and there is every reason to believe that it will come to be so regarded in western New York. Experiments for the control of this insect were begun in 1927.

2. The grape rootworm and grape leafhopper, particularly, have been increasing. The new grape grading law as passed by the State Legislature will place increasing demands for experiments on the Station. This law, therefore, makes it absolutely necessary that the Station continue all projects on grape pests already begun. These include: Tests of dusts for control of the grape rootworm; tests of nicotine dusts for control of the grape leafhopper; investigations of adhesiveness of insecticides (including tests of dusts for rootworm and berry-moth control); tests for the control of the grape berry moth; test of paradichlorobenzene for the control of the grape rootworm. Experiments with the blackberry leaf-miner should be continued with the view of developing a more efficient control. Experiments with the oriental fruit moth should certainly be continued because of the threat it makes against profitable production of peaches and quinces in western New York.

Experiences in other infested areas would indicate that parasites may become an important factor in control of the oriental fruit moth. Therefore, arrangements have been made for the importation and dissemination of parasites in the infested areas of western New York.

Due to the recent agitation about spray residue it has become necessary to pay particular attention to this phase in the grape experiments. In the past satisfactory control of the grape berry moth has been secured but a spray residue was left which has come to be regarded as undesirable, therefore work must be done with a view of eliminating this residue.

From April to November I am stationed at Fredonia. My routine duties consist of making field experiments and in checking the results. The winter is spent in

Geneva working up the results of the summer's experiments and making such laboratory tests as are required. I have been working out the morphology of the peach cottony scale. During the summer while at Fredonia, some six or eight groups of farmers, in addition to a steady stream of individual farmers, visit the Station to get first-hand information in regard to the control of grape pests. I answer during the summer about 300 inquiries and about 400 telephone calls in regard to control of grape pests. I have attended some three or four Grange meetings (no more probably because I am away from Fredonia during the winter). I have written some 25 or 30 short articles for the Rural New Yorker on grape insect pests. I am a member of the American Association for the Advancement of Science and of the American Association of Economic Entomologists.

3. There will be required for labor in connection with making and checking the results of experiments about two hundred (\$200) dollars. It will be necessary for the Station to furnish all spray and dust materials used in cooperative experiments as the grower cooperating with the Station assists in making the applications and leaves certain plats with no treatment as a check on the results. The expense for laboratory equipment and materials for the year, including glassware (bell jars, lantern globes, etc.) and a compound microscope, will amount to about four hundred (\$400) dollars.

Division of Horticulture

U. P. Hedrick, Chief

**H. B. Tukey
F. E. Gladwin
Richard Wellington
C. B. Sayre
F. H. Hall
G. P. Van Eseltine
G. H. Howe
F. H. Hall
L. R. Hawthorn
O. Einset
G. L. Slate
L. Van Alstyne**

REPORT
OF
THE VICE-DIRECTOR AND HEAD OF THE DIVISION OF HORTICULTURE

As Vice-Director of the Station, my work is that of the Director in the Director's absence; to make an occasional address in place of the Director; to aid in the preparation of the annual budget; and to advise with and assist the Director. As head of the Division of Horticulture, in which there are now fourteen scientific workers, I have general oversight of the experiments under way, and advise in regard to the details of carrying them on, almost from day to day. More and more the task of counseling and planning with the men has occupied my time until now my office, combined with that of the Vice-Directorship, is largely one of administration. Still, there are individual accomplishments to be recorded, and there is work quite separate from that of any other member of the staff. I now report these in detail:

1. I keep a supervisory eye on the tests of hardy fruits which are being carried on at this Station, now recognized the world over as being the most extensive ever attempted. The number of distinct varieties of fruits and nuts now under test is 2510. The object is to ascertain whether each variety is distinct; the time of blooming, leafing, and fruit ripening; how long to come into bearing; susceptibility to insects and fungi; whether self-fertile or self-sterile; for what purpose adapted; to describe varieties so they can be identified, and to ascertain adaptability to climate and soil. The results of these tests are set forth in seven volumes, illustrated with colored plates, on the several groups. Two of these volumes have appeared within the last five years. Supplementary to these large volumes are a series of bulletins called New or Noteworthy Fruits, nine of which have been published, and three of which have been issued during the past five years.

Perhaps the next most important item of accomplishment is in the breeding of new fruits. During the twenty-three years the writer has had charge of the horticultural division at this Station, more than 80,000 seedlings have been grown, of which 41,000 have fruited. From the number that have fruited, 90 varieties have been named, of which 45 sorts are now being grown in the state and country. Of the 45, 27 have been named and distributed during the past five years. The writer is a Director and a constant advisor in the management of the New York Fruit Testing Association which grows and distributes the new fruits produced at this Station.

Besides the fruit books and bulletins on new fruits, the writer has published during the past five years a bulletin on "Plum Stocks"; another entitled "Twenty years Profit from an Apple Orchard"; and with H. B. Tukey, a third, entitled "Twenty-five years of fertilizers in a New York Apple Orchard." Besides these bulletins there have been a half a dozen circulars on one phase or another of Pomology.

2. My present program of work is, as I have indicated above, that of helping to plan experiments with my assistants, and advising with them in regard to the details of the experiments. At present the chief specific investigation occupying my attention is that in association with Mr. Hall and Mr. Hawthorn of bringing forth a series of books on Vegetables similar to the one on fruits. The details of the investigations for this series of books have been set forth in Mr. Hall's report, and need not be repeated here. My part of these reports on vegetables is that of writing the introductory chapters, histories of the various vegetables, and correlating the work and seeing it through the Press. I have, besides, perhaps as many as fifteen or twenty addresses to Horticultural and Agricultural meetings during the year. A major task which cannot be escaped, even by dividing up the work among the members of the Department, is that of answering letters. Roughly,

about six thousand letters asking for information on horticultural subjects are answered by the members of the Department during the year. Of these, perhaps the head of the department answers five thousand. From a half dozen to a dozen papers are prepared for scientific meetings or scientific publications during the year.

3. Several members of my department have set forth their individual needs for additional facilities for the effective prosecution of their work. It suffices for me to specify but the major needs. Chief of these is a new horticultural building. Twelve members of my staff now carry on work in rooms with laboratories which were built twenty-five years ago to accommodate three scientific workers in the division. In order to move about, two of my staff must work in a crowded, dark, poorly heated room in the basement, and two others have offices away from their associates in the Administration building, where neither library nor herbarium facilities are at hand. I may add as a second prime need of this Department the necessity of a well trained man who can carry on work in plant physiology and cytology. At nearly every turn the workers in this division need the help of a plant physiologist. We cannot hope to make the progress we want to make in several phases of the work without the aid of a physiologist who is well trained in cytology as well.

MEMORANDUM REGARDING ACCOMPLISHMENTS, PLANS, AND NEEDS.

H. B. Tukey, Acting Chief In Research (Horticulture)
New York State Agricultural Experiment Station

I. Results Accomplished from April 15, 1923, to April 14, 1928.

Three lines of research have been undertaken during the period between April 15, 1923, and April 14, 1928, namely,

- A. General horticultural work at Geneva as Assistant in Research (Horticulture) until June 30, 1923.
- B. General horticultural work in the Hudson River Valley as Associate in Research (Horticulture) from July 1, 1923 to April 14, 1927.
- C. Nursery work as Acting Chief in Research (Horticulture) from April 15, 1927 to date.

The accomplishments of each of these periods will be considered in order.

A. General Horticultural Work

1. Fruit breeding. One of the major projects of the Horticultural Division is the improving of fruit varieties by systematic breeding. The accomplishments of this work are measured through the accumulations of the efforts of many individuals, culminating in such meritorious new varieties as have been produced at this Station, among others the Cortland apple, the Portland and Ontario grapes, and the Seneca cherry.

It was one of the duties of the writer until June 30, 1923, to assist in the breeding work, in making the crosses, in describing the fruits, and in recording the data.

2. Fruit variety testing. A second major project of the Horticultural Division is the testing of varieties, the cataloguing of their blooming dates, season of ripening, keeping quality, susceptibility to insect and disease attack, vigor, and general plant characters. This data has eventually found its way into the series of fruit books published by this Station of which the "Apples of New York" was the first and the "Small Fruits of New York" the last, and the monographs on "New and Noteworthy Fruits". The writer assisted in the accumulation of this general data until June 30, 1923.

3. Orchard management. A fertilizer experiment with apple trees was begun at this Station in 1896 and has become one of the classic experiments with fruit trees. The responses from nitrogen, phosphorus, and potassium, either alone or in combination have been negative and have been so reported at the end of 10-year and 20-year periods. At the completion of 25 years a final report was made reaffirming previous recommendations, that "in the average western New York apple orchard that is well cultivated, properly drained, and sufficiently supplied with organic matter and humus by means of a cover crop commercial fertilizers are not needed". These results are the basis for the standard fertilizer recommendations for western New York.

4. Studies of fruit seed storage and germination. The nursery interests in New York State are extensive. They are depend-

ent upon seedlings as stocks upon which to bud and graft known fruit varieties, seedling stocks in turn being raised from seed. Seed from the hardy fruits will not germinate immediately it is mature, but must go through a period of so-called "after-ripening" in which its internal make-up is changed and prepared for germination.

It is the common opinion that seeds of the hardy fruits must be frozen before they will germinate, and practices of storage and stratification are based thereon. Results of investigations conducted at the Station show this idea to be erroneous. In the case of the peach, freezing did not necessarily crack the stone, but temperatures below freezing were actually harmful to the vitality of the seed. After-ripening processes were effected best under moist conditions and at a temperature just above freezing.

Cherry, plum, apple, and pear seed responded in general to similar conditions. Apple and pear seeds gave high germination after 6 to 8 weeks under cool, moist conditions; peaches slightly longer; and cherries longer still.

Tests with berry seeds showed a combination of both internal and external factors involved in after-ripening and germination. Gooseberry seed germinated after storage under cool, moist conditions, but blackberry seed presented an additional problem of an impermiabile seed coat. Treatment with sulfuric acid was of uncertain benefit.

The results of these investigations are treated in full in a bulletin published by this Station and have been the basis for recommendations to nurserymen in the handling of fruit seeds.

B. Hudson Valley Fruit Investigations.

Because of increased activity in fruit growing in the Hudson River Valley and because of the differences between eastern New York and western New York growing conditions, appropriation was made by the Legislature of 1923 for research work in fruit problems in the Hudson River Valley. The writer was placed in charge of the horticultural work and planned and developed the work as it now exists. Following are reports of the projects.

1. A test of fertilizers for apples. Tests in three cultivated orchards on three principal soil types during three seasons showed a response from applications of nitrogen, though in no instance was the response what would be considered beneficial. Phosphorus and potash, either alone or in combination, produced no effect. In a young orchard the effect of nitrogen was seen solely upon a heavier growth of the cover crop. In a young bearing orchard the effect was seen in darker foliage but no crop increase. In a mature biennial orchard the effect was to set an overload of undersized and poorly colored fruit in the "on" year, at a financial loss to the grower.

2. A test of fertilizers for nursery stock. Tests with two parcels of apple trees of 3,000 each showed a slight gain in diameter from applications of nitrogen but no increase in the number of first-class trees. Phosphorus and potash, either alone or in combination produced no effect.

3. A test of fertilizer applications for apple trees at planting time. Tests during three seasons with various natural and chemical fertilizers have indicated the possibility of injury to newly planted fruit trees from the injudicious use of fertilizers.

Too close or too heavy applications, especially of the more soluble and more readily available fertilizers, have proven undesirable. Slower acting materials, such as bone meal and urea, have shown some increase. These tests gave the first comparative effects in New York State of some of the newer forms of nitrogen, in which it was shown that cyanamid was very harmful even in very small amounts, and that calcium nitrate was more slowly available than nitrate of soda.

4. Types of pruning for apple trees at planting. Trees whose scaffold branches were headed-back when the trees were planted made more shapely trees but not such large ones as those which were left with the scaffold branches unpruned.

5. A variety test with fruits. A test orchard planted at Kinderhook, including only new and noteworthy varieties of fruits, contributed information upon the growing and bearing habits of young trees. Among other notes, the Macoun apple, which had been observed to be a weak grower at Geneva, proved an exceptionally vigorous grower in the Hudson River Valley. The "blightproof" Pineapple pear succumbed to blight, and the Cortland bore fruit at four years of age.

6. A test of fertilizers for sour cherries. Three season's records showed definitely that applications of nitrogen resulted in increased shoot growth, trunk diameter, leaf area, and yield of fruit. Phosphorus and potash produced no response, either alone or in combination. Studies of the growing and fruiting habits of Montmorency, Early Richmond, and English Morello trees showed that the first season of nitrogen applications resulted in greater

shoot growth. Since leaf-buds, as contrasted with fruit-buds, are formed on growth over 7 inches in length, the consequence of this greater shoot growth is to form leaf-buds the first season. The leaf-buds develop into spurs the second season, and fruit the third season. Because spurs can carry much more fruit than short shoots fruiting from lateral blossom-buds, the yield is greatly increased.

This information is the first available in New York State showing clear-cut response from nitrogen fertilizers on sour cherry trees. It is especially valuable because of the fact that the sour cherry is now perhaps the one profitable orchard fruit in the State. Fertilizer recommendations in the State are based upon these results.

7. A test of fertilizers for grapes. Applications of nitrogen, phosphorus, and potash, alone and in combination have shown a response from nitrogen. Evidence has been found in the increased growth of cover crop, larger and greener grape foliage, and increased yield. These findings agree with those reported from the Chautauqua grape region.

8. Cover crops for orchards in the Hudson River Valley. Because Hudson Valley orchard soils are acid, low in fertility, and low in organic matter, tests have been conducted with eighteen different cover crops using six different rates of limestone application. Three year's records of dry weight produced per acre on the 108 plots at Kinderhook and the plots on other soil types at Hudson and at Germantown have given some indication as to which crops will produce the most humus at the least cost.

It was determined that a combination of buckwheat and millet was reliable, cheap, and produced a good quantity of organic matter.

Limestone applications less than 2 tons per acre were of little or no value. Two to 4 tons per acre gave good results. Corn sown broadcast gave an abundance of green matter and could be plowed under with little difficulty if taken before the stalks became hard. Such heavy limestone applications as 8 tons per acre decreased the growth of most crops used as cover crops.

In a search for an acid-tolerant legume, a new clover was brought into New York State from Iowa and tried with some success. Known as Wood's clover, it produced a good amount of organic matter on plots receiving no limestone while alfalfa plants nearby by contrast grew no alfalfa whatsoever.

9. Pruning and renewing mature sour cherry trees. Because many mature sour cherry trees in the Hudson River Valley have reached a height at which harvesting is accomplished with difficulty, and because these trees tend to produce the bulk of their fruit in their tops, investigations were begun designed at lowering these trees. Trees thinned-back to outside laterals so as to reduce the height of trees approximately 6 or 7 feet were severely dwarfed unless also fertilized with nitrogen fertilizers. Applications of nitrogen fertilizers to pruned trees resulted in greater trunk diameter, larger leaves, and increased yields. The first season after pruning the pruned and fertilized trees carried approximately half the crop of the unpruned and unfertilized trees. The second season the pruned and fertilized trees had nearly caught up, and the third season they had passed them.

Investigations with the English Morello, Early Richmond and Montmorency varieties have shown how each should be handled for

maximum gains.

The results, like those with fertilizers, have come at just a time when New York State growers were seeking information of this kind. They are the only data available, and that upon which recommendations are made to cherry growers.

10. Pollination of fruits. Because of the tendency to plant the newer commercial Hudson Valley plantings in solid blocks information was desired by growers on the sterility relations between fruit varieties in that section. Three season's results with the more important commercial varieties showed practically all apples, pears, and sweet cherries to be self-sterile. The J. H. Hale peach was found to be self-sterile, as it had been in other States, and any of the common varieties grown in the Valley were found to be good pollenizers for it.

In a solid block of Windsor cherries striking results were secured showing the necessity of having pollenizers adjacent to the trees they are to pollenize. From a percentage set of 42% in trees adjacent to pollenizers the set decreased to 26% in the second row, and so on down to approximately 10% in rows beyond the fifth.

11. Observations and tests upon the bearing habits of fruit trees in the Hudson River Valley. A study of the various ways in which a given variety may carry its fruit under different conditions may give indications as to how to change its habit from one of biennial bearing to one of annual bearing. Baldwin trees were found which produced their fruit on one-year wood much as a Wealthy tree may do. Baldwin trees were found which produced crops annually, but always in different parts of the tree. By these studies the attention of growers was focused upon studying and observing what their trees were doing.

C. Nursery Investigations.

Because of the likelihood of the promulgation of a Federal Quarantine in 1930 against the importation of nursery stock and because American nurserymen have not as yet developed an adequate and satisfactory domestic supply of understocks to replace the imported stocks upon which they are now largely dependent, appropriation was made by the Legislature of 1927 at the request of New York State nurserymen for studies in "problems of the production, storage, and distribution of seedlings and nursery stock of trees, shrubs, and plants". The work was undertaken by the writer on April 15, 1927.

