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New York Agricultural Experiment Station.

GENEVA, N. Y.

DIRECTOR'S REPORT FOR 1905.

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.

* In Second Judicial Department.
BULLETIN No. 274.

DIRECTOR'S REPORT FOR 1905.

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

Gentlemen:—I have the honor to submit the following report of the institution under your charge, for the year 1905. In presenting this report it gives me sincere pleasure to express my warm appreciation of the helpful attitude of sympathy and wise support which you have steadily maintained towards me as your executive officer.

It is no less gratifying to record again my sense of obligation to the members of the Station staff for their most earnest and loyal cooperation in carrying on the work of the Station. My associates share generously with me the responsibilities attending our efforts. It has for some years been the policy of this institution to grant to the members of the staff, especially to the heads of departments, large liberty in initiating and maintaining those lines of work which seem likely to be most fruitful of beneficial results. That this policy has justified itself I am firmly convinced. Indeed, in no other way can there be secured the atmosphere of freedom and inspiration so essential to scientific inquiry.

CHANGES IN THE STATION STAFF.

In no year during the life of the Station have the changes in the staff been so numerous, and in no year more important. The larger number of changes have occurred in the chemical department, in fact these have been so many as to cause more or less embarrassment.

It is my painful duty to record here the death of Mr. W. H. Andrews, a member of the chemical staff, which occurred at his home in Geneva on September 29. Mr. Andrews first became connected with the Station in 1891, and had been in its service continuously since October 1, 1895. Not long previous to his last illness he was placed in immediate charge of the
analytical work performed for the Commissioner of Agriculture in the inspection of fertilizers and feeding stuffs. Faithfulness and efficiency characterized Mr. Andrew's work no less emphatically than the qualities of a high-minded gentleman characterized his everyday life and his relations to his associates. His death has brought to all his co-workers a sense of deep personal loss.

Prof. S. A. Beach severed his connection with the Station on September 1 because of his acceptance of a call to the chair of Horticulture in the Iowa Agricultural College. During his fourteen years of service as head of the Horticultural Department, Prof. Beach gained the attention of the fruit interests of New York to an unusual degree. Such confidence was placed in his conservative and well-guarded utterances that his advice had without question come to exert a marked and highly beneficial influence upon the horticultural practice of the State. Prof. Beach's period of service was brought to a fitting close by his authorship of "The Apples of New York," which is the most notable pomological publication of recent years. Horticultural education in Iowa is certainly much strengthened by the acquisition of Prof. Beach, for whom his friends and recent associates wish the most abundant success in his new field of labor.

Mr. F. D. Fuller, for nearly nine years connected with the chemical work of the Station, received a well earned promotion to larger responsibilities and salary by his appointment to a position in connection with the Pennsylvania Department of Agriculture, the duties of which he assumed on May 15, 1905.

The Station was further honored by the selection of Mr. A. J. Patten to become the chief chemist of the Michigan Agricultural Experiment Station. Mr. Patten's experience as a chemist in two experiment station laboratories, a year of advanced study in Germany and recent association with important lines of research have rendered him well fitted to enter successfully upon the work of investigation.

Upon the request of the Commissioner of Agriculture, Mr. Charles W. Mudge, Assistant Chemist, was transferred to the Department of Agriculture on June 1st. Mr. Mudge's connection with the Station covered something more than six years, during
which time he applied himself diligently to the duties that were assigned to him.

Mr. F. A. Urner, Assistant Chemist, after less than two years' service, resigned his position on January 9th, 1905, to take up chemical work along commercial lines.

The position vacated by Prof. Beach has been filled by the selection of Prof. U. P. Hedrick, M.S. Prof. Hedrick comes to us from the Michigan Agricultural College, of which institution he is a graduate and in which he served for six years as Assistant Professor or full Professor of Horticulture. He had previously held positions as Inspector of Orchards and Nurseries in Michigan and as Professor of Botany and Horticulture in the agricultural colleges of Oregon and Utah. The wide acquaintance with the facts and principles of Horticulture possessed by Prof. Hedrick, his extended opportunities for practical observation and his experience as a public speaker, designated him as peculiarly fitted to lead the horticultural activities of the Station.

