New York Agricultural Experiment Station.

GENEVA, N. Y.

DIRECTOR'S REPORT FOR 1916.

W H. JORDAN.

PUBLISHED BY THE DEPARTMENT OF AGRICULTURE.
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George W. Churchill,
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Joseph F. Barker, M.S., Agronomist.
Reginald C. Collison, M.S., Associate Chemist (Agronomy).
William W. Baer, B.S., Assistant Chemist (Agronomy).
Everett P. Reed, B.S.A., Assistant Agronomist.
William P. Wheeler,
First Assistant (Animal Industry).
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Harold J. Conn, Ph.D., Associate Bacteriologist.
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James D. Brew, B.S.,
Assistant Bacteriologists.
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Arthur J. Flume, B.S., Assistant Chemists.
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Percival J. Parrott, M.A., Entomologist.
Hugh Glassow, Ph.D.,
*Fred Z. Hartzell, M.A. (Fredonia),
Associate Entomologists.
Harold E. Hodgkiss, B.S.,
Bentley B. Fulton, B.A., Assistant Entomologists.
Ulysses P. Hedrick, Sc.D., Horticulturist.
Roy D. Anthony, M.S.A.,
*Fred E. Gladwin, B.S. (Fredonia),
Associate Horticulturists.
George H. Howe, B.S.A.,
Joseph W. Wellington, B.S.,
Assistant Horticulturists.
Orrin M. Taylor,
Foreman in Horticulture.
F. Atwood Surrine, M.S. (Riverhead),
Special Agent.
Jessie A. Sperry, Director's Secretary.
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Willard F. Patchin,
Lena G. Curtis,
Agnes E. Ryan,
Mae M. Melvin,
Maude L. Hogan,
Clerks and Stenographers.
Elizabeth Jones,
Computer and Mailing Clerk.

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. 428.

DIRECTOR'S REPORT FOR 1916.

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

Gentlemen.—It again becomes my duty to present to you a report of another year's operations of this institution, which I shall accompany by a discussion of certain conditions affecting the institution and of our continued needs.

The work of the Station during 1916 has continued along much the same lines as during previous years. As now organized, the institution occupies a broad field of inquiry and the problems considered touch almost every phase of agricultural practice. It has become a question, in view of the increased cost of maintaining such an institution and of failure to secure additional funds commensurate with the increased expense and demands for assistance, whether the scope of our activities is not too broad. We may seriously ask whether a fuller concentration upon fewer problems would not be more beneficial to the agriculture of the State. There are still pressing needs of the institution which have not been met, and to which I shall take the liberty of calling your attention.

ADMINISTRATION.

STATION STAFF.

Changes in the Station Staff have been less than in some former years. Charles B. Tubergen, B.S., who was connected with the horticultural department of the institution for a period of over five years, resigned on October first to enter upon commercial work. During these years of service, Mr. Tubergen established very pleasant relations with his associates, and he carries with him the hearty wishes of his friends for success in his new field of effort.

Edward J. Lewis, B.S., Assistant Chemist in the agronomy department, resigned after a somewhat brief stay at the institution in order to further prosecute his studies in chemistry.

John C. Baker, Ph.D., was appointed on July first to fill the vacancy caused by the resignation of Alfred W. Bosworth late in 1915. Mr. Baker pursued special studies at Columbia University in biological chemistry, and received from that institution the degree
of Doctor of Philosophy. For the present, he will be engaged in the chemical department in the study of problems relating to milk and milk products.

William W. Baer, B.S., has been appointed to the position of Assistant Chemist in the department of agronomy to fill the vacancy caused by the resignation of Edward J. Lewis. Mr. Baer is a graduate of the Pennsylvania State College.

William C. Stone, M.S., a graduate of the University of Vermont and for several years an assistant in the Experiment Station at that institution, having given attention during that time to special problems in plant breeding, has been selected to fill the vacancy caused by the resignation of Charles B. Tubergen. Mr. Stone enters upon his duties on the first of January, 1917.

The institution is fortunate in retaining the continued services of the heads of the various divisions of the scientific staff. This is not because attractive opportunities have not come to them through offers from other institutions, but because of a devotion to their work and a loyalty to the institution which leads them to remain in the service of the people of this State.

Under the new fiscal policy of the State, it will without any question be increasingly difficult to secure long-continued service on the part of members of the staff, especially when financial interests are seriously involved. The fundamental law establishing the institution states that the Board of Control "may employ competent and suitable chemists and other experts and persons necessary for carrying on the work of the Station and shall fix the compensation of all persons connected with the work of said Station." The autonomy of the Board of Control is now seriously limited in this direction inasmuch as the salaries of the members of this staff are now fixed by the budget committees, subject of course to legislative enactment. Any policy which involves promotion, and no scientific institution can be managed successfully without a policy of promotion for meritorious service, can now hardly be sustained, as the legislative mind is more sensitive towards increases of salaries in our educational institutions than towards almost any other line of expenditure. In several ways the policy and management of the Station by its Board of Control have been seriously disturbed through various fiscal and other regulations. It cannot be too strongly urged by those whom the Station is expected to serve that
the policy of the State should be to appropriate what money it thinks it can afford for the support of the institution and leave its policy and management to those more intimately acquainted with its conditions and needs.

**MAINTENANCE FUNDS.**

The fiscal law of the State of New York was amended by the Legislature of 1916 by changing the fiscal year so that it begins on July 1 instead of October 1. This brings the actual expenditure of the funds provided nearer to the time when the various departments and institutions of the State must make recommendations for their budget, but even under the new arrangement the items for the budget are requested not less than nine months before the beginning of the fiscal year to which the budget is to be applied.

The following were the appropriations made available for the fiscal year beginning July 1, 1916:

<table>
<thead>
<tr>
<th><strong>Salaries</strong></th>
<th><strong>General Fund</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Administration</td>
<td>$13,200.00</td>
</tr>
<tr>
<td>Research</td>
<td>56,000.00</td>
</tr>
<tr>
<td><strong>Labor</strong></td>
<td></td>
</tr>
<tr>
<td>Classified</td>
<td>6,700.00</td>
</tr>
<tr>
<td>Regular and temporary</td>
<td>14,797.88</td>
</tr>
<tr>
<td>Special service</td>
<td>174.80</td>
</tr>
<tr>
<td><strong>Maintenance and operation</strong></td>
<td>$90,872.68</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$120,572.68</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Inspection Fund</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries</td>
</tr>
<tr>
<td>Labor</td>
</tr>
<tr>
<td>Regular and temporary</td>
</tr>
<tr>
<td><strong>Maintenance and operation</strong></td>
</tr>
<tr>
<td><strong>Total for inspection</strong></td>
</tr>
<tr>
<td><strong>Total appropriation 1916-17</strong></td>
</tr>
</tbody>
</table>

| **Salaries for all divisions** | $82,270.00 |
| **Labor (Classified)** | 6,700.00 |
| **Labor (Regular and temporary)** | 16,280.30 |
| **Special service** | 174.80 |
| **Maintenance and operation** | 32,100.00 |
| **Total** | $137,525.10 |
This is $6,215.00 less than was deemed necessary by the Board of Control for the maintenance of the institution.

