New York Agricultural Experiment Station.

GENEVA, N. Y.

DIRECTOR'S REPORT FOR 1919.

W. H. JORDAN.

PUBLISHED BY THE DEPARTMENT OF AGRICULTURE.
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MILLARD B. MOORE, B.S.,
Assistant Chemists.

Address all correspondence, not to individual members of the staff, but to the
NEW YORK AGRICULTURAL EXPERIMENT STATION, GENEVA, N. Y.
The Bulletins published by the Station will be sent free to any farmer applying
for them.

*Connected with Grape Culture Investigations.
BULLETIN No. 470.

DIRECTOR’S REPORT FOR 1919.

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

Gentlemen.—It is my duty and privilege to again report to you a year’s operations of the institution under your charge, together with a statement of its financial relations and responsibilities and the needs of the institution if it is to efficiently maintain its work.

The Station, like all institutions of an educational character was seriously affected by the war. It can be said, however, that it has now become readjusted to a pre-war basis, and is in a position to go on with its work as efficiently as in the past.

ADMINISTRATION.

STATION STAFF.

An unusual number of changes have occurred during the year in the personnel of the Station Staff. It does not appear that these changes have been due to dissatisfaction on the part of the members of the Staff who have gone to commercial houses or other institutions, but because, owing to the very peculiar and embarrassing policy enforced upon the institution through the present budget system, it is not possible to make such moderate changes in salaries as would retain their services.

As noted in my last report, John C. Baker, Ph.D., accepted a position in New York City, at a salary two and one-half times that he was receiving at this institution. He closed his connection with the Station on Jan. 31, 1919. Dr. Baker exhibited qualities peculiarly fitting him for research work, and the inability of the Station to hold him at the small advance of salary which he was willing to accept is an evidence of the unfortunate effect of our existing budget system.

On April 30, 1919, two members of the Staff accepted positions with the Pennsylvania State College: Roy D. Anthony, M.S., as Experimental Pomologist in the Department of Horticulture; Harold E. Hodgkiss, B.S., as Professor of Extension Entomology.
Bentley B. Fulton, M.S., resigned his position on April 30, 1919, to accept the position of Assistant in the Department of Entomology of the Oregon Experiment Station.

Joseph W. Wellington, B.S., on June 30, 1919, accepted a position in the Bureau of Plant Industry of the U.S. Department of Agriculture.

The reasons given in all cases for leaving the institution was the necessity for larger compensation. These four resignations have occurred after long periods of service, and it is to be regretted that the institution was not in position to retain experienced men.

It is with great regret that I record the resignation, because of illness, of Frank H. Hall, who for twenty-two years had served the institution as Station Editor and Librarian. Mr. Hall was a pioneer in editorial work performed for an institution of this character. It was his duty not only to edit the publications of the institution but to give a popular expression to the scientific results having a practical bearing that were reached by the Scientific Staff. It is generally conceded that this work was performed with admirable judgment, and the success of the institution and its influence in the agriculture of the State is due in no small part to the services that Mr. Hall rendered. As advisor to the members of the Staff in the preparation of their publications, Mr. Hall proved himself invaluable, and his absence from our number, enforced by physical disability, is a matter for profound regret.

F. A. Sirrine, B.S., who became connected with the institution on July 1, 1902, as Assistant Entomologist, and who later occupied the position of Special Agent of the Station on Long Island, closed his connection with the institution on July 1, 1919. It should be recorded that Mr. Sirrine rendered valuable service to the agricultural people of Long Island, especially in matters pertaining to the control of plant and insect pests. The amount of work which it was possible to do at long distance in that section of the State did not seem to justify the continuance of the office of Special Agent, especially as his time was largely occupied with extension service rather than investigation.

Rossiter D. Olmstead, B.S., was appointed on May first to the position of Assistant Entomologist. Mr. Olmstead is a graduate of Wesleyan University, Middletown, Conn. He served for one year as instructor in Biology in the St. Lawrence University, Canton, N.Y.,
and resigned to enter the aviation service of the U. S. Army, where he served for two years, and received a commission as second lieutenant.

George J. Hucker, M.A., was appointed to the position of Assistant Bacteriologist on August 12, 1919. Mr. Hucker is a graduate of Lenox College, Iowa. He reinforced his under-graduate work with a year's study in Columbia University. He has served as Special Field Agent in the Federal Department of Agriculture, later entering war service where he was appointed to be lieutenant in the Sanitary Corps.

Harold S. Winston, B.S., was appointed to the position of Assistant Chemist on April 1, 1919. Mr. Winston is a graduate of the New York State College of Agriculture. He rendered war service as a member of the Coast Artillery Corps.

Clarence R. Phipps, B.S., a graduate of the Massachusetts Agricultural College spent a year in the aviation service of the U. S. Army. He was appointed to the position of Assistant Entomologist on July 1, 1919.

Theodore E. Gaty, Jr., B.S., is a graduate of the New York State College of Agriculture, and rendered war service for nearly two years as ensign in naval aviation. He was appointed to the position of Assistant Horticulturist on July 1, 1919.

Millard B. Moore, B.S., was appointed to the position of Assistant Chemist on November 16. Mr. Moore is a graduate of the University of Maine, in the Chemical Engineering Course.

George H. Howe, B.S., who entered the institution in 1910, as Assistant Horticulturist, was promoted on April 30, 1919, to the position of Associate Horticulturist.

Miss Laura G. Collison, on September 1, 1919, was appointed to the position of Station Editor and Librarian to fill the position vacated by Frank H. Hall.