Land was leased, tilled, and laid off in plate for experimental purposes. An extension to the greenhouse was completed, and an organization with working equipment was built up to effectively carry on the projects.

This work is the first of its kind that has been undertaken by an experiment station in this country so that it was necessary to confer with nurserymen and to secure their point of view on the problems involved before effective work could be done. In conferences with nurserymen and representatives of the New York State Nurserymen's Association the following list of projects was outlined work upon which is now under way.

1. Comparison of seedling stocks from various regions. Fruit tree and rose seedlings have been secured from the principal seedling producing sections of both America and Europe, to determine the best source 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 the foreign stocks.

2. Sources and varieties of seed for seedling stocks. Tests are being carried on to determine the best sources of seed and the most suitable varieties for the growing of seedling stocks under New York conditions.

In the selection of seed from varieties of cherries it was determined that there is a definite relation between the time of fruit-ripening and the soundness of seed. Seeds from varieties requiring less than 60 days in which to mature seed had almost no viable seed. Those requiring 65 to 75 days developed 30 to 60% sound seed, and those requiring 80 days or more developed almost 100% sound seed. These facts are important because the production of cherry stocks is dependent upon the securing of viable seeds. It is now possible to advise the seed collectors to take seed from the late ripening cherries.

In the case of the apple it was found that certain domestic varieties, namely Rome Beauty, Ben Davis, and Northern Spy produce seedlings of good vigor and uniformity, while others, as Tompkins King and Baldwin, are unsatisfactory. With the cherry, seedlings from several domestic sweet varieties appear superior to Mazzard seedlings.

3. Methods of growing seedling stocks. Extensive investigations are in progress to determine the best methods of growing seedling stocks under New York conditions. These include the determination of the best rates of seeding, a comparison of fall vs. spring planting, and especially a study of methods of transplanting. Unless the seedling trees are transplanted at an early stage they grow with a straight tap-root instead of a branching root system. This is undesirable. In Europe, with the cheap labor supply these little seedling trees are transplanted by hand. Such methods are impracticable under our con-

ditions. Efforts are therefore being made to devise some efficient and cheap method of transplanting such seedlings.

Three methods of transplanting were tried, (1) by hand, (2) with planting boards, and (3) by machine. Hand transplanting gave good seedlings but was too expensive. Planting board transplanting proved as good as hand transplanting and was much faster. Machine transplanting was developed to a point where plants could be set 2 inches apart. A reduction in speed to 7 feet a minute was accomplished, the slowest that a machine of this type has yet been made to operate. The plant losses from machine planting, however, were too high to be practicable.

Applications of such fertilizers as nitrate of soda, ammonium sulfate, calcium nitrate, and urea failed to produce any response in Mahaleb seedlings. Thinning plants to different numbers in the row showed 7 to 9 to the foot to give the best grade of stock.

4. Study of storage conditions. Since seedling stocks must be stored over winter it is important to determine the exact conditions necessary for satisfactory storage in the climate of New York State.

In cooperation with other storage investigation projects in the State, attention has been given to storage problems to find out just what the conditions are in different cellars. Records of humidity and temperature are being secured in five different storages selected because of their accessibility and because they represent five different types of storage, for example (1) Constant temperature cold storage, (2) Modern concrete storage, (3) Low-ceiling wood construction, (4) High-ceiling concrete construction, and (5) Dirt Bank Cellar.

Records show that fungus develops under conditions of high

humidity and poor ventilation and that it is definitely associated with the maturity of the stock. Fungicidal sprays have not controlled fungus once it has become established in the plant.

5. Asexual propagation. Seedling trees grown from the same source of seed differ greatly in many characteristics, including vigor. Hence fruit trees propagated on such seedling roots are not uniform, and many trees in an orchard are consequently inferior individuals. It is, therefore, important to determine whether an economical method can be developed of propagating fruit trees asexually; in other words, by propagating them by methods somewhat similar to those used in propagating grapes and raspberries. Some progress in this direction has been made in England and in some sections of the United States.

If fruit trees can be propagated at a low enough cost from uniform and selected root stocks, such trees would have manifest advantages. The important successful asexual stocks have been secured from both European and American sources, the best collection of its kind in America today.

6. Use of cover crops to retain fertility of nursery land. At present, most nurserymen find it necessary to use new land for each crop of fruit trees, which occupies the soil only about three years. Often they go to the expense of tiling the land for the one crop of trees. The growing of the fruit trees is so "hard" on the land that after the crop is harvested the field is either sold for whatever price can be secured or other crops are grown for a considerable period of years on the land before putting it into fruit trees again. This is an expensive process. A thorough study is therefore being conducted to ascertain whether the fertility of nursery land can be built

up and maintained by the use of suitable cover crops, so that the same field can be used successively for more than one crop of trees.

Plats have been laid out and seed sown for these tests.

7. Fertilizer requirements of nursery stock. Most nurserymen are making large expenditures for fertilizers with but very limited data to show whether such expenditures produce sufficient results to justify the expense. Fertilizer tests are therefore being conducted with apples, cherries, and rose stocks to secure definite data on this matter.

Bulletins and Circulars

- Bul. 509. Studies of fruit seed storage and germination. 1924
- Bul. 516. Twenty-five years of fertilizers in a New York apple orchard. 1924
- Bul. 541. Responses of the sour cherry to fertilizers and to pruning in the Hudson River Valley. 1927
- Cir. 79. A guide to the Horticultural Work of the Hudson Valley Fruit Investigations. 1925
- Cir. 17. (Revised) Propagating Plants. 1928 (In press)

Scientific Papers and Journal Articles

- An experience with pollenizers for cherries. Proc. Am. Soc. Hort. Sci. 69. 1924
- Pruning and fertilizing young apple trees at planting. Proc. Am. Soc. Hort. Sci. 13. 1925
- The comparative effect of various kinds and amounts of fertilizers upon yearling apple trees. Proc. Am. Soc. Hort. Sci. 59. 1926
- The possibilities of Wood's clover as an orchard cover crop. Proc. Am. Soc. Hort. Sci. 56. 1926
- The viability of seed from certain cherry varieties. Proc. Am. Soc. Hort. Sci. 129. 1927
- Observations on an own-rooted Kieffer pear orchard. Jan. Heredity. 1928. (In press)
- Horticultural problems in the Hudson River Valley. Rpt. N. Y. St. Hort. Soc. 91. 1925
- New developments in eastern marketing. Rpt. Kans. St. Hort. Soc. 1925, and in Rpt. Missouri St. Hort. Soc. 1925
- What the Horticultural Investigations are accomplishing. Rpt. N. Y. St. Hort. Soc. 156. 1926
- Profits from delaying the cherry harvest. Rpt. Mich. St. Hort. Soc. 138. 1926
- Recent tendencies in eastern marketing. Rpt. Pa. Hort. Soc. 53. 1927

- Rambles in horticultural research in the Hudson River Valley.
 Rpt. Pa. Hort. Soc. 75. 1927
 New developments in eastern marketing. Rpt. Vt. Hort. Soc. 5.
 1927
 A fruit tour of the Pacific Northwest. (Delivered both at
 Rochester and at Poughkeepsie.) Rpt. N. Y. St. Hort. Soc. 1927
 Rambles in horticultural research in the Hudson River Valley.
 Rpt. N. Y. St. Hort. Soc. 191. 1927
 Growing sour cherries for the freezer. Rpt. N. Y. St. Hort. Soc.
 147. 1927
 The trend of eastern marketing. Rpt. Mass. Fruit Growers Assoc.
 1928
 Rambles in horticultural research in the Hudson River Valley.
 Rpt. Mass. Fruit Growers Assoc. 1928
 Experiences with fruit stocks in New York State. Rpt. National
 Assoc. Prop. Nurserymen. 1928
 Plans and accomplishments of the N. Y. St. Nursery Investigations.
 N. Y. St. Nurs. Assoc. 1928 (Mimeographed)

Encyclopedia Articles

1924	Americana Annual.	Horticulture in 1924
1925	" "	" " 1925
1926	" "	" " 1926
1927	" "	" " 1927

Books

The Pear and its Culture. New York City 1928

Addresses at Farm Bureau and Grange Meetings (19)

Kinderhook Farm Bureau	March	1924
Hudson " "	"	"
Germantown " "	"	"
Claverack " "	"	"
Livingston " "	"	"
Ulster Park " "	February	1925
Athens " "	March	"
Kinderhook " "	May	"
Ulster Park " "	February	1926
Muitzeckill " "	March	"
Kinderhook Grange	August	"
Athens Farm Bureau	"	"
Germantown Co-operative	November	"
Germantown Fruit Show	October	"
Marlboro Farm Bureau	February	1927
Muitzeckill " "	March	"
Upper Red Hook " "	"	"
Catskill " "	April	"
Sodus " "	February	1928

Addresses to Garden Clubs (1)

Kinderhook April 1926

Radio Broadcasting (19)

WEY, Schenectady, N. Y.	December	1924
" " " "	January	1925
" " " "	February	"
" " " "	March	"
" " " "	April	"
" " " "	May	"
" " " "	June	"
" " " "	September	"
" " " "	October	"
" " " "	November	"
" " " "	December	"
" " " "	January	1926
" " " "	February	"
" " " "	March	"
" " " "	April	"
" " " "	May	"
" " " "	June	"
WDAF, Kansas City, Mo.	December	1925
WTAG, Worcester, Mass.	January	1928

Rotary and Kiwanis Talks (4)

Hudson Rotary	July	1925
" "	"	1926
" Kiwanis	August	"
Geneva Rotary-Community at Bellona	May	1927

Addresses to Miscellaneous Organizations (9)

Pennsylvania Horticultural Society	York,	July	1925
" " " "	Arendtsville,	"	"
" " " "	Lancaster,	"	"
Connecticut Annual Field Day	New Haven,	"	"
Yakima Fruit Growers	Yakima, Wash.	June	1926
Salem " "	Salem, Ore.	"	"
Tacoma " "	Tacoma, Wash.	"	"
N. Y. St. Hort. Soc. (Summer Meeting)	Poughkeepsie,	August	1924
" " " " " " " "	Marlboro,	"	1925

Scientific Meetings Attended

Amer. Assoc. for the Advancement of Sci.	Washington, D. C.,	1924
" " " " " " " "	Philadelphia, Pa.,	1925
" " " " " " " "	Nashville, Tenn.,	1927

Official Capacities with Scientific Bodies

Secretary-Treasurer American Society for Horticultural Science and
Editor of Annual Proceedings 1928

Official Connections with Other Organizations

American Pomological Society;
Executive Committee and Board of Managers 1924
" " " " " " 1925
" " " " " " 1926
" " " " " " 1927

Connections with Publications

Chairman Advisory Board, Fruits and Gardens 1925-1927
Member " " " " " 1926, 1927, 1928
Contributing Editor, The Rural New-Yorker 1925, 1926, 1927
Member of Executive and Editorial Staff, Rural New-Yorker, 1928

Fruit Tours Assisted in Promoting

American Pomological Society August 1925
(Pennsylvania, Delaware, New Jersey, New York, and Connecticut)
Pennsylvania Horticultural Society August 1926
(Hudson River Valley)

Fruit Judging (11)

Germantown Fruit Show 1924
N. Y. St. Hort. Soc. Poughkeepsie Meeting 1924
Germantown Fruit Show 1925
N. Y. St. Hort. Soc. " " 1925
" " " " " " 1926
" " " " " " 1927
" " " " " Rochester " 1927
Yates County Fair 1927
Rochester Exposition 1927
N. Y. St. Hort. Soc. Poughkeepsie " 1928
" " " " " Rochester " 1928

News Items Furnished (Daily and weekly-64)

No. 247	Special fruit work begun in Valley	July 5, 1923
" 272	How to buy apples	Sept. 22, "
" 289	About buying apples	Nov. 24, "
" 284	Hudson Valley fruit growers	Dec. 11, "
" 349	Sour cherries to be studied	Apr. 14, 1924
" 379	Orchard cover crops for Hudson Valley	June 14, "
" 380	Germination of fruit seed studied	" " "
" 383	Fruit seed germination	" 21, "
" 416	Hudson Valley fruit growers secure State aid	" 23, "
" 418	Fertilizers in the apple orchard	" " "

No. 426	Fertilizing apple orchards not profitable	Sept. 6, 1924
" 429	Buying apples	" 13, "
" 430	Some hints on buying apples	" 20, "
" 498	Big fruit exhibit at Poughkeepsie	Feb. 7, 1925
" 524	Cherries affected by pollination	" 21, "
" 531	Study fertilizer needs of Hudson Valley soil	March 28, "
" 554	Fertilizing young apple trees	Apr. 18, "
" 555	Pollination of peaches studied	" 25, "
" 570	Fertilizing apples	May 9, "
" 574	" " may not pay	" 16, "
" 576	Fruit trees bagged for pollination study	June 19, "
" 577	How nursery stock is propagated	" 26, "
" 618	Why nitrate kills plants	July 18, "
" 619	Cover crops show marked differences	" " "
" 640	Fertilizing apples	Aug. 29, "
" 644	" " does not pay	Sept. 5, "
" 652	Buying apples	" 19, "
" 653	Hints on buying apples	" 26, "
" 656	Pollinating peaches	" " "
" 657	Report on peach pollination studies	Oct. 3, "
" 661	New fruits displayed at Germantown show	" 5, "
" 730	Hudson Valley growers meet	Feb. 13, 1926
" 731	Cherries need cross-pollination	" " "
" 733	Fruit studies in Hudson Valley reviewed	" 20, "
" 737	Mixed cherry plantings advocated	" " "
" 793	Fruit growers plant trip west	May 22, "
" 849	Fertilizing apples	Sept. 18, "
" 852	Fertilizers do not pay on apples	Oct. 2, "
" 946	Issues report on cherry growing	March 19, 1927
" 959	Fertilizing young trees	Apr. 9, "
" 962	Wood's clover	" 16, "
" 975	Use care in fertilizing young trees	" 30, "
" 976	To study nursery stock production	May 7, "
" 977	New cover crop worth trying	" " "
" 982	Will aid nursery stock production	" 14, "
" 994	Seedling fruit stocks	June 4, "
" 1003	Nursery investigations are showing results	" 18, "
" 1013	To honor the Jonathan apple	July 9, "
" 1018	Jonathan apple tree to receive monument	" 16, "
" 1032	Fruit growers to meet at Woodstock	Aug. 6, "
" 1034	Beautifying the home grounds	" 13, "
" 1041	What to plant about the house	" 20, "
" 1055	Tells how to buy apples	Sept. 17, "
" 1062	Buy apples on quality basis	Oct. 1, "
" 1073	Fruit seed germination	" 22, "
" 1090	How to make fruit seeds grow	Nov. 19, "
" 1099	Growing cherries for the freezer	Dec. 10, "
" 1107	Increasing cherry yields	" 17, "
" 1172	Cherry growing	March 10, "
" 1175	Fertilizing and pruning aid cherries	" 17, "
" 1191	Care of nursery stock important	" 31, "
" 1194	Urges care of nursery stock	Apr. 7, "
" 1209	Fertilizers may injure shrubs and trees	" 21, "
" 1211	Care needed in fertilizing trees	" 28, "

II. Present Program of Work

During the session of the Legislature last year, the nurserymen of the State took the initiative in securing an appropriation of \$5,400 for the remainder of 1927-28 to permit the undertaking of investigations on nursery problems at the New York Agricultural Experiment Station, Geneva. The primary reason for their request of the Legislature for such action was that under the quarantine regulations of the Federal Horticultural Board all importations of seedling nursery stock will be prohibited beginning 1930.

In the past, the nurserymen of the United States have relied almost exclusively on seedling nursery stock grown in Europe for the propagation of all varieties of fruit trees except peaches and for many other classes of ornamental nursery stock, including roses. The seedling stocks have been grown mainly in eastern France and in Holland, where climatic conditions are especially favorable. The nurserymen of this country have imported these seedlings and then grafted or budded upon such seedling stock the buds or scions of improved varieties of trees or shrubs, growing this grafted or budded stock in their nurseries until it reaches an appropriate age.

The Federal quarantine regulations which will become effective in 1930 mean that the nurserymen are faced with the most immediate and pressing problems. After that time, the nurserymen cannot secure seedling stocks from Europe, but must have available in the United States satisfactory sources of such material. Up to the present time but very little has been done to ascertain whether satisfactory seedling stocks can be produced in the United States. Furthermore, with the cheap labor in Europe, hand methods of transplanting can be

employed which would make material produced by such methods in the United States unduly expensive. In many other respects, European methods cannot be transplanted without change to the different conditions in this country.

Most of the seedling stocks thus far grown in the United States are deemed inferior by nurserymen to the usual European stocks. On account of the importance of the nursery industry in New York, it is essential that careful investigations be conducted as expeditiously as possible to aid the nurserymen in meeting this emergency.

As soon as the appropriation was made in April, 1927 by the Legislature, the following lines of investigation were decided upon by the Experiment Station in conference with representatives of the New York State Nurserymen's Association. Work upon all these projects is now under way.

