State of Connecticut
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Forty-fourth Annual Report

OF

The Connecticut Agricultural Experiment Station

Being the annual report for the year ended October 31

1920

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THE BOARD OF CONTROL.

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CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

OFFICERS AND STAFF

October 31, 1920.

BOARD OF CONTROL.

His Excellency, Marcus H. Holcomb, *ex-officio, President.*

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STAFF.

Administration.
E. H. JENKINS, PH.D., *Director and Treasurer.*
MISS V. E. COLE, *Librarian and Stenographer.*
MISS L. M. BRAUTLECHT, *Bookkeeper and Stenographer.*
WILLIAM VEITCH, *In charge of Buildings and Grounds.*

Chemistry.

Analytical Laboratory.
E. MONROE BAILEY, PH.D., *Chemist in Charge.*
R. E. ANDREW, M.A.
C. E. SHEPARD, H. D. EDMOND, B.S., } *Assistant Chemists.*
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FRANK SHELDON, *Laboratory Assistant.*
V. L. CHURCHILL, *Sampling Agent.*
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Protein Research.
T. B. OSBORNE, PH.D., D.SC., *Chemist in Charge.*

Botany.
G. P. CLINTON, SC.D., *Botanist.*
E. M. STODDARD, B.S., *Assistant Botanist.*
MISS FLORENCE A. MCCORMICK, PH.D., *Scientific Assistant.*
G. E. GRAHAM, *General Assistant.*
MRS. L. D. KELSEY, *Stenographer.*

Entomology.
W. E. BRITTON, PH.D., *Entomologist; State Entomologist.*
B. H. WALDEN, B.AGR., JOHN T. ASHWORTH, } *Assistant*
M. P. ZAPPE, B.S., PHILIP GARMAN, PH.D., } *Entomologists.*
SAMUEL T. SEALY, *Deputy in Charge of Mosquito Control.*
MISS GLADYS M. FINLEY, *Stenographer.*

Forestry.
WALTER O. FILLEY, *Forester, also State Forester and State Forest Fire Warden.*
A. E. MOSS, M.F., *Assistant State and Station Forester.*
H. W. HICOCK, M.F., *Assistant Forester.*
MISS PAULINE A. MERCHANT, *Stenographer.*

Plant Breeding.
DONALD F. JONES, S.D., *Plant Breeder.*
C. D. HUBBELL, *Assistant.*

Vegetable Growing.

Report of the Board of Control
OF
THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION

To His Excellency, Marcus H. Holcomb, Governor of Connecticut:

As required by law, the Board of Control of the Connecticut Agricultural Experiment Station herewith respectfully presents its report for the year ending October 31, 1920.

Changes in the Station Staff.

Miss Etta L. Avery, who had rendered efficient service for nine years as stenographer in the forestry department, died on March 8, 1920.

Michael D'Esopo, assistant chemist, resigned December 1, 1919, to accept an engagement elsewhere.

To fill vacancies in the staff of the chemical department, R. E. Andrew, M.A., began his duties on November 10, 1919, and Owen Nolan on April 1, 1920.

John T. Ashworth succeeded I. W. Davis as deputy in charge of gipsy moth work, on June 1, 1920.

K. F. Chamberlain, assistant in entomology, resigned March 1, 1920.

Samuel T. Sealy was appointed deputy in charge of mosquito work in April of this year.

W. C. Pelton, in charge of vegetable work, resigned May 1, 1920, to accept an assistant professorship in Pennsylvania State College.

A brief summary of the work of the year follows:

The Botanical Department.

Dr. Clinton in Charge.

An extensive study of the life history of the rusts, Petrie dish infections with rusts, as well as a special study of the pine blister rust, are being carried on by Dr. Clinton with the assistance of Miss McCormick.

Dr. Clinton also continues his study of peach yellows.

During the year a disease survey of tobacco has been prosecuted in coöperation with the Extension Department of the Conn. Agricultural College and the Hartford County Farm Bureau; and for the purpose a temporary summer laboratory for the Station's use was established through the courtesy of the Hartford County Farm Bureau at its headquarters in Hartford. A report of this survey has been prepared.

