New York Agricultural Experiment Station.

Geneva, N. Y.

Director's Report for 1903.

W. H. Jordan.

Published by the Station.
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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 Fertilizer Control.
† Absent on leave.
‡ In Second Judicial Department.
BULLETIN No. 244.

DIRECTOR'S REPORT FOR 1903.

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

Gentlemen:—I have the honor to submit herewith my report as Director for the year 1903. It is a pleasure to report that the year has been one of general prosperity in the affairs of the Station, although some conditions have been embarrassing, chiefly those occasioned by the disastrous fire of the previous year. Broadly speaking, experiment stations in their organization and work are, I believe, approaching each year more nearly their true function and the relation of helpfulness which they should sustain to the art of agriculture. In this respect the New York Station is, I trust, not an exception. It is certainly true that each year brings to it a closer relationship to agricultural practice and a greater number of increasingly complex problems for solution.

In what follows I have endeavored to set forth the present status of the institution, the changes and results for the year that is past and the more pressing needs for the future.

CHANGES IN THE STATION STAFF.

The frequency of changes in the Station staff noted for the year 1902 have continued, through various causes, during 1903. Other institutions seem disposed to forage on us when they are in need of men, and while from one point of view this is a matter for congratulation, it is no less embarrassing at times.

It is with unspeakable regret that I must record here the death of Victor H. Lowe, M.S., Entomologist to the Station, which occurred at Fort Collins, Colorado, on Aug. 27th. Mr. Lowe became connected with the Station in 1894, being first located at the branch office at Jamaica, L. I. In 1896 he was transferred to Geneva and was placed in charge of the entomological work of the institution. Judged by the character of his work and by the
personal and social relations which he easily established, Mr. Lowe met with unusual success. He combined in a rare manner the ability to accomplish results which secured the approval both of his professional associates who were looking for well established scientific data and of the men of practice who were seeking for aid on the farm and in the orchard. He developed, moreover, into a most popular platform speaker in the presentation of the results of his investigations. Mr. Lowe’s influence as a station official was greatly strengthened by his personality which not only inspired confidence in the integrity of all his purposes but drew to him a large circle of friends. His death creates a deep sense of personal loss in all who knew him intimately, for he was a devoted friend and a faithful and loyal co-worker.

Mr. Percival J. Parrott, M.A., was appointed to succeed Mr. Lowe as Entomologist to the Station and entered upon his duties Oct. 1st. Mr. Parrott was formerly a member of the Station staff as Assistant Entomologist. This position he resigned to become Entomologist to the Ohio Experiment Station, at which institution he was meeting with marked success when asked to return to New York.

Mr. E. B. Hart, Assistant Chemist, in view of the ability which he has shown in the field of chemical research, has been promoted to the rank of Associate Chemist.

Mr. John F. Nicholson, B.S., Assistant Bacteriologist, resigned to accept a similar position at the Oklahoma Agricultural and Mechanical College.

Mr. Martin Prucha, Ph.B., a recent graduate of Wesleyan University, where he specialized in bacteriology, was appointed to fill the vacancy occasioned by Mr. Nicholson’s resignation.

Mr. Frank A. Urner, A.B., a graduate of Cornell University, where he specialized in chemical studies, was appointed to a vacancy occasioned by the resignation of Mr. J. Arthur LeClerc in 1901.

Mr. Howard O. Woodworth, M.S., resigned his position as Assistant Entomologist and accepted a position in California. No one has, as yet, been appointed to succeed him.

It is to be regretted that the assistants in the various departments of the Station are being called to other institutions at higher
salaries after comparatively short periods of service with us. While this indicates that worthy and desirable men are selected for appointment to this staff, it is obvious that such frequent changes can but result in injury to our work. It is extremely desirable that such arrangements shall be made in the future with reference to the term of service of our assistants, under conditions which they shall consider desirable, that changes shall be less frequent.

THE FUNCTION OF THE STATION.

The institutional efforts now put forth in the interest of agriculture involve three general and distinct functions: (1) Research, which, broadly speaking, includes the discovery of new principles and facts and the application of these principles and facts to the processes of the farm; (2) instruction in known facts, which includes the teaching of students at a school or college and the spreading of information in a popular way among the agricultural people; (3) the protection of the people by law against fraud and against the spread of pests and other untoward conditions.