The appropriations requested for the fiscal year beginning July 1, 1917, are as follows:

<table>
<thead>
<tr>
<th></th>
<th>General Fund</th>
<th>Inspection Fund</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Salaries</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Administration</td>
<td>$13,420.00</td>
<td></td>
</tr>
<tr>
<td>Research</td>
<td>57,300.00</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$70,720.00</td>
<td></td>
</tr>
<tr>
<td><strong>Labor</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Classified</td>
<td>6,820.00</td>
<td></td>
</tr>
<tr>
<td>Regular and temporary</td>
<td>16,000.00</td>
<td></td>
</tr>
<tr>
<td>Special services</td>
<td>1,674.80</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$24,514.80</td>
<td></td>
</tr>
<tr>
<td><strong>Maintenance and operation</strong></td>
<td>32,075.00</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$56,589.80</td>
<td></td>
</tr>
</tbody>
</table>

| **Total appropriation requested** | $127,299.80 |

| **Inspection Fund**             |               |                 |
| **Salaries**                    | $13,670.00    |                 |
| Labor, regular and temporary    | 1,515.00      |                 |
| **Total for inspection**        | $15,185.00    |                 |
| **Total appropriation requested** | $144,874.80 |

| **Salaries for all divisions**  | $84,390.00    |                 |
| Labor (Classified)              | 6,820.00      |                 |
| Labor (Regular and temporary)   | 17,515.00     |                 |
| Special service                 | 1,674.80      |                 |
| Maintenance and operation       | 34,475.00     |                 |
| **Total**                       | $144,874.80   |                 |

I trust it will be possible for your Board to urge upon the Legislature with the utmost emphasis the need of returning to the former budget system under which appropriations were made to this institution. As it is now, your Director is asked to recommend specific sums along specific lines, such as fuel, light, power and water, printing, equipment, supplies, hired horses and vehicles, traveling expenses, communication (which includes freight, express, telegraph and telephone bills), general plant service (which means horseshoeing, laundry work and the employment of outside men for general repairs), and rent. The expenditures of an Experiment Station, if it is doing the work it ought to do, cannot be standardized,
nor is it possible for the management to prophesy six to nine months before the beginning of the fiscal year how its general expense money appropriation should be distributed. As evidence of this, I present the following analysis of our expenditures for the fiscal year 1914–15 and the expenditures from July 1, 1915, to June 30, 1916:

<table>
<thead>
<tr>
<th></th>
<th>1914–15</th>
<th>1915–16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel, light, power and water</td>
<td>$4,031.37</td>
<td>$2,753.52</td>
</tr>
<tr>
<td>Printing</td>
<td>401.68</td>
<td>94.07</td>
</tr>
<tr>
<td><strong>Equipment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Office</td>
<td>46.43</td>
<td>428.34</td>
</tr>
<tr>
<td>Motor vehicle</td>
<td></td>
<td>625.00</td>
</tr>
<tr>
<td>Research</td>
<td>2,786.57</td>
<td>4,394.65</td>
</tr>
<tr>
<td>Farm and garden</td>
<td>2,391.99</td>
<td>1,618.78</td>
</tr>
<tr>
<td>Books</td>
<td>1,250.35</td>
<td>857.80</td>
</tr>
<tr>
<td>General plant</td>
<td></td>
<td>15.00</td>
</tr>
<tr>
<td>Livestock</td>
<td>7.00</td>
<td></td>
</tr>
<tr>
<td>Wearing apparel</td>
<td>56.20</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$6,538.54</td>
<td>$7,939.57</td>
</tr>
<tr>
<td><strong>Supplies</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Office</td>
<td>1,340.28</td>
<td>1,009.56</td>
</tr>
<tr>
<td>Laundry, cleaning and disinfecting</td>
<td>52.80</td>
<td>79.83</td>
</tr>
<tr>
<td>Motor</td>
<td>371.77</td>
<td>460.78</td>
</tr>
<tr>
<td>Research</td>
<td>1,739.61</td>
<td>1,822.94</td>
</tr>
<tr>
<td>Botanical and agricultural</td>
<td>4,069.97</td>
<td>4,734.92</td>
</tr>
<tr>
<td>Forage and veterinary</td>
<td>861.07</td>
<td>995.94</td>
</tr>
<tr>
<td>General plant</td>
<td>1,119.63</td>
<td>467.50</td>
</tr>
<tr>
<td>Household</td>
<td>25.96</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$9,581.09</td>
<td>$9,571.47</td>
</tr>
<tr>
<td><strong>Hired horses and vehicles</strong></td>
<td>$3,028.29</td>
<td>$2,417.41</td>
</tr>
<tr>
<td><strong>Traveling expenses</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation</td>
<td>1,888.59</td>
<td>1,697.95</td>
</tr>
<tr>
<td>Hotel</td>
<td>1,998.07</td>
<td>1,361.85</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$3,886.66</td>
<td>$3,059.80</td>
</tr>
<tr>
<td><strong>Communication</strong></td>
<td>1,755.44</td>
<td>2,358.23</td>
</tr>
<tr>
<td>General plant service</td>
<td>3,166.74</td>
<td>1,023.71</td>
</tr>
<tr>
<td>Rent</td>
<td>1,291.29</td>
<td>961.62</td>
</tr>
</tbody>
</table>

The foregoing figures show how absurd it is in the management of an institution of this character to base the distribution of funds for a future fiscal year upon what has happened during a year that has past. The present year affords an admirable illustration of situations which may be encountered in any year. The expenditure for coal is an important item with any institution and the price of soft coal has increased from a little over $2.00 a ton to $5.50. With a fixed item for fuel, what can an institution do? If some
relief from such a fiscal policy is not arrived at through a better understanding of the situation, not only will the autonomy of the management of the institution be seriously limited but it will be impossible to administer funds efficiently. This matter is not presented in the way of criticism, but is a frank and necessary discussion of a situation which the Experiment Station is obliged to meet.