1. Comparison of seedling stocks from various regions. Extensive tests are being carried on to compare fruit stocks raised in various districts of the United States with the standard foreign grown stocks, to determine the best source of domestic stock for New York conditions, and particularly to ascertain whether any of the domestic stock now being produced meets the needs of New York nurserymen as satisfactorily as the foreign stock.

2. Sources and varieties of seed for seedling stocks. Thorough tests are being carried on to determine the best sources of seed and the most suitable varieties for the growing of seedling stocks under New York conditions for the propagation of fruit trees.

3. Methods of growing seedling stocks. Extensive investigations are in progress to determine the best methods of growing seedling stocks under New York conditions. These include the determination of the best rates of seeding, a comparison of fall vs. spring planting, and especially a study of methods of transplanting. Unless the seedling trees are transplanted at an early stage they grow with a straight tap-root instead of a branching root system. This is undesirable. In Europe, with the cheap labor supply these little seedling trees are transplanted by hand. Such methods are impracticable under our conditions. Efforts are therefore being made to devise some efficient and cheap method of transplanting.

4. Study of storage conditions. Since seedling stocks must be stored over winter, it is important to determine the exact conditions necessary for satisfactory storage under our climate.

5. Asexual propagation. Seedling trees grown from the same source of seed differ greatly in many characteristics, including vigor. Hence fruit trees propagated on such seedling roots are not uniform, and many trees in an orchard are consequently inferior individuals. It is, therefore, important to determine whether an economical method can be developed of propagating fruit trees asexually; in other words, by propagating them by methods somewhat similar to those used in propagating grapes and raspberries. Some progress in this direction has been made in England and in some sections of the United States.

If fruit trees can be propagated at a low enough cost from uniform and selected root stocks, such trees would have manifest advantages.

6. Use of cover crops to retain fertility of nursery land. At present, most nurserymen find it necessary to use new land for each crop of fruit trees, which occupies the soil only about three years. Often they even go to the expense of tiling the land for the one crop of trees. The growing of the fruit trees is so "hard" on the land that after the crop is harvested the field is either sold for whatever price can be secured or other crops are grown on the land before putting it into fruit trees again. This is an expensive process. A thorough study is therefore being conducted to ascertain whether the fertility of nursery land can be built up and maintained by the use of suitable cover crops, so that the same field can be used successively for more than one crop of trees.

7. Fertilizer requirements of nursery stock. Most nurserymen are making large expenditures for fertilizers with but very limited data to show whether such expenditures produce sufficient results to justify the expense. Fertilizer tests are therefore being conducted with apples, cherries, and rose stocks to secure definite data on this matter.

Seasonal activities.

The growing season extends from the first of April until the first of November. Beginning with the first of March, cold frames are prepared and fruit tree seeds sown for later transplanting. In April, seeds and stocks are planted out. In May transplanting and fertilizer treatments are carried on. June and July demand cultivation, insect and disease control, and note taking on the performance of plants. The last of July and August is devoted to budding and to collecting seed. In September is the State Fair Exhibit and

preliminary digging of stock. October and November are the months for laying-by stock and for storing. December, January, and February are given over to the trimming of stock preparatory to spring planting, to grafting and greenhouse propagation. In this way the labor force is occupied throughout the season. In addition to the field activities storage problems are studied from November until May, and greenhouse propagation is practiced with greenwood cuttings during May and June.

Meetings with nursery and fruit organizations require attendance and preparation during August and January, with occasional executive meetings during the year. A report of the season's activities are given before the New York State Nurserymen's Association in January.

News items that may help the nursery industry are sent out on an average of one a month to the newspapers of the state.

An exhibit of nursery plants is made at the State Fair in September.

Letters of inquiring and correspondence estimated at 900 to 1,000 letters are answered during the year.

Addresses and talks before organizations number fifteen or twenty.

Contributions are made to such scientific organizations as the American Society for Horticultural Science.

Official duties in connection with scientific organizations are: Secretary-Treasurer, "American Society for Horticultural Science" and Editor of the Annual Proceedings; and member of the Board of Managers and of the Executive Committee of the "American Pomological Society."

III. Additional Needs for Effective Prosecution of Nursery Investigations.

The needs of the Nursery Investigations for more effective prosecution of the work include,

1. Storage facilities. At the present time there are no facilities of any kind for proper storage of nursery stock. Make-shift arrangements were made under an old barn during the winter of 1927-28 to handle the small amount of stock for spring planting. These accommodations are entirely inadequate. Requirements are for a common insulated storage forty feet by twenty feet, eight feet high, with adjoining work room twenty feet by fifteen feet.

Facilities are also needed for studying the storage of nursery stock, one of the major lines of investigations in these projects. Requirements are for a storage with four controlled temperature chambers, ten feet square and eight feet high which can be maintained constantly at temperatures between 20 and 40 degrees Fahrenheit and in which humidity and ventilation are also controllable. These chambers could be built in conjunction with fruit storage facilities or with common nursery storage facilities. With facilities of this kind it would be possible to determine the best conditions for the storage of nursery stock, including fungus control. Under the present cooperative arrangements with nurserymen such disappointments are encountered as one during this past season where four weeks of work on the storage of roses was entirely lost because of the misunderstanding of new labor at one of the nursery cellars where the stock was stored.

2. Greenhouse facilities. Reliable work in propagation of plants cannot be done without controlled conditions. Unless it is

possible to tell under what set of conditions certain results are secured they are of no value to the nurseryman because he does not then know how to duplicate them. The Station is pitifully lacking in modern equipment of this kind, so that problems of an exact scientific nature cannot be worked upon. Controlled greenhouses which are divided into smaller sections with controlled conditions are badly needed.

3. Facilities for seed storage and after-ripening. Because Federal Quarantines are becoming more inclusive and are forcing American nurserymen to resort to their own methods of propagation with plants which they formerly imported, studies are necessary in this field. Many plants propagated by seed are now grown with difficulty because the proper conditions are not known under which the seeds should be held. With cherry seed, for example, it is not known definitely whether late stratification affects germination or not. Furthermore some conifer seeds require two years to germinate under some conditions and only one year under others.

A small automatic refrigerative unit such as those used in household refrigerators is needed for this work.

4. Assistance in chemical studies. Assistance is needed in such studies as tests for maturity of nursery stock, internal condition of stock grown under various conditions and stored under different conditions, and composition of plants at different periods under-going propagation tests. At the present time it is impossible to say in what way the various treatments are affecting the internal make-up of the plant.

The cooperation of plant chemists would result in an outstanding contribution in a field now untouched.

H. B. Tukey

Acting Chief in Research(Horticulture)

Geneva, New York
April 27, 1928

F. E. Gladwin - Report of Activities

1. The work for the past five years at The Vineyard Laboratory, Fredonia, N. Y., has been quite largely a continuation of the problems which were initiated during the first few years of the laboratory's beginning. The projects began at that time, 19 years ago, included rather extensive field experiments on vineyard fertilization. These tests have been enlarged, until at the present time approximately 12 acres of Concord grapes are subject to various fertilizer treatments. The latest and most comprehensive test with fertilizers was begun three years ago, with the detailed study of several synthetic forms of nitrogen under vineyard conditions. The fertilizer tests have shown rather conclusively that quickly available commercial nitrogen is the limiting factor in vine fertility and further that this source of nitrogen is just as effective as that from animal manures. The practical results of these tests are shown in the increasing use of commercial nitrogen, not alone in southwestern New York, but in all grape districts of the state as well as in other distant parts of the United States. We have seen the use of commercial nitrogen increase from a single 200 pound sack of nitrate of soda in a single area to several carloads annually. It has been requisite that a substitute be found for animal manures since the supply of the latter was too costly and insufficient to meet the needs.

Co-incident with the starting of fertilizer and manure tests, experiments were begun with several different methods for training the Concord and several other varieties of American grapes. These tests have run for 15 years. It has been found that certain methods of training are more valuable for certain varieties than other methods. Thus it has been shown that the single-stem four-cane Kniffen of training is much more to be preferred for training the Concord than the

Chautauqua, which has been in use since the beginning of grape growing in the district. It has likewise been found that other varieties as Delaware, Niagara and Worden confirm readily to the Kniffen method. The vineyardists in New York as well as in other States are rapidly adopting the latter as a result of our tests influencing tests by other stations. Growers, in New York, who have adopted the Kniffen method are convinced of its value directly as a result of this work. This pruning and training work has been continuous and is still carried on. In connection with these studies we have compared winter and late spring pruning in relation to freezing and frost injury, and as a result, have some rather definite relationships.

Some 15 years ago a variety test vineyard was put out, which at the time included some 250 sorts. Each year the characteristics of the different varieties have been studied and noted. Those unfit for any purpose are eliminated from time to time, and other new promising kinds planted. As a result of this study, we have been in a position to advise the growers of New York as to the desirability of planting the different sorts.

In addition to the test of the named varieties, the laboratory has from time to time tested out the promising seedling grapes bred at Geneva, and their behavior noted.

For several years The Vineyard Laboratory has made many crosses of grape varieties. Several of the seedlings from these are very promising. One of them has been named Fredonia and has been offered to the Public.

About ten years ago the laboratory started a vineyard with 8 varieties grafted on three stocks. These grafted vines are being tested alongside of un-grafted plants. The results to date show that certain varieties grafted are more productive than the un-grafted, while others are not so influenced. Grafted plants are now planted commercially in New York. Our work has shown that imperfect varieties of grapes may be

made to set compact clusters thru artificial fertilization of the blossoms from varieties having very potent pollen.

The resistance of varieties to low temperatures has been studied and the causes of resistance sought.

Selective breeding with Concord has been given attention for several years.

Some work on the time of differentiation of the floral parts of the Concord has been under study.

A correlation between the color of unfolding grape leaves and color of fruit has been studied.

2. All of the above problems except the last named are still under investigation. Especial attention is being given to the development of more productive and long keeping sorts. Most of the above problems have a very practical value to commercial grape growing. In addition a problem in the relation of leaf to fruit production and in turn to the off crop year is undertaken this Spring.

Most of the time during the growing season is spent observing the various experiments in the field, taking notes and supervising the various cultural operations. During the winter months the data is studied and in some instances statistically analyzed. Much writing for the press is done, circulars and bulletins written and farmers meetings addressed. The latter include many in the State as well as at distant points. At all times of the year we have a great many personal visits from growers and groups from New York, other states, and Canada. I have given papers before The American Society for Horticultural Science, Farmers Week at Ithaca, etc.

During my incumbency I have published two bulletins on grape fertilizers and two circulars, one bulletin and two circulars on grape pruning and training, one bulletin and one circular on winter injury of the vine, one bulletin on the cost of producing Concord grapes,

one bulletin and two circulars on the grafting of American grapes, a bulletin on a non-parasitic malady of the vine, and a bulletin on a correlation between leaf color and fruit color.

I have also published in Phytopathology, and I have prepared articles for The International Viticultural Congress held in California, and also for "The Fruit Growing Industry of New York" published by the Department of Farms and Markets. I have appeared many times at meetings of The New York State Horticultural Society.

3. Some equipment is needed for further studies in varietal resistance to low temperatures, some additional land is needed for planting to vineyard as well as for propagation purposes, and a small greenhouse is badly needed.

1. Results accomplished during the past five years.

With the aid of assistants in the department, 1168 fruit crosses and selfs that have been productive of seed were made during the past five years. In addition many more crosses and selfs were attempted but have proved abortive. The three main objects of the work have been first, to obtain varieties superior to the ones extant by combining the desirable characteristics of either seedlings or varieties; second, to study the inheritance of characters so that the breeding work may be conducted more scientifically; and third, to determine what varieties may be planted together in an orchard to insure fruitfulness. All crosses and selfs are made with a definite object in view, but it is obvious that it is not advisable to note the reasons for making each cross. The more important objects sought for in each fruit, however, may be mentioned.

Apple. All of the commercial varieties of apples, such as the Baldwin, R. I. Greening, Northern Spy, McIntosh, Rome and Delicious have their defects. For example, Baldwin is lacking in hardiness of tree, and quality; Northern Spy is slow in coming into bearing and is too partial to soil requirements; McIntosh has too short a season and its fruit drops too easily and bruises too readily; etc. Productive, high quality, highly colored apples are required which will supply the market from the earliest to the latest season. A few new promising seedlings have been sent out to fruit growers during the past five years for trial under a wide variety of conditions. The earliest kind is the Lodi, an improved type of the Yellow Transparent; the Early McIntosh, which resembles the McIntosh, but ripens two months earlier; the Milton, another McIntosh type, but a month earlier than McIntosh; Maccoun, a McIntosh type, but a month later; the Medina and Orleans, two apples of Delicious type but far superior in size of fruit. An extensive bulletin has been published on the apple breeding work which supplements the publication of the same subject issued in 1912. As it will take ten or twelve years to test the progeny obtained from the 214 crosses made during the past five years, no report can be given at this time, except that a large number of trees are now being grown. The smallest are in seed boxes, many are in the nursery, and many have been set in the plats for fruiting.

Pear. The greatest bane to the pear industry is the blight. Fortunately certain varieties, such as the Tyson, Seckel and Kieffer withstand the ravages of this disease, and consequently have been used extensively in the breeding of blight resistant types. At present the Bartlett is the only important commercial pear and its season is very short. Crosses have been made with the object of securing desirable varieties which will cover the entire range of the pear season. Within the past five years, three pears of the Bartlett type, but later, have been introduced under the names of Gorham, Phelps and Pulteney. As in the case of the apples, it will be a number of years before results can be compiled on the 155 crosses made during the past five years.

Plum. The plum industry is on the decline due largely to the growing of inferior varieties such as Lombard, Bradshaw, Diamond, Arch Duke, etc. The high quality plums such as Agen, Imperial Epineuse, McLaughlin, Pearl, etc., lack productiveness, resistance to brown rot, or some other necessary character. Such being the case, the high quality

plums have been crossed with some of the coarse-fleshed, inferior flavored, productive types so as to procure superior types. A promising prune type, named Stanley, was obtained by crossing the Agen with Grand Duke, and this variety has been introduced for trial, as also a large Mirabelle type, known as the American Mirabelle. We believe that if high quality varieties which are productive and cover the plum season can be developed, that the plum industry will be materially improved. The results obtained in the plum breeding work were published recently in a Station bulletin.

Cherry. There are three distinct types of cherries that deserve consideration; namely, sweet, sour, and semi-sour known as Duke. With the possible exception of Windsor, all the sweet cherries have their faults. The early varieties are soft fleshed and of little value for shipping and the later varieties are subject to cracking, lack productiveness, or some other necessary character. All the Dukes, with the possible exception of one, lack productiveness and consequently have not received due consideration. A good Duke variety, as well as better sour, are desired by the canning industry.

Two hundred and twenty-six crosses and selfs have given seed during the past five years, but many of the early maturing varieties produced largely abortive seed. Many more crosses have given no seed, but the data derived from the failures is valuable as it furnishes information on the compatibilities of varieties. Since many varieties are self-unfruitful, and others incompatible with one another, it is essential to know what varieties may be planted together, so as to insure proper pollination.

Peach and Nectarine. Since the nectarine differs from the peach mainly in one character, that is, lack of pubescence, they are grouped together. The peach industry needs several varieties of high quality, yellow, free-stoned peaches that will cover the season from the earliest date to the latter part of September. At present Elberta is the only reliable commercial variety but its season is short and its quality is mediocre. The Crawford peach possesses excellent quality but lacks productiveness and uniformity of size and ripening. A combination of the good qualities of Elberta and Crawford would make an ideal variety. Such being the case, Elberta and J. H. Hale, another large peach, have been crossed with Crawford types and earlier maturing varieties.

The nectarine is a very desirable type of fruit that will receive instant commercial recognition as soon as larger-sized, free-stoned, yellow-fleshed varieties can be obtained. Crosses have been made between the largest types of nectarines and the largest peaches. The second generation of the peach-nectarine hybrids should give desirable progeny. During the past four years, peach and nectarine crosses, 34 in number, have given seed, but as in the case of the cherries, the early maturing kinds have proved abortive.

Apricot. The apricot is another excellent fruit that is handicapped by too early blooming, and consequent frost injury. Twenty-five crosses have been made during the past five years in order to secure a more reliable blooming sort. A Russian variety which is a reliable cropper but bears very small fruits has been used as a parent, as also the largest fruited varieties and two local seedlings.

Grape. The grape industry in New York State is badly handicapped by the lack of desirable varieties. Concord, the leading commercial kind, has a short season and its quality is mediocre. The skin of the Worden is too tender, Delaware has too small berries, Catawba ripens too late, and Niagara is subject to black rot. The European varieties possess the desired flavor, productiveness, and keeping qualities, but they are deficient in hardiness. During the past five years seed has been procured from 199 crosses, many of them being between the early maturing European varieties and our native sorts. Generally speaking, hybrids containing 50% to 75% Vinifera characters are hardy and high in quality. Three such hybrids namely Keuka, Golden Muscat and Stout Seedless have recently been produced and are being distributed for trial. A black seedling grape, known as Sheridan, is attracting much attention since it is proving more productive than Concord, and a far better keeper. Fredonia, an early black grape originated by Gladwin, gives promise of being a valuable new variety, but other varieties varying in color and season are still needed.