The institutions created by law which exercise these various functions are the experiment station, the college, the school, the farmers' institute, the fair, and state departments charged with duties of a purely administrative or executive character. Each institution or department is equipped with men and means adapted to its work. While the several functions enumerated have to some extent been exercised by the same institution, experience has shown that the same group of men cannot combine, with the largest degree of success, duties so unlike in character as those here enumerated. As a rule the teacher, under the conditions prevailing in the United States, whether in the academic or in the popular field, finds little time for investigation; and neither the investigator nor the teacher should be greatly burdened with duties of an administrative character, because such consume time and are antagonistic to a studious or reflective state of mind. The present tendency is certainly towards the differentiation of institutions along the line of functions.

The peculiar function of the experiment station is investigation and experimentation. The New York Agricultural Experiment Station is organized and managed in a way that is consistent with
this function and its work neither duplicates the work of any other state institution nor is it an infringement thereof. It teaches no students, it engages in inspection work only in those lines which seem to require close association with scientific laboratories and with professional knowledge, and it engages in popular instruction at institutes only to the extent necessary to spread a knowledge of its work and results and to place its staff in touch with the problems that confront farmers. There is in New York an inter-relation between the station, the college, the Department of Agriculture and the farmers' institutes which is helpful, but which constitutes neither duplication nor interference. The work of the Station is more fertile of useful results because the members of its staff are able to devote themselves with singleness of purpose to the discovery and application of truths that are important to the farmers' art.

THE GROWTH OF THE STATION AND ITS SUPPORT.

The New York Agricultural Experiment Station was organized over 21 years ago. During this period its activities have become greatly enlarged, with a corresponding increase in income and equipment. It is hardly to be expected that this growth has ceased. The scope and relations of experiment station work are steadily broadening. Agricultural practice is coming to rely more and more, as time passes, on the expert information and processes that so largely originate in scientific investigations and experiments, so that the experiment station is now an increasingly essential factor in agricultural affairs. While the time has come when such a view of the experiment station work is so evidently correct as scarcely to need a supporting argument, it is wise to summarize occasionally the facts which justify a continuance, or even an increase, of the public support given to the Station in New York; and thus to present a concise expression of facts which are seen in their full significance only by those who are entirely familiar with the growth of the Station and its activities during its history.

Establishment of the Station.—The New York Agricultural Experiment Station was established in 1880 by an act of the legislature passed June 26th, constituting Chap. 592, laws of 1880.
Geneva was selected as its location and the first director took possession of the Station property on March 1st, 1882. The equipment then consisted of 125 acres of land with the usual farm buildings, fruit orchards of reasonable size, and a scientific and clerical staff of five persons. Scientific laboratories and apparatus were entirely wanting.

The sum of $20,000 was made available annually for the support of the Station.

Increase in buildings and other equipment.—The buildings acquired with the Station property were a mansion house and the usual outbuildings.

The following are the buildings now situated on the Station grounds: A thoroughly equipped Chemical Building containing four laboratories, accommodating a large force of chemists necessary to the research and inspection work carried on by the Station; a Biological and Dairy Building in which are located the departments of bacteriology, botany, entomology, horticulture and dairying, together with five well-equipped laboratories; an Administration Building which is devoted wholly to administrative offices and the library; forcing houses with 6,500 feet of glass; poultry houses built for experimental work; a fine cattle barn; a horse stable in process of construction; six dwelling houses and various small buildings.

This increase in buildings has nearly all been effected since 1890, more than half of it having been secured since 1896. It has brought with it a corresponding increased expense for care, heating and repairs.

The farm has been improved from a somewhat run down condition to a satisfactory state of fertility. On it has been developed one of the finest collections of living fruits, large and small, to be found in the world, and nearly all of the land is used for strictly experimental purposes. The cost of maintaining such a farm can scarcely be appreciated by those who have had no experience in such matters.

Increase of staff and employees.—Since 1882 the scientific staff has increased from four members to twenty-one. Eight members have been added since 1896. The clerical force has increased from one person to four.
The addition to the buildings and laboratories, as well as the large increase of experimental work, both in the laboratories and in the field, have rendered necessary a corresponding increase in the number of employees such as laboratory helpers, janitors, forcing house assistants, herdsmen, teamsters and common laborers.

Increase in work.—Since 1875 control of a scientific basis has invaded every department of agricultural activity. The agricultural practitioner now relies upon the experiment station for advice along certain lines where expert processess are important. This is especially true of this State, 56 per ct. of whose products are those which are especially susceptible to scientific aid. This is shown, for instance, by the present relations of the Station to the control of commercial dairying, the use of spraying mixtures and other means for controlling injurious insects and fungi, the study of fertility and feeding problems, the investigation of horticultural problems and aid given in the purchase of fertilizers and feeding stuffs.