Special studies of the black rot of tobacco (*Thielavia*) are being carried on by Miss McCormick.

In the field, an experiment on the merits of spraying *versus* dusting for control of the insects and fungi attacking apples has been carried on by Mr. Stoddard of this department, in coöperation with the entomologist.

Other spraying tests on apples and peaches have been conducted by Dr. Clinton and Mr. Stoddard.

The tests of the effect of different fertilizers on the prevalence of fungus troubles are continued.

Work on the improvement of the quality of sweet corn seed by the prevention of disease and by improvement in curing has been carried on under the supervision of Mr. Stoddard.

Four hundred and sixty-three samples of field and garden seeds have been tested for farmers and dealers, chiefly by Mr. Graham. Several hundred samples of sweet corn seed have also been tested in the course of our experiments.

The special publications of the department have been: Report of the Botanist, Bulletin 222, of 86 pp. and 24 plates; Treatment of Apple Trees Girdled by Mice, by E. M. Stoddard, Bulletin of Immediate Information No. 10, 8 pp.

The Chemical Department.

Dr. Bailey in Charge.

Some time has been given to the study of improved methods, especially for the determination of caffein. But the larger share of the time of this department has been taken up with the work of chemical analysis. The testing of samples for the Dairy and Food Commissioner has required much more work than ever before.

Seven hundred and sixty-four samples of fodder materials and field crops, over six hundred samples of fertilizers, and about twenty-four hundred samples of foods, drugs and miscellaneous articles have been analyzed and the results prepared for publication—the latter a matter involving much labor. Twenty-four hundred and sixty-two pieces of Babcock glassware have been tested and either certified correct or rejected. About two per cent. were found to be inaccurate.

Expert testimony in court has been required in 16 cases. The department has coöperated with the Police and Health authorities in a number of other cases, notably in Hartford in December, 1919, which was the first of a series of prosecutions growing out of the distribution, sale and consumption of liquor containing wood alcohol, by which many persons were poisoned.

This department has issued the annual report on Fertilizers, Bulletin 217; annual report on Food Products and Drugs, Part 1, Bulletin 219; Part 2 (Diabetic Foods), Bulletin 220; annual report on Feeding Stuffs, Bulletin 221.

Dr. Bailey continues as Expert on Diabetic Foods for the American Medical Association, a referee of the Association of Official Agricultural Chemists, and State Chemist.

The Entomological Department.

Dr. Britton in Charge.

On account of the Federal quarantine, the importation of foreign nursery stock has greatly decreased, only seventeen shipments requiring the entomologist's inspection, of which eleven were infested with insects or fungi.

Ninety-five nurseries were officially inspected and sixty-five orchards and gardens examined.

Four hundred and eighty apiaries, containing about 2,250 colonies, were also inspected, to eliminate foul brood.

In coöperation with the Federal Bureau of Entomology the work of controlling the gipsy moth has been actively prosecuted. The number of infestations found and the number of egg clusters destroyed have been about the same as last year. For this department a new automobile truck power sprayer and two new Ford trucks have been purchased. A Ford touring car has also been acquired by exchange.

An experiment on the efficiency of dusting compared with spraying to control insects and fungi has been carried out in the apple orchard of Mr. W. F. Platt in Milford. About 116 large trees were included and all the fruit from certain trees in each plot was examined and scored.

Spraying tests to control the potato aphid have also been completed.

Mr. Zappe has studied the life history of a new species of sawfly on Austrian pine and has made preliminary studies of the hatching and development of the apple red bug and apple leaf-hopper.

Dr. Garman has studied the life history of the bulb mite and measures of control, and the results are now ready to publish. He has found in six widely separated Connecticut orchards the European plum mite, a species not hitherto known to occur in this country, but since reported in New Jersey and Pennsylvania. The damage done by it is more severe and becomes apparent earlier in the season than that of other orchard mites. Spraying and dusting tests indicate that summer treatment is nearly futile, but where commercial lime-sulphur was used as a dormant spray the injury was much less severe.