THE NEW BUILDING

It is fitting that grateful acknowledgment should be made to the Governor and Legislature for the appropriation of one hundred thousand dollars with which to erect an administration, library and demonstration building. According to plans which are practically completed and which have had the approval of your Building Committee, this building will contain the administrative offices, a library, two audience rooms, one with a seating capacity of approximately six hundred persons and another with seating capacity of one hundred, and museum space. This building is to be of essentially fire-proof construction. According to the vote of your Board, it is to be located on the north side of North Street, facing the space between the present administration building and the biological building. This location has been made possible through the purchase of a lot of land with 250 feet frontage, running back 225 feet. This area will give an admirable opportunity for giving the building a setting of trees and shrubbery.

FURTHER BUILDING NEEDS.

The Legislature of 1916 was asked to furnish means for the erection of new plant houses and a cold storage house. The reasons for this request may be restated in language used in my report for 1915:

"The time has come when in order to carry on its work with the desired efficiency new and greatly enlarged plant houses should be provided. The present plant houses of the Station were erected about twenty-five years ago. They have exceeded the usual life of such structures, and are now neither adequate nor efficient. There is a large amount of work in agricultural investigation which should be carried on in such houses, if carried on at all, including plant breeding, plant nutrition and studies of plant diseases and
injurious insects, to all of which lines the Station is obliged to give much attention.

"The small cold-storage house, established chiefly for the storing of fruits, was erected at the Station something more than twenty years ago. The preservation of fruits, of which the Station has several thousand varieties, requires cold storage facilities in order that such materials may be used for study and exhibition purposes. The present cold-storage plant is inadequate in size and construction and if retained will need enlargement and extensive repairs. A new building should be erected."

It is not to be expected that an institution which has been in operation for thirty-four years should not find it necessary to replace buildings of a somewhat perishable character that have been in use during that time. The State must either provide the means for such replacement or allow the institution to deteriorate seriously in appliances and efficiency.

ACQUISITION OF MORE LAND.

In my last report, attention was called to the great desirability of acquiring for this institution a tract of land on the east side of Castle street, adjacent to the Station property, of about twenty-three acres. The owner of this land, with fine public spirit, has refrained for several years from breaking it up into building lots because of his desire that it shall become the property of the State, as an adjunct to the Experiment Station. This land is needed in order to establish upon it not only an arboretum for the study of ornamental trees and shrubs but for the establishment of a collection of the progenitors of our fruit trees and shrubs as a means of promoting the study of plant breeding work which this institution is carrying on very extensively and, as we believe, to the great benefit of the horticulture of the State. More money could be realized for this park by disposing of it in a commercial way. The owner has been willing to delay offering it to the public for building purposes in order that opportunity may be given for the Legislature to take the necessary steps to acquire it for Station purposes. It is hoped that the Legislature will not commit so great a mistake as to allow this land to be absorbed for other purposes.
STATION PUBLICATIONS.

The distribution of Station publications is in accordance with the following figures:

**Popular Bulletins**
- Residents of New York: 38,898
- Residents of other States: 2,408
- Newspapers: 777
- Experiment stations and their staffs: 2,318
- Miscellaneous: 100

Total: 44,501

**Complete Bulletins**
- Experiment stations and their staffs: 2,318
- Libraries, scientists, etc: 401
- Foreign list: 332
- Individuals: 3,965
- Miscellaneous: 100

Total: 7,116

It is easily seen that not over one-fifth of the farm owners of the State are receiving the Station bulletins. If this were the only way in which the results of the Station's investigations were disseminated, the situation might seem discouraging. As a matter of fact, however, information based upon the knowledge which the Station staff is able to acquire through its researches is spread among the people of the State in various other ways, as, for instance, through instruction in the class-room at the College of Agriculture and the agricultural schools, through imitation by his neighbors of what a farmer or fruit grower accomplishes through the application of new knowledge, through the activities of county agents and institute schools and through the rural press. It is indeed a worthy result to educate a young man for usefulness in some walk of life, but it is even a greater thing to accomplish to develop a new truth which in all time and among all people promotes human welfare. It would be a serious mistake to suppose that the dissemination of any new knowledge is limited numerically by the mailing list of any institution whatever.

There is presented this year as a part of the annual report of the Station, manuscript of another fruit book to be known as "The Peaches of New York." I can assure your Board that this publica-
tion will surpass in artistic features and in thoroughness of preparation any one of the four previous publications which have been issued.

The fruit growers of the State should bear in mind that, if the present regulations of our printing department are maintained, 5,000 copies of this report will be absorbed by members of the Legislature, 2,000 copies will go to the Commissioner of Agriculture and only 2,000 copies will be available by the Station itself to meet the demands made upon it. The popularity of these publications with the resultant extensive demand for them has often placed the Station in an awkward position because of the number of requests which it has been obliged to refuse for some one of these publications.

POLICY TO BE APPLIED TO STATION ACTIVITIES.

The question of the policy which an Experiment Station shall follow in the selection of its work is an ever recurring one. This selection generally lies between a close scientific study of facts or principles which underlie agricultural practice or efforts of a more popular character which relate quite directly to practice. Doubtless the latter line of endeavor is more likely promptly to secure a popular verdict and increased good will toward the Station among its constituency than the former.

The great value of past investigations of the severer sort is well illustrated in many directions, as for instance by a study of the relation of germ life to leguminous plants, the discovery of the useful nitrifying organisms of the soil, the relation of certain compounds to the maintenance of plant life, investigations concerning the functions of certain nutrients in the development and maintenance of animal life and the underlying chemical and biological factors which are important in dairy technology. The great benefits that have been derived from these and many other researches of the same general character are too evident to be denied. Work of a more popular character may be illustrated by tillage experiments, fertilizer tests, comparisons of rations, and illustrative experiments in spraying and along other phases of farm practice. Work of this latter kind may properly be classed as demonstration or extension work.