The vacancies in the chemical department have been filled by the choice of Mr. Ernest L. Baker, B. S., a graduate of the University of Maine, and at the time of his election a post-graduate student in Columbia University; Mr. Alfred W. Bosworth, B.S., a graduate of the Rhode Island College of Agriculture and Mechanic Arts, and later a student for a time at Yale University, who, when called to Geneva, was serving as Chemist at the Storrs (Conn.) Agricultural Experiment Station; Mr. William E. Tottingham, a graduate of the Massachusetts Agricultural College, who subsequent to his graduation served his Alma Mater first as Assistant Chemist to the Experiment Station and later as Instructor in chemistry; and Mr. Arthur W. Clark, a graduate of the University of Vermont who previous to accepting his present position was assistant chemist in the Pennsylvania Agricultural Experiment Station.

THE GROWTH OF THE STATION AND ITS NEEDS.

During the past ten years there has been a gradual, and in the aggregate a large growth of the Station equipment and work. There has not been a corresponding increase of maintenance funds and the time has now come when the question of the fur-
ther development of the Station's activities, indeed the mainten-
ance of the work it is now doing, must receive your serious con-
sideration.

A few comparisons will serve to set forth the situation as it
now exists.

In 1896 the science staff numbered fourteen (14) as against
twenty-two (22) at the present time, an increase of 57 per ct.
During this period the clerical staff has doubled.

Since 1896 there have been erected the Biological and Dairy
Building, the Director's House, a large forcing-house and two
poultry houses. The barns of the institution have been built
entirely new because of the destruction of the old ones by fire;
the building occupied by the offices and library has been entirely
remodeled inside, and the head house at the forcing-house has
been enlarged.

In its capacity for carrying on various lines of scientific
inquiry, the building equipment is more than doubled, involving
a large addition to the cost of maintenance, one item of which
is the addition of three to the force of janitors and caretakers.

It can not be accurately said that ten years ago the work of
the institution was divided into departments, although the inves-
tigations then carried on fell, in a general way, under the head
of chemical and horticultural work, with some feeding tests and
similar work with animals and poultry. The Station has now six
well-defined and fairly well-equipped departments, viz., animal
husbandry, bacteriology, botany, chemistry, entomology and
horticulture. There has also been added to the staff an officer
known as Editor and Librarian, the first of the kind in any
Station in the country. In consequence of this enlargement of
the Station staff and the definite division of the work into
departments, the investigations carried on have broadened in
scope, and it is believed, increased in thoroughness, therefore in
expensiveness. This growth has in no sense been forced but has
simply been a response, though an insufficient one, to the
demands made upon the Station.

The list of names to which the Station publications are mailed
has trebled since 1895, thus greatly adding to the printing bills.

Such an enlargement of the salary list, material equipment
and work of an institution ordinarily involves a corresponding increase of maintenance funds. As previously stated, this has not occurred. For the fiscal year 1895–6, our maintenance funds outside of the support of inspection work, amounted to $59,500. and for 1905–6, the sum is $64,500, an increase of only $5,000. But since the $10,000 applied to the inspection of fertilizers was formerly appropriated by the State from the general treasury funds and is now secured from license fees imposed on brands of fertilizers, it is really costing the State $5,000 less annually to maintain the Station than it did ten years ago, notwithstanding the large growth of the institution. These facts indicate what is certainly true, that your Board has persistently, and it would seem successfully, endeavored to administer economically the funds committed to its care. But the limit of economy is reached and the State is now face to face with the question either of abandoning the policy of further developing the Station to meet existing needs or of supplying increased maintenance funds.

There are two lines of effort in which the members of the Station staff are engaged. First, the scientific study of problems, largely by laboratory methods, involving the determination of unknown principles and facts which are believed to be fundamental to agricultural practice; second, the determination of the economic applicability to agricultural technics and practice of such principles and facts as the Station discovers. Experience has demonstrated that the same man cannot effectively prosecute both lines of endeavor in an extensive way. The botanist, for instance, cannot successfully conduct laboratory researches with plant diseases and at the same time be responsible for the personal supervision of field experiments. An absorption of mind and continuity of effort essential to scientific research should not be disturbed by frequent and extended absences for excursions about the State. Efficient organization requires that field work and other practical demonstrations should be assigned to men who are able to give such work their undivided attention, and the same is true of the efforts that are more distinctively scientific or investigational. At the present time the Station force is not adequate to the prosecution of such investigations and such outdoor demonstrations as seem to be demanded of us. I there-
fore most earnestly recommend that you endeavor to secure such financial support as shall enable us to enlarge our force so that the present members of the staff may give greatly increased time to the problems which are pressing upon us for solution.