Dr. Garman is also studying the life history of the spittle insects attacking grasses, and is also preparing two papers for the Natural History Survey of the State, one on the Dragon Flies, and the other on the Mites of Connecticut.

Mr. Walden has collected an important series of leaf-hoppers from different host plants.

Dr. Britton has nearly completed the preparation and editing of a paper of one thousand pages on the Hemiptera of Connecticut, for the Natural History Survey. Fifteen specialists have coöperated in its preparation. The check list of Connecticut insects, by the Entomologist, is now being printed as Bulletin 31 of the Survey.

This department has prepared Bulletin 216 on Insects Attacking Squash, Cucumber and Allied Plants in Connecticut, and the Annual Report of the State and Station Entomologist, Bulletin 218.

Mosquito Elimination.

S. T. Sealy in Charge.

This work, required by statute, is closely related to that of the entomologist, under whose general supervision it has been carried on for a term of years. This year Mr. Sealy has been in direct charge of it.

A constant patrol has been maintained on all the drained salt marsh in Fairfield, Orange, New Haven, East Haven, Branford, Guilford and Madison, the total area of drained marsh being 5,000 acres. Supplementary ditches have been made where necessary and the outlets to the sea reopened when blocked with sand thrown up by storms.

At no time have any considerable broods of mosquitoes developed on the drained marshes. The trouble has mainly come from neighboring marshes which are not ditched, and from the "rain barrel" mosquitoes, which breed in stagnant fresh water about houses and inland pools.

The only new ditching this year has been a tract of 60 acres at Groton Long Point.

The Forestry Department.

Mr. Filley in Charge.

Owing to labor shortage, forest plantings were greatly reduced this year, only 11,700 trees being set on the State and Station forest areas. Eleven examinations of forest land have been made for the owners, to advise as to management and planting.

Blister Rust Work.

The blister rust control work has been carried on by this department under the direct supervision of Mr. Hicock, the botanical department coöperating in studies on the nature and method of spread of the disease. An eradication camp was established in Colebrook, and during July and August more than 2,000 acres were freed from currant and gooseberry plants in an area east

of that worked in previous years in Norfolk. Over 80 per cent. of this is forest land and contains much pine reproduction as well as some old timber. Some pine blister rust infection was found. Mr. Hicock scouted the northwestern corner of the State, finding no new pine infection centers, but the *ribes* infection is general throughout Litchfield county. Careful examination indicates that in the eradication area no pine infections have occurred since 1916 when the work was begun.

Work by State Park Commissioner.

The assistant forester, Mr. Moss, was employed by the State Park Commission from July to December, 1919, in gathering data for a topographic and type map of Macedonia State Park, a tract of 2,000 acres, chiefly woodland, in the town Kent.

State Forests.

As State Forester, Mr. Filley has added 408 acres to the Eastford State Forest, making the total area of State Forests 4,267 acres.

About $2,500 was received for ties, poles and cord wood, and 10,000 pines were set on the cut-over land.

State Forest Fire Warden.

As State Forest Fire Warden, Mr. Filley reports that, because of weather conditions, much less damage by forest fires has been done this year than is usual.

In 1919 there were 720 forest fires, but only 39 of these occurred after October 1st, and during the first six months of the present year, only 349. The property damage in 1919 was $78,000, and for the first six months of 1920, only $35,000. This decrease is almost entirely due to weather conditions, as the fire warden service has been greatly handicapped by labor cost.

Tree Protection Examining Board.

The botanist, entomologist and forester of this Station are a board required by law to examine commercial tree workers as to their fitness for improving trees by pruning, filling, spraying, etc. The forester is secretary of this board. In the 12 months ending June 30, 1920, 59 applicants were examined and 55 certificates issued. Three certificates were refused. From July 1, 1920, to September 30, 1920, one new certificate was issued and thirty-four certificates were renewed. It has been necessary to examine the work of some applicants before issuing certificates and to investigate a few complaints. No certificates have been revoked because of improper method.

The Department of Market Gardening.

Mr. Pelton in Charge.