**MAINTENANCE FUND.**

The expenditures of the Station during the fiscal year ending June 30, 1919, were as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal service</td>
<td>$107,072 72</td>
</tr>
<tr>
<td>Maintenance and operation (including repairs)</td>
<td>60,860 81</td>
</tr>
<tr>
<td>Construction or permanent betterments</td>
<td>65,803 99</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$233,737 52</strong></td>
</tr>
</tbody>
</table>
The Legislature of 1919 made the following appropriations for the use of the Station during the fiscal year beginning July 1, 1919:

<table>
<thead>
<tr>
<th>Personal service</th>
<th>$116,650 00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries and wages</td>
<td></td>
</tr>
<tr>
<td>Maintenance and operation</td>
<td></td>
</tr>
<tr>
<td>Fuel, light, power and water</td>
<td>5,000 00</td>
</tr>
<tr>
<td>Printing</td>
<td>15,400 00</td>
</tr>
<tr>
<td>Equipment and supplies</td>
<td>13,000 00</td>
</tr>
<tr>
<td>Hired horses and vehicles</td>
<td>2,500 00</td>
</tr>
<tr>
<td>Traveling expenses</td>
<td>3,000 00</td>
</tr>
<tr>
<td>Communication</td>
<td>2,200 00</td>
</tr>
<tr>
<td>General plant service</td>
<td>750 00</td>
</tr>
<tr>
<td>Repairs</td>
<td>2,250 00</td>
</tr>
<tr>
<td>Rent</td>
<td>1,000 00</td>
</tr>
<tr>
<td>Total</td>
<td>$161,750 00</td>
</tr>
</tbody>
</table>

At a meeting of your Board on September 20, 1919, you adopted a budget for presentation to the Legislature of the present year to cover the expenditures of the institution for the fiscal year beginning July 1, 1920. Subsequent events have led to the recommendation, after mature deliberation, that certain salary items in that budget should be increased above the amounts first recommended. The budget as amended carries the following sums for the various needs of the institution:

<table>
<thead>
<tr>
<th>Personal service</th>
<th>$148,050 00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance and operation</td>
<td></td>
</tr>
<tr>
<td>New construction and permanent betterments</td>
<td>51,000 00</td>
</tr>
<tr>
<td>Total</td>
<td>$251,450 00</td>
</tr>
</tbody>
</table>

Unless the Legislature of the State gives favorable recognition to the requested increases for salaries of the members of the Station Staff, serious results are likely to follow. There appears to be on the part of our national and state legislatures a disposition to give somewhat adequate recognition to the increased cost of living as related to the wages of the industrial class. This increased cost of living affects other classes just as fully, and there is no logic in larger wages for industrial workers, even wages that are above the salaries of teachers or professional workers, without applying the same policy to the employees of the State or Nation.

Certain leading members of the Station Staff have had no increase in salary for nine and a half years, and the argument that they
were either greatly overpaid nine years ago or are greatly underpaid now is unanswerable. It is encouraging that the agricultural people of the State have become aroused to the danger that is threatening their College of Agriculture and Experiment Station through the insufficient payment of the members of the Staffs of these institutions. They have come to recognize that these teachers and investigators will inevitably accept positions at higher salaries, either with similar institutions or in many cases with commercial houses, unless relief is afforded. It appears that committees representing the agricultural people have been formed, the duty of which is vigorously to advocate to the Budget Committee of the State Legislature a liberal increase in the salaries of the members of the faculty of the New York State College of Agriculture and the Staff of the New York Agricultural Experiment Station.

NEW POSITIONS.

Three new positions should be established in the Station Staff, namely, Associate Botanist, Assistant Librarian and Museum Preparator.

The inspection of agricultural seeds is assuming great importance because of adulteration of these seeds and, in many instances, their poor quality.

The Experiment Station has been carrying on seed inspection under an inefficient law, and has also examined hundreds of samples of seeds sent in by farmers. A new law, practically the Uniform Seed Law, which is in force in between twenty and thirty states, was passed last winter, but, because of an error, the Governor deemed it wise to veto it in order that it might be passed in satisfactory form by the coming Legislature. Undoubtedly, a new law involving new responsibilities and a larger amount of work will be passed by the Legislature of 1920. It will not be possible to administer this law with the present number in the Botanical Staff, namely, the Chief, his Assistant and a helper, and carry the other work of the Department. The work of an ordinary helper has not been found to be satisfactory as it has needed constant supervision. It is, therefore, believed to be wise to promote the present Assistant Botanist to Associate Botanist and appoint an Assistant Botanist at a salary sufficient to secure reliable service.
The existence of an adequate scientific library properly classified is a primary asset in the equipment of an agricultural experiment station. Moreover, current scientific literature, so far as it relates to the immediate work of the members of the Station Staff, should be properly classified and more or less of it abstracted. Heretofore, the entire care of the library has been placed upon the Station Editor, but the proper editing of the station publications and the writing of the popular bulletins do not leave sufficient time for giving the library the needed attention. It is, therefore, highly desirable that an Assistant Librarian should be appointed, competent to take chief charge of the library under the direction of the Librarian.

In the construction of the new administration building at the Experiment Station generous space has been assigned to the placing of a museum, the purpose of which is to visualize the important results which the Station has reached in its investigations. It is greatly desirable that this be accomplished, because many visit the Station for the purpose of gaining some comprehension of what is being done, sometimes along very special lines. The only way in which this knowledge can be imparted in a brief time is by visualizing the results of past investigations. Museum cases are now being constructed, and there should be located at the Station a competent expert who can prepare the exhibits under the eye of the men that are familiar with the results accomplished.

The work in Horticulture and in the control of various pests offers a fine opportunity for a museum of the character indicated. It is not possible for the members of the Station Staff to prepare these museum materials, which is a time-consuming piece of work, and at the same time carry on the work under their charge.

THE BUDGET SYSTEM AS RELATED TO EDUCATION AND RESEARCH.

Some time since, your Director assumed the responsibility of issuing a pamphlet discussing the relation of the budget system to public welfare, especially to education and research in this State. While much has been said and written on this topic, its importance is such as to justify a continued appeal for changes that are essential to the welfare of at least some of the State institutions. The following is a quotation from the pamphlet mentioned:
"A budget, whether national or state, should reflect public needs, and only public needs. This requires that the information upon which departmental and institutional appropriations are based should be obtained from administrative officials who understand in detail what is demanded and upon whom will rest the responsibility of handling the funds. The formulation of a budget from the point of view of decreasing or increasing former appropriations may be utterly irrational. The advice of the accountant may often wisely be disregarded.