Fundamentally this is a question of expediency. Which policy will the better serve the interests of New York Agriculture? Would it be profitable to further enlarge the work of the Station? Certainly the Station is unable to accept more than a small minority of the opportunities that come to it for the study of important problems. It is equally certain that the agricultural practice of the State has by no means fully adopted the advanced methods which the Station's investigations have been the means of suggesting.

As it may be easily demonstrated that the work of the Station has in the past been highly productive, there is every reason to believe that it may be largely increased with equal profit.

HOUSES FOR THE STATION STAFF.

Attention is again called to the great desirability of erecting more houses for the use of members of the Station staff. In presenting the reasons for this recommendation I cannot do better than to quote from my report for 1904. "The building equipment of the Station now provides for the housing of five families belonging to the Station staff. Under the conditions at present prevailing the homes of the staff are widely scattered. The married members, other than those provided for on the Station grounds, live in various parts of the city in rented houses. There is involved in this arrangement a great deal of uncertainty as to permanence and desirability of location. It is also often inconvenient; and under such conditions is exceedingly difficult, and almost impossible, to maintain that social unity that should prevail at such an institution and which is a large factor in its spirit and success. The desirability and attractiveness of any salaried position are to a very large degree determined by social relations and by the environment and influences which surround the home. In view of the fact that there is an almost continuous effort to draw away from the Station its best men, sometimes successfully, it would seem to be a good policy to do all that is
possible to render positions at the Experiment Station so attractive that efficient and useful men shall not be drawn away. It is fair to raise the question, therefore, whether, if it is not inconsistent with the established policy of the State, several more houses should not be erected on the Station grounds, sufficient in number at least to accommodate the heads of departments and certain minor officials whose presence near the Station at all times is very essential."

MAINTENANCE FUND.

The various funds that were appropriated by the legislature of 1905, for the maintenance of the Station during the fiscal year beginning Oct. 1, 1905, were as follows:

Salaries .................................................. $23,000
Labor ....................................................... 13,000
Expenses of various departments of research .................. 15,000
General expense, heat, light, water, apparatus, repairs, etc. 4,000
Expenses of horticultural investigation ...................... 8,000
Fertilizer inspection ...................................... 10,000
Feeding stuff inspection .................................. 3,500

By action of your Board, the legislature is asked to appropriate the following sums for the fiscal year beginning Oct. 1st, 1906:

Salaries .................................................. $33,000
Labor ....................................................... 14,000
Expenses of various departments of research .................. 26,000
General expense, heat, light, water, apparatus, repairs, etc. 5,000
Expenses of horticultural investigation ...................... 10,000
Fertilizer inspection ...................................... 10,000
Feeding stuff inspection .................................. 3,500

STATION PUBLICATIONS.

The Station mailing list now requires sending out approximately 46,000 single copies of our publications. As stated elsewhere, this is not far from three times the number mailed in 1895. This larger use of our literature has come about almost entirely through requests which have been received at my office. There has been no padding of the mailing list.

It is gratifying to note that the results of our work are receiving increased attention not only on the part of intelligent farmers but also from professional men and teachers. Requests have been
received for our publications from the professors in one of our oldest universities that has no specific relation to agricultural education and from the principals of high schools, with a view to using this material in the class rooms and science laboratories. Members of the medical profession have commented favorably on the results of our chemical and biological investigations of milk and cheese as contributing directly to a knowledge of certain phases of human nutrition. All this illustrates the fact that knowledge useful to the farmer is broadly related to all human needs and activities. A better understanding of the air, the soil, and plant and animal life, serves to strengthen man's mastery of the earth, in whatever calling. It is entirely rational that our urban population should come to understand and support the work of the agricultural experiment station as directly contributory to the welfare of all classes of persons. The city family has reason to thank modern science, largely applied to agriculture through Station effort, for better fruit and vegetables and for more palatable and more healthful dairy products.