A study of the Hahto Soy Bean, edible in its green state and a possible substitute for lima beans, was begun and material gathered for improvement by selection. Tests of seedmen's varieties and strains of onions, string beans, carrots and beets bearing on the standardization of crops, and comparisons of yield and quality of strains of other vegetables were begun and carried through one season. Studies on the soil of the Wallingford plain were also undertaken.

It was with great regret that this work, which promised to be very useful, had to be dropped soon after it was well under way. Mr. Pelton resigned in May, 1920, to accept a position in another institution, and a successor was not appointed as it was evident that it could not be done with the funds at the disposal of the Station but only by creating a deficit.

Researches Supported by the Adams Fund.

Dr. Osborne and Dr. Jones in Charge.

It is required by Federal authorities, who control the payments from this fund, that it shall be entirely spent in research on subjects approved by the Office of Experiment Stations and preferably on projects continued through a term of years.

One of these projects in charge of Dr. Osborne is a study of the different protein bodies found in food products and of their relative value in nutrition.

The current work under this project consists of elaborate studies of the proteins of the green leaves, a subject which has hitherto not been investigated to any considerable extent, and which the agricultural importance of these food stuffs seems to render most timely.

By methods which Dr. Osborne has developed, it has become possible to isolate and purify the proteins of green, actively growing plants, either before or after drying, in spite of the special difficulties which such work presents.

It will therefore be possible to subject these proteins to the same rigid study which the proteins of the seeds and grains have already received in this laboratory.

The publications of this department are listed on a following page.

In the field of nutrition investigations a study is being made of the quantitative and qualitative aspects of vitamine problems which have been raised by the experience gained in the Station work during the past few years; likewise a study of the role of fats *per se* in the ration.

The second project on problems of inheritance is in charge of Dr. Jones.

A new tobacco, "Connecticut Round Tip," being a combination of Sumatra with broad leaf, which has been established by years of selection, has been tested by thirteen growers, in amounts ranging from one-half acre to eight acres. Its superiority to Connecticut Havana is in shape of leaf, somewhat larger growth, greater number of leaves, and better resistance to adverse soil conditions. Competent judges consider it a most promising variety which deserves further careful trial.

A hybrid type of corn derived from inbred strains by a process called "double crossing," has been grown in some twenty different parts of the State.

The corn variety testing work, in coöperation with the Storrs Station, is being continued until all the promising varieties so far located have been grown at least three years.

The investigations dealing with the process of heredity in corn and tobacco are being continued.

The publications of this department are listed on a following page.

Library and Collections.

The Station library now numbers something over 5,300 bound volumes insured for $20,000. The botanical collection numbers over 48,000 specimens, and the entomological collection over 20,800 specimens of which 5,300 are determined and arranged systematically.

Publications.

During the year the Station has issued the annual report for 1919, consisting of Bulletins 215 to 222, and Bulletins of Immediate Information, Nos. 10 and 11, aggregating in all 487 pages, with 60 full page plates.

A considerable part of the research work of the Station cannot be printed in its bulletins, partly because space is lacking, and partly because the subject matter is not of immediate practical value to farmers, to whom the larger part of our editions is sent.

Following is a list of papers written by members of the Staff and published elsewhere than in Station publications:

By T. B. Osborne and others in his Department:

Do Fruits Contain Water-Soluble Vitamine? Thomas B. Osborne and Lafayette B. Mendel. Proc. Soc. Exper. Biol. and Med. (1919) XVII, 46-47.

Extraction and Concentration of the Water-Soluble Vitamine from Brewer's Yeast. Thomas B. Osborne and Alfred J. Wakeman. Jour. Biol. Chem. (1919) XL, 383-394.