For mother stocks, many early maturing European sorts have been collected and their response to different treatments, such as pruning, rootstocks, etc., studied.

Small Fruits. The breeding work with small fruits is being conducted with the aid of G. L. Slate. In 1923, fifteen crosses were made for the purpose of obtaining a desirable canning strawberry. Over 5000 seedlings were grown and over 100 were selected for a second test. Many of these selected types give promise of being valuable for canning and table purposes.

The ravages of the mosaic disease have seriously injured raspberry industry, especially that of the red raspberry. One hundred and ninety crosses have been made during the past five years in the genus Rubus and about 7000 plants have been grown. A new black raspberry, named Dundee, two purples, Brant and Webster, and a new red, Newburgh, have recently been selected - the first three having been sent out for trial.

Crosses have also been made with currants and gooseberries in order to secure improved sorts. The American gooseberry is too small and most of the European sorts are either injured by mildew or hot weather. A new large fruited kind, namely Fredonia, has recently been sent out for trial.

The eastern Elderberry has been hybridized with the largefruited vigorous but tender north-western Elderberry. Since the elderberry is grown by the canning factories, and as an ornamental, and since it may be grown on low lands unsuited for other fruit crops, it is deemed worthy of improvement.

2. Present Program of Work.

According to our plans the breeding work will be continued largely along the lines mentioned. The importance of the problems are mentioned briefly in section 1 of this report.

My activities are regulated mainly by the season. Commencing with March 1st, attention is given to starting seed in the greenhouse and making plans for conducting the breeding work during the season.

About the latter part of April, crossing work in the field commences with the apricots and Ribes and continues until after the middle of June with the grapes. After the crossing has been completed, the remainder of the open season is devoted to describing plants, fruits and harvesting seed. The winter time is used largely in collaborating data. My time is interrupted considerably by visitors, especially during the summer months, by answering inquiries, and by occasional addresses. Probably three or four letters per day are answered on the average during the year. Four or five days are spent in judging fruit ~~exhibitions~~ at fairs and exhibitions, and a week to ten days attending scientific and Farmers' Meetings. As a rule I usually prepare a paper for the American Society for Horticultural Science and another for the State Horticultural Society.

3. Needs for additional facilities.

The breeding work is now checked by the lack of ground. In the summer we are short handed in securing adequate data on the seedlings. Better storage facilities are needed in testing the keeping quality of pear, apple and grape seedlings as well as the parent varieties. Improved office facilities would also be of material aid in carrying on my work.

REPORT OF ACTIVITIES
OF
C. B. SAYRE

In accordance with the memorandum from Director Morrison, the following is a report of the activities of the undersigned:

During the first season of my appointment in 1925, I visited the important canning crops producing sections in order to get acquainted with canners and growers and their problems. The following winter I spent in planning experiments, and plans were perfected for the operation of the canning crops farm. The results of the tests now under way have been published in Bulletin #553, dated February 1928, and in a mimeographed report of the pea seed trials dated December 5, 1927. The outstanding results will be mentioned in the order of the project numbers.

Project No. 35. Rotation and Fertilizer experiment with vegetable canning crops.

Project No. 35 has definitely indicated that phosphorous is the principal limiting plant food in growing tomatoes in New York State. This information will enable farmers to buy their fertilizers more economically and to increase their yields by more effective applications of fertilizers. This Project is also yielding valuable information in regard to fertilizer requirements for cabbage, sweet corn, peas, beets and stringless beans. There is very little information in the literature in regard to plant food requirements of these canning crops, and considerable valuable information will be obtained through the continuation of these experiments.

The value of rotation of crops is apparently not appreciated by canners and growers of canning crops. The practice has been to select the best area on the farm for canning crops and to continue to grow these crops on that area until it is no longer profitable. Many cases have been found of continuous single cropping for a period of 10 years and one extreme case was found where beans had been grown continuously on an area for 18 years and the canners were wondering why yields were unsatisfactory. Two excellent rotations of canning crops are included in Project No. 35 and should prove a very valuable demonstration to canners and growers of canning crops, and should aid in developing a more permanent and profitable system of canning crops production. This year sweet clover is included in one of these rotations to demonstrate its value as a soil builder for canning crops growers. The fertilizer series is so planned as to enable study to be made of the effects of the different plant foods, and likewise the cumulative effects of each fertilizer, a point which is lacking in so many fertilizer experiments. Consequently these experiments should become increasingly valuable with each year's results.

A sub-project under Project No. 35 is giving valuable information in regard to comparing various forms of nitrogen fertilizers as side-dressings for tomatoes. Two new sub-projects should be included in this series, namely, a comparison of the effect of drilling fertilizer with bean seed and drilling it in a separate operation. The same thing should be repeated with peas. I am sure that much damage is done in fertilizing both these crops by applying the fertilizer as the seed is being sown, which undoubtedly injures the germination of the young seedlings.

Project No. 36, Sub-Project No. 1. Tomato Selection and Breeding.

Selections of tomatoes have been made each season of particularly superior plants, and as a result two very high yielding strains have been developed. These could be multiplied and distributed to growers if desired. They are distinctly superior to any seed now on the market. Tomato breeding has also been started, from which eventually it is hoped to develop superior varieties. There is a definite need for improved varieties of canning crop tomatoes, and the development of a satisfactory variety would be of great benefit to the growers and canners.

Sub-Project No. 2. Tomato Variety Testing.

The principal varieties of canning crops tomatoes have been tested and of 33 varieties it has been quite definitely established that the John Baer is the best variety for this region. I am also cooperating with the Orleans County Farm Bureau in a tomato variety test at Albion to determine the best variety for producing green tomatoes for pickling.

Sub-Project No. 3. Comparison of Various Methods of Growing Tomato Plants.

This has demonstrated that in most cases growers sow their tomato seed too early and that the expense of producing the plants can be reduced and the yields increased if plantings were delayed until about the 25th of March. Many plant growers sow their seed three or four weeks earlier than this, which plants must be severely checked before they can be transplanted. This increases the expense of growing the plants, and reduces the yields.

Sub-Project No. 4. Determination of Best Distances of Spacing Tomatoes in the Field.

This has demonstrated that 3 1/2 x 4 feet is the optimum distance for planting tomatoes in the field. The majority of growers set their plants 4 x 4, and it would seem that their yields could be increased about one-sixth by changing their distances in accordance with these recommendations.

Project No. 37, Sub-Project 1. Effect of Size of Sweet Corn seed on Yield, Quality and Uniformity.

This has demonstrated that in growing sweet corn for canning it is particularly advantageous to grade the seed for size before planting. This grading can be done at a trifling expense and is an important factor in uniformity of maturity which results in higher quality pack and reduced harvesting expenses, because the grower can harvest an entire field in prime quality at one picking, which cannot be done with ungraded seed.

Sub-Project No. 2. Determination of Best Distances of Planting and Rate of Seeding Sweet Corn.

This is yielding valuable information in regard to optimum planting distances of two leading types of corn grown in this State for canning.

Sub-Project No. 3. Treating Corn Seed with Seed Disinfectants.

This project is of considerable importance in determining the practical value of treating seed corn with organic mercury compounds.

Project No. 38, Sub-Project No. 1. Testing Commercial Pea Seed Stocks.

Tests of the commercial seed stocks offered to the canning trade of New York State have been conducted for two years, and the results of these comparisons have been sent to the canners sending in seed. There was a noticeable improvement in the quality of the pea seed in this State the second year of this trial. This is probably due to the fact that the seed trade is only sending their better strains to this State where they know they will be subjected to comparison with other strains. The very poor stocks offered by one seed firm have been practically eliminated from this State, which is certainly a valuable service to both canners and growers.

Sub-Project No. 2. Effect of Size of Seed on yield, quality, and uniformity.

This test indicates that grading pea seed for size is of no value, although small sizes of peas bring the highest returns, yet it is shown that planting the small seed separately from the large seed does not increase the proportion of the more valuable smaller sizes. Neither do the large sizes increase the yield.

Sub-Project No. 3. Determination of Best Rate of Seeding Canning Crop Peas.

This is giving valuable information in regard to the optimum rate of seeding peas. The cost of the seed is one of the large items of expense in growing peas, and the optimum rate of seeding is of considerable value. The tests show that yields of peas could be increased by slightly heavier rates of seeding than is most commonly practiced.

Sub-Project No. 4. Effect of Treating Pea Seed with Organic Mercury Compounds.

This test is showing that treating pea seed with organic mercury compounds is justified as a form of crop insurance.

Sub-Project No. 5. Inoculation of Pea Seed with Nitrogen gathering Bacteria.

This test gave negative results the one year it was tried and it is doubtful if it should be continued here. The results of the inoculation of pea seed is a matter of local application, consequently results secured here would not be generally applicable, and it is recommended that this sub-project be abandoned.

Sub-Project No. 6. Pea Breeding.

Great good could be done to the growers of canning crops, the canners and consumers by developing improved varieties of canning peas. Consequently a number of crosses have been made from which it is hoped superior varieties can be developed. This is a long term proposition but one that, if successful, would bring considerable fame to the Station and real service to the public.

Sub-Project No. 7. Relation of Time of Planting to Development of Peas and Vines.

Results secured in regard to the relation of time of planting to

development of peas and vines have shown that timely planting of peas, generally practised would bring increased pea yields of 12%, and would also reduce canning expenses. In this test the value of timely planting has been demonstrated, and detailed studies made to show why the yields have been increased by timely planting. As a result of this test, the largest canning organization in the State, operating 19 factories, after studying their own planting records and yields for the past two years, with the suggestions of the undersigned, have definitely decided to require timely plantings from their entire acreage of peas. They are confident that this would increase their yields and reduce their vining costs 20%.

The present program of work includes all of the projects previously enumerated. The value of all these projects would be increased by repeating them for several years. My activities during the season are about as follows:

From April to November, my time is completely occupied with the management of the canning crops farm and the details of executing all of these projects in the field, including the accurate laying out of all the work and accurate yield records. From November to April my time is occupied in compilation of the results secured in the field and to some extent with addresses. Likewise, during this period, I take a month's vacation. Addresses during the past season include the following:

The annual meeting of the Association of New York State Canners, and likewise their Spring meeting.

The Annual meeting of the New York State Vegetable Growers Association.

The Annual Meeting of the Vegetable Growers Association of America.

The Annual Meeting of the National Canners Association.

The Annual Meeting of the Central New York Vegetable Growers Association.

Also addresses at meetings sponsored by the Orleans County Farm Bureau, Erie County Farm Bureau, and three meetings sponsored by the Genesee County Farm Bureau; also the Seneca Castle Grange, Phelps Grange, and three days School for Canners Field Men, held at Geneva. Inquiries from farmers and canners which are answered by mail average about eight per week.

In regard to needs for additional facilities for the most effective prosecution of this work, one of the most pressing needs is for additional scientific personnel. A scientific assistant would make it possible to carry on additional projects, and particularly for detailed studies of genetics, and considerable more work in plant breeding which will become of more importance in the future development of this work. New York State leads in the production of wax and green beans, yet lack of personnel has prevented any breeding work on these crops. There is much need for improved varieties of beans. For example, a high quality stringless bean of erect habit of growth is much needed in order to make effective the newly invented bean harvester. This machine, with an improved variety, would unquestionably revolutionize the bean growing industry just as the pea viner revolutionized the pea growing industry. It is physically impossible for the undersigned to take on any additional work, but the need for this breeding work is great. At the present time I am taking accurate yield records from 940 plats of 1/50th acre. In addition to that I

an making careful observations of each plant in the row and taking yield records from 430 rows of peas and tomatoes in the selection and breeding experiments.

There is also a need for breeding improved varieties of sweet corn for canning in this State.

Increased greenhouse facilities would expedite the breeding work. In fact, in growing F 1 generation of crosses, a whole year's time can be saved if this generation could be grown during the winter months so that the F 2 generation could be planted in the field the following Spring. Likewise, in greenhouses with controlled temperature and humidity apparatus, more detailed studies could be made of many factors affecting the growth of these crops.

It can be seen from the above report that most of my activities are of a practical nature, rather than fundamental science, yet one function of the Experiment Station is to carry on these tests for the farmers of the State, and keep them posted on the best methods of growing the crops to save them costly experiments. Work on these projects seemed of the utmost importance in the beginning of this work, and as these projects near solution, probably a few more practical projects must be added, but the opportunity should also come for more practical and pure scientific research. The breeding work is one step in this direction.

Very truly yours,

CBS:MF

For more than twenty years prior to 1919 I was Editor and Librarian of the Station, inaugurating and developing the "Popular Edition" idea in Station publication, work regarded as of very great importance in giving to the agricultural public accurate, brief, readable stories of scientific investigations.

For several years of this time I also served as Vice-Director, acting as Director for six months at one time during absence of Director in Europe on Sabbatical leave.

Since return to Station from temporary severance of connection owing to ill-health, my duties and services have been entirely in the collection of material to be used in the authorized publication, Vegetables of New York. This work is to meet a demand similar to that which resulted in the eight volumes of Fruits of New York, the preparation and publication of which volumes having given the Station widespread recognition, both at home and internationally, as the leading authority on fruit varieties.

Such work with vegetables is of equal or greater importance than was that with fruits, since vegetables are more widely grown than fruits, and, except in a few states, have greater commercial value; while there nowhere exists any publication, or series of publications, which attempts to give accurate historical, botanical, systematic and varietal notes and descriptions of the multitudinous kinds of vegetables, now or formerly grown in New York; and grown in New York means, practically, grown in the United States.

This work has involved, for about four years alone and three years with an assistant, the collection, by study of all available seedsmen's catalogs, of seeds of all current varieties of the vegetables to be grown, planting and growing these varieties in easily comparable small plats, preparation of description sheets for each vegetable, with entries for every character believed to be of value from the growers standpoint, for recognition and separation or segregation of the varieties, or for use of plant breeders in improvement work or studies in heredity.

The crops already grown in this series include peas, beans, cucumbers, muskmelons, squashes, vegetable marrows, pie pumpkins, asparagus, horseradish, rhubarb, sweet corn, pop corn, radish, leeks, garlic, chives, okra and martynia; each from one to four years, the aim being to secure at least three fair crops of a vegetable upon which to pass judgment, thereby eliminating as far as possible variations in varieties due to changed climatic conditions.

Practically all of the above vegetables will be grown this year, the mostly on smaller areas or with reduced numbers of varieties; and to the list will be added carrots, parsnips, peppers and red celeries. Other vegetables will be added as time and available land area permit, until the entire field has been covered. Material from each vegetable has been collected for reproduction in color photographs in the Vegetables of New York, and also for wax models in the Station Museum.

The work done hitherto has included the collection, for from one to four years, of the detailed data for the following approximate numbers of varieties, strains or identical varieties under other names: Peas 500; Beans 560; Muskmelons 275; Squashes 110; Pie pumpkins 40; Vegetable marrows 30; asparagus 40; horseradish 9; rhubarb 35; sweet corn 290; pop corn 36; radish 425; and miscellaneous vegetables 40, practically 2500 in all. During the coming season about 1400 kinds will be under study.

In preparation of the material for publication, hundreds of added varieties are included from compiled data secured from old books on horticulture, gardening and special vegetables, horticultural and agricultural periodicals, encyclopedias and files of seedsmen's catalogs, work which requires as much or more time than does the collection of field notes. Work upon peas, which will be first published, is practically completed, awaiting only a decision from the State Printing Board as to the exact form and amount of space allowable; and the collection of historical and other compiled data on beans and on radishes (by my assistant, L. R. Hawthorn) has been done so that material for these vegetables can be soon made ready for printing.

In working upon peas, marked differences were noted in strains of the same variety from stocks of different seedsmen, differences which indicated greater or less adaptability of the strains for canning.

Realizing the importance of this variation to the canning industry, tests were made for two seasons of all procurable strains of the leading canning peas,--large plat tests confirming and emphasizing the differences noticed in the variety work. The two bulletins (Nos. 526 and 532) giving results and conclusions from these tests have been much in demand by canners and growers of canning peas; and, with subsequent work done by the Canning Crops Section, have had a decided influence on the pea canning industry of the State and, to some extent, in other sections growing peas for the cannery.

To meet increasing interest and popular demand, Cornell Extension Bulletin No. 81, Culture of Asparagus, was prepared by the writer and has been much used both by Cornell Station and this one.

G. P. VanEseltine.

Statement of work done since February 1, 1927 (Date of appointment)

1. Reorganized herbarium - resulting in an arrangement identical with that of the larger herbaria whereby quicker reference and considerable saving of time in the future is assured.
2. Identified several hundred specimens of plant material submitted by nurserymen, florists, farmers, gardeners and other herbaria, including the Department of Agriculture at Washington. Much of this work is time consuming and difficult owing to the fragmentary nature of the specimens submitted. This work also calls for a very broad knowledge of plant life because of the great variety of material received - weeds, ornamentals of all sorts, crop plants, fruit trees, etc.