The distribution of the information given out by the Station is by no means confined to reports and bulletins. These simply state principles and facts which are used by the press, and by institute speakers before hundreds of farmers, and which when illustrated by progressive farmers are the basis of a more or less contagious example to every other farmer in the surrounding communities.

"THE APPLES OF NEW YORK."

This publication, in two volumes, was announced in my report for 1904. The first volume is now being distributed. In order that the public may fully understand the sources of supply it should be stated that of 19,000 copies ordered printed, 2,000 copies are assigned to the Station, 2,000 to the Commissioner of Agriculture and 15,000 copies are placed at the disposal of the members of the Legislature. The Station supply is being largely drawn upon by our official list and by several hundred correspondents who aided in supplying data. These facts will serve to explain the inability of the Station to comply with all the requests that we have received for these volumes.

The approval which this publication is receiving from all
quarters is most gratifying, and encourages the hope that the State will be willing to meet the expense of similar publications for other fruits. The Station has collected at great cost, extensive data relating to peaches, pears, plums and grapes. Such a mass of facts is too valuable to lie unused. It is now time that plans should be formulated for publishing this material, the preparation of all of which will require not less than five or six years. I commend to your favorable consideration the suggestions that, if funds can be provided, an editorial staff be secured in the near future for the preparation of this valuable material for publication under the supervision of the Station Horticulturist. It is out of the question for the regular horticultural staff to do this work without dropping all other efforts, a situation hardly to be tolerated in a department so closely in touch with the extensive fruit interests of the State.

THE MAILING LIST.

Since January 1st, 1905, approximately three thousand and eight names have been added to our mailing list.

BULLETIN LISTS, DECEMBER 15, 1905.

Popular Bulletins.

Residents of New York................................. 35,000
Residents of other states............................. 2,215
Newspapers ............................................ 780
Experiment stations and their staffs............... 1,154
Miscellaneous ....................................... 131

Total ................................................. 39,280

Complete Bulletins.

Experiment stations and their staffs................. 1,154
Libraries, scientists, etc.......................... 170
Foreign list .......................................... 234
Individuals .......................................... 2,915
Miscellaneous ....................................... 131

Total ................................................. 4,604

DEMONSTRATION EXPERIMENTS.

The Station still continues to maintain in numerous places in the State, experiments having for their object the determination of the applicability of certain methods to agricultural practice.
The lines of work and the localities in which the experiments are located are given below. It is a pleasure to acknowledge the efficient aid which the Station is receiving at the hands of the various persons mentioned in the following list:

**Study of Cabbage Rot.**
W. A. Fleet............Cutchogue.

**Prevention of Red Spot in Cheese.**
E. L. Carpenter............Russia.

**Treatment of Asparagus Rust**
F. A. Sirrine.............Riverhead.

**Spraying for Potato Blight.**
Brainerd & Beaumont......Gainesville.
J. S. Burke..............Syosset.
D. Clark.....................Peru.
T. S. Darling.............Atlanta.
P. S. Doolittle...........Cassville.
F. E. Gott...............Spencerport.
George H. Hyde...........Cortland.
E. E. Halsey.............Bridgehampton.
F. G. Rathbun.........Verona Mills.
E. T. Ryder..............Gowanda.
W. H. Satterly........Mattituck.
W. R. Shaw................Hebron.
Oliver Smith & Son......Chateaugay.
Taylor Bros..............Arkport.

**Tests of Sulphur Washes—cont.**
C K. Scoon...............Geneva.
Gilbert Scudder........Huntington.
F. A. Sirrine...........Riverhead.
Frank Stevens...........Geneva.
White & Rice...........Yorktown.
Sophie M. Woodhull......Laurel.
W. H. Woolworth.........Youngstown.

**Control of Bud Mite.**
W. P. Rogers............Williamson.

**Experiment with Grape Stocks.**
I. A. Wilcox..............Portland.

**Orchard Management.**
W. D. Auchter...........So. Greece.
Grant Hitchings........Syracuse.

**Economy of Dwarf Orchards.**
F. E. Dawley............Fayetteville.
Albert Wood & Son..Carlton Station.
Edward Van Alstyne..Kinderhook.