"The budget should be sufficiently flexible in its provisions to meet the demands of the various state departments and institutions, or else be differentiated to meet the requirements of dissimilar state agencies having an utterly unlike function. To apply the same fiscal system in all its details to a prison and to a university or college may be absurd, in fact, as would be the practice of prescribing the same medical treatment for typhoid fever and pneumonia.

"A budget should be sufficiently flexible to meet unforeseen demands without undue embarrassment. In view of the frequent changes in the requirements for personal service and in the cost of supplies and other maintenance items, an inflexible budget, closely segregated for specific purposes, may become a serious administrative handicap. This is fully realized by officials who have had to deal with such a situation.

"The fiscal system should give full play to the judgment of administrative officials. To seriously limit administrative autonomy is to render officials irresponsible. More than this, such limitation suppresses rather than encourages the initiative, only through the exercise of which public service may be improved.

"A close analysis of the provisions and limitations of the budgetary system now in force in the State of New York shows that, with a single exception, it lamentably fails to meet these specifications. The method by which the financial committees of our legislature secure the information upon which to base their budgetary recommendations is the one feature that is above serious criticism. The officials responsible for the management of state departments and institutions are given full and extended hearings on the recommendations which they have previously presented at the request of these committees, at which times the items of the budget proposals are discussed in great detail. The administrative point of view is
given the most courteous and careful consideration, but it remains true, nevertheless, that the final determination of salaries and the segregation of the total amount of money appropriated into items for specific purposes rests with the legislative committees. Heads of state departments and institutions realize that these committees do not always adequately recognize in their conclusions special conditions and needs which can only be understood through intimate experience.

"The budget of the State of New York, so far as it applies to departmental and institutional activities, is formulated in flexible terms. The salary for appointive positions, with the exception of the wages paid common laborers, is fixed, and may not be exceeded. No salary contingent fund is provided, and a transfer may not be made from one salary item to another. This proves to be a most serious handicap, especially in the management of research and educational institutions. These institutions must meet competition from other states in the appointment and retention of members of their staffs. It is peculiarly true of the State College of Agriculture and the Experiment Stations that this competition is keen. With fixed salaries, administrative heads are helpless to defend their institutions against the inroads of similar institutions and the inducements offered by commercial interests, and they are at the present time losing men who sometimes could be profitably retained by a readjustment of salary expenditures without increasing the total salary appropriation. The chief function of a Dean of a College of Agriculture or the Director of an Experiment Station is the selection and retention of his associates, and, under the conditions prevailing in the State of New York, his autonomy in the exercise of this function is often disastrously limited. The result of this is already seen in a lowering of the standard of service in agricultural education and research in New York. If the present budgetary policy as applied to personal service is allowed to continue, efficiency in scientific investigation and in education, so far as these efforts are supported by public funds, will almost certainly fall below the standards maintained by privately endowed institutions.

"This inflexible budget is applied to all state agencies alike, ignoring their greatly varying functions and the great differences in the extent to which their operations may be standardized. Institutions whose problems and expenditures may not be intelligently
scheduled months in advance are hedged about by the same fiscal
regulations as departments whose work is clearly clerical and the
activities of which may be quite definitely stabilized.

"The funds provided for the maintenance and operation of our
State departments and institutions is segregated in inflexible terms
under something like sixteen heads. These divisions include "Fuel,
"Traveling Expenses," "Communication," "General Plant Service,"
"Repairs" and so on. The price of coal may materially change;
railroad fares and hotel expenses may be greatly increased; higher
freight and express rates may be established; postage may be
changed from two cents to three cents; the wages of industrial
labor involved in making certain repairs may be materially raised,
and yet upon administrative officials is placed the perplexing and
often exasperating burden of carrying on the activities under their
charge with a fixed, highly segregated budget, adopted months in
advance of the current fiscal year, which takes no account of all
these variations in expense.

"The question may be asked,— Do not these officials recommend
the items of the budget? They certainly do, but their recommenda-
tions, based upon past experience, which is a treacherous guide, are
called for on the first of October for a fiscal year beginning on the
first of next July, and no man has the prophetic vision which enables
him to foresee the maintenance expenses which may be necessary
in the way of repairs, some of which are accidental in their origin,
or the industrial changes which greatly increase the cost of operating
institutions of all kinds. It is rational to ask for these detailed
recommendations, but it is irrational to adopt them in an inflexible
form. It is a serious question whether a careful analysis of past and
present expenditures would not show the present fiscal plan to be
wasteful rather than economical.

"If, then, the budgetary system now in force in New York is
unsatisfactory, what method of financing the State can be adopted
that will accomplish the desired control of public funds? Without
question, the people have a right to detailed information as to how
their contributions to the State Treasury are expended. It cannot
reasonably be denied that the budgetary policy now in operation
has some commendable features. The present method of obtaining
information about needed appropriations and the submission of
budget proposals in detail are essential features of an efficient fiscal system. The figures so obtained should be co-ordinated and adjusted to the financial resources of the State and then published in available form for legislative use and public enlightenment.

"But if a reasonable autonomy of administrative officials is to be maintained, if the boards and other officials of the State are to be in certain particulars something more than rubber stamps, if a flexibility is to be given to the use of funds that will permit responsible officials to exercise their judgment under unforeseen and varying conditions, if real needs rather than the confines of a rigid fiscal structure are to determine expenditures — then legislative appropriations should be made in lump sums or in broadly segregated items. Judgment as to the proper and legitimate use of funds should then be based upon a comparison of the detailed budget proposals with the actual expenditures. An explanation might well be demanded concerning a wide departure from the departmental and institutional requests. Probably the addition of a liberal contingent fund provision or the permission after adequate explanation to transfer from one budget item to another would render the present plan much more workable. Under either method, with proper accounting and severe auditing, the people of the State might feel assurance that the expenditure of their money is sufficiently safeguarded."