It is further shown by the fact that experiments have been carried on or are planned in 29 localities outside the Station laboratories and farm during the past two years. These experiments have included the use of cover crops, systems of managing apple orchards, the relative value of certain stocks for grape production, the commercial value of dwarf apple orchards, studies of the fertility of grapes, profits from shading strawberries, value of foreign varieties of chestnuts, financial results from spraying potatoes, prevention of certain cabbage diseases, prevention of red spot or rust in cheese, control of the San Jose scale and studies of certain troubles in canning peas.

Moreover, coöperative work in several lines has been carried on with the United States Department of Agriculture, notably in ascertaining the possibilities of producing high grade sugar beet seed in this State, in testing new forage crops, in studying the value of a large number of varieties of apples for cold storage purposes and in ascertaining the financial outcome of cold storage of cheese combined with the paraffining process.

The financial value of experiment station work.—It is not easy to express this value in exact terms. That it is far greater than the cost of the Station can easily be made evident, however.
There are 226,000 farms in New York. If the Station makes possible one dollar more profit yearly on each farm, the institution is a profitable investment. That intelligent farmers are helped many times this amount cannot be successfully questioned. We should consider, for instance, what our condition would be if there was no systematic study of the great problems of fertility and of plant and animal life, if we had no defence against the diseases and insects that infest farm crops and fruit, if no remedies were found for the troubles that afflict the dairymen, if science had lent no aid in preventing frauds that directly affect the farmer's pocketbook, and if we were still in the days of tradition and superstition concerning Nature's ways. If specific instances of station work need to be cited to make its value clear, mention may be made of the spraying of potatoes with a possible saving of millions of dollars yearly, of the study and control of the San José scale that threatened our fruit interests with their annual income of not less than $15,000,000, of the saving of the pickle industry on Long Island against the ravages of a fungus pest, of the means provided for controlling troubles affecting value of cheese and of information gathered by Station activity showing that this State is adapted to the production of sugar beets of the highest grade.

THE FINANCIAL SUPPORT AND NEEDS OF THE STATION.

Past expenditures.—It should be freely acknowledged that the State has been reasonably generous towards its experiment station. The annual income for the maintenance of all its work was at first $20,000 and Oct. 1st, 1894, it had become $69,500 in accordance with the following items:

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>For maintenance fund</td>
<td>$50,000</td>
</tr>
<tr>
<td>For outside horticultural investigations</td>
<td>8,000</td>
</tr>
<tr>
<td>For enforcing provisions of the fertilizer law</td>
<td>10,000</td>
</tr>
<tr>
<td>From United States Government</td>
<td>1,500</td>
</tr>
</tbody>
</table>

Total ........................................... $69,500

This continued to be the annual maintenance income of the Station until the fiscal year 1899–1900.

The legislature of 1899 amended the fertilizer law so as to require the payment annually of a license fee on the various brands of fertilizers, the same to be used in administering the
law, and also passed a law requiring the inspection of cattle foods by the Station, the expense of this to be met also from license fees.

From 1899 to Oct. 1st, 1903, the receipts of the Station for the maintenance of its various lines of work were as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance Fund</td>
<td>$50,000</td>
</tr>
<tr>
<td>For outside horticultural investigations</td>
<td>8,000</td>
</tr>
<tr>
<td><strong>Total raised by taxation</strong></td>
<td><strong>$58,000</strong></td>
</tr>
<tr>
<td>Enforcement of Fertilizer Law, from license fees</td>
<td>$10,000</td>
</tr>
<tr>
<td>Enforcement of Feeding Stuff Law, from license fees</td>
<td>2,500</td>
</tr>
<tr>
<td><strong>Total from license fees</strong></td>
<td><strong>$12,500</strong></td>
</tr>
<tr>
<td>From United States Government</td>
<td>$1,500</td>
</tr>
<tr>
<td><strong>Total annual income of Station for period stated</strong></td>
<td><strong>$72,000</strong></td>
</tr>
</tbody>
</table>

The amount hitherto given for outside horticultural investigations was not appropriated for the fiscal year 1903–4, so that, for the coming year, the revenue of the Station will be $8,000 less than for many years previous, the total income from the State being $62,500. Of this, only $50,000 is raised by taxation, a sum $18,000 less than was appropriated annually for five years previous to 1899 when the expense of inspection work was met directly by the State, instead of indirectly, by license fees, as is the case at present. This is the financial situation notwithstanding the growth of the institution.

For the fiscal year 1894–5 the cost of maintaining the work of the Experiment Station, exclusive of inspection, was approximately $6,200 for each member of the scientific staff. For the fiscal year 1902–3 the cost of maintaining the institution, exclusive of inspection, averaged only $3,600 for each member of the scientific staff. It is not intended by this comparison to imply that in the earlier days of the Station there was any extravagance or unwisdom in the use of funds but simply to show that through careful management the Station has been able to increase its work and activities without causing added expense to the state.