A close study of Station activities in the United States leads to the conviction that a large percentage of the energy and resources
of these institutions has been expended in dealing with the immediately practical side of farm problems. In other words, much so-called investigation or experimentation has dealt with variables, that is, with matters that are of only relative importance and that have no fundamental and general relation to any phase of farm practice. Without question, Experiment Stations have busied themselves to a great extent with problems that are simply business factors in farm management and which must be settled by the farmer himself as an essential part of his business operations. It is for these reasons that we have a large mass of Station literature that is rapidly disappearing from our attention — simply because it added nothing of a permanent character to agricultural science. Doubtless the institution under your care has been guilty of transgressions of this sort.

It is safe to assert that individual farmers have often been misled through giving them advice based upon circumstances in other localities and under other conditions. Within certain limitations the farmer must be left to work out his business salvation, and the influence of any outside agency must be introduced with great caution. The observation is pertinent in this connection that Experiment Stations are seriously in error when the results of their studies, whether in the field or elsewhere, are given in terms of dollars and cents. If there are good reasons for conducting a field experiment where the yield of different plats treated in an unlike manner is compared, it is not rational to say that one plat gave a profit of six dollars more than another plat, because the six dollars is a variable which might be some other figure with labor and supplies having a different cost and the product selling at a different price. Measurements of this kind should be in units of production.

In the former statements it is not intended to condemn so-called practical experiments. They are valuable adjuncts to research. It is often necessary to do field work in order to determine the applicability of a theory or a suggested practice, sometimes in the field, sometimes in the orchard and sometimes in the cheese factory or dairy. Many problems have two phases, the underlying facts or principles and the application of these facts or principles, and the application can only be studied by entering into practice.
INSPECTION WORK.

The inspection work of this institution includes the examination of Babcock glassware and agricultural seeds.
The number of seed samples examined is as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Official samples</td>
<td>569</td>
</tr>
<tr>
<td>Samples sent by farmers and other correspondents</td>
<td>775</td>
</tr>
</tbody>
</table>

The following figures show the pieces of Babcock glassware examined:

<table>
<thead>
<tr>
<th>Item</th>
<th>Pieces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk bottles</td>
<td>21,839</td>
</tr>
<tr>
<td>Cream bottles</td>
<td>5,492</td>
</tr>
<tr>
<td>Pipettes</td>
<td>4,003</td>
</tr>
<tr>
<td>Skimmilk bottles</td>
<td>330</td>
</tr>
<tr>
<td>Acid measures</td>
<td>728</td>
</tr>
<tr>
<td><strong>Total pieces inspected</strong></td>
<td>32,392</td>
</tr>
</tbody>
</table>

Rejected from milk and cream bottles: 141
Rejected from pipettes: 43

The data in regard to the examination of samples of fertilizers and feeding stuffs are given under the head, "Department of Chemistry."

RESULTS OF STATION WORK ACCOMPLISHED IN 1916.

The Experiment Station has published 15 bulletins and 9 technical bulletins covering the work of the institution during the year 1916, including those which report the inspection of fertilizers and feeds. Of these bulletins 8 have been reproduced in popular or summarized form. There follows a brief summary of Station work for the year consisting mainly of certain of the principal data presented in these bulletins:

DIVISION OF AGRONOMY.

FIELD WORK DONE OUTSIDE OF STATION FARMS.

Alfalfa and sweet clover culture on southern New York hill lands:

L. Gallagher, (1/2 acre), Oxford.
C. G. Baker (2 acres), Chenango Forks.
H. G. Skinner, Jr. (1 acre), Prattsburg.
A. S. Matheny (1 acre), Binghamton.
W. P. Mead & Son (4 acres), Jamestown.
A. R. Chappel (2 acres), Sidney.
W. D. Carey (1/2 acre), Watkins.
Earl D. McGilliard (2 acres), Penn Yan.
F. A. Wigsten (1 acre), Elmira.
Apple orchards: Fertilizer, cultivation and cover-crop tests:

Cherry orchard: Fertilizer cultivation and cover-crop tests:

Pear orchard: Fertilizer, cultivation and cover-crop tests:

Vineyards: Fertilizer and deep-plowing tests:

Tobacco-culture experiments:

Hop-culture experiments:

Great Bear Springs Co. (8 acres), Fulton.
R. B. Densmore (8 acres), Albion.
P. F. O'Neil (3 acres), Geneva.
Lawrence Howard (3 acres), Kinderhook.

S. E. Stone, Jr. (4 acres), Fredonia.
D. W. Blood (2 acres), Dunkirk.
F. A. Tuerk (12 acres), Baldwinsville.
B. I. Crego, Baldwinsville.
P. R. Bennett (6 acres), Milford.

BACTERIOLOGICAL AND DAIRY DIVISIONS.

The chief attention of the members of these divisions has been given to the study of problems connected with stable and milk sanitation, and to a study of soil micro-organisms.

The sanitary milk problems which have been given the greatest attention are: (1) Methods of controlling the sanitary quality of market milk; (2) the importance of the machine milkers as a source of bacteria in market milk; and (3) the accuracy of methods of bacterial analysis of milk.

(1) Methods of controlling the sanitary quality of market milk.—During the past two years, the Station has undertaken the sanitary inspection and control of the greater part of the milk supply of the City of Geneva in order to test out the value of the methods of control which have been developed in connection with the experimental work. By agreement with the two local milk companies, the dairymen and the local and state boards of health, the Station has undertaken a laboratory inspection of the milk received at the two milk stations and the findings have been used as a basis of payment to the dairymen and as a means of controlling the milk supply. The information secured from the laboratory analyses has been supplemented by that secured from visits to the farms. Special analyses have been made in order to discover the sources of trouble wherever time permitted or there were indications that the results would be valuable. In this way the findings from the studies made at the Station have been compared and contrasted with conditions met with in the field. A preliminary report on this work will be ready for publication during the coming year.
(2) *The influence of various barn factors upon the bacteriological quality of milk.*—The particular phase of this general problem which has occupied the attention of these divisions during the past year has been the importance of machine milkers as sources of bacteria in milk. The work has progressed far enough to show that they, like other dairy utensils of similarly complicated construction (bottlers and the like), are ordinarily the sources of a very large bacterial contamination of milk. Methods of cleaning and sterilizing these machines are now being studied and it has been found that they can be completely sterilized (except for an insignificant contamination from the air) by using steam for the metal parts and a solution of chloride of lime for the rubber parts. It is believed that the methods used are capable of being so simplified that results very nearly as good can be obtained by any intelligent farmer. The next experiments made will be carried out in an effort to determine whether or not this belief is justified.