**Growth of Foreign Varieties of Chestnuts.**
W. D. Barns & Son....Middlehope.

**Methods of Applying Fertilizers to Potatoes.**
D. L. Downs............Baiting Hallow.
W. A. Fleet..............Cutchogue.

**Soil Renovation Crops.**
W. A. Fleet..............Cutchogue.
F. A. Sirrine...........Riverhead.

It is seen that the foregoing list includes forty-four different experimental operations conducted on thirty-nine farms and in one cheese factory. The area of land covered by these experiments is approximately 250 acres, on 83 of which the expense of the work, whether for spraying, fertilizer tests or otherwise, is borne entirely by the Station. Such a series of observations on
a commercial scale and from a business point of view can hardly fail to be profitable to New York Agriculture.

Sixteen of these experimental operations, or more than one-third of the whole, have been carried on in the Second Judicial Department, in addition to which a special agent of the Station has given his time to that department alone during nearly nine months of the year. This disproportionate attention to one section of the State is justified only on the ground that a region so long under market garden cultivation is severely afflicted with fungus and insect pests and offers specially good opportunities for experimental work.

DEPARTMENT OF ANIMAL HUSBANDRY.

The adaptability of concentrated by-products for feeding poultry.—The question as to the source of additional protein for the ration continues to be an important one. This is particularly true in poultry feeding when large flocks are kept in confinement. Earlier experiments have shown that at times, especially during periods of rapid growth by the young, there is needed in the ration a much larger proportion of protein and of mineral matter than is supplied by the foods that must chiefly be used, as the common grains. To prevent a lack of these essential constituents, various concentrated by-products are fed. The adaptability of many of these materials cannot be satisfactorily determined except by observing the effects of their use under various conditions. As contributing towards this knowledge, Bulletin No. 271 reports the results from a few feeding trials in which certain by-products were freely used.

Of three highly nitrogenous rations fed to ducklings, one containing dried blood and bone meal was associated with much slower rate of growth than one containing animal meal and another containing "milk albumen" and bone meal; though the same amount of food under each ration gave equal increase in weight. The superiority of the two rations seemed due chiefly to their greater palatability.

Of four rations carrying much concentrated food, one containing a large proportion of gluten meals proved inferior, when fed to young chicks, to another having in addition bone meal, and
much inferior to others in which most of the gluten meal was replaced by animal meal or a by-product called "milk albumen." Unpalatability seemed largely responsible for the inferiority of the two rations. The poorest was also deficient in mineral matter.

The rations containing "milk albumen" were more palatable and seemed more healthful than the others, but owing to the higher price for this food it was not profitably used in the desired quantity. The rations containing animal meal were more profitably fed.

The results and observations in general, like those from other trials, show a greater disadvantage in the free use of foods of uncertain palatability and healthfulness during the earlier stages of growth than at any other time.

DEPARTMENT OF BACTERIOLOGY.

Quality of commercial cultures for legumes.—Bulletin No. 270 gives the results of an extended study of the commercial bacterial cultures for inoculating legumes. These cultures had been dried upon cotton which was afterward wrapped in paper and tin foil as a preparation for shipment.

Eighteen packages of this inoculated cotton were purchased in the open market and tested at the Station laboratory. Ninety-eight tests were made, a majority of them at Geneva, but 36 of them were carried on by bacteriologists in other states in order to compare results with duplicate samples. The outcome of these examinations may be summed up in the statement that these cultures were worthless for practical purposes.

Further study showed that the explanation of this situation lies in the inability of Pseudomonas radicicola, the germ living in the nodules upon the roots of legumes, to survive when placed upon dry cotton. The worthlessness of the commercial cultures was inherent in their method of preparation.

Since the publication of this bulletin the Department of Agriculture at Washington has taken up the distribution of liquid cultures of Ps. radicicola, and the above results which refer to the former method of distribution upon cotton, should not be understood as applying to these new cultures.
DEPARTMENT OF BOTANY.