Circular 92 - "Directions for the Preparation of Plant Specimens Submitted for Identification" was published to aid one phase of this work.

3. The preliminary treatment of "The Botany of the Cultivated Peas and their Allies" by A. Berger was revised and completed; This involved examination here and at Washington of herbarium specimens and original descriptions for verification.

Mss. now ready for publication.

4. "The Botany of the Cultivated Beans" by A. Berger was also revised and completed in the same manner.

Mss. now ready for publication.

5. A preliminary investigation into the cytology of apple species and hybrids was made as a basis for a more accurate systematic treatment of this important group and as a foundation for better methods of breeding work. This involved a careful study of the various conceptions of taxonomic relationships in this group. (Dr. B. Nebel did the microtechnical work involved.)

A preliminary discussion was published in Science, Nov. 11, pp. 442-444.

6. A taxonomic and cytological study of the cultivated cucurbitaceae was begun.

7. An investigation into the cytological behaviour and the systematic position of the cherries was carried as far as possible during the season.

8. Herbarium material of many groups was collected and prepared for mounting.

9. Five flower shows were held in Jordan Hall in an endeavor to stimulate local interest in the Station and to enable the people of the vicinity to receive the aid they may legitimately seek from the Station as regards spraying, cultural practices, choice of plants for this region, etc.

Present Program of Work.

1. The development of the economic herbarium. The herbarium forms a reference library that must be made since it cannot be bought. Its fundamental importance to the plant breeder and horticulturist is attested by the value given it at the centers from which most of our knowledge of cultivated plants has emanated, Washington, Kew, etc. The present collection contains between 7000 and 10000 sheets. It is lacking in many groups concerning which requests for information come almost daily during the growing season - May 1st to November 1st. Preparation of material for inclusion herein will take nearly half of the time during the six months noted. Some time in winter is required for the study of some groups in placing them in the herbarium.

2. Continuation of the systematic and cytological studies on:

- (a) Apple species and hybrids.
- (b) Cherry " " "
- (c) Other pomaceous and drupaceous fruits.
- (d) The cultivated cucurbitaceae.
- (e) The genus *Vitis* - grapes.

In consideration of the fact that all plant breeding work involves the questions of hybridism and the behavior of the hereditary mechanisms (chromosomes) of plants, it is at present conceded by all geneticists that the future progress of plant breeding is dependent on a complete knowledge of the systematic relationships and cytological behavior of the plants bred. While results may and do come from breeding work without such a basis, the waste of time, money, effort and planting space involved is most uneconomical. The most striking change in the methods of plant breeding institutions both in American and abroad in this century has been the very recent emphasis on the taxonomy and cytology of our common cultivated plants. This Station characteristically was one of the first to recognize the need of systematic work on cultivated plants and has been among the foremost to appreciate the urgency of cytological work as a corollary to it.

3. The flower shows involve a sum of less than 1/2 day's work per month. A large number of people became acquainted with and interested in the Station through the shows of last year and we plan to insure further good will of the local people by encouraging their cooperation in staging the shows of the present year.

4. Identification of plants for farmers, nurserymen, gardeners, etc. will probably take a total of three or four weeks from the working time of the growing season. It is difficult to judge from one season's experience just how much there will be of this work. This Station should be the center of information on cultivated plants for this State and so inquiries of this sort are encouraged as much as possible.

5. Addresses at Garden Clubs and Judging at Fairs, Flower shows, etc. will probably involve about a week (total) during the year though it is to be hoped that such opportunities where they form profitably contacts for the Station will increase as I become better known throughout the State.

Needs for additional facilities.

1. For the economic herbarium - we need very badly insect and dust proof cases though these may be put over until next year if we can get them as part of the equipment of the new building.

2. We shall need aid for mounting plants for the herbarium during the fall and part of the winter months.

3. A very urgent need is equipment for cytological work as follows:

(1) A good binocular microscope - Spencer Research No. 7 - with achromatic low power oculars and objectives.	\$531.00
(2) Zeiss apochromatic oculars and objectives for higher powers. (estimate)	100.00
(3) Paraffin oven (Columbia type)	20.00
(4) Precision microtome (Spencer 820)	240.00
(5) Spencer holder for Safety razor Blades	9.00
(6) Miscellaneous chemicals (stains & fixatives) (est.)	15.00
(7) Miscellaneous apparatus (slides, bottles, etc. (est.))	<u>10.00</u>
Total	725.00

Note: It is possible that a cheaper microtome might be used.
(Will Corp. No. 12077, \$129.00) This microtome will do the work but
at a cost in research time that makes the purchase of the better
type more economical in the long run.

April 16, 1928.

Memorandum for Director Morrison:

Report of Progress of G. H. Howe, Division of Horticulture.

During the period following my initial appointment to the Staff of this Station to the time of my entrance in the United States Army in 1918, my work covered many phases of horticultural investigations then under way at the institution. This included routine note taking and observations in connection with the testing of fruit varieties and experiments conducted therein; work in plant breeding; preparation of manuscript for personal reports; and assistance in writing two of the series of monographs on fruits, namely "The Cherries of New York" and "The Peaches of New York." This preface brings me to the period of my activities during the past five years.

1. Results Accomplished.

In connection with the work of testing all varieties of fruits which can be grown in New York, my activities have centered on three fruits, namely apples, pears, and cherries. This has meant the yearly selection and planting of new varieties followed by observation and notes as to their behavior, and descriptions for permanent record. This work, of course, has been the foundation for the publication by the Station of the seven monographs on New York fruits, now nationally and internationally known. It has taken from two and one-half to four years to issue each of these fruit books, on four of which I have worked. My work with "The Small Fruits of New York", issued during the last five years, consisted in the supervision of and assistance in listing all references, histories, and technical descriptions of fruit, and the supervision of photographing fruits for the colored plates, and proof revision.

Besides and in connection with variety testing of fruits, pruning, propagation, and stock experiments have been conducted. Reports on these have been issued for which I have been actively responsible, namely bulletins 500 and 544, as well as assisting in preparing data for bulletins 497, 498, 514, 531, and 551.

In connection with the plant breeding projects which have been carried on during recent years, I have tested personally several thousand seedlings of apples and pears as well as smaller numbers of seedlings of stone fruits. Several new fruits have been named and distributed as a result of this work. There is every reason to expect that some of these will find their way into commercial fruit growing as has the Cortland apple. Besides the practical horticultural value growing out of this work, much data have been obtained which are of genetical importance to the plant breeder.

2. Present Program of Work.

The testing of fruit varieties continues, my active interest being concerned with apples, pears, and cherries. The importance of testing varieties of these fruits under New York conditions is to report their value to the Station's constituents, thereby accomplishing that which is physically impossible for individuals to do. There is the added advantage of having an extensive collection of varieties for use in breeding.

Work has commenced on a revision of "The Apples of New York", an edition now antiquated after serving a valuable purpose for a quarter of

a century. This means the completion of field notes on varieties and the photographing of such sorts as have been selected for use as color plates. Actual work in manuscript preparation, of course, is performed during the winter months.

Trees are being propagated for a new variety apple orchard to replace Orchard 20 which soon will have served its usefulness. To the new orchard will be added also plantings of new sorts procured from time to time.

A stock and cion experiment has been started to determine the effect if any one has on the other. Fifteen apple varieties have been grafted on several kinds of seedling roots. These trees will be dug after three seasons' growth and their root systems examined.

Observations and notes on the propagation experiments already under way will be continued.

Descriptions of seedling apples, pears, and cherries will continue as these trees come into bearing. Out of these descriptions and observations should come data of practical and genetical importance.

The yearly program for these projects consists of field work during the growing season which involves notes, observations, and a supervision of cultural operations. During the winter these notes are elaborated in the office and permanent records formulated for reports and reference.

Thruout the year inquiries from farmers and workers are answered in the number perhaps averaging two or three daily. In the autumn many personal and written inquiries are answered concerning the identification of fruits, chiefly apples and pears. Many visitors are shown about the orchards during the summer. An occasional trip is made to adjacent orchards to dispense advice on fruit problems. Sometimes trips are made to other institutions for mutual conferences and an exchange of ideas. Reports are sometimes made at the annual meetings of the American Society for Horticultural Science. Such a report is contemplated this year.

3. Needs for Additional Facilities.

Four outstanding needs for additional facilities for the prosecution of my work are urgent, altho each applies to other members of the Division as well. These needs are:

- A. Additional land for horticultural plantings.
- B. Additional office and fruit storage space. Present facilities for the latter are all but worthless.
- C. More farm labor at certain seasons. This would mean more thorough cultivation and care of orchards and plots which is essential.
- D. Some means of courteously disposing of visitors who come to the Station out of pure curiosity and for no definite purpose.

Report of the work of L. R. Hawthorn during the past three years.

1. This report covers a period of somewhat less than three years as I did not work at the Station previous to July 1, 1925. As I am Mr. F. H. Hall's assistant, my work is closely connected with his, and the general nature and plan of the work has been described by him.

At this time the pea work is practically ready for publication. Mr. Hall is now well on the way in his preparation of our bean data for publication. To me has been assigned the radishes and I have already grouped the varieties, and collected some of the historical data. Much of this yet remains to be collected, but preparation for publication will be a comparatively short process after all historical data is in.

2. The present program of work is essentially the same as it has been during the past three years. As one vegetable is completed, another is taken up. This year we are growing for the first time all the varieties, or so-called varieties, of carrots, and parsnips that are grown in this country. Of course a number of vegetables mentioned above will be grown again as our results are not based on less than three years' trials. New varieties of these vegetables now under trial, or previously under trial, are added to the planting lists, in order that our information along these lines may be constantly up-to-date.

Incidental work for the present year will be:-

a. A study of red and pink celeries with a view to the introduction to commercial use of some of these high quality celeries.

b. An attempt to produce a parthenocarpic American greenhouse cucumber. This is being done in cooperation with Mr. Richard Wellington who made the original crosses a number of years ago. I am trying to complete the work now, as such a cucumber would be a great addition to the trade in that it would eliminate the necessity of bees for pollination.

c. Breeding work with home garden and market garden peas with a view to their improvement.

My general activities during the year are as follows:

Late winter and early spring:- Listing new varieties, ordering seeds and arranging samples for planting. This year over 1300 samples will be planted.

Spring: Planting and taking early field notes.

Summer and early Fall: Taking field notes, classifying material in field and in the laboratory.

Late Fall and Winter: Collecting historical data from various sources.

3. Among the additional facilities which we need are:

a. More help. A reliable man who could and would do manual labor, and yet who could at the same time be intrusted with some of the routine jobs such as packeting seed samples, making labels, and so on. These are simple operations, and yet because of the nature of our work, error must be reduced to an absolute minimum. Much mis-labeling, for example, would result in serious confusion.

b. More ordinary farm labor in the growing season from time to time.

c. The use of a light truck. Three of our plots are away from the Station (so located in order to have suitable growing conditions) one as far as 120 miles, and not near a railroad nor any public conveyance.

d. More greenhouse space. Some of the crops to be taken up soon will need greenhouse space not at present available at the Station.

Director Morrison:

In answer to your memorandum asking for a Report on the work I am carrying on, I wish to make the following statement:

I was appointed assistant in the Division of Horticulture from July 1, 1923, and it was my duty to assist other members of the Staff in the work on different projects carried on by the division.

At present I am ^{further} engaged in studies on the pollination of our deciduous fruits. I started this ^{work} in 1926 and expect to publish on the pollination of the sweet and sour cherries within another year. Apples, pears and plums have further been worked on and from this Spring peaches and grapes will also be included in these studies.

The aim is to acquire definite information for the New York grower on the pollination problems. The work that has already been done in this field seems to indicate rather strongly how the pollination requirement of our cultivated fruits is to a great extent of local character, dependent on climate, soil and other cultural conditions, and consequently these studies will have to be worked ^{out} more or less independently for the different important fruit districts.

This Station with its large number of varieties should be exceptionally well suited for such studies.

Starting with the Spring season, it has been my duty to assist in the breeding work, beginning in April and lasting until about the middle of June. The work on the pollination studies comes at the same time.

Beginning in June the different fruits, varieties as seedlings from the breeding work come on for description, strawberries in June, raspberries in July, and so on.

I have charge of the Station orchard of peaches, nectarines and apricots. A new orchard of these with a number of new varieties, especially of nectarines and canning peaches has just partly come into bearing age. Last year the first descriptions of peaches were made in early August, while the latest varieties were not harvested until the last week of October. During this time I estimate that more than half of my time was spent in these fruit descriptions, and I expect so to be the case for a couple of seasons more. It is considered most essential that an accurate record can be obtained, ^{of the adaptability} of the Western canning peaches as well as the many varieties of nectarines ~~will~~ in this section.

As the different fruits ripen the seeds from the breeding work are collected and stratified. This work is usually not finished until November, the grapes and late apples maturing about that time. During the winter months, December - February, most of my time has been taken up with the compilation of material for the fruit books - from 1923 to 1925 to the Small Fruit book and from 1925 to 1927 to the revised edition of the Apple book - while this last winter has been given to the working up of breeding records and to prepare for the pollination studies under way.

Usually I have to assist in the setting up of the Station exhibits at the State Fair at Syracuse early in September, at the meetings of the Horticultural Society in Rochester in January, and at Poughkeepsie in February, and have to be present at the exhibits to answer questions in regard to the fruits exhibited.

Under additional facilities I would like to mention a microscope which could also be used for cytological studies in connection with the pollination researches, a number of petri dishes and different other equipment for the determination of pollen germination.

Olav Einset

George L. Slate - Report of Activities.

I was appointed to the position of Assistant in Research, (Horticulture), in April, 1922. During the first three years I assisted the other men in the department in the breeding and descriptive work with fruits as follows:

Assisted Mr. Hall one summer describing and classifying peas and muskmelons.

Assisted Mr. Wellington in making crosses, caring for seed and seedlings, and description of the seedlings of all fruits grown at the Station.

For three seasons I had charge of the plum variety orchard during which time a number of descriptions were made in addition to the usual routine note taking.

Two summers were spent assisting Mr. Taylor in describing and classifying a large number of small fruits for the "Small Fruits of New York."

About one month of each year is occupied with the preparation of fruit exhibits for the State Fair, and the two winter meetings of the State Horticultural Society.

The first three winters were spent in compiling and writing up the histories and descriptions of the various small fruits for the "Small Fruits of New York."

One month each fall for the past two years has been spent in Fredonia assisting Mr. Gladwin weighing the crop on his plats.

Two winters have been spent in compiling and writing up varieties for the "Apples of New York." At least two more winters will be required to complete my part of this work.

Part of last winter was spent working on strawberry breeding data which it is hoped to publish next year.

Four or five hundred inquiries are answered each year in correspondence.

Publications:

Assisted in preparation of "The Small Fruits of New York."
Circular - Raspberries, Blackberries and Dewberries.
Circular - Strawberries.
Prepared small fruit and grape descriptions and writeups for last new fruit bulletin.

I have charge of the library of the Horticultural Department.

The academic year 1925-26 I spent at the Bussey Institution of Howard University studying genetics and securing the degree of Master of Science.

Present program:

In 1926 I was given charge of the small fruit work, and now have the following lines of investigation under way:

1. Breeding and improvement of small fruits.

a. Raspberries: Crosses are being made or have been made for the purpose of securing varieties resistant to mosaic and other virus diseases. In addition to breeding for disease resistance, crosses are being made for the purpose of securing varieties suitable for special purposes such as canning, preserving, or shipping. A few species crosses are made each season in the hopes of securing unusual vigor or resistance to disease.

b. Currants: Breeding work was started in 1927, crosses being made for the purpose of securing better varieties and data on the inheritance of characters. The chief object is to combine the large size, high quality fruit of Perfection with a more productive, upright bush which does not lose its foliage so early in the season. A few species crosses were made.

c. Gooseberries: The object of gooseberry breeding is the securing of varieties combining the size and quality of fruit of the European varieties with the vigor and health of the American varieties. A thornless form recently secured will be used as a parent hereafter. As with the other fruits, species crosses are made.

d. Strawberries: 140 second test seedlings are on trial and at least a dozen have shown unusual merit. At least two will be named this year if they are as good as last season. The objects in breeding are the getting of new varieties resistant to leafspot, adapted to special purposes such as canning or preserving. With the cooperation of the National Preservers' Association last year three seedlings were selected as being superior to the varieties now grown for that purpose. The canners will cooperate in this work also and their requirements are considered in making crosses. Some everbearing crosses will be made this Spring.

e. Blackberries: The present varieties are all very unsatisfactory and badly mixed in the trade. As enough good characters exist in the blackberry varieties, these are being combined in the hope of getting something of value. A thornless variety was used as a parent last year.

f. Filberts: Filberts are all self incompatible and have blooming dates which in many cases do not overlap. Hence blooming dates and pollination will be studied. Crosses are being attempted between native and European types in the hope of combining the hardiness and resistance to disease of the American forms with the size and quality of the European types. Breeding work in this field necessarily must wait until the present variety planting indicates that filberts may be profitable in New York, and my knowledge of varieties is such that I can make intelligent crosses.

g. Minor fruits: Elderberries thrive on swamp lands and sell well in certain markets. Their improvement is being attempted and promises to be successful. One private grower had remarkable success in improving the fruit.