*Increase in buildings and other equipment.*—The legislature of 1903 made appropriations for additional buildings and equipment as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>For horse stable and carriage house</td>
<td>$5,000</td>
</tr>
<tr>
<td>For fire protection system</td>
<td>5,000</td>
</tr>
</tbody>
</table>
The horse stable and carriage house are well advanced in construction. The fire protection system is nearly installed. It will consist of a steel tower 100 ft. high surmounted by a tank holding 15,000 gallons of water. This tank is connected by a six inch pipe with hydrants so distributed as to be available to all the Station buildings of any size.

A Holloway chemical engine, with two 30-gallon cylinders, has been purchased, also three hose carts with one thousand feet of 2½ inch hose. The Station is now for the first time well equipped to combat fire.

**Buildings and equipment needed.**—The disastrous fire of May 7th, 1902, left the Station without any building for the storage of farm machinery and other materials which should not be located either in a cattle barn or horse stable. Such a building is imperatively needed and if so built as to accommodate grain storage in vermin proof bins should cost not less than $4,500 at the present very high prices for labor and building materials.

**The appropriations asked for 1904–5.**—The following are the appropriations needed for the fiscal year 1904–5:

For salaries of scientific and clerical staff ........... $27,500
For wages of the labor class, including engineer, janitors, laboratory helpers, employees in forcing house and orchards, herdsmen, teamsters, and common labor ......................... 13,000
For general expense, including heat, light, water, laboratory supplies, outside experiments, traveling expenses, equipment of scientific apparatus, farm machinery, and general expenditures of all sorts ........................................ 20,000

Total ........................................ $60,500

For fertilizer inspection (from license fees) ........... $10,000
For feeding stuff inspection (from license fees) ...... 3,500

For inspection .................................... $13,500
Total ........................................ $74,000

For building for storage farm machinery and grain $4,500

The above estimates are carefully made upon the basis of present needs, without allowing for much growth. The sum asked for outside of inspection work is $2,500 more than the Station has been receiving for the last four years but is $7,500 less than the sum appropriated for several years previous to 1899 from money raised by taxation. The sum named for feeding stuff
inspection is increased by $1,000. The receipts from license fees justify this and the additional sum can be well used.

The building for farm machinery and grain is certainly a real need. The farm machinery is now scattered in out of the way places, partly outside of the Station grounds, and during the working season it cannot be housed if kept where it is convenient for use.

THE MAILING LIST.

The mailing list continues to increase steadily. The increase in the popular bulletin list during 1903 is 1,707. Of these names, 1,103 are residents of New York.

BULLETIN LISTS, JAN. 1ST, 1904.

POPULAR BULLETINS.

Residents of New York .................. 36,384
Residents of other States ................ 1,800
Newspapers .................................. 770
Experiment Stations and their staffs ....... 917
Miscellaneous ............................... 131

Total ........................................ 40,002

COMPLETE BULLETINS.

Experiment Stations and their staffs ........ 917
Libraries, scientists, etc .................. 270
Foreign list .................................. 210
Individuals .................................. 2,265
Miscellaneous ............................... 131

Total ........................................ 3,803

INSPECTION WORK.

This includes the same lines of inspection that are enumerated in previous reports:

An outline of what has been accomplished in 1903 is as follows:

Inspection of fertilizers.—As is to some extent already known, the bulletin giving the results of the analyses of fertilizers for 1903, which usually appears not later than November, has been withheld from publication, temporarily at least. The necessity of this action, due to an insufficiency of statutory provisions, is certainly to be regretted. As a result of contentions arising from complaints made by me to the Attorney-General in accordance with Section 8 of Chapter 955 of the Laws of 1896, the question
of authority for the publication of the fertilizer bulletin was raised for the first time. After considering this point, the Attorney-General of the State rendered an opinion, the summary of which is as follows: "I am of the opinion, therefore, that there is no statutory authority, either mandatory or otherwise, for the publication of the results of the examinations in question, and, therefore, if the Board of Control, or the Director appointed by it, makes such publication it is subject to the same rights and liabilities as an individual would be who made such publication."

Litigation was threatened if the bulletin was published, and it is clear that neither your Board nor myself should be asked to assume personally the possible burden and vicissitudes of such litigation in behalf of the State, consequently the publication of the bulletin in question was withheld. It is evident that the fertilizer law should be amended to give the necessary authority for the publication of the results of the examination of samples of fertilizers.