The value of having joined efforts with the Illinois Station in this general study of the sources of the bacterial contamination of milk has been shown by preliminary publications from the latter Station during the past year dealing with the importance of dairy utensils as causes of trouble and of publications which corroborate the findings previously published from this Station in regard to the relative unimportance of dust in the stable air, special methods of wiping the udder and of cleaning the cows, and interior finish of the stable as sources of bacterial contamination of milk. As a result of all of these studies upon stable sanitation, a trial form of dairy score card has been drawn up which is now being used at the Illinois Station in a practical way in order to determine its value.

(3) *The accuracy of present methods of bacterial analysis of milk.*—The increasing use of the bacterial count in this State as a means of grading milk makes studies of the accuracy of the results highly desirable. From the beginning bacteriologists have recognized the great difficulties involved in getting an accurate count of objects as minute as bacteria, especially as these occur at times in incredible numbers. The methods which have been used in making these counts have been indirect ones based upon the growth of the bacteria into colonies visible to the naked eye. It has been recognized that there were certain possible errors in the counts which would tend to make the numbers too low; but no method of measuring the amount
of the errors has ever been devised until recently. The errors have been controlled as well as could be done by the adoption of standard methods of analysis and the counts secured have agreed fairly well when made by trained workers using satisfactory methods of analysis.

The common use of this technique in control and commercial laboratories, where tens of thousands of samples of milk are handled yearly, has, however, caused various modifications and simplifications of the methods of analysis to be brought into use and the question has arisen whether the results secured are accurate enough so that the farmer and dealer can depend upon them. As a result, this Station joined with four New York City laboratories in carrying out the most extensive series of comparative analyses which has ever been attempted; and the findings were published by the U. S. Public Health Service in Public Health Reports for August 13, 1915. These findings were not altogether reassuring to the farmers and dealers and showed the necessity for further studies. These, the Station has undertaken both at Geneva and also in cooperation with the Department of Dairy Industry of the State College of Agriculture and the work is in progress at the present time. A discussion of one of the sources of error has been published during the year as Technical Bulletin No. 53.

The recent development of microscopical methods of counting bacteria in milk (the work having been done largely at this Station) permits comparative analyses to be made from which it will be possible to determine the amount of the errors in the count and their causes much more accurately than has ever before been possible. A description of this method of counting has been published during the year as Technical Bulletin No. 49. A description of the technique has also been incorporated in the report of the official standard methods of bacterial milk analysis adopted tentatively by the American Public Health Association.

Soil flora studies.—In spite of the advances in knowledge regarding the microorganisms which live in the soil, no comprehensive attempt has been made to classify the microorganisms therein or to learn their relative abundance and distribution. The Station has been undertaking this work for the past five years and two technical bulletins dealing with certain phases of the studies have been issued during the past year. A general report discussing all of those
organisms which can be studied by the ordinary bacteriological methods is now being prepared and will be issued in a series of technical bulletins. The results secured indicate that the methods used have probably disclosed the larger part of the most important soil organisms, though this is far from being certain. Three main groups of organisms have been recognized: (1) Long, rod-shaped, spore-forming bacteria, (2) a group of organisms sometimes regarded as bacteria and sometimes as true fungi, known technically as Actinomycetes, and (3) the group of non-spore-forming bacteria. In Technical Bulletin No. 51, it has been shown that, while the spore-forming bacteria are always present in soil, forming about 5–10 per ct. of the colonies on agar plates, there is good reason for believing that they exist in normal soil only as spores and that they are therefore not ordinarily active in soil. This finding is contrary to what has generally been assumed, as it has been thought that they were active ammonifiers in soil and therefore very important agents in the decay of organic matter in the soil. The Actinomycetes have been found to be more abundant in sod soils than in cultivated soils (Technical Bulletin No. 52), ordinarily forming about 30–40 per ct. of the colonies on plates from sod soil and only 15–30 per ct. of the colonies from cultivated soil. Because of their association with grass roots, it has been suggested that they are the organisms which are active in causing the decay of dead grass roots. A study of the classification of these organisms has thus far revealed a surprisingly large number of different types, about 70. New methods have been developed for this study which it is hoped will permit a satisfactory classification of them to be made. Further knowledge of this obscure and little known group, which apparently is very important in soil activities, is greatly needed. It is the group which contains the organism causing potato scab as well as some organisms which cause diseases of animals, one of the more important of which, from the agricultural standpoint, is the one causing lumpy jaw of cattle. The group of non-spore-forming bacteria has been found to be the most abundant of all bacteria in soil, apparently the most active, and therefore probably the most important of all. However, thus far they have proved to be very difficult to study in any way which will show how many kinds there are or what their function is in soil. No methods have yet been devised which give any real knowledge in regard to these points.
COOPERATIVE STUDIES
Stable and milk sanitation. Illinois Agricultural Experiment Station,
Urbana, Ill.
Methods of counting bacteria in milk. State College of Agriculture, Ithaca,
N. Y.
Methods of controlling the sanitary quality
of market milk. White Springs Farm Dairy Co.,
Geneva Milk Company,
Geneva Board of Health, and about 40
dairymen in the vicinity of Geneva.

BOTANICAL DIVISION.

Tree crickets as carriers of parasitic fungi.—In earlier work of the
Station it has been shown that the areas of dead bark surround-
ing the oviposition punctures of tree crickets on apple branches are
often caused by the fungus of raspberry cane-blight, Leptosphaeria
coniothyrium. Naturally, the suspicion arose that tree crickets
carry the spores of the fungus. This suspicion has now become an
established fact. It has been shown that they may carry the cane-
blight fungus from raspberries to apple trees and infect them; also
that they carry within the digestive tract and on the outside of their
bodies spores of many other kinds of fungi. Spores and fragments
of mycelium of many kinds of fungi have been found in the excre-
ment of tree crickets captured in the field and in the excrement
covering their oviposition punctures.

By means of feeding experiments it has been proven that the
spores of fungi causing such diseases as corn smut, raspberry cane-
blight and the blister canker and black-rot canker of apple trees
may pass through the digestive tract of tree crickets without loss of
viability. Also, typical apple cankers have been produced by feed-
ing tree crickets on raspberry cane-blight fungus and then permitting
them to oviposit on apple branches.

This work was done in cooperation with the Entomological
Division. The results have been published in Technical Bulletin
No. 50.