Prunus tomentosa and *P. glandulosa* offer some promise as bush fruits. They make an excellent jelly and may take the place of currants for home use because of the white pine blister rust. 1200 *tomentosa* cherries will fruit soon and selections will be made.

A few persimmon and pawpaw seedlings are being raised to secure a hardy form for this State.

2. Variety testing of small fruits.

This work is closely tied up with breeding work. Two new foreign raspberries of unusual merit have been discovered and their introduction is being pushed. One seedling of unusual merit for shipping has been named and another superior to Cuthbert for preserving has been selected.

The newer strawberries are recommended from time to time.

The filbert experiment is primarily a variety test to determine what sorts are adapted to New York. Future work will depend on the outcome of this test. So far it is promising.

3. Fertilizer experiment with raspberries.

An acre each of Cuthbert and Columbian raspberries have been planted on the canning crops farm for a fertilizer test. Little definite information as to the fertilizer requirements of these fruits is available and there is a considerable demand, especially from the canners, for this information. Mr. Collison's advice is being followed in this project which was started in 1927.

4. Pruning experiment with red raspberries.

A preliminary test in 1927 indicated that present pruning practices are too severe and that the crop is being decreased thru the removal of too much wood. The pressure of other work and the report of a similar experiment in Michigan have made it necessary to drop this work until a later time.

5. Pepper breeding.

Owing to the lack of space for small fruits until some orchards have been discarded, this work must be cut down and as a result the work with peppers is being started. A glance at the piles of peppers in grocery stores will show one a multiplicity of types which is not desirable. The objects of this work are the selection of pure lines to get uniform types, the crossing of these inbred lines to secure hybrid vigor, and the development of early varieties. The work of Joseph Harris, seedsman in this State, who has introduced several important varieties indicates that pepper breeding has a place in this state. This work is being combined with Mr. Hall's variety testing.

6. Establishment of an arboretum.

The present plan of growing species in variety collections is unsatisfactory, so I am planning the establishment of an arboretum on some semi-waste land. This will include all species of apples, pears, plums, cherries, nuts and other fruit plants of lesser importance. A collection of material was made in the Arnold Arboretum this spring and is now being propagated for this purpose.

The seasonal work is about as follows:

Winter. Work on fruit books, compiling variety and breeding data. Trying of new varieties, and preparation of fruit exhibits.

Spring. Planning of planting work, pollination and breeding of fruits previously mentioned, and when time permits assisting in pollination work with tree fruits.

Summer. Description of varieties and seedlings of small fruits, including the selection of improved forms. Guiding visitors. Harvesting and care of seed resulting from crosses.

Fall. Assistance with note taking with grape varieties and seedlings, and assisting at Fredonia Laboratory.

Present needs.

For more effective work I need a guide to relieve me of the major part of the duty of showing visitors around. It takes more time than I can well spare to attend to men from other institutions in similar lines of work. Last summer my work was neglected seriously because of visitors. This neglect means the holding of a plantation until the data can be secured and much additional expense for cultivation which should be applied to a new crop of seedlings.

A private office is needed since there are two other men in the same room, one of whom is dictating most of the morning. The horticultural library is in the same room and those using it cause some interruptions. Between the disturbance from dictation, the interruptions from visitors to the others, and users of the library, I am considerably less efficient than I would be in a private office. I realize the impossibility of a private office, but wish to bring the matter to your attention.

Land, labor and scientific assistance are also needed.

George L. Slate - Report of Activities.

1. Collection of data, chiefly variety descriptions for "Small Fruits of New York."

Writing part of "Small Fruits of New York."

Taking of field notes on varieties and seedlings as they fruit.

Crossing of various fruits.

Work on "Apples of New York."

2. Small fruit variety testing and breeding.

Fertilizer test on red and purple raspberries. Started Spring 1927, field just getting established.

Variety test and pollination work with filberts.

Variety testing and breeding work with minor fruits, including elderberries, nuts, persimmons, pawpaws, *Prunus tomentosa* and *Prunus glandulosa*.

Pepper and eggplant breeding.

Seasonal work.

Spring. Planting, pollinating.

Summer. Field notes on varieties and seedlings. Caring for seed.

Fall. Field notes on grapes at Geneva and Fredonia.

Winter. Work on fruit books and compiling of data. Preparation of fruit exhibits.

Correspondence. Four or five hundred inquiries are answered each year.

3. More land and labor needed to care for seedlings.

Guide needed during summer months as my work was seriously neglected last summer because of visitors.

Assistance needed for field notetaking and description of seedlings.

Since my appointment July 1st, 1926 the results accomplished are:

1. Collection of data, chiefly variety descriptions of plums and apricots.

Taking field notes of varieties and seedlings as they fruit.

Assisting Wellington and Slate in crossing various fruits.

Work on "Apples of New York."

2. Plum variety testing and breeding.

Apricot breeding.

Pollination work in plums and pears.

Seasonal work.

Spring: Pollination work. Assisting Wellington and Slate with crossing varieties. Taking blooming dates of grapes and plums.

Summer: Field notes on varieties and seedlings.

Fall: Field notes on grapes and plums and describing seedlings. State Fair exhibit.

Winter: Work on "Apples of New York" and compilation of data. Assisting Slate with Fruit Exhibits.

Correspondence: A hundred inquiries are answered each year.

3. A guide needed during summer months to take visitors around, as work is neglected for this reason during the summer.

Poultry Division

W. P. Wheeler

REPORT OF WORK FOR PAST FIVE YEARS

W. P. Wheeler

Experiments with poultry carried on at this Station during recent years concerned certain breeding problems, feeding practices and some relations of sunlight to nutrition and reproduction.

Feeding Experiments With Poultry

On one project which sought information as to the physiological needs for succulent vegetable foods and limitations in their use, feeding trials were made during several seasons. This series considered only laying hens, and controlled feeding covered the greater part of each year. The chief reason for repeated, altho somewhat varied feeding trials for several years, is that large flocks could not be handled in the Station's comparatively small plant. Because of seasonal variations in production, however, which cannot be prevented, and the causes of which are not all understood, there is some advantage in having observations distributed over several years.

Because certain food constituents and accessories, small in amount but important, cannot so well be supplied by other than "green food", it is desirable to know approximately the minimum amount needed in the ration. Also as crude nutriment is more cheaply available in coarser vegetable foods of the farm than in most concentrated foods of the market it is of practical importance to learn the approximate extent to which such foods can be utilized without unprofitably retarding production.

Altho the common fowl cannot subsist largely upon the coarser foods like other farm animals, and can maintain good health and production for long periods without them, we have data showing that in some rations nearly one-third of the total food can consist of this cheaper material,

supplying nearly ten per cent of the dry matter in the ration, for long periods without diminished egg production and with the eggs much stronger for hatching. With most rations not such large proportions of the coarser foods can be fed with advantage. For simple maintenance, however, larger amounts can be used.

A number of feeding trials have also been made on the continuation of a former "war-time" project, undertaken because it considered the utilization of foods not possible for human consumption, and not marketable. This has supplied data on production of poultry by supplementing the regular rations with food, other than grain, obtained by the fowls themselves from different fields. Results varied somewhat with weather conditions and according to season, but equally rapid growth and development have been often secured from these cheaply supplemented rations as under ordinary rations providing all the food.

Breeding Experiments

Breeding experiments have been carried on continually during the last few years, using inbred lines of stock previously established by selection during a number of years. Two lines, in each of two types or classes, selected on the basis of production, have been perpetuated and individuals used for inter-breeding. Altho the common fowl reaches breeding maturity during the first year, more satisfactory progeny are obtained from hens of the second year, and any selection on the basis of performance cannot be made with certainty before the end of the first year. So new generations are secured only once in two years. There are matings each season, however, and rearing of young is a yearly problem. Because of failures to secure progeny from many individual matings for various unpreventable reasons, many more matings are necessary than would suffice under perfect conditions. Where eight matings could serve for

the work planned, more than twenty are usually necessary to insure against loss of "blood" already developed.

Altho some characters are readily "fixed" in a few generations, others can be established only with great difficulty and a few cannot be segregated. In our work crossing of unrelated lines results, almost always, in increased vigor of progeny as evidenced in several ways, especially by more dependable reproduction and usually ability to sustain increased egg production.

The Importance of Sunlight For Fowls

Experiments made during the last few years relating to the importance of unobstructed sunlight have been with laying hens. Hens matured under ordinary out-door conditions can survive the confinement usually necessary during the winter months without appreciable injury, and maintain heavy egg production under good rations, but cannot longer remain strong without access to sunlight not depleted by passing thru ordinary glass (or without having some costly and inconvenient substitutes in the way of unusual foods, &c). After this period of resistance there soon begins pronounced loss of vigor and rapid falling off in egg production. Sometime before laying ceases the eggs cannot be hatched. Calcium assimilation is seriously disturbed; the bones are weakened and egg shells are thinner before final "break-down". (Previous studies at this Station have shown that magnesium, altho associated with calcium as a normal constituent of the bones and egg shells, as well as more abundantly in most poultry foods, will not take the place of calcium in the body, when that element is lacking, even for purely structural purposes. Strontium, however, altho not a recognized constituent of the normal body, nor of foods, will quite largely replace calcium). Even after laying has practically ceased, if exhaustion is not allowed to become complete, exposure

to unobstructed sunlight will promptly induce resumption of laying, and soon normal hatches are obtained.

From our work it seems that much less than the total amount of sunlight available in the open field will prevent these disastrous effects. Final data are not available, but one-tenth, or perhaps much less, of the possible amount of unobstructed sunlight will suffice for continued good health. It also appears that sunlight reflected from sky, clouds and ordinary buildings will serve to keep hens, of necessity confined where southern exposure is not available, in good health and normal production. Experiments are now in progress to test these indications.

Some of this information is immediately desirable because hens often must be kept, if at all, in situations not perfect, and it is important to know what limitations can be met without disaster. Other data secured in such experiments, even if not immediately applicable to problems of poultry keeping, are often helpful on other farm problems. Although special physiological activities observed for one class of animals cannot be attributable without qualification to another class, yet in a general way a knowledge of the influence of certain factors profoundly affecting the life of one warm blooded vertebrate may justifiably be used to help to an understanding of the needs of others.

A Study of Soil Requirements

Considerable work has been done during the last few years on a study of certain soil requirements. This is based upon observations on soils and crops from a field in which certain strips of soil have been gradually modified, without sudden extreme disturbance of natural conditions, by annual applications of chemicals for a long time. The soil is of a type ("Dunkirk clay-loam") representative of a large part of the better agricultural land of the state. To supply data for estimating

the normal expectation of crops on this field, parallel strips were laid off at regular intervals, the treatment for these strips being identical. No fertilizing materials, other than some of the residues from the crops grown on them, have been applied for many years, so in the respect crops from them may be considered more nearly "normal" in composition than others from the same type of soil elsewhere which may have received applications of farm and commercial manures in unrecorded amounts at unknown intervals.

The questions originally considered were chiefly certain relations of calcium and magnesium in soil and plant and that of possible sulphur deficiency, altho other questions later developed. Adding sulphur to this soil, very low in original sulphur content, by the application of certain sulphates was found unnecessary, for ordinary farm crops. Some unexpected results from the cumulative use of sulphates were obtained. The addition of calcium sulphate, quite generally considered a harmless or beneficial natural sulphate, resulted in diminished yields for most crops. Sodium sulphate, generally considered a potentially harmful constituent, usually induced an increased yield. The causes for these effects have not been definitely ascertained. In the clovers, generally considered the best sources of calcium for dairy animals, the calcium content was noticeably depressed and the magnesium content considerably increased by applications of magnesium sulphate to the soil. Other sulphates did not induce this result. With red clovers, and apparently with others (work not completed) there was some increase in calcium content when either calcium sulphate or calcium carbonate was applied to the soil, associated with no increase or some diminution of the magnesium. The increase in calcium was not all as sulphate.

More complete data are available from a tobacco crop recently grown on this field than from some other crops, and these indicate that crops

grown on such a field may give results from which practical crop production may profit. The use of sodium sulphate resulted in somewhat increased yield of tobacco, but in noticeable depression of nicotine content. The use of sodium chloride also resulted in increased yield, and some depression of nicotine content. Calcium carbonate applied to the extent of making the soil plainly alkaline brought a reduced crop of increased nicotine content. Other treatments had little effect. The question is occasionally being asked as to the possible accumulation of sodium when sodium salts are repeatedly used as fertilizers. The absolute accumulation of sodium in this field has not been determined, but there is no indication of an accumulation harmful to most standard crops from many years continued application of either sodium sulphate or sodium chloride. With such crops as tobacco and sugar beets there is an effect on composition, of consequence or not according to the intended use of the crop.

So far as can be learned from men most likely to be informed, no dependable laboratory method is known for the examination of soils that will forecast their relative crop producing power, altho these men agree that such a method would be most desirable. In any search for such a method, along any possible lines, an important essential would seem to be samples of representative soil known to have reasonable permanent inherent differences in general crop producing power. "Normal" untreated strips on this field show such differences, altho alike according to ordinary means of appraisal. For at least thirty years these strips have been treated alike.

Present Program of Work

Work is now being carried on with three of the projects outlined above:- "Breeding experiments with poultry", "The importance of sunlight for poultry", and "Studies of certain soil requirements". Results se-

cured in work on the other projects will be reported as soon as the data collected can be prepared for publication. The considerations that make such work of importance enough for this Station to undertake have been mentioned.

Distribution of Work

Work on these projects is practically continuous thruout the year. The breeding experiments involve extra attention during the normal hatching season and as the birds approach maturity just before winter. Field work for the soil study is done mostly between March and November, and laboratory work whenever there is opportunity. There is always clerical work on records to be done.

It has always been the policy of the Station not to refuse any correspondence relating to agriculture. There is always some of this. The total involving this department is much less than before help of the extension service in this State and the farm bureaus developed. Occasional telephone calls of inquiry are made, and visitors come for personal consultation. All these interruptions, of course, delay the progress of the regular work. The total averages several hundred a year altho no record is kept.

Repairs and Equipment

The water supply for the poultry house, for hot water brooders and watering stock, comes thru a line of small pipe about 50 rods long. This supply is liable to be interrupted at any inopportune time. The pipe has been in use for 30 years and is badly rusted, permitting only a fraction of its original small flow. The incubators are all old, twenty years or more, two of them unsafe. Two new ones are needed of about 300 egg capacity each. Replacement for worn out dishes and pails will be needed.

L. I. Vegetable Research Farm

E. E. Clayton

H. C. Hockett

INVESTIGATIONS OF VEGETABLE CROP DISEASES

BY

E. E. CLAYTON
VEGETABLE RESEARCH FARM
RIVERHEAD, N.Y.

Work with Cruciferous Crops (Project No. 14)

Brussels Sprouts

At the time the writer began work, 1922, the Long Island brussels sprout growers were suffering severe losses from the blackleg disease. Investigation showed that infection came from two sources: (1) the seed, which was all locally grown, and (2) the seedbed soil. As a result of our work, practically all growers now treat their seed to free it from disease and select for planted sites land that has grown no cruciferous crop for the previous five or six years. The success of this program is universally recognized by the growers and the men are now producing healthier crops of brussels sprouts than any time in the past decade.

Publications:

- Bul. 550. Blackleg disease of brussels sprouts, cabbage, and cauliflower.
- Reports at A.A.A.S. meetings of 1924 and 1926.
- Technical bulletin manuscript.

Cauliflower

Major attention has been given to two serious problems, black-rot (blight) and whiptail.

Black-rot has been a very serious disease and a few years ago there was much discussion as to whether, owing to the severe losses, cauliflower was not a losing crop on Long Island. The writer has conducted extensive breeding and strain testing work with the object of developing or finding disease resistant strains. At present we have such a strain which is the result of a cross made between the collard and cauliflower in the winter of 1923. A second line of investigation showed (1) that this disease lives over freely in seed, (2) that it was very common in locally grown sprout seed, and (3) that it spread widely and rapidly in the planted. A hot water method of seed treatment which destroys this disease infection in the seed was developed and tested. To do this, a treating plant was built and operated at the Research Farm in 1925, 1926 and 1927. The success of this piece of work has been publicly recognized both by individual growers and local organizations. The use of this treatment in connection with careful seedbed selection has greatly reduced losses from disease.

Whiptail was described and named by the writer (Bul. 506) and the cause - malnutrition associated with highly acid soils - definitely proven. It was shown that applications of lime prevent this trouble 100 per cent, and as the result of our findings Long Island cauliflower growers generally lime their ground except when it is also to be used for potato growing, in which case potato scab, another disease problem, must be considered. Scab is favored by lime. Owing to this fact efforts have been made to develop or find a strain of cauliflower resistant to whiptail and which consequently could be used on the acid potato lands. The same cauliflower-collard selection that has proven resistant to black-rot also shows promise as a whiptail resistant strain. Thus we are working in the hope of ultimately producing a cauliflower that will be both black-rot and whiptail resistant.