For 1903, 83 manufacturers licensed 644 brands of fertilizers. The Station's collecting agents visited 203 towns between March 24 and August 28, obtaining 948 samples of fertilizers, representing 540 brands.

The following tabulated statement shows the average composition of the complete fertilizers collected during the year, together with a comparison of the guaranteed composition and that found by analysis:

**AVERAGE COMPOSITION OF COMPLETE FERTILIZERS COLLECTED.**

<table>
<thead>
<tr>
<th></th>
<th>Per ct. guaranteed.</th>
<th>Per ct. found.</th>
<th>Average per ct. found above guarantee.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen ..............</td>
<td>0.41</td>
<td>8.23</td>
<td>2.04</td>
</tr>
<tr>
<td>Available phosphoric acid</td>
<td>1.50</td>
<td>12.00</td>
<td>7.67</td>
</tr>
<tr>
<td>Insoluble phosphoric acid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potash ...............</td>
<td>0.50</td>
<td>15.00</td>
<td>4.55</td>
</tr>
<tr>
<td>Water-soluble nitrogen</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water-soluble phosphoric acid</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
COMMERCIAL VALUATION AND SELLING PRICE OF COMPLETE FERTILIZERS.

<table>
<thead>
<tr>
<th>Commercial valuation of complete fertilizers.</th>
<th>Selling price of one ton of complete fertilizer.</th>
<th>Average increased cost of mixed materials over unmixed materials for one ton.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average.</td>
<td>Lowest. $16.00</td>
<td>Highest. $60.00</td>
</tr>
</tbody>
</table>

In the table below we present figures showing the average cost to the purchaser of one pound of plant-food in different forms in mixed fertilizers.

AVERAGE COST TO CONSUMERS OF ONE POUND OF PLANT-FOOD IN MIXED FERTILIZERS.

- Nitrogen .................................................. 23.0 cents.
- Phosphoric acid (available) ....................... 5.75 “
- Potash ..................................................... 6.10 “

Inspection of concentrated feeding stuffs.—A summary of the work accomplished in this line is presented below, as shown by Bulletin 240.

(1) One hundred manufacturers have licensed one hundred and fifty-one brands of feeding stuffs for the year 1903.

The list of licensed brands may be classified as follows:

Proprietary or mixed feed...78 brands Sugar beet refuse... 2 brands
Meat and bone meal........ 15 “ Brewers' grains........ 1 brand
Distillers' grains......... 14 “ Corn bran................ 1 “
Humin feeding or chop..... 13 “ Corn oil cake.......... 1 “
Linseed meal................. 9 “ Gluten meal............ 1 “
Cottonseed meal............ 5 “ Molasses grains........ 1 “
Gluten feed.................. 6 “
Malt sprouts................. 4 “

Total..................151 brands

(2) Five hundred eighteen samples of feeding stuffs, officially collected from October, 1902, to February, 1903, have been analyzed.

These samples may be classified as follows:
<table>
<thead>
<tr>
<th>Name of feed</th>
<th>No. samples</th>
<th>No. brands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cottonseed-meal</td>
<td>15</td>
<td>8</td>
</tr>
<tr>
<td>Distillers' grains</td>
<td>18</td>
<td>8</td>
</tr>
<tr>
<td>Brewers' grains</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Linseed cake, ground</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Linseed oil meal</td>
<td>23</td>
<td>10</td>
</tr>
<tr>
<td>Gluten meal</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Gluten feed</td>
<td>22</td>
<td>7</td>
</tr>
<tr>
<td>Hominy feed</td>
<td>28</td>
<td>11</td>
</tr>
<tr>
<td>Malt sprouts</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>Germ oil meal</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Oats, ground</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Corn meal</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Bran and corn meal</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>Mixed feeds (bran and middlings)</td>
<td>56</td>
<td>33</td>
</tr>
<tr>
<td>Wheat offals (bran and middlings, unmixed)</td>
<td>76</td>
<td>69</td>
</tr>
<tr>
<td>Proprietary and mixed feeds (mostly corn and oat products)</td>
<td>177</td>
<td>123</td>
</tr>
<tr>
<td>Poultry foods</td>
<td>39</td>
<td>25</td>
</tr>
<tr>
<td>Miscellaneous feeds (oat hulls, screenings, etc.)</td>
<td>14</td>
<td>14</td>
</tr>
</tbody>
</table>

Total: 518 353

(3) No adulteration was observed among the cottonseed and linseed meals, gluten products and brewery and distillery residues, as shown by the official samples. Corn cobs were shown to be present in three brands of licensed feeds, in two samples of unlicensed bran and in one sample sold as pure corn meal. Several proprietary feeds were found, as usual, to be made up in part of oat hulls.