MAINTENANCE OF RESEARCH.

It is very evident that agricultural research should have every possible encouragement at the present time. For two reasons, at least, there is real occasion for solicitude concerning the future maintenance of Experiment Station activities. In the first place, the Stations staffs are being depleted of some of their most useful members by the very attractive salaries offered by commercial enterprises. In the second place, Station activities are more or less submerged by the rapid development of the extension service. In 1917–18, the funds available for extension work from federal and state appropriations was almost twelve millions of dollars; in 1918–19 over sixteen millions of dollars. In 1917, the federal and state funds available for the Stations amounted approximately to three million, nine hundred thousand dollars. It appears that the financial support given to the popular extension of knowledge is at least three times larger than that given to its production.
Because of this generous support, the extension movement has made very rapid growth, and, as a consequence, has successfully invaded Experiment Station staffs in order to secure the necessary service. More important than this is the fact that young men, with little post graduate experience or training, desirous of entering the agricultural field, have found it possible to secure at once in extension work salaries equal to those paid for the higher grade of scholarship and experience necessary to successful research, thus avoiding the use of time and the expense involved in more extensive preparation for the service in Experiment Stations which they otherwise might have entered.

It is obvious that research supplies the subject matter used for teaching in the class room and in the field, and there are many unsolved problems yet untouched, and others that have not been invaded beyond the outskirts, concerning which the teacher must as yet be silent. It surely is irrational to spend millions in agricultural extension, and reduce to a mere pittance the sum applied to the acquisition of the fundamental knowledge.

PUBLICATIONS.

It is gratifying to know that the Legislature of 1919 made appropriation for the publication of "The Pears of New York" and "Sturtevant's Edible Plants." The latter is now passing through the press. It is the work of a distinguished botanist, the first Director of this Station. It is unique in character, and probably contains the most comprehensive information available concerning plants which may be used as food for the human family of any work issued in this country or elsewhere. "The Pears of New York" is nearing completion, and the manuscript will probably be submitted to the State Printer within the present calendar year.

The number of names to which the Station publications are now issued in this State and others is as follows:

**Popular Bulletins.**

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residents of New York</td>
<td>37,500</td>
</tr>
<tr>
<td>Residents of other States</td>
<td>2,497</td>
</tr>
<tr>
<td>Newspapers</td>
<td>744</td>
</tr>
<tr>
<td>Experiment Stations and their staffs</td>
<td>2,400</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>350</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>43,491</strong></td>
</tr>
</tbody>
</table>
Complete Bulletins.

Experiment Stations and their staffs ........................................... 2,400
Libraries, scientists, etc .......................................................... 400
Foreign list ................................................................................. 432
Individuals ................................................................................. 4,154
Miscellaneous ............................................................................ 350

Total ......................................................................................... 7,736

Building Needs.

Buildings erected at State institutions are not immune to decay. It seems almost futile to call attention to the fact that the forcing houses of this institution were erected somewhere about thirty years ago, and are now in such condition that a disaster resulting in the loss of the contents of the houses may occur at any time. It is difficult to understand why there is any reluctance in replacing buildings of this character when they are needed for important work. If the State is to continue in its efforts to improve the fruits of the State, and exhibit the results of its work at the State Fair and at the meetings of the Horticultural Societies, the cold storage plant which is small and now considerably decayed must be replaced by a more efficient structure. The budget for this year includes an item covering the probable cost of these two buildings.

Results of Station Work in 1919.

There is presented here only a brief summary of the results accomplished. These are conveyed to the constituency of the State through the use of bulletins, any of which may be obtained on application by residents of the State. It is proposed to issue, some time during the year 1920, a comprehensive summary written in a more or less popular form of the important results which the Experiment Station has reached that have a direct bearing on agricultural practice and conditions.

Bacteriological and Dairy Divisions.

Ammonification of manure in soil.—The results of this work have been published as Technical Bulletin No. 67. This report primarily discusses the part that two common soil organisms (Pseudomonas fluorescens (Flügge) Migula and Ps. caudatus (Wright) Conn play in the ammonification of manure after this is added to soil. The proof seems to be complete that these bacteria are active ammonifiers
under the conditions specified. Yet it seems probable that other organisms may take equally as active a part in the process, and that other bacteria take the lead in the process when it takes place in the manure pile before addition to soil. *Bacillus cereus* Frankland, an organism commonly believed to be active in ammonification processes, was not found to be active under the conditions tested.

Further studies of the organisms concerned in the ammonification of manure, and of the effect on the flora of adding phosphates, peat, straw, and like materials to manure have been made during the year, but no report on the results has been prepared as yet. A part of this work has been done in coöperation with the Division of Agronomy.

*Taxonomic work.*—As bacteriologists find great difficulty in distinguishing between the types or species of bacteria concerned in specific agricultural processes, some time has been given during the year to a study of methods useful for this purpose. In fact, more attention has been given to this subject than usual in order to aid in the preparation of a general committee report on "Methods of pure culture study" drawn up for the Society of American Bacteriologists under the chairmanship of a member of the department. Some of these studies have been discussed in Technical Bulletin No. 73 under the title "The use of the nitrate-reduction test in characterizing bacteria."

Two papers entitled "Comments on the classification and evolution of bacteria" and "The nomenclature of the Actinomycetaceae" have been published from the department in the Journal of Bacteriology. These were written as the results of discussions started thru the formulation of a general classification of bacteria by a committee of bacteriologists. As all research in agricultural bacteriology is being badly retarded by the lack of a generally approved classification of bacterial species, the committee report promises to be generally useful in our work.