Nutritive Value of the Proteins of the Barley, Oat, Rye and Wheat Kernels. Thomas B. Osborne and Lafayette B. Mendel. Jour. Biol. Chem. (1920) XLI, 275-306.
Nutritive Factors in Plant Tissues. III. Further Observation on the Distribution of Water-Soluble Vitamine. Thomas B. Osborne and Lafayette B. Mendel. Jour. Biol. Chem. (1920) XLI, 451-468.
Fat-Soluble Vitamine of Green Foods. Thomas B. Osborne and Lafayette B. Mendel. Proc. Am. Soc. Biol. Chem., Jour. Biol. Chem. (1920) XLI, p. vii.
Nutritive Factors in Plant Tissues. IV. Fat-Soluble Vitamine. Thomas B. Osborne and Lafayette B. Mendel. Jour. Biol. Chem. (1920) XLI, 549-565.
Milk as a Source of Water-Soluble Vitamine. II. Thomas B. Osborne and Lafayette B. Mendel. Jour. Biol. Chem. (1920) XLI, 515-523.
The Proteins of Green Leaves. I. Spinach Leaves. Thomas B. Osborne and Alfred J. Wakeman. Jour. Biol. Chem. (1920) XLII. 1-26.
The Water-Soluble Vitamine. Thomas B. Osborne. N. Y. State Jour. Med. (1920) XX, 217-222.
The Occurrence of Water-Soluble Vitamine in Some Common Fruits. Thomas B. Osborne and Lafayette B. Mendel. Jour. Biol. Chem. (1920) XLII, 465-489.
Does Gliadin Contain Amide Nitrogen? Thomas B. Osborne and Owen L. Nolan. Jour. Biol. Chem. (1920) XLIII, 311-316.
Nutrition Experiments with Rats. A Description of Methods and Technic. Edna L. Ferry. Jour. Lab. and Clin. Med. (1920) V, 735-745.

By D. F. Jones.

Teas' Hybrid Catalpa. D. F. Jones and W. O. Filley. Jour. Heredity (1920) **11**: 1-9.
A Paraffine Ruler for Drawing Curves. D. F. Jones. Science, N. S. (1920) **51**: 245.
Selection in Self-Fertilized Lines as the Basis for Corn Improvement. D. F. Jones. Jour. Amer. Soc. Agron. (1920) **12**: 77-100.
Heritable Characters in Maize, IV. A Lethal Seed Factor.—Defective Seeds. D. F. Jones. Jour. Heredity (1920) **11**, 161-167.
Selective Fertilization in Pollen Mixtures. D. F. Jones. Biological Bulletin (1920) **38**: 251-289. Abstract in Proc. Nat. Acad. Science (1920) **6**: 66-70.

By G. P. Clinton and Florence McCormick.

Artificial Infection of Pine with *Cronartium ribicola*. Amer. Plant Pest Committee, Bull. 4.

By G. P. Clinton.

Biographical Notice of Prof. W. G. Farlow. Phytopathology (1920) X, 1-7.

By W. E. Britton.

Some Phases of Beekeeping in Connecticut. Jour. of Econ. Entomology (1920) **13**: p. 91.
A Connecticut Corn Field Injured by *Crombus præfectellus*, Zinck. Jour. of Econ. Entomology (1920) **13**: p. 222.
More about the Cyclamen Mite. Florists' Exchange (1920) XLIX, p. 285.

The following statistical summary includes some features not referred to earlier in this report:

Number of letters written	9,603
Fertilizers analyzed	600
Feeds analyzed	764
Foods and Drugs analyzed	2,400
Babcock apparatus tested	2,462
Nurseries, orchards and gardens inspected	160
Imported nursery stock inspected (cases)	87
Apiaries inspected	480
Specimens identified for applicants	406
Papers published in scientific journals	19
Addresses delivered	61

The Present Condition and Needs of the Station.

The salaries paid by this Station have been lower than those paid for corresponding ability and experience in other agricultural institutions, and, in consequence, within the last biennial period valued members of the Station Staff have resigned to accept more adequate salaries elsewhere.

The increased cost of all materials and of labor has also added to the difficulties which have confronted this and all other stations.

Owing to an unprecedented increase in the work required for the dairy and food commissioner, the appropriation of $2,500 per year for the work was so grossly inadequate that the State Board of Control granted $2,500 to meet the emergency.