Potato spraying experiments.—During the season of 1904 the Station made extensive potato spraying experiments, which are reported in Bulletin No. 264. The results, taken in connection with those obtained in previous years, indicate that potato spraying may be highly profitable in this State. In fourteen farmers’ business experiments, including 180 acres, the average gain due to spraying was 62¼ bushels per acre and the average net profit $24.86 per acre. Forty-one other farmers who made experiments on their own account reported an average gain of 58½ bushels per acre. In the Station ten-year experiment at Geneva, five very thorough sprayings increased the yield 233 bushels per acre while three sprayings increased it 191 bushels. In a duplicate of this experiment at Riverhead, the gain due to six sprayings was 96½ bushels per acre and to three sprayings 56½ bushels.

In one experiment soluble bordeaux was compared with soda bordeaux and with the regular lime bordeaux. Soluble bordeaux increased the yield 11 bushels per acre; soda bordeaux 51½ bushels per acre; and lime bordeaux, 68½ bushels per acre. The conclusion is that neither the soluble bordeaux nor the soda bordeaux is to be recommended; at least not until further tests have been made.

Effect of arsenites on potato foliage.—Two arsenites were tested, paris green and arsenite of soda, the results of the work appearing in Bulletin No. 267.

The experiments with paris green were designed to determine whether it is injurious to potato foliage when properly applied. It was used with bordeaux, with milk of lime and with water. Some rows received bordeaux only and others no treatment of any kind, the bugs being controlled by hand picking. There was no evidence that the paris green injured the foliage anywhere and the rows receiving paris green outyielded those to which no paris green had been applied. An unexpected result of the experiment was the discovery that paris green has some value as a preventive of blight. Rows treated with paris green in water yielded 46 bushels per acre more than the check rows.

The experiments with arsenite of soda indicate that if used in
Bordeaux it may be safely applied to potato foliage; but when used with milk of lime serious injury may result. Safety requires that it be used only in combination with bordeaux mixture.

Winter injury to fruit trees.—The extremely low temperature of the winter of 1903 and 1904 together with the unfavorable weather conditions and insect and fungus epidemics of 1904, injured or killed many fruit trees in the State, especially in the Hudson River Valley. The investigation of the condition of orchards and tests of methods of treating injured trees are discussed in Bulletin No. 269.

Old trees did not withstand the cold nor recover as well as young trees. Difference of variety was usually subordinate to location, age and previous health of the trees, though in many cases there was plainly a difference in the susceptibility of varieties.

Experiments indicated that, when peach trees were less than five years old, a severe pruning or cutting back to large limbs was a successful method of treating injured trees. The same treatment for older trees was a failure. Trees that did not carry any fruit made a better recovery than those that carried even a light crop.

Department of Chemistry.

Some of the relations of casein and paracasein to bases and acids, and their application to cheddar cheese.—The relation of milk-casein to the cheese industry is one of fundamental importance, and the changes taking place in the processes of cheese-making and cheese-curing can be understood fully only by a careful study of milk-casein. The work reported in Bulletin No. 261 had for its object such a study of milk-casein. Casein exists in milk as a compound with calcium, containing about 1.5 per ct. of calcium oxide (lime). When treated with acids, the lime is removed from combination with casein and free casein is formed, which is soluble in five per ct. salt solution and in hot 50 per ct. alcohol. When free casein is treated with acid, it forms a casein salt of the acid; casein lactate, for example, is familiar in curdled sour milk as the white solid or curd. When milk-casein is coagulated by rennet, as in cheese-making, the curd formed is calcium paracasein, which changes, in the presence of the acid
formed in the cheese-making process, into free paracasein, and it is this compound that the cheese-maker aims to produce in as large amounts as possible in the cheese-curd before putting it in press. It is this free paracasein that forms the starting point of the various complex changes that take place in cheese-ripening.

The proteids of butter in relation to mottled butter.—Buttermakers are frequently troubled by the presence of white streaks and spots in butter, which do not make their appearance until the day following the packing of the butter. This trouble has commonly been attributed entirely to the uneven distribution of salt in butter. The experiments discussed in Bulletin No. 263 show that the presence of buttermilk in butter is essential to the production of mottles. The casein lactate contained in buttermilk is acted upon by salt, whether the salt is evenly distributed or not, and white masses result when buttermilk is present to too great an extent in the butter granules. It was found that mottles can be prevented by removing buttermilk as fully as possible from butter-granules before salting.