*Physiological and fermentation studies of milk.*—Two pieces of investigation have been completed during the year in coöperation with the Division of Chemistry. The first of these is a physiological study, and deals with the reaction of fresh milk as influenced by the entrance of blood serum during secretion. A report of the work is in process of preparation. The report of the second investigation has been completed, and is being published as Technical Bulletin
No. 74 under the title "Relation between lactic acid production and bacterial growth in the souring of milk."

**Methods of counting bacteria in milk.**—A report on the series of milk analyses carried out in cooperation with the Department of Dairy Industry of the College of Agriculture at Ithaca has been completed, and is to be published as Technical Bulletin No. 75. The results secured, together with those previously presented (Bulletins Nos. 439 and 443), show without question that current conceptions regarding the number of bacteria in milk must undergo radical modification. The numbers of bacteria present are greatly in excess of the numbers usually given as the result of analyses made by the agar plate method. The latter figures really show the number of groups of bacteria capable of developing on agar under the conditions maintained. As the groups of bacteria in fresh milk commonly contain an average of from two to six or eight bacteria, and frequently contain more than these numbers, the figures ordinarily given should be corrected by multiplying by the number of bacteria per group. As the errors introduced by the clumping of the bacteria are so large and so irregular, it is evident that the doubts that many bacteriologists have had regarding the accuracy of these counts have been fully justified.

While these analyses show that it is possible to make reasonably accurate estimates of the number of individual bacteria present where conditions are favorable for accurate work, yet the fact that these conditions are uncommon makes accurate work impossible in most cases. However, the results secured in the grading of milk by routine methods into two or three classes according to the number of bacteria present, as previously reported in Bulletin No. 443, show that the methods now in general use for this purpose may be made to yield results of sufficient accuracy to justify this use. It is unfortunate that dairy analysts still continue the custom of reporting agar plate counts as if they indicated the number of individual bacteria present. This custom gives the layman an erroneous idea of the accuracy of the counts.

**Dairy sanitation and tuberculosis studies.**—During the year, attention has been given to the testing, under practical farm conditions, of the methods of cleaning milking machines developed at the Station. A report on this work is in process of preparation. The department has also coöperated with the Extension Service of the
College of Agriculture in adapting these methods to the needs of the dairy farmers of the State.

The past year has been the fourteenth since a case of demonstrated tuberculosis has occurred in the Station herd. During this time the tuberculin test has been made regularly, and three apparent reactions have been found; but careful autopsy has failed to reveal any sign of tubercular lesions. A report, giving the facts in detail, has been made during the year to the New York State Dairymen's Association, and this will appear in the proceedings of the association. It is felt that this good record has been secured thru the development of the herd without the introduction of any outside stock other than pure bred sires. The latter have been brought from herds known to be free from tuberculosis. The herd at the present time is composed of pure bred or practically pure bred Jerseys. During the past five years the amount of milk produced per cow has varied between 6,204 and 7,251 pounds. This milk has shown an average butter fat percentage of about 5.8.

**Testing of Babcock Glassware from December 1, 1918 to December 1, 1919.**

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
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<tbody>
<tr>
<td>Ten percent milk bottles</td>
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<tr>
<td>Eight percent milk bottles</td>
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<td>Acid measures</td>
<td>446</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>42,266</strong></td>
</tr>
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</table>

Rejections ........................................ 362
Express packages sent out ........................ 749

*Coöperative Studies* — During the year the Station has continued to coöperate with the city of Geneva in directing the milk inspection work for the city. This has given many opportunities to test out laboratory findings under field conditions. The work has
yielded results of value in connection with the milking machine investigations, investigations on the relation between the cooling of milk and its bacterial quality, prevalence of garget, effect of utensils on the bacterial contamination of fresh milk, and the like. During the coming year it is expected that further summaries of the entire series of stable and milk sanitation studies carried out at this and at the Illinois Station will be prepared, so as to make the findings of more direct use to the dairymen of the State in their efforts to produce milk containing few bacteria.

BOTANICAL DIVISION.

Missing hills in potato fields.—Among potato growers there is much difference of opinion concerning the effect of missing hills upon the yield. Some assume that they are a total loss, while others hold that a large part of the loss is made up by the increased yield of adjoining plants. Even among professional experimenters there is lack of agreement as to the proper method of comparing the yields of plats differing in percentage of stand.

An experiment conducted by the Station during the season of 1918 was designed to shed light on this point.

At planting time, each of 360 potato tubers was divided lengthwise into two equal pieces. The 720 seed-pieces so obtained were planted 15 inches apart in the row in groups of four with blank spaces of 30 inches between groups. In other words, every fifth hill was a missing hill. Each group of four contained the two pairs of seed-pieces from two tubers. Hence, one member of each pair of the resultant plants adjoined a missing hill. The difference between the yield of this member (the exterior plant) and the yield of its mate (the interior plant) was taken as the measure of the influence of the missing hill.

Data were obtained from 351 pairs of plants. In weight of total yield the exterior plants outyielded the interior ones by 23.2 percent on the average. Accordingly, the answer given by the experiment is that, under such conditions as obtained in this experiment, the loss from missing hills is offset to a considerable extent by the increased yield of adjoining plants. In the case of a skip consisting of a single missing hill the two adjoining plants (one on either side) together make up 46.4 percent of the loss in total yield, and a little more in yield of marketable tubers.
As a sort of check on the experiment, an attempt was made to determine the magnitude of the variation in yield between the two members of a pair of plants from the same tuber when grown under conditions as nearly parallel as they could be made. For this purpose pairs of seed-pieces similar to those used in the experiment proper were planted in continuous rows without blank spaces. Data were obtained from 85 pairs of plants. In different pairs the difference in total yield varied from 0 to 66.7 percent of the mean yield of the two plants of the pair, the average being 20.7 percent. Such a wide variation in yield between plants under supposedly parallel conditions indicates that there are factors having a very important bearing on the yield of potatoes which are either unknown or not estimated at their proper value.