(4) Many samples of wheat offals, bran, middlings and the same mixed, were found to be unadulterated and of good quality. The same can be said of numerous samples of corn and oats ground together.

(5) The markets are offering many inferior feeding stuffs. At the same time, the great bulk of commercial cattle foods available to buyers are unadulterated and of good quality.

DEPARTMENT OF ANIMAL HUSBANDRY.

The importance of mineral matter and the value of grit.—In poultry feeding the supply of mineral matter is a most important consideration, and a number of feeding experiments have
been undertaken to ascertain what deficiencies exist in ordinary foods.

In feeding chicks the beneficial results attending the use of certain animal foods were found sometimes to be due chiefly to the bone or mineral matter which they contained. Bone ash was found to supply a deficiency existing in most rations which consisted wholly of grain and other vegetable foods.

In order to get further intimation as to the extent that the inorganic material was of nutritive value and how much of the benefit from its use might be due to mechanical assistance, certain other feeding experiments have been made.

In these tests nineteen lots of chicks were fed for either ten or twelve weeks, beginning with chicks from one to three weeks old.

The mixing of sand in the food, both in a ration containing animal food and one without, results in better health for the chicks and more efficient use of the food. The advantage of the sand was most apparent during the first four weeks.

The addition of raw ground Florida rock phosphate and sand to rations both with and without animal food resulted in better growth and more efficient use of food than when sand alone was added.

The addition of the ground rock to rations without animal food resulted in more rapid growth and more efficient use of food than the addition of sand alone.

Ground rock phosphate proved a better addition to rations both with and without animal food, than ground oyster shell. Better growth resulted and, on the whole, from less food.

Food mixed with finely ground oyster shell was less healthful and less efficient than when mixed with fine sand.

Mixing bone ash and ground oyster shell in the food resulted in more rapid growth than the mixing of sand alone, but injury attributed to the ground oyster shell made the feeding less profitable.

DEPARTMENT OF BACTERIOLOGY.

Black rot of cabbage and cauliflower.—This trouble has been studied in cooperation with the Botanical Department. The treatment by removing all diseased leaves which has been recom-
mended by other investigators has been found worse than useless under New York conditions. A fundamental study of the germ causing the disease is now in progress.

_Cheese curing._—Work on this problem is going forward in connection with the Chemical and Dairy departments. The publications of the year have dealt with the influence of the acid-forming bacteria upon the manufacture and early stages of curing of the cheese.

It is found that under normal conditions both the activity of the rennet in curdling the milk and the presence of the compounds which give the characteristic texture to the cheese curd are due to the action of the acid-forming bacteria. The rennet plays a part in the first stages of cheese ripening but it can only do this in the presence of an acid reaction. This acid reaction is normally brought about by the activity of the acid-forming bacteria.

These results may be summed up in the statement that the presence and activity of the acid-forming bacteria is the first requisite to the manufacture of normal cheddar cheese.

The influence of various factors upon the later stages of curing is now being studied.

_Fermentation of canned peas._—Before the opening of the canning season a circular explaining the true cause of this trouble and giving the lower limit of the heating required to prevent this fermentation was sent to the press and to all canners in the State.

Observations were continued throughout the season in a large cannery operated in accord with these suggestions. This establishment canned a ton of peas in a special experiment to determine the lower limits of temperature and time of heating to insure the destruction of the bacteria under factory conditions, as well as to determine the greatest amount of heating which could be given without injury to the quality of the peas. By this means it was found that there is a considerable range of temperature within which the peas are rendered sterile without injury to their quality.
DEPARTMENT OF BOTANY.

Potato spraying experiments.—The ten-year potato spraying experiment begun in 1902 has been continued during 1903, both at Geneva and Riverhead. Again, spraying has resulted in a large increase in yield. At Geneva the increase in yield due to three sprayings was 88 bushels per acre and that due to five sprayings, 118 bushels. At Riverhead three sprayings increased the yield 39½ bushels per acre and five sprayings increased it 56 bushels per acre.

In order to determine the actual profit in spraying potatoes under ordinary farm conditions, six business experiments were conducted in cooperation with farmers in different parts of the State. In each experiment the increase in yield was determined and an account kept of all expense. Since late blight was unusually destructive the past season, spraying proved highly profitable. On a total area of 61½ acres sprayed in the six experiments there was a total increase in yield of 3746 bushels which is at the rate of 61.24 bushels per acre. The value of 3746 bushels of potatoes was, at least, $1,873. Subtracting from this sum the total expense of spraying, $296.49, there is a remainder of $1,576.51, which is the total net profit. This is at the rate of $25.77 per acre.