Plant-food constituents used by bearing fruit trees.—The work described in Bulletin No. 265 was undertaken for the purpose of ascertaining the amounts of nitrogen, phosphoric acid, potash, lime and magnesia used in one growing season by well-matured, bearing fruit trees. Three standard varieties were studied of each of the following kinds of trees: Apple, peach, pear, plum and quince. The fruit, leaves and new growth of wood were carefully gathered, weighed and analyzed. Peach trees used the largest amounts of plant-food per acre, after which came in their order, apple, quince, pear and plum trees. The relative amounts of the different constituents used by the different trees did not vary greatly.

DEPARTMENT OF ENTOMOLOGY.

The San José Scale: Sulphur washes for orchard treatment.—The investigations of this Department for the year were largely to ascertain to what extent sulphur washes may be used in the place of the bordeaux-arsenical mixtures for orchard treatment.

As the relative abundance of orchard diseases and insects is often determined by local conditions, the experiments were dis-
tributed over a larger area than before that data regarding the fungicidal and insecticidal properties of these washes might be obtained upon as many orchard pests as possible. The orchards in which the experiments were conducted are situated on Long Island, near Riverhead; in the lower Hudson Valley, near Yorktown; and in Western New York, at Geneva in Ontario Co., near Carlton Station in Orleans Co., and at Youngstown in Niagara Co. The number of trees sprayed with the sulphur washes was 7325, divided as follows: Prunes 150, cherries 348, plums 1359, peaches 1149, pears 2822 and apples 1497.

In most of the orchards the applications efficiently controlled the scale but no additional data were obtained in these as to the combined fungicidal and insecticidal properties of the sulphur washes. But in one orchard in Ontario County results were obtained showing the effectiveness of these sprays for apple scab. One application of a sulphur wash reduced the scab by 22 per ct. A combined treatment, consisting of one application of a sulphur wash before blossoming and two applications of a bordeaux-arsenical mixture after blossoming reduced the scab 73.7 per ct., and wormy apples (codling moth injury) 27.1 per ct., which are practically identical with the results obtained by the usual three applications of the bordeaux-arsenical mixtures for the control of these two pests.

In the experiments with pear trees in another orchard an application of a sulphur wash before blossoming proved an efficient remedy for the pear blister mite (Eriophyes piri Nal.). Owing to the absence of pear scab no results were obtained as to the value of this treatment for this disease. For the same reason there were no data as to the effects of an early application of a sulphur wash upon brown rot.

From the results obtained in this season’s work it seems safe to conclude that one application of a sulphur wash during dormant season may be safely relied on to take the place of one treatment with the bordeaux mixture for the control of apple scab and scale. A system of spraying that seems well adapted for the treatment of scale infested orchards for scale, scab and codling moth is one application of a sulphur wash during dormant season, followed with the usual second and third applications of the bordeaux-arsenical mixture.
Spraying for the San José scale—In this work, reported in Bulletin No. 273, attention was largely directed to determine the effects of fall applications of various lime-sulphur washes upon scale and fruit trees, and to ascertain the merits of the new sprays, known as the kerosene-lime mixture and the miscible oils, for the treatment of the San José scale. The experiments were conducted at Northville, L. I., and at Geneva. The total number of trees under treatment was 596, composed of 41 apples, 304 plums and 251 peaches.

The sulphur washes gave on the whole satisfactory results. In several instances peaches and plums sustained more or less injury. The treatment was generally effective upon the scale.

The kerosene-lime mixtures have proven rather unsatisfactory, for the applications often gave variable results upon the scale and the trees. Comparative tests with several grades of lime indicated that limoid made the more stable emulsion. Analyses of several preparations of the kerosene-lime mixture showed that the larger percentage of the oil did not settle with the lime but appeared on the surface in an emulsion with the lime. The variable results upon trees and scale seem to be due to the uneven distribution of the emulsified portion in the mixture.

In the tests with a miscible oil, known as Scalecide, some satisfactory results were obtained in the treatment for the scale. Owing to injuries to buds and some unsatisfactory results upon scale by a number of the applications, experiments will be continued to determine the merits of Scalecide for the treatment of commercial orchards.

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