Publications:

Bul. 506. Investigations of cauliflower diseases on Long Island.
Also Bul. 550.

Other Investigations with Cruciferous Crops

The value of treatments in the plantbed for the control of diseases encountered there, club-root, blackleg, black-rot, and wire-stem, was investigated and it was found that the treatment used for the control of cabbage maggot was partly effective in controlling these diseases. These results were reported in Bul. 537, Control of seedbed diseases of cruciferous crops on Long Island by the mercuric chloride treatment for cabbage maggot.

Mosaic disease of various cruciferous plants, including rutabaga, brussels sprouts and cauliflower, has been thoroly investigated as to its host range. Mosaic troubles are among our most serious and baffling, and it was important to know whether the cruciferous mosaic was liable to be a cause of serious losses. It was found that of the commonly grown crucifers, brussels sprouts is moderately susceptible; cauliflower slightly susceptible; and cabbage immune. On the other hand, some of the less important crucifers, such as mustard and Chinese cabbage, proved highly susceptible to the disease. The conclusion was that the cruciferous mosaic will not become a serious problem with our important crops.

The work is complete and will be prepared for publication as soon as time is available.

Improvements of Present Methods of Spraying Vegetables (Project 15)

Spraying is the most commonly recommended control measure and also, compared with such things as seed treatment and use of disease resistant varieties, the most laborious and expensive of disease control measures. It was planned in initiating this investigation to work both on the spraying of specific crops for specific diseases and also to work on the development of improved materials and methods of spraying in general.

The first problem attempted was the spraying of lima beans for the control of bacterial spot and mildew, two troubles that are both common and destructive on Long Island where beans are an important crop in some sections. It has been demonstrated that beans can be effectively protected by spraying with bordeaux mixture and that applications during the period of August and early September are most important. Following the successful results of our tests, growers are beginning to spray this crop and the value of the recommendations was thoroly demonstrated last year. The spraying results with lima beans are at present in preparation for early publication.

In considering the general aspects of the spraying problem, it is evident that while bordeaux mixture, our standard preparation, is inexpensive, it is inconvenient to use and very corrosive in its action on spray equipment. Much work has been conducted in the laboratory on the development of substitutes without these objections, and some progress made. Certain more promising preparations will be subjected to field tests this year.

Work with Seed Treatments (Project 23)

Potatoes

At the present time Long Island potato growers do not treat their seed potatoes before planting. The standard corrosive sublimate treatment recommended for New York state they consider to be slow; also its value was doubted. The writer undertook a twofold investigation, first as to whether it was profitable for Long Island growers to treat their seed by the corrosive sublimate method; second as to whether more rapid dust or instant dip treatments could be substituted for the longer process. This is the fourth year in which tests have been run on a large scale. The results at present indicate that, contrary to experiences in up-state New York, potato seed treatment on Long Island is not profitable as a scab or black scurf control measure. These diseases occur almost universally in Long Island soil owing to almost continuous potato growing over fifty or more years. The treatments have, however, aided in securing a good stand by protecting the seed pieces against decay. Whether this protection is sufficient to justify the expense seems doubtful, but final conclusions will not be drawn until the extensive tests of the present season have been harvested.

It is worthy of note, as an indication of the characteristically fine cooperation received by the writer from both farmers and dealers, that this spring both the du Pont and Bayer companies, who manufacture potato seed treatment materials, sent sales representatives to the Island with the intention of conducting aggressive selling campaigns. The men were referred to the writer by both growers and dealers, and at our request abandoned their plans for the present year.

Sweet Corn, Beans, Peas, Cucumbers, etc.

The second phase of the seed treatment investigation has consisted of a general consideration of vegetable seed treatment problem.

The value of treatments, as a means of protecting seed against decay in the soil after sowing, has been investigated. It has been shown (Bul. 554) that the organic mercurials exercise a long continuous protective action, and when seed is sown very early, treatments with these preparations have resulted in securing much better stands. On the other hand, there was little gain if the seed was sown later when the soil was warm and germination rapid. Liquid treatments gave much better results than dust treatments, especially with the earliest seed sowings.

The effect of various forms of seed treatment on the subsequent germination of seed has been studied particularly with cauliflower, sprout and cabbage seed. It has been found that many treatments shorten the life of the seed and consequently it is advisable only to treat seed enough for the current year's use; if stock is to be held over a year it is best also to delay the treatment.

The effect of seed treatments on the subsequent growth of the plants has been given attention and found to be an important factor in some cases. Thus treatment of cruciferous seed with mercuric chloride tended to weaken the subsequent growth of the plants; treatment by the hot-water method tended to strengthen and invigorate them. These effects have been measured in terms of ability to withstand transplantation. Thus, in one test, the number of replants in the mercuric chloride treated plats was 209; in the same number of hot water treated plats 29. The favorable effect of hot water treatment on plant growth has been generally recognized by Long Island cauliflower and sprout growers.

Publications:

Bul. 554. Increasing stands from vegetable seeds by seed treatment. Other publications on these investigations will appear in the near future.

**Investigation of Control Measures for Cucumber Mosaic and Wilt Diseases
(Project 31)**

The growing of pickling cucumbers was at one time an important industry on Long Island. Recently the acreage had decreased rapidly due entirely to the severe losses from disease. Mosaic has been the most destructive and is estimated during the period 1923 to 1928 to have reduced the yield of pickles one-third to one-half. Under such conditions the crop has naturally failed to be profitable. Wilt has also been troublesome and consequently was included in the scope of the present investigation, the subject of which was to discover practical means of control for these diseases.

The work was begun in 1925 along two lines:

- (1) Spraying early in the season to prevent the diseases from gaining a foothold.
- (2) Breeding to produce disease resistant varieties.

Two years' work demonstrated that there spraying or dusting during the first six weeks of growth was an highly effective and entirely practical means of controlling wilt disease. The same program, however, merely delayed the appearance of mosaic without providing effective protection. Consequently the efforts with respect to this latter disease were centered on the breeding work. Progress along this line is necessarily slow, but results to date are most encouraging.

Publications:

Effect of early spray and dust applications on the late incidence of cucumber wilt and mosaic diseases.
Phytopathology Vol. 17, pp. 473-481. 1927.

SEASONAL PROGRAM OF WORK

April and May

Laboratory: Only necessary records.
Greenhouse: Breeding work, - seed production from disease resistant selections.
Field: Potato, pea, corn, bean, etc., field plats.

June, July, August

Laboratory: Only necessary records.
Greenhouse: None
Field: Investigation along all lines in full swing:
Seed treatment plats with potatoes and vegetable seed.
Comparisons of selections for disease resistance.
Spraying experiments, etc., etc.

September, October, November

Laboratory: Working up the season's results and preparing to publish results of matured projects.

Greenhouse: Breeding and seed treatment tests in full swing.

Field: All work with sprouts, cauliflower and cabbage in progress. Some of the tests with potatoes and early sown vegetables are completed.

December, January, February, and March.

Laboratory: Intensive work in testing of promising new materials as spray mixtures and seed treatments, culture work with fungi and bacteria.

Greenhouse: Intensive work in selfing, crossing and selecting in the cauliflower and other breeding work. Testing out numerous materials as sprays and seed treatments observing their fungicidal value, plant injury, effect on germination, etc.

Field: None.

During this past year the following vegetable crops were grown and used in one or another project: potatoes, sweet corn, cabbage, muskmelon, tomato, peppers, lettuce, radish, peas, green beans and lima beans. Experimental plots were located not only at the Research Farm but also with farmers scattered all the way from Mineola to Orient Point. The growing season and field work occupied the period April 1 to December 15. The greenhouse assigned to pathological tests was completely filled with experimental work from September 1 to the following July. The laboratory and office are in use the entire twelve months. Just as one example of the routine involved in these investigations, during the period January 1 to April 1, 1928, under Project 28, 820 two hundred seed lots of cabbage and cauliflower, 290 one hundred seed lots of cucumbers, 248 one hundred seed lots of peas, and 100 one hundred seed lots of corn were planted and full germination and disease counts recorded.

Personal service: This consists of requests from people living on Long Island by telephone and in person, and letters from people living at a distance. As to the local calls a few examples from the past week will best explain their nature. (1) The county agent called with diseased cabbage plants from a large grower who was much concerned and in doubt as to whether he should not discard the entire bed. The trouble was wire-stem (Rhizoctonia). He was advised that it was not serious, and merely discarding the poorest ones at the time of pulling would be all that was necessary. (2) A greenhouse grower sent in a sample of diseased sweet pea. The trouble was typical for the crown-gall disease and hence involved the problem of cleaning up a soil infestation. He was advised that I would stop at his place soon and give him full instructions as to how to do this. (3) A local farmer called with a sample red pine branch girdled by large gall. The trouble was Peridermium. He stated that there were just a few infected

branches in a lot of planted trees. Advised him to prune out and burn the diseased limbs at once since the fungus sporulates and spreads a little later in the season.

There is a steady volume of calls such as these, sometimes three or four or more a day and sometimes as many as that in a week. In general they consist of questions regarding experimental work that we have in progress or of problems too technical for the local extension agents to handle.

MISCELLANEOUS

The writer is a Fellow in the A.A.A.S. and Ohio Acad. of Science, also a member of the Phytopathological Society of America, Botanical Society of America, Crop Protection Institute and Potato Association of America. The annual meetings between Christmas and the New Year are regularly attended and papers presented. In the past considerable time has been given to addressing farmers' meetings, chiefly on Long Island, and to the preparation of popular articles for local publication. The pressure of work, however, has been such during the past year that many invitations of both sorts had to be refused since it was felt that the efficient conduct of the research program was our primary purpose.

PLANS OF WORK FOR THE COMING YEAR

Project 14

Attention will be given to the breeding of disease resistant varieties suitable for use on Long Island. The previous work with seed treatment methods will be continued and also the other investigations now in progress.

Project 15

The spraying work will be extended along more general lines so as to include a consideration of spraying problems in the entire vegetable crop field, including potatoes.

Project 22

The test with the organic mercury instant dip treatments will be completed this year and attention will be given to other lines of potato seed treatment work. The experiments with vegetable seeds will be extended to include tests with a variety of chemicals as preventatives of seed decay after sowing.

Project 31

The work with cucumber mosaic will be pursued with chief attention given to the breeding of disease resistant strains.

FUTURE NEEDS

The present Long Island vegetable disease program uses all available funds for labor and supplies. Additional work can be undertaken only in conjunction with additional appropriations. Attention is called to the Long Island greenhouse flower industry which has tripled in size during the past few years. The investment in this industry is very large and diseases are becoming serious. It seems probable that in the near future these growers will seek the help of the Station in solving their problems.

May 15, 1928.

REPORT OF INVESTIGATIONS
LONG ISLAND VEGETABLE RESEARCH FARM

RESULTS 1922-1927

H. C. Hockett

1. The development of satisfactory measures for controlling insect pests attacking cruciferous seedbeds on Long Island: e.g., cauliflower, brussels sprouts, cabbage. Such pests include the cabbage maggot, flea beetles, aphids, thrips, diamond-back moth, cabbage looper, and cabbage worm.

Publications:

- (a) The control of aphids which infest cauliflower seedbeds on Long Island by means of tobacco dust mixtures. Jour. Econ. Ent. 1925, XVIII, 128-132.
- (b) Control of insects in the cauliflower seedbed on Long Island. Cir. 80, N. Y. (Geneva) Agric. Exp. Station 1925, pp. 1-11.

2. The presentation of data gathered from field and laboratory experiments to show the possibilities of tobacco dust as an aphicide, especially when such dusts contain a high nicotine content, hydrated lime, and small amounts of water. The high cost of nicotine sulfate (40 per cent solution) has made it very necessary that nicotine should be procured from a cheaper source at less cost. The use and development of tobacco dust shows promise of providing a cheaper form of nicotine for the farmer.

Publications:

- (a) The control of aphids which infest cauliflower seedbeds on Long Island by means of tobacco dust mixtures. Jour. Econ. Ent. 1925, XVIII, 128-132.
- (b) Further studies concerning the aphicidal properties of tobacco dust. Tech. Bul. 121, N. Y. (Geneva) Agric. Exp. Station, 1926, pp. 3-29.

3. The presentation of data annually regarding potato spraying and dusting experiments against insect pests for the purpose of providing farmers with the latest information regarding results from such important phases of the work as spraying vs. dusting, nicotine in spray and dust form, three nozzles vs. two nozzles per row, improvements in the technique of applying sprays and dusts. Potato insect pests include flea beetles, Colorado potato beetle, aphids, leafhoppers.

- (a) Spraying and dusting experiments with potatoes on Long Island in 1926. Cir. 90, N. Y. (Geneva) Agric. Exp. Station 1927, 1-10.

(b) Dusting and spraying experiments with potatoes on Long Island in 1927. Cir. 94, N. Y. (Geneva) Agric. Exp. Station 1928, 1-10.

4. The adaptation of satisfactory measures for protecting cucurbits against injury from cucumber beetles on Long Island. The development of methods and insecticides that give promise of killing beetles in a practical way. Owing to the great number of recommendations made for the successful control of cucumber beetles in various localities in the United States, it was necessary to find out which measures were most efficient under Long Island conditions. Most of these measures were effective in protecting the plant from feeding injury by their repellent action, but none were successful in killing beetles when applied under commercial conditions. By the use of traps for beetles and high strength nicotine dusts such progress has been made toward developing a method that will kill the beetles in an economical way.

Publications:

- (a) Dusting cucumbers, melons and squash with special reference to the striped cucumber beetle. Market Growers Journal, 1926, LXXVIII, pp. 331-333.

INVESTIGATIONS IN PROGRESS

1. Studies of potato insects:

This investigation has been carried on for four years and it is planned to continue it annually over a considerable period of years with a view to (1) estimating the comparative importance of each insect pest of the potato for each season; (2) estimating the value of spraying and dusting for the control of insect pests for each season.

So far the results tend to show that the returns from spraying and dusting vary more according to individual farmers than according to any other factor. It therefore appears most likely that each farmer must find out for himself whether it pays him to spray or dust for insect pests. The results of the investigations carried on at the Research Farm and on the farms of cooperator have mostly shown what the individual has been able to do. The solution of the problem of adapting such measures to one's own farm practices, where thought of value, has been largely left to the discretion of the farmer. The results also tend to show that local conditions, such as soil, topography, and weather, have an important influence on the relative value of spray or dust practices.

The importance of carrying on the work is emphasized by the fact that the acreage under potatoes on Long Island exceeds the acreage of all other vegetable crops combined. The investment in seed and fertilizer material for the potato crop each year exceeds such investments on all other vegetable crops combined. It is thus essential that such a universal interest should be protected from losses due to the possible injurious results from insect epidemics. Under favorable conditions such insects as aphids, leafhoppers and flea beetles are capable of inflicting serious injury to growth in a very short period of time.

2. Studies of cucumber insects:

This investigation has been carried on for five successive years. It is planned to bring to a close that phase of it dealing with the protection of cucurbits from injury by cucumber beetles thru the use of repellents, and to exploit the possibilities of killing the beetles in a practical way. It is proposed to accomplish this by taking advantage of the response of beetles to certain stimuli and by the development of a method that is efficacious in destroying the beetles. It is felt that the problem of cucumber beetle control has not been successfully solved until a practical method has been devised for killing the beetles.

The importance of carrying on the work is readily appreciated when it is realized that the cucumber growing industry on Long Island is annually seriously crippled by losses caused by disease and insect injury, many of the most important of the former being transmitted chiefly thru the agency of insects; e.g., mosaic, wilt. Added to this is the fact that so far no methods have been successfully developed for destroying cucumber beetles in a practical

manner, altho during the past two years much progress has been made in exploring the possibilities of this phase of the problem.

3. Studies of cabbage insects:

This investigation has been carried on for five successive seasons. The problem has naturally divided itself into two parts: (1), pests affecting seedbeds, and (2), pests affecting field plantings. The extent of injury caused in the seedbeds and field plantings has varied considerably during the course of years, depending largely on weather conditions. So far as the seedbeds are concerned, observations tend to indicate that warm, dry weather in May and early June is usually followed by serious thrip and aphid infestation; e.g., 1923, 1924. In cool, wet seasons these pests do not develop in serious proportions, eg. 1925, 1926, 1927. The cabbage maggot and cabbage looper are also pests that occur periodically in destructive numbers, altho it is not so evident what conditions are favorable for their development and which not. The economic use of control measures for these pests therefore depends largely upon the farmer being able to gather information for himself by frequent inspections of the seedbeds; by becoming familiar with the appearance of injured foliage; by knowing where to first find each insect and by recognizing the different stages of development of each insect on the plants. In field plantings the cabbage looper and cabbage worm are most destructive during September, especially if the weather is dry. Spraying or dusting with an arsenical has given good results provided the crop was treated when the worms had recently hatched.