The details of this experiment have been published in Bulletin No. 459.

Seeds and seed testing.—The work done along this line during 1918 has been reported in Bulletin 462. In addition to tests of 179 official seed samples collected by agents of the Commissioner of Agriculture, and analyzed for purity in accordance with the provisions of the State seed law, there were made 287 purity tests and 396 viability tests of unofficial samples sent in by farmers and seed dealers. A study of the results of these tests shows plainly the need of a stricter law governing the sale of agricultural seeds. It should be required that every lot of seed offered for sale in the State shall bear a label showing its approximate purity and viability.

The seed mixtures upon the market, particularly the cheap mixtures offered by mail-order houses, are notorious for impurity. They should be avoided. When mixtures are desired, the different kinds of seed required should be purchased separately, and mixed at home.

In the spring of 1918 the viability of seed corn was very generally quite low. Under such conditions it is highly important that all seed corn used should be tested for viability. For this purpose the home-made rag-doll seed-tester is very satisfactory. Often much time and labor may be saved by rejecting, without test, all ears having kernels with amber-colored germs because they are likely to have been injured by freezing.

Miscellaneous notes on plant diseases.—Incidental to his principal line of research, the Station Botanist has opportunity for making
observations upon a great variety of plant diseases. Some of these, altho fragmentary, are worthy of record, and so it has been deemed advisable to occasionally publish collections of them in bulletin form. Bulletin No. 463, published in June 1919, contains about 40 such notes, the most important being the following: A stem-and-root disease of apple and pear seedlings, the cause of which has not been determined; a bacterial soft rot of the fleshy petioles of the spotted arum; cabbage blackleg, an important fungus disease which is becoming rather common in the State; black leaf-speck of cabbage, cause undetermined; a destructive storage rot of carrots caused by a fungus and a bacterium; an insect twig blight and leaf spot of catalpa resembling a fungus or bacterial disease; a destructive anthracnose of red clover caused by the fungus *Gloeosporium caulivorum*; crinkle leaf, a non-parasitic disease of currants; an instance in which a severe attack of *Fomes ribis* on currant bushes appeared to do them no harm; *Hypholoma perplexum* growing upon living canes of red currant; gooseberry powdery mildew attacking leaves and twigs of red and black currant; a white, crystallin deposit on currant canes; a witch's broom of unknown origin on red currant; and an injury to the trunk of an elm tree caused by enclosing it in a box "protector."

*Control of dandelions in lawns.*—Experiments made at the Station during the past eight years show that dandelions may be eradicated from lawns by proper spraying with a solution of iron sulfate. The treatment is comparatively inexpensive, and does not materially injure the grass. Usually, four or five applications are required. The first spraying should be made in May just before the first blooming period of the dandelions. One or two others should follow at intervals of three or four weeks; and, finally, one or two more in late summer or fall. During the hot, dry weather of midsummer the spraying should be discontinued because of the danger of injury to the grass. A conspicuous blackening of the lawn which follows each spraying soon disappears if the grass is growing vigorously. Of the other common lawn weeds some are killed while others are but slightly injured by spraying. Unfortunately, white clover, also, is killed.

Tests of certain methods of supplementary treatment, such as reseeding, liming of the soil, and the use of commercial fertilizers and stable manure, were made in conjunction with the spraying
experiments. The results obtained warrant the strong recommendation that spraying be supplemented by the use of fertilizers and the application of grass seed in the spring and fall of each year. With proper management a lawn may be kept practically free from dandelions by spraying every third year.

The cutting-out method of fighting dandelions is laborious and ineffective unless the greater part of the root is removed. Shallow cutting, unless done frequently, is worse than none at all, because each cut-off root promptly sends up one or more new plants.

A full account of these experiments has been published in Bulletin No. 466.

Field Experimental Work of Botanical Division.

Potato experiment. L. L. Foote, Malone.
F. A. Sirrine, Riverhead.

Division of Chemistry.

Bulletins Prepared in 1919 by Chemical Department.

1. Analyses of 588 samples of commercial fertilizers.
2. Analyses of . . . samples of feeding stuffs.
3. Carbonic acid and carbonates in cow's milk.
4. Conditions causing variation in the reaction of freshly-drawn milk.
5. A method for the preliminary detection of abnormal milks.
6. A method for the determination of the keeping quality of milk.

The amount of CO₂ present in cow's milk in the udder is, under normal conditions, about 16 percent by volume. It may fall as low as 7 percent and, in case of diseased udders, may rise to above 80 percent. The CO₂ is present as one part of H₂CO₃ and two parts of bicarbonate.

In studying the variation of reaction in milk, the results are expressed in terms of hydrogen ion concentration in the form of values of pH. In examining some 300 samples of freshly-drawn milk, the pH value is found to vary from 6.50 to 7.20. It varies with the composition of the milk. In general, with a decrease of acidity (as indicated by an increase of pH value) there is a marked tendency toward a decrease in specific gravity and in percentage of fat, solids-not-fat, casein, and lactose, but an increase in proteins other than casein, and in ash and chlorine. These changes in composition are such as would be expected in case blood-serum or lymph were added to normal fresh milk. Diseased conditions in the udder may cause such addition.
A method is much needed in official milk inspection to enable the inspector to select suspicious samples quickly, and then take samples of such milks for further detailed examination in the laboratory. Such a method has been worked out here, one which depends upon the effect of milk upon a solution of a dye called brom-cresol purple. One drop of this solution is added to 3 cc. of milk, and the color is observed. Normal fresh milk gives a grayish-blue color. The production of a lighter or darker color serves to awaken suspicion in regard to the normal character of the milk. The color is made lighter by acids, acid salts, formaldehyde, and also by heating above the usual point of pasteurization. The color becomes deeper blue in the case of milk from diseased udders, watered milk, skimmed milk, and milk containing added alkaline salts. In the inspection of milk, a sample is taken for further detailed examination in the laboratory, if the color is sufficiently lighter or darker than normal to indicate the probability of some abnormal condition. The method has been applied to about 600 samples of market milk with satisfactory results.