Lime-sulphur solution versus bordeaux mixture for potatoes.—Each
summer during five consecutive years an experiment was made in
which lime-sulphur solution and bordeaux mixture were compared
as to their efficiency in the spraying of potatoes. The bordeaux
mixture proved superior in every case. Its use resulted in an
average increase in yield (over the check) of 68.6 bushels of market-
able tubers per acre; while from the use of lime-sulphur solution there
was an average decrease of 25.8 bushels per acre. In all five seasons the lime-sulphur solution caused injury to the foliage. Only in the last season of the experiment was there an opportunity to test the effect of the two mixtures on late blight. Bordeaux mixture checked it very materially but lime-sulphur solution not at all. Clearly lime-sulphur solution should not be used for spraying potatoes.

The degeneration, or "running out," of potatoes.—The so-called "running out" of potatoes is usually due to certain obscure diseases or forms of degeneration known as leaf-roll, curly-dwarf, mosaic and spindling-sprout. For the purpose of increasing our knowledge of these diseases a large number of potato plants of known parentage were kept under close observation.

One striking feature of the study was the frequency with which the progeny of plants having normal foliage and high yield suddenly degenerate into worthless dwarfs affected with some one of the diseases above named. From this it appears doubtful if any method of seed selection will prevent the "running out" of potatoes under certain conditions.

In general, plants from different tubers of the same plant are similar; also plants from different eyes of the same tuber usually resemble each other closely; but exceptions to both rules are frequent. Various combinations of normal, mosaic, leaf-roll and curly-dwarf plants may be obtained from the several eyes of one tuber.

Although the cause of none of the diseases was determined, the conclusion was reached that leaf-roll, mosaic and curly-dwarf are very closely related disorders. All three are transmitted through the seed tubers, and, apparently, are not communicated in any other way. Spindling-sprout is not correlated with the other diseases. Whether this, also, is an hereditary disorder has not been determined.

Field work.—An experiment on the mosaic disease of potatoes, is being conducted on Mr. Sirrine's farm at Riverhead in cooperation with Mr. W. A. Orton, of the United States Department of Agriculture.

CHEMICAL DIVISION.

Chemical changes in souring milk.—In studying the chemical changes that take place in the souring of milk, it is found that in 60 hours about 22 per ct. of the milk-sugar is changed by the lactic acid bacteria, 88.5 per ct. of the amount so changed being converted into lactic acid. Citric acid completely disappears. The insoluble
inorganic constituents of the fresh milk are made soluble by the lactic acid, the latter passing into combination mainly as calcium lactate. Albumin of sour milk passes through a porcelain filter completely. Calcium caseinate is changed into free protein and precipitated. Most of the change of milk-sugar occurs between the 10th and 24th hours. When the amount of lactic acid reaches 0.7 per cent., the bacterial activity is much reduced. The acidity increases most rapidly during the first 24 hours, the rate of increase diminishing after that. The acidity of the serum increases, owing to increase of lactic acid. In the insoluble portion of the milk the acidity is due to free casein. Calcium, combined as dicalcium phosphate in milk, goes into solution completely in $13\frac{1}{2}$ hours, forming acid calcium phosphate. Calcium combined as caseinate is acted upon more slowly, complete solution requiring about 24 hours. The amount of albumin nitrogen in serum increases with increase of acidity; all the albumin of the milk appears in the serum in about 14 hours. These investigations are discussed in Technical Bulletin No. 48.

The utilization of inosite by the animal organism.—Phytin is a somewhat important compound found in our cereal grains, of which inosite is a constituent part. In studying the rôle of this inosite-bearing body, it seemed desirable to determine the fate of inosite itself in the animal organism.

Experiments with dogs showed that inosite is not used by this animal to any great extent.

When taken by man at the rate of a half gram per kilogram of body weight, it had no effect upon the general metabolism. About nine per cent. of it appeared in the urine, but none in the feces. Just what happened to the 91 per cent. not eliminated through these two channels was not determined. For details of these experiments those interested are referred to Technical Bulletin No. 54.

A study of the volatile oils in the urine of cows, goats, horses and human beings.—The volatile oils that may be isolated from the urine of the several species of animals, including man, have been investigated comparatively little.

Such oils, as isolated from the urine of the animals mentioned in the heading, have been given considerable attention in our laboratory and progress made in determining their chemical nature. They appear to vary with the season and the available food supply. Discussion of these studies appears in Technical Bulletin No. 55.
Inspection analyses.— During 1916, 650 samples of fertilizers were analyzed. There were 234 samples of complete fertilizers; 218 samples of mixed fertilizers, containing nitrogen and phosphoric acid; 70 samples of acid phosphate; 28 samples of calcium or lime compounds; 32 samples of bone; 15 samples of tankage; 10 samples of nitrate of soda; 10 samples of dried animal manures; and a small number of samples each of blood, dissolved bone, mixtures of phosphoric acid and potash, insoluble phosphoric acid materials, ashes, garbage tankage, ground fish, soot, stone-meal, mixtures of nitrogen and insoluble phosphoric acid; and mixtures of calcium compounds and phosphoric acid.

During the year 1916, 1015 samples of feeding-stuffs were analyzed. There were 45 samples of cottonseed meal, 13 of linseed meal, 13 of malt sprouts, 14 of distillers' dried grains, 5 of yeast or vinegar dried grains, 11 of brewers' dried grains, 12 of corn gluten feed, 1 of corn gluten meal, 29 of hominy feed, 117 of compounded feeds, 132 of molasses compounded feeds, 95 of compounded poultry foods, 12 of calf meals, 54 of animal products, 23 of alfalfa meal, 130 of wheat bran, 114 of wheat middlings, 65 of wheat bran and wheat middlings, 8 of wheat bran and low-grade wheat flour, 60 of buckwheat products, 3 of ground corn and oats, 7 of wheat bran and corn by-products, 3 of wheat middlings, rye middlings and ground screenings, 13 of corn feed meal, 15 of rye by-products, 5 of ground screenings, and 18 of miscellaneous mixtures.

ENTOMOLOGICAL DIVISION.