It is estimated that the loss from potato blight in New York in 1903 was fifty bushels per acre on the average. Since the acreage of potatoes in the State is about 396,000 acres and the average price of potatoes last fall fifty cents per bushel, the total loss sustained by New York farmers was nearly $10,000,000. A large part of this loss might have been prevented by spraying.

The results obtained by the Station during the past two years especially, indicate plainly that the spraying of potatoes is a subject which should receive careful consideration by every potato grower in the State.

Unusual apple decays.—During March there was reported to the Station by apple dealers the occurrence of an uncommon decay of apples in storage. The trouble was investigated and determined to be caused by a fungus, a species of Hypochnus, which had never before been known to cause a decay of fruit.

It was found that the fungus always entered a fruit through
breaks in the skin made by scab, and investigations showed that it was impossible for it to grow through the unbroken skin. From the fact that only fruit affected with the scab was attacked by the rot the importance of preventing the scab by spraying is again emphasized.

In February, 1903, it was observed that a core rot of Baldwin apples was quite prevalent. Outwardly a fruit would appear perfectly sound, while an area about the core was decayed. An investigation did not reveal the trouble to be traceable to fungi or bacteria. A cause could not be found in the use or absence of fertilizers, soil conditions or imperfect ripening of the fruit. That it may have been due to overbearing or the excessively wet season, or to a combination of both of these factors is a possibility.

Commercial cold storage (30° F.) entirely checked the development of the decay.

_Combating the black rot of cabbage._—This work has been done in cooperation with the Department of Bacteriology. During four consecutive seasons, 1899–1902, field experiments were made on the removal of diseased leaves as a means of preventing cabbage black rot, a method which has been recommended by certain other investigators. Each season the area of the experiment field was one acre, one-half receiving treatment and the other half being left untreated for a check. On the treated half acre all diseased leaves were removed from the plants and carried out of the field once a week.

In the first three seasons there was so little black rot, even on the check, that no conclusions could be drawn from the experiment; but in 1902 there was a moderate attack of the disease and the results show conclusively that this method of treatment is not only a failure but worse. The treatment actually reduced the yield by 5,285 pounds on one-half acre, which is at the rate of 5½ tons per acre.

The treatment fails for four reasons:

(1) The removal of so many leaves reduces the vitality of the plants; (2) infection occurs through the roots as well as by way of the leaves; (3) infection may occur at the base of the leaf close to the stem and get into the stem unobserved; (4) the germs of the disease are so widely distributed that it is useless to
try to stamp out the disease by the removal of diseased material. No successful method of combating the disease is known. Further investigations on the subject are in progress.

DEPARTMENT OF CHEMISTRY.

In addition to the work done in the different lines of inspection, the Chemical Department has been carrying on lines of work, as follows:

The relation of acids in the process of cheese-manufacture to the ripening of cheese.—The study of the relation of paracasein monolactate, which was first discovered and identified in this laboratory, to the ripening of cheese, has been continued; and it has been shown that this compound is of great importance in cheesemaking and cheese-ripening, forming the essential compound with which the cheese-ripening process begins. The influence of such factors as time, temperature, moisture, salt and rennet, upon the disappearance of paracasein monolactate in cheese has been carefully studied from a chemical standpoint.

The sources of carbon dioxide in cheese-ripening.—The results of this chemical work suggest that in normal cheese certain changes occur that can be attributed only to living organisms, which remain yet to be discovered by biologists.

Rennet-enzyme as a factor in cheese-ripening.—This work, largely chemical, has been carried on in connection with the Bacteriological Department. It has been proved that rennet is a peptic enzyme and as such is able to digest the paracasein monolactate of cheese to some extent, but it does not appear to form the compounds that produce the flavor of cheese.

Conditions affecting chemical changes in cheese-ripening.—In this work a strictly chemical study has been made of the more prominent conditions that influence the changes taking place in cheese during the ripening process. The factors studied are such as time, temperature, moisture content of cheese, size of cheese, varying quantities of salt, different amounts of rennet, and acid. The facts discovered have an important practical bearing upon the conditions of the manufacture of cheese and of cheese ripening.

Experiments in curing cheese at different temperatures, with and
without a covering of paraffin.—This was a most valuable piece of
d work, carried on in coöperation with the U. S. Department of
Agriculture. The results are very striking and may be briefly
summarized as follows:

(1) The loss of cheese is less at low temperatures, and there-
fore there is more cheese to sell.