There has been no recognized satisfactory test for determining the keeping quality of milk, by which is meant the length of time milk remains sweet, and otherwise palatable and suitable for direct consumption. A method has been devised here for making such a determination, using the same solution of brom-cresol purple that is used in detecting abnormal milks. The same procedure is followed, except that the pipettes and test-tubes used are sterilized before sampling the milk, and, further, the samples of milk in the test-tubes must be incubated a given time at a definite temperature. The milk is examined for changes of color after certain intervals. The principal factor shown by this test as related to keeping quality is production of acid, but additional factors to be observed in connection with it are coagulation of casein, digestion of casein, production of alkali, production of gas, development of abnormal odor, or taste.

DIVISION OF ENTOMOLOGY.

Control of Green Apple Aphid in Bearing Orchards.

The green apple aphid is a common dwarfing and deformative agent of the new growth of younger trees. It prefers succulent tissues, such as exist on terminal growths and water sprouts, and is generally present in injurious numbers for more or less extended
periods during the summer months in nursery plantings and young apple orchards. In occasional years it is very abundant and destructive in old apple plantings. The dwarfing of fruit and defoliation of affected branches have established its status as an important apple pest. The results of this study as presented in Bulletin No. 461 show that oviposition by Aphis pomi occurs in the autumn, and the eggs hatch the following spring. The maximum numbers of newly-hatched nymphs are ordinarily observed as color is showing in the leaf tips of the opening blossom buds. Development of the insects is rapid, winged forms of the second generation appearing during late May or early June, when there is a migration to other plantings. The species breeds continuously throughout the summer, producing many broods, which vary in size and number according to seasonal conditions. The invasion of fruit clusters may be attended with dwarfed, misshapen apples which display pimpling and red stippling of the surfaces.

In the Station experiments, the delayed dormant treatment protected bearing orchards until about the middle of June, when there was a reinestation from winged migrants. While plantings that were given the delayed dormant treatment were not conspicuously injured by the aphis, the experiments so far conducted do not indicate conclusively that this treatment may safely be relied on to afford reasonable and satisfactory commercial control. A spraying during midsummer resulted in the efficient control of the green aphis. Following the treatment there was noticeable improvement in the conditions of apples in most orchards with respect to shape, size and freedom from reddish discolorations.

Comparative tests of nicotine sulphate with soap or large amounts of lime indicated few differences in insecticidal qualities of these preparations. The advantages of the lime wash were the deterrent action on the aphids, and its cleansing properties to the fruits. On account of its lack of surface tension and the difficulty and cost of application to large trees, the use of the lime mixture should properly be limited to young, non-bearing trees or those of moderate size. The rapid killing with nicotine sulphate in combination with soap and its greater spreading properties point to its superiority for large trees. It is probable, for these considerations, that apple growers having trees of great height with widespread branches will continue
to place their dependence on the nicotine-sulphate-soap spray for the control of the green aphis.

The conclusions drawn from the Station experiments are that, in regions where aphids are annually destructive or attacks are apprehended, reliance should be placed on the delayed dormant treatment with lime-sulphur and nicotine sulphate, and on a supplementary spraying during midsummer with nicotine sulphate and soap when the green aphis threatens to develop to destructive numbers on fruit clusters.

*The Rosy Aphis in Relation to Abnormal Apple Structures.*

Of the various species of aphids that exist on the apple tree, the rosy aphis is conspicuous for its partiality for the foliage of blossom and fruit clusters and, by reason of this preference, the presence of large numbers of the insects on the host is generally attended with damage to both foliage and fruit. Technical Bulletin No. 66 presents with considerable detail various effects of the insect on the size, color and internal structures of apple fruits. Of special interest to growers is the fact that apples attacked by the rosy aphis usually display suppression of the transverse and axial diameters. Inhibition of growth occurs to a greater extent with the transverse diameter. The injury varies in extent, even with fruits of the same cluster, and the amount of damage is largely determined by the earliness and intensity of attacks, and the duration of the period of infestation. The shrinkage in yield on account of the so-called aphis apples is obvious. There should also be taken into account another source of loss—that many apples from infested trees, while marketable, may be below normal size. Besides being smaller, affected apples are frequently poorly colored, and are often not symmetrical in shape. Aphis apples usually have, on an average, fewer seeds than normal fruits. Severely malformed fruits sustained no reduction in the number of primary fibro-vascular structures.

*Comparison of Methods for Computing Daily Mean Temperatures: Effect of Discrepancies upon Investigations of Climatologists and Biologists.*

The daily mean temperature is usually determined by taking the average of the highest and lowest temperatures that occur during twenty-four hours, readings being taken at a fixed hour of observation
and from accurate maximum and minimum thermometers. The hour of observation is usually in the evening, but each observer uses a convenient hour, the most common time being from 5 P.M. to 8 P.M. The true daily mean is given by a summation of the average hourly temperatures, divided by twenty-four. Comparison of the daily means calculated by the two methods shows that, throughout a year, important discrepancies occur and that these discrepancies are the greater the longer the period from the hour of observation to the following midnight. By means of statistical analysis the effect of the daily discrepancies upon the daily mean, monthly mean, and annual mean temperatures have been determined. The deductions are so numerous that the reader is referred to Technical Bulletin No. 68, which contains the results of this study.

Since biological activity is rather closely related to thermal influence, it is important that the temperature data be exact, otherwise important relationships may be masked. It was found that the approximate means gave very misleading data when daily differences are considered, and that thermograph averages alone can be depended upon in the scientific investigation of the effect of heat upon plants and animals. These considerations are of importance in some phases of agricultural research.