Plant lice injurious to apple orchards.— Injurious as are several species of aphides to apple orchards, there was, prior to this study, a lack of detailed information as to their activities as fruit pests and of practical measures for the prevention of losses to fruit yields. Of the three aphides that attack apple foliage and fruit the rosy aphis (Aphis sorbi Kalt.) is the most injurious species, although the associated forms, the green apple aphid (Aphis pomi De Geer) and the oat aphid (Aphis avenæ Fab.) are capable of causing harm. The rosy aphid, when abundant, produces small deformed apples commonly known to orchardists as "aphis apples" which for the most part have no value. Studies on the life history and habits of this species show that it breeds on apple trees during May, June and early July. During the two latter months winged forms are
produced which migrate to various species of plantains. On these weeds the rosy aphis exists until autumn when it again seeks apple trees. Experiments with the insect to determine its influence on the development of the young fruit indicated that inhibition of the growth of the apples varied largely according to the extent of infestation. In general the rate of development was in inverse proportion to the degree of infestation — the larger the number of aphides the smaller the size of the affected fruit. Of forty-nine apples exposed to attack by the rosy aphis only two fruits were at the end of the growing season of marketable size and shape, while many of the apples besides being undersized were also one-sided or otherwise deformed. All checks, thirty-one in number, were normal in shape and ranged from $2\frac{1}{4}$ to $3\frac{3}{8}$ inches in diameter. Besides the obvious shrinkage in fruit yields from the so-called "aphis apples" it is apparent from these figures that growers may sustain more or less important losses from attacks of the insects which, while not serious enough to render apples unsalable, nevertheless prevent them from attaining maximum size.

On the basis of experiments conducted by this Station the most promising means of combating the aphides is a thorough spraying of the trees at the time when the insects are assembled on the ends of the buds showing green and while the buds are compact and the tips of the unfolding leaves are barely showing. Complete directions for the spraying of apple trees as well as an account of the results of the biological studies to date are given in Bulletin No. 415 of this Station.

_Cabbage maggot: Biology and control._—Bulletin No. 419 contains the results of studies on the life history and habits of the cabbage maggot for a period of eight years and data on the effects of weather and of different crops on its numbers as well as on its susceptibility to certain control measures. The cabbage maggot is a northern insect and, like its host, attains maximum development in a cool, moist climate. Studies on the life history of the pest show that when conditions are favorable there are at least three broods and perhaps a partial fourth brood. However, the summer temperatures that frequently occur during July and August in western New York are unfavorable to the normal development of the insect, and seem to cause a retardation which may last until the weather becomes cool. High temperatures affect the insect both directly and indirectly.
The roots of cabbage and other cruciferous plants become tough and woody at the appearance of hot weather, so that the larvae grow very slowly. Also, it appears that the weather may directly influence the pupal stage and that this period may be lengthened or shortened so that the insect may be one-, two- or three-brooded. This situation has been interpreted in the same way as that outlined by various writers for the Hessian fly, which is, namely, that high temperature or severe drought causes a retardation of the developing larvae and pupae. It is probable that the optimum temperature for the development of the pupae is around 80° F. for the average maximum temperature and 55° for the minimum.

The control work has been mainly directed to perfecting the method of growing cabbage seedlings under cheesecloth for the protection of young plants in districts devoted to the cultivation of late varieties of cabbage. In localities where injuries are confined to seed-beds the use of cheesecloth has proven a practical and economical means of preventing loss. In addition to protection from injurious insects cheesecloth helps to conserve the moisture and prevents the soil from becoming crusted. Plants raised in screened beds grow faster during most seasons and attain the size desired for transplanting sooner than plants in open beds. The extra cost of protecting plants by this method ranges approximately from six to twenty cents per thousand, and in the opinion of farmers this additional outlay is more than met by the saving in seed over the old method of growing seedlings. For the protection of early cabbage tar pads attached about the collars of the plants have proven the most efficient and economical method for the prevention of losses.

Miscellaneous notes on injurious insects.—Bulletin No. 423 deals briefly with a number of insects which are generally of minor importance, though certain of them reveal harmful potentialities; and other species are sufficiently numerous in occasional years to cause considerable damage. The most important species discussed are the orchard ermine moths (*Yponomeuta malinellus* Zell. and *Y. padellus* L.) which are very destructive fruit pests in Europe. Especial importance is attached to the insects at this time since, in spite of previous warnings by this Station, they are being introduced in greater numbers than ever before. The largest importation in a single year was noted in 1915 when over three thousand seedlings infested with ermine-moth nests were detected in more than a
dozen localities widely distributed in the fruit regions of western New York. As there is danger of the permanent establishment of these pests, horticultural inspectors and fruit growers alike should be alert to the importance of recognizing and combating them on their first appearance. Observations on the larval activities on apple are in accord with those of foreign writers upon the species attacking this host. The leaf-weevil (*Anametis granulata* Say) is recorded as being present in destructive numbers in plantings of young peach trees in Niagara County. The insects ate opening buds and margins of unfolding leaves. Injurious outbreaks are also noted for the lesser peach borer, the linden cankerworm and the goose-berry fruit-worm. In an effort to correlate the different green fruit worms on apple with the moths of the various species, one form (*Graphiphora alia* Guenée), which belongs to a group not known heretofore to contain noxious insects, proved to be quite common and destructive to young apples.

*Leaf weevil (Polydrusus impressifrons* Gyll.).—Technical Bulletin No. 56 is an account of an imported species of leaf-weevil which was recently discovered in the State of New York where, in certain localities, it has become very abundant. The beetle apparently manifests a choice for willows, poplars and birches. It causes damage to plants by nibbling the developing buds of budded and grafted stock and attacking the foliage and succulent tissues, as stems of newly-unfolded leaves and stalks of terminal growth. The gouging of tender tissues is not infrequently attended by severing of leaves and destruction of tips of shoots. The life stages and habits of the beetle have been carefully studied and are described for the first time with considerable detail. The weevil is attacked by at least one parasite, which proves to be a new species of braconid of the genus *Diospilus* Haliday. Protection from the leaf-weevil is obtained by applications of arsenicals at standard strengths.

*Cherry leaf-beetle.—* This species, which suddenly developed to enormous numbers during 1915 and 1916 and seriously attacked various stone fruits, principally the cherry, is the subject of Circular No. 49. This is a popular treatise, illustrated with two plates, in which the different stages are described and figured and the seasonal history is discussed. On the basis of some preliminary experiments by this Station, brief directions are given as to the most efficient methods for the prevention of injuries.
Periodical cicada in 1916.—Circular No. 50 was prepared to notify orchardists of the probable occurrence of the cicada during 1916 and to solicit information as to dates of appearance, distribution and local importance. The chief point of interest noted in the reappearance of the species was the occurrence of great numbers of the creatures in old apple orchards generally, growing north of Victor, where considerable damage was done to both apples and peaches as a result of oviposition.