(2) The commercial quality of cheese cured at low tempera-
tures is better and this results in giving the cheese a higher
market value.

(3) Cheese can be held a long time at low temperatures with-
out impairment of quality.

(4) By utilizing the combination of paraffining cheese and
curing it at low temperatures, the greatest economy can be
effected.

Studies of phosphorus.—The status of phosphorus in certain
vegetable and animal materials has been studied. A method has
been developed by which the amounts of organic and inorganic
phosphorus can be differentiated. This work has been prelimin-
ary to a proposed study of the metabolism of phosphorus in the
animal body.

DEPARTMENT OF ENTOMOLOGY.

Further experiments with sulphur sprays for San José scale.—
The investigations of this Department for the year were largely
directed towards obtaining an efficient sulphur spray, which
could be more conveniently prepared than the lime-sulphur-salt
wash. In some preliminary tests conducted to this end in 1902,
a wash consisting of 33 pounds lime, 16½ pounds sulphur, 4-6
pounds caustic soda or potash, and 50 gallons of water, appeared to
have this qualification and proved to be the most satisfactory of the
various formulæ tested.

To ascertain its value under average orchard conditions for the
control of scale and the prevention of plant diseases, extensive
experiments, with the coöperation of the Horticultural Depart-
ment, were conducted with the wash at Queens, L. I., Yorktown
and Carlton Station. The trees treated numbered 1214, of which
375 are peaches, 287 pears, 5 cherries, 225 plums, 26 quinces and
296 large apples.
In September an examination was made to determine the effects of the treatment upon the scale and fruit diseases. The results upon the scale were variable. In some cases the treatment affected an almost entire destruction of the insects, while in others the numbers of the scale seemed to have been but little affected. This variability seems to have been due to the lack of sufficient heat from the lime and soda to make the necessary sulphur compounds. Owing to the slight attacks of diseases in these orchards, the fungicidal value of the wash was not determined. Apple scab and sooty blotch were almost entirely absent. The fruit of the checks and treated trees seemed to be equally free from these troubles. Peach leaf curl, while more prevalent, was not sufficiently abundant to indicate the merits of the wash for its prevention.

In view of the varying results obtained, investigations are being made to determine methods by which the wash may be made uniform in all preparations. For the present this wash is advised only for experimental purposes. As the lime-sulphur-salt wash has proven more satisfactory, it is recommended for the treatment of the scale. Directions for its preparation and application are given in Bulletin 228.

The peach snout beetle (Anametis granulatus Say).—Observations upon this insect were begun last year and are being continued. It has apparently not been recognized as a species of economic importance till this year when its destructive attacks upon young peach trees entitle it to a place upon the list of injurious insects. The life history of this species is not fully known. The beetles make their appearance in early May. They feed at night upon the foliage, and during the day remain partially concealed in the ground. Some new facts upon the egg-laying habits were obtained. The eggs were usually deposited in folds of the leaves or between two leaves, drawn and glued together.

The habits of the beetles indicate two methods of treatment; first, catching the beetles at night by means of a curculio catcher; and second, spraying trees with arsenate of lead once before buds burst and again after blossoms have fallen.
Thinning apples.—Observations have been made on the effect of thinning apples upon the color, size and market value of the fruit; also upon the amount and regularity of fruit production. The thinning was done during June and July. The experiments were continued with the same trees for four consecutive years. These trees were mature, in good condition and well cared for. Under certain conditions thinning improved the size, color and market value of the fruit, but with the trees under experiment it had no appreciable effect upon either the amount or regularity of fruit production.

Spray apparatus and spray mixtures.—No small part of the Station's correspondence relates to plant diseases and injurious insects and the treatment of the same. To assist in answering questions which are appearing in such correspondence and to put in concise, readily available form the notes and observations acquired in Station experience, Bulletin 170 was prepared in 1899, by the Horticulturist, Botanist and the Entomologist. It gives popular information concerning diseases and insects injurious to orchard fruits. A revised edition of this is now available, embodying recent notes. This is now supplemented by a bulletin from the Horticultural Department on spraying apparatus and spray mixtures, which gives an up-to-date account of the preparation and application of liquid fungicides and insecticides, including illustrated descriptions of spraying apparatus. It is, in fact, designed for a handbook on this subject embodying classified information drawn from experimental tests and from years of Station experience in orchard and field work, as well as from correspondence and personal interviews with orchardists and others who use spray mixtures extensively and successfully. This bulletin is well worthy of being kept for reference.
BULLETINS PUBLISHED IN 1903.


No. 239. September. Thinning apples. S. A. Beach. Pages 30, plates 2.


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