The importance of carrying on the work in control of insects affecting cruciferous plants is appreciated when it is realized that cauliflower is the next important cash crop to potatoes on Long Island. The seedbed is sown during May and June when insect activity is rapidly increasing. The seedling plants are therefore exposed to great risks during this period from insect development. The fact that the plants are at such a tender stage of development makes it imperative that each year careful supervision be given to the seedbed.

In the field, one of the chief causes for loss in the cash value of cauliflower heads is the blemished caused by worm excreta. It is therefore essential that the worms be killed when young and by insecticides that are rapidly toxic.

NEEDS

1. Storage and tool shop

Additional space is required for storing present equipment on hand, e.g. sprayer and duster, cages, etc., and also for the storage of equipment for further experimental purposes, e.g. hepper and aphid dozer, mechanical means of collecting insects. On Long Island, with the salt laden rains, tools and equipment rapidly deteriorate if left in open sheds.

A tool shop is required for repair purposes as well as for the erection of a small mill for mixing dusts.

2. Additional acreage.

The renting or purchase of additional land (four acres) from Mr. Kingsley (adjacent farm) for potato spraying and dusting experiments. At present the experiments carried on on one acre of land at the Research Farm suffer thru the limitations of ground area for each unit of the experiment.

3. Cellar facilities.

In carrying out of life history and insecticidal tests a cellar with cool temperatures and humidity would provide conditions that would greatly accelerate the handling of large numbers of insects as well as greatly add to the accuracy of life history data.

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Hudson Valley Horticultural Investigations

E. V. Shear, Jr.

F. G. Munding

L. C. Anderson

R E P O R T O N T H E W O R K O F E . V . S H E A R

HUDSON VALLEY FRUIT INVESTIGATIONS

POUGHKEEPSIE, N. Y.

MAY, 1928

Project No. 12
Sub-project 1

DIVISION: Botany

NAME OF PROJECT: Raspberry Diseases: Mosaic of Red and
Purple Raspberries.

PROGRESS OF THE WORK:

The work on this project during the past five years has definitely eliminated a number of raspberry varieties from consideration as possible commercial sorts because of the severity with which virus disease attacks them. The work has further suggested the desirability of other varieties for commercial production. Numerous tests in small experimental plantings and in commercial production plantations have been and are now being conducted.

Five and six years ago the red raspberry industry in the Hudson Valley was completely disorganized. The industry is still far from having resumed its one-time importance but a definite new start toward commercial production has been made with clean stock grown under methods calculated to curb loss from virus disease. The stock has been furnished partly by the New York State Experiment Station and partly by other Experiment Stations. The methods are those developed in entirety by the New York Station, other Experiment Stations and the United States Department of Agriculture.

The fundamental studies on the ~~XXXXXX~~ cause and transmission of virus disease of red raspberry in the Hudson Valley has yielded no results that have been interpreted to add to the knowledge of this type of disease. At present, May 7, 1928, there are 610 inoculated red raspberry plants growing in the experimental plots in the Hudson Valley. 200 additional plants are available for new work.

May 7, 1928

DIVISION: Botany

Project 2

NAME OF PROJECT: Apple Fruit Spot Diseases in the Hudson Valley.

PROGRESS OF THE WORK:

This project has developed chiefly along the lines of studying apple scab and the use of fungicidal sprays against this disease. Efforts have been made to combine insecticidal materials with scab sprays.. Much attention has been given to the study of spray injury. A minor division of this spray work has been the study of removal of spray residue from fruit.

No fundamental work on any phase of this project has been done.

Work was begun in 1924 on new sprays containing oils, coppers and sulfurs designed to serve as efficacious treatments against both diseases and insects in early spraying treatments for apple trees. Most of the ideas for these sprays were borrowed from the published work of the U.S. Department of Agriculture and Experiment Stations on the Pacific Coast, in the Middle West and in Florida. The adaptation of these materials to apple spraying and the choice of the time for using them were largely original with this Station. cursory reports of the work have been published in the Proceedings of the New York State Horticultural Society for 1925 to 1928 inclusive.

Also this work is far from finished and great need for additional research has proved desirable in this field. *However* the materials and methods developed at this laboratory have shown sufficient promise so that they have been adopted by commercial fruit growers. In 1927 and 1928 half or more of the commercial spraying in the Hudson Valley was modeled on the experimental work of this laboratory. In 1927 more than half a million barrels of apples were produced in the orchards where spray practices corresponding to the experimental work prevailed.

The matter of injury to trees by spray materials deserves most serious study. This work has not progressed far enuf for this laboratory to make a report. It is that that much careless speculation in this field by investigators has so confused the issues involved that any statements should be supported by better evidence than has so far been obtained.

The arsenic scare of 1926 forced the search for a method of cleaning fruit from an experimental plot. Hydrochloric acid was used and proved desirable in commercial trials during the fall of 1926. since this work a great deal of careful experimental work has appeared in the Western boxed apple states. wide commercial adoption of this method has followed with very encouraging results. Acid washing experimenting with eastern type fruits has continued at this laboratory. The work has been widened to investigate the possibility of removing superficial fungous fruit spotting following infestation of sucking insects. No success has followed this latter phase of the work. This laboratory initiated what

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Project 22

has proved a successful method for cleansing fruit from some types of dirt. This work was done at a time when many other investigators were reporting satisfaction with other methods that have since been shown to be inferior to the hydrochloric acid method. Preliminary results of fruit washing experiments were published in the proceedings of the N.Y. State Horticultural Society 1927:149-151.

Normally the apple is the fifth or sixth most valuable agricultural product of the United States and the group of fungous diseases causing fruit spots include the worst pests of this fruit. It is that this justifies continued study of this problem. It is also planned to continue work on the related problems involving the fungicidal value of sprays, combined insecticidal and fungicidal materials, spray injury and cleansing fruit.

May 7, 1928
Project No. 24

DIVISION: Botany

NAME OF PROJECT: Root diseases of Fruit Trees in the Hudson Valley.

PROGRESS OF THE WORK:

During the early part of the work on this project a great deal of time was spent reconnoitering areas with sick orchards. Over 200 blocks of trees are listed in this project file as containing trees with root, crown or trunk disorders. This part of the work was pursued to find whether there were valuable correlations between varieties, sites, soils, water relations or areas of fungous parasitism and the occurrence of sick trees. Efforts are now made to keep these known plots under observation and future work is intended to take this course.

Different types of cover crops and cultural and manurial treatments are being used on adjacent plots. Numerous inoculation experiments with suspected organisms have been made. Work has started on determinations of soil quality, soil temperature and soil moisture. Considerable work has been done in bridge grafting across injured spots at the bases of trees and more extensive experimenting has been done in grafting into the bases of sick trees the tops of small trees previously transplanted about the bases of diseased trees. Crab stock, stock of unknown parentage and stock of named varieties on their own roots have been transplanted in supposedly severe sites.

There have been no practical results under this project. It is expected that, in time, some of this work may yield something of practical value to fruit growers. Some of the work is not expected to furnish any conclusions for some years in the future.

It requires long years and large money outlays to grow orchard trees and the death of such trees wipes out the fruit growers' investment and hope. The problem is of great importance to the fruit industry and it is intended that the present program as given in the first two paragraphs above shall continue, at least during the immediate future.

Perhaps it is best to describe the year's program in the plant disease laboratory by beginning with the spring season. In spring time is divided between apple scab, raspberry, and sick tree projects. The last named work continuing from winter and ending with grafting work during late April and May. The scab and raspberry work begins about April first and the scab work is about over by June first. The raspberry work continues thru the growing season.

During midsummer considerable time is consumed by the care of the sick tree blocks and the raspberry inoculation plots. The Station produces most of the stock used in planting and this nursery stock requires considerable time in summer.

Autumn calls for least work as the work is now arranged. Early September and late November are especially light. Mid-autumn is taken up by checking up spray plot experiments and putting all plots in shape for winter and work in cleaning fruit begins and continues thru the winter.

Most of the winter time is spent on ~~misc~~ literature. Spray materials and fungous collections receive most of the attention given them during the year.

Attendance at Farm Bureau meetings and similar sessions during 1927 totalled 23 days. I think these covered 33 meetings. This is considerable reduction from previous years as it has been decided this may not be the most profitable research work.

Probably fifty letter inquiries reach this laboratory yearly from fruit growers. A larger number of ~~these~~ *letter* inquiries come from manufacturers of spray materials and other institutions concerned with horticulture. Most inquiries come by phone during the scab period in spring when such calls run up to a dozen a day. As this laboratory is located in a section where gardening and greenhouse interests and truck farming are extensive and where there are hundreds of large estates, many calls pertain to troubles on flowers, truck crops, ornamentals, shade trees and exotics. A large percentage of these inquiries are not satisfactorily answered because of lack of knowledge. Such questions are referred elsewhere.

From a plant pathologist's viewpoint this laboratory needs better facilities for hiring semi-skilled labor for experimental plots and laboratory work. The equipment needs are: a typewriter, soil temperature apparatus, camera, apparatus for securing constant temperatures and humidities. Authorization to purchase pleasure type automobiles instead of commercial cars is desirable. It costs thirty cents ~~more~~ to cross the ferry with a car bearing a commercial license and there is no compensation to offset this.

REPORT ON ENTOMOLOGICAL INVESTIGATIONS IN THE HUDSON VALLEY
1924-1928

F. G. Munding

1. Important results accomplished:

- A. Determined the value of calcium cyanide as an insecticide against the pear psylla and the safeness of this method of treatment in the hands of average growers.
- B. After three years of work, have devised a dust mixture for use in the control of the pear psylla which is effective against the insects, noninjurious to trees, cheap and easily applied. This is the hydrated lime-plaster of paris-nicotine dust. This season's experiments should determine definitely the merits of the dust for treatment of pear orchards.
- C. Have conducted experiments to determine the value of oil sprays for the control of pear psylla, red mite and aphid.
- D. Secured data on the habits of the apple maggot fly. The data has made possible better control since we have a definite basis for the timing of the spray applications. The new method for spraying against the insect has made it possible to reduce the number of treatments formerly employed and thus has reduced the danger from excessive amounts of spray deposits on apples.
- E. Secured data on the habits of the pear midge in the Hudson valley which doubtless will make it possible to devise control measures.

Publications:

Experiments with calcium cyanide as an insecticide, pp. 134-135
N. Y. State Hort. Soc. Proceedings 69th Annual Meeting 1924.

Susceptibility of the pear psylla to calcium cyanide dust, pp.
182-186 N. Y. State Hort. Soc. Proceedings 70th Annual Meeting 1925.

Investigations on the control of pear psylla, New York State Agr.
Exp. Sta. Bul. 529. 1925.

Some Insect Pests of the Hudson Valley, pp. 142-144. N. Y. State
Hort. Soc. Proceedings 71st Annual Meeting 1926.

Some experiments relative to insect control, pp. 138-144.
N. Y. State Hort. Soc. Proceedings 72nd Annual Meeting 1927.

Results of some investigations on insect control in the Hudson Valley,
pp. 189-195. N. Y. State Hort. Soc. Proceedings 73rd Annual Meeting
1928.

2. Present program of work:

- A Continue with pear psylla investigations. The results obtained with oils against the flies and the data secured from treatments with the new dust mixture on both psylla nymphs and flies indicate that we are not far from solving the problem of finding an economical and efficient method of combating this pest. Since the pear psylla is the worst enemy of pear growers in the Hudson valley and since practically all known control measures are costly and none fool-proof, it seems advisable that a little more time be spent on this problem in order that we may be sure of our position. The most diligent fruitgrowers find it difficult and nearly impossible to attain the protection they desire with present control measures in seasons of heavy infestation.
- B Continue with apple maggot investigations: Two seasons of experimental work have been done on this pest and some helpful data found relative to its control. Several effective sprays have been used. The timing of applications appears to be of paramount importance. With the proper timing of applications, which can only be determined by emergence records, the grower will be able to secure the maximum amount of protection with the minimum amount of lead arsenate residue on his fruit. In 1925 the apple maggot fly took a large portion of the apple crop in the Hudson valley and is a serious pest in many apple-growing regions.
- C Continue with pear midge investigations: A study of this pest was begun in 1926 but more attention has been given to it during the last two years. Some important facts regarding its life history have been found and a step toward control has been made. However, it is felt that further investigation is needed to solve the problem. There are many locations about Hudson, Germantown, and Marlboro, N. Y., where the pear midge has caused serious damage. Where investigations are now being carried on at Hudson the midge has taken practically every crop of pears since the orchard has been in bearing.
- D Activities during year: General observations on pear psylla and pear midge begin in March and early April. The first control measures are tried against pear psylla in late March or early April and continued thru the summer and into the fall. Control practices begin early in April for midge and continue thru May, and possibly June. At this time preparation is begun for apple maggot study which runs thru summer and into the fall when fruit counts and final observations are made. During the winter months there is often material to be worked over from cage collections and seeded boxes. Inquiries from farmers are answered and talks given at meetings. Usually there are from three to five such meetings. Some time is given to the reading and examination of literature bearing on my problems. When data is thought valuable enough manuscript is prepared for publication.

3. My work could be facilitated by the aid of an assistant during the busy summer months. A good typewriter would be of value to this Laboratory.

HUDSON VALLEY FRUIT INVESTIGATIONS OF THE
NEW YORK STATE EXPERIMENT STATION.

The present program of work of the Hudson Valley Fruit Investigations consists largely of fertilizer experiments on different varieties of apples, on grapes and on cherries. The fertilizer reaction on the different soil types is also considered.

The pruning and fertilizer experiment on sour cherries is in its fifth year. Nitrogen has proven to be advantageous in the production of cherries and the growth of the tree, and has given a more luxuriant foliage. The combination of pruning heavily, chiefly by cutting the tops of the trees back, and an application of nitrogen has proven to be the most beneficial to good growth. While production is decreased for two or three years, yet, it soon catches up. This method of treatment also has a desired effect in keeping the bearing surface of the tree nearer the ground. It will probably be unnecessary to continue this experiment after this year.

The cooperative fertilizer experiment at Red Hook consists of the application of acid phosphate, potash, and nitrogen alone and in combinations on young bearing McIntosh. The soil is a Dutchess Stony Loam. Nitrogen is the only fertilizer giving direct results. These results are seen in the production, the growth of the tree, and the better color ^{of} foliage. This experiment is in its fifth year. It will probably be desirable to run this experiment longer to see how the trees react to the fertilizers as they bear heavier loads.

The cooperative fertilizer experiment at Germantown on Newtown Pippin trees consists of the application of the acid phosphate, nitrogen, and potash alone and in combinations. This experiment had as one of its objects, the possibility of changing the bearing habits

of the trees, and asking them annual bearers. This experiment is in it's fifth year and has shown no such tendency. Nitrogen has shown to be advantageous in growth of tree and production. It seems advisable to continue this experiment and do some pruning and thinning in the next bearing year.

The cooperative fertilizer experiment at Germantown on grapes consists of the application of nitrogen, acid phosphate, and potash alone and in combinations. Nitrogen shows some increase in production and better color of foliage. It is questionable as to the advisability of continuing this experiment after this year.

The rented ground at Kinderhook is divided into fertilizer experiments a varietal planting. The larger fertilizer test consists of the application of nitrogen, phosphate, and potash alone and in combinations on young trees. This experiment has been running since the trees were planted and is now in the fifth year. The soil at Kinderhook is practically a virgin soil, of a coarse sand. This experiment should run indefinitely.

The varietal plantings consist of the more promising fruits originated mostly at Geneva to find their adaptability to Hudson Valley conditions.

This spring three new experiments have been started. Two on McIntosh using six different nitrogenous fertilizers, one at Kinderhook and the other at Saugerties. These are both cooperative. The question of the best form of nitrogen to apply is one which is giving a great deal of concern among the fruit growers. The third experiment is with cover crops, on McIntosh, Wealthy, Baldwin and Ben Davis all in one orchard. This experiment will be carried on with golden millet and sweet clover as cover crops and to the soil will

be added lime and acid phosphate in plots.

The nitrogen fertilizers are first spread in the spring and soon after the phosphate and potash. Later a check on the bloom is made. The set of fruit is watched as well as it's development during the season, and data taken as developments prove worthy. During the summer, cover crops are sown on the experiments, growth of the trees watched, and records taken on cherry production. In the fall records are taken on the production of the McIntosh, Grapes, and Newtown Pippin experiments, and the plot at Kinderhook looked after. There were seven groups of people last summer who visited the experiments; one group was from the Massachusetts Station and one from the N. J. State college. There were also several smaller groups who visited the experiments. During the winter, the data taken on the various experiments is worked up and put into shape. Details are worked out for the work of the coming season.

Among other duties performed have been talks to twelve meetings of fruit growers and one each at Rotary and Kiwanis Club meetings. At least 250 inquiries from fruit growers concerning horticultural problems have been answered. The problems have been chiefly that of pruning fruits, fertilizers to apply, root stocks for new plantings, and varieties for cross-pollination. At present I am giving some assistance in making arrangements for the eastern meeting of the Horticultural Society this summer.

April 20, 1928.

L. C. Anderson.