Some insects attacking the pear and their control.—Circular No. 51 was originally prepared for a publication for the New York State Department of Agriculture and was reprinted by this Station without change in text. It is a brief compendium, dealing with the more destructive insects of the pear, in which chief emphasis is placed on such species as the sinuate borer, the pear thrips and the pear psylla.

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HORTICULTURAL DIVISION.

New or noteworthy fruits. IV.—All interested in better fruits should welcome new varieties. No one of our fruits is yet perfect; and, until perfection be attained, new varieties, better in one or more characters, are well worth their cost for the progress they make in the development of fruit. If the multiplication of kinds helps to evolve more perfect fruits, what matter if many, even most, new fruits turn out to be unprofitable in dollars and cents? The little time and expense needed to apply the test of fitness to a new fruit is a cheap price to pay for the development of better fruits. Again, there is profit in growing many varieties for variety's sake. In the business of growing fruit a multitude of varieties is needed for a multitude of consumers; dessert and culinary requirements are many and are not nearly met by the niggardly assortment which commercial fruit-growers are now putting on the markets. A greater variety from which to choose would further the enjoyment and the consumption of fruits.

Unfortunately, neither time nor money suffices for the fruit-grower to determine for himself the merits of all of the new fruits. This Station attempts, as far as it is able, to do this for him, and from year to year bulletins are published to show what fruits on the Station grounds, either novelties or old sorts now neglected, are sufficiently noteworthy to deserve the attention of fruit-growers. In Bulletin No. 414, the fourth in this series, are discussed the Perfect apple, Rochester peach, Reine Hortense cherry, Empire State grape and Herbert raspberry.
New or noteworthy fruits. V.—In Bulletin No. 427 is given a fifth report on new or noteworthy fruits grown on the grounds of the New York Agricultural Experiment Station. The purpose of this series of bulletins is to call attention to the best recent fruit-introductions or to an old, deserving variety of merit at present but little grown. In the introductory remarks emphasis is laid on the fact that varieties do not grow equally well in all soils and climates, and that a sort succeeding in one place may fail in another locality. The objects of growing many varieties on the Station grounds are: To make certain whether each is distinct; to tell relative time of blooming, leafing, ripening, and maturity of plant; to determine earliness or tardiness in coming in bearing; to ascertain, to some extent, susceptibility to insect and fungus pests; to determine for what purpose varieties are best adapted; to make full and complete descriptions for purpose of identification; to make it possible to state what varieties succeed on the soil, under the climate and with the treatment given them on the Station grounds. Report is made of the number of fruits growing on the Station grounds.

Following this discussion various fruits thought to be worthy of attention are described. These are the J. H. Hale and the Pearson peaches, the Mirabelle plums, the Empire raspberry and the Good Luck strawberry.

Some notes on the breeding of raspberries.—Bulletin No. 417 discusses some of the results secured in nearly a quarter of a century of raspberry breeding at this Station. At first the work was largely confined to the red raspberry and a number of excellent seedlings was secured from various combinations of Marlboro, Loudon and Superlative. Since 1910 greater attention was paid to the black-cap and purple raspberries. About 3,300 seedlings were tested. The breeding of purple raspberries was undertaken to secure better varieties of this popular sort and to show, beyond a doubt, that these originated as hybrids of the black-cap and red raspberry. Some very promising seedlings have been secured. Hybrid seedlings were produced by crossing two different black-caps with the same red raspberry. With one cross the seedlings were all purple; among the 289 seedlings of the other cross were ten yellows. None propagated by suckers.

In order to find which are the best parents, a study was made of the performance of various varieties. The record of Marlboro,
Herbert, Cumberland and Smith No. 1, a seedling black-cap of unknown origin, is given.

A study of the inheritance of color of fruit would indicate that several of our black raspberries are heterozygous for color and that probably several color factors are present. The same thing holds for the red raspberries. Selfed seedlings of Columbian, a purple, gave one yellow, one black and forty that were probably varying degrees of purple. A black-cap which was pure for color produced only purples when crossed with a red containing a factor for yellow but, when both were heterozygous, some yellow hybrids were produced. From a correlation which was found between leaf coloration and fruit it would seem that it is entirely possible to tell plants of the yellow raspberries from either the red or purple sorts by the absence of any tinge of red on the leaves. It is probably true also that the bark of the young canes of the yellow varieties is entirely lacking in any touch of red or purple color. Glaucousness, rough and smooth bark, and spines are seemingly Mendelian characters.

Of more than 600 purple raspberry seedlings having Smith No. 1 as the female parent, all were standard plants; but nearly one-third of the 289 Cumberland seedlings were dwarfs. The factor for dwarfinh is evidently one of rather rare occurrence.

Some interesting hybrids were secured when the Herbert red raspberry and the Blowers blackberry were pollinated by the flowering raspberry, Rubus odoratus. This work of hybridization will be continued with many other species, of which there are now nearly fifty growing on the Station grounds.

Witloof chicory. — This is a salad plant little grown in America but of wide and extended use throughout Europe. The leaves forced from the dormant roots by application of artificial heat constitute an excellent salad material for use during the winter season. Large quantities were imported into this country from Belgium and France previous to the war.

Bulletin No. 418 reports the results of studies at this Station of the culture and forcing of Witloof chicory. It was found that plants may be easily grown from seed under our usual garden environment. Roots of a diameter between one and two inches produce the greater percentage of marketable heads. Sand proved an excellent medium with which to cover the forcing roots in that it blanched the leaves perfectly and promoted the formation of desirable
heads. Temperatures ranging between 50° and 60° F. were found satisfactory for the forcing soil. The crop harvested warranted the conclusion that Witloof chicory may be forced satisfactorily and profitably in America either in greenhouses or cellars.

PUBLICATIONS ISSUED DURING 1916.

BULLETINS.

No popular edition issued.


No popular edition issued.


Popular edition, pages 8, plates 2.

No. 420. May. Inspection of feeding stuffs. Pages 149.
No popular edition issued.

No. 421. May. Lime-sulphur vs. bordeaux mixture as a spray for potatoes. IV. M. T. Munn. Pages 7, plate 1.
No popular edition issued.

Popular edition, pages 8, plates 2.

Popular edition, pages 8, plates 2.

No popular edition issued.

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No popular edition issued.
TECHNICAL BULLETINS.


No. 56. December. The leaf weevil (Polydrusus impressifrons Gyll.) P. J. Parrott and H. Glasgow. Pages 24, pls. 8, figs. 6.

CIRCULARS.

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W. H. JORDAN,

Director.

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