The activities during the summer at Fredonia were directed to two principal phases: the investigation of the life history and control of the Red-headed Systena (Systena frontalis), and the testing of new forms of arsenicals on grape foliage. The Red-headed Systena was abundant during the past season and, as it annually injures the young vines (cuttings) in the nurseries as well as doing much damage to young and even old grape vines, it was deemed of sufficient importance to study. The life history had not been investigated to any extent before this season.

Of late years a number of new arsenical poisons have been placed upon the market, and, as a number of these are considerably cheaper than the standard arsenate of lead, it was decided to try all that could be obtained on grape foliage. The result has been that all were found injurious to Concord grape foliage, so the growers are very strongly advised to use the standard materials for spraying.

Since the grape root-worm is becoming more abundant, constant observations were made for vineyards in which the pest might be
numerous, both with the aim of conducting further investigations, and to keep the growers informed of any threatened outbreak. At the same time notes were kept of the activities of other grape pests, and insectary investigations of life histories were continued.

During the season much attention was given to the study of ecology with special reference to grape pests. The object of this investigation was to determine the conditions most favorable for such insects, and to compare these with vineyard conditions to determine the possibility of certain insects becoming vineyard pests. At present writing it seems that the reason certain insects which attack vines of all species under natural conditions cannot thrive under vineyard conditions is that at some critical stage of their life they are unable to live because either moisture or temperature conditions make this impossible, the difference in the two habitats being greater than their adaptability in this respect. Another factor is that the undisturbed conditions in a native habitat permit them to pass thru certain stages, while in vineyards the cultivation of the soil and other operations destroy them.

**Coöperative Experiments.**

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<tr>
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<tr>
<td>Control of pear thrips</td>
<td>Webster Coons</td>
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<td>V. E. Litchenhan</td>
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<tr>
<td>Control of pear thrips</td>
<td>Wessel Ten Broeck</td>
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<td>Control of cabbage aphis</td>
<td>McKay Brothers</td>
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<td>Control of pear psylla</td>
<td>Middlewood Farms</td>
<td>Varick</td>
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<td>Fred Hammond</td>
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HORTICULTURAL DIVISION.

A test of commercial fertilizers for grapes.—In the spring of 1914 this Station published in Bulletin No. 381 the results of a five-year test of commercial fertilizers on grapes. Another five-year period has elapsed, and Bulletin No. 458 is published to show the results of fertilizers on grapes for the added period. The work was carried on by Fred E. Gladwin in the experimental vineyard at Fredonia, N. Y.

The tests show that nitrogen, phosphorus, and potassium have had a marked beneficial effect upon wood growth, yield, and quality of fruit. The data indicate that, of the three elements, nitrogen has been most helpful.

Potassium has given more pronounced results than phosphorus up to the present, altho the latter has had a more beneficial effect upon the green-manure crops in the vineyard.

Nitrogen has not only favorably affected the growth of wood, but it has increased the fruit, and given larger berries and clusters. Phosphorus and potassium have increased the production of wood and fruit, but have not influenced the quality of the fruit to the same extent as the nitrogen. Potassium has caused earlier ripening of the foliage than the other elements.

Even tho the same number of canes be tied up for fruiting purposes, the data show that the fertilizer plats have produced a decided gain of fruit over the unfertilized.

The foliage, after the first few years, has been of better color and size in the plats to which nitrogen was applied. That from the phosphorus and potassium plats ranked second, with that from the check a poor third.

Twenty years of fertilizers in an apple orchard.—In Bulletin No. 339 of this Station, published in 1911, the results are presented for the first seven harvests in a fertilizer experiment which was begun with the planting of the trees on the Station grounds in 1896. The present bulletin discusses the results secured in eight additional harvests.

The factors considered in interpreting results are yield and size of fruit and tree growth. In nearly all cases the result given in the tables is the average of the five trees in the plat. The results may be summarized as follows:
Adding acid phosphate at the rate of 340 pounds per acre per year has not given a noticeable increase in yield.

The addition of 196 pounds of muriate of potash to the 340 pounds of acid phosphate seems to have resulted in an increased yield.

The annual application of 50 pounds of readily available nitrogen in addition to the phosphoric acid and potash has caused no increase in yield.

Plats receiving stable manure have yielded no more than the check plats.

In general there are so many inconclusive or contradictory results that no conclusion of practical value can be drawn from the yields.

When we compare the rank in yield of the plats for the period ending in 1910 with the rank for the last eight years we see a tendency of the checks and phosphoric acid plats to take a slightly lower rank as the experiment has continued.

The average percentage of fruit grading two and one-half inches or larger is given for each plat. There is a greater difference between two nearby check plats than between any fertilized plat and its nearest check. This, together with the variations among the duplicates of the fertilizer treatments, makes it impossible to draw any definite conclusion as to the effect of treatment upon size of fruit.

The average trunk diameter and the approximate average tree volume for each plat are excellent factors to use in comparing the various plats. The two phosphorus and potassium plats lead their adjoining plats both in size of trunk and in tree volume, but it is not possible to say whether the increases are due to the potassium or the combination of the two elements, or to some tree or field variation which does not show.

Heavy applications of nitrogen in a complete fertilizer and in manure have not increased tree growth.

When the costs are considered, certain plats have given increases sufficient to equal the costs, or even to show a profit, but in other plats the same plant food elements have shown a financial loss.

If the results continue in the present direction for another ten years, the increased yields may justify the recommendation of one or two of the treatments, but at present this cannot be done.

These results are from a cultivated orchard on soil naturally well supplied with the plant food elements. On thin, infertile soils or in sod orchards, the results might be quite different.
PUBLICATIONS ISSUED DURING 1918.

BULLETINS.


TECHNICAL BULLETINS.


CIRCULARS.

No. 54. Revised. Milking machines. Pages 5.


PUBLICATIONS ISSUED DURING 1919.

BULLETINS.


No. 469. December. Inspection of feeding stuffs. Pages —.


TECHNICAL BULLETINS.


W. H. JORDAN

NEW YORK AGRICULTURAL EXPERIMENT STATION,