With this aid and by the utmost economy, involving the suspension of the department of vegetable growing, the Station has avoided a deficit, the treasurer's account showing a balance of $13.45 at the end of the fiscal year.

But to keep within the present appropriation has involved loss of efficiency, which if continued, must, we feel, result in serious injury to agricultural interests. The work of the agricultural station is fundamental. It forms the basis of the teaching of the Agricultural College and Extension Department. Like all fundamental work, it is not in the public eye, it cannot be exploited in print, and its help to agriculture is not generally and justly appreciated and valued.

But it is certain that if the investigation and experiment carried on at the Station lose in character and amount, there will be corresponding loss in the character of the teaching and practice of agriculture.

We shall therefore ask the next General Assembly for a considerable increase of the appropriation hitherto made to this Station.

All of which is respectfully submitted.

George A. Hopson,
Secretary.

New Haven, Connecticut, October 31, 1920.

REPORT OF THE TREASURER.

July 1, 1919–June 30, 1920.

E. H. JENKINS, in account with THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION for the fiscal year ending June 30, 1920.

RECEIPTS.

Balance on hand, July 1, 1919 (Analysis Fees)		$9.76
State Appropriation, General	$22,500.00	
State Appropriation, Food	2,500.00	
State Appropriation, Food Deficiency	2,500.00	
State Appropriation, Insect Pest	7,500.00	
United States Appropriation, Hatch	7,500.00	
United States Appropriation, Adams	7,500.00	
Fertilizer Analysis	10,019.33	
Connecticut Agricultural College (for A. E. Moss)	1,250.00	
Connecticut State Department of Health (rent)	200.00	
State Park Commission (for A. E. Moss)	500.00	
New Laboratory Appropriation (for moving greenhouses)	511.77	
Mosquito Elimination Appropriation (for automobile)	650.00	
Sale of Gasoline and Oil	336.58	
Interest on Bank Deposits	99.49	
Miscellaneous	69.32	
Lockwood Trust Income (including sale of tree seedlings and wood and Mt. Carmel Farm produce, $2,483.54)	11,483.54	
		75,120.03
		$75,129.79

DISBURSEMENTS.

E. H. Jenkins, director, salary		$2,800.00
E. H. Jenkins, treasurer, "		400.00
V. E. Cole, "		1,300.00
L. M. Brautlecht, "		900.00
J. P. Street, "		216.67
T. B. Osborne, "		3,000.00
E. M. Bailey, "		2,766.67
C. B. Morison, "		574.74
C. E. Shepard "		1,700.00
W. E. Britton, "		2,783.34
G. P. Clinton, "		2,783.34
E. M. Stoddard, "		1,581.25
W. O. Filley, "		2,775.00
A. E. Moss, "		2,250.00
E. L. Ferry, "		399.99
D. F. Jones, "		2,683.33
Michael D'Esopo, "		462.49
Florence McCormick, "		816.66
W. C. Pelton, "		1,741.67
H. D. Edmond, "		1,200.00
R. E. Andrew, "		1,540.00
V. L. Churchill, "		1,200.00
Wm. Veitch, "		894.58
Etta L. Avery, "		366.67

C. D. Hubbell, salary		$ 880.00
G. E. Graham, "		1,133.33
Alta H. Moss, "		555.00
H. W. Hicock, "		250.00
L. J. Treadwell, "		245.00
Owen Nolan, "		360.00
P. A. Merchant, "		133.33
Mrs. L. D. Kelsey, "		572.00
Henry Kiley		1,115.00
O. J. Welch		1,115.00
Herbert Edwards		286.67
Leonal Hand		813.33
T. F. Barrows		605.00
Frank Sheldon		1,040.00
Richard Merwin		394.00
Ervin Applegate		554.00
Labor		3,317.96
Publications		398.37
Postage		226.90
Stationery		585.13
Telephone and Telegraph		223.07
Freight and Express		99.97
Gas, Electricity and Kerosene		1,009.23
Coal		1,984.32
Water		132.45
Chemicals		545.50
Laboratory Supplies		377.36
Seeds, Plants, etc		247.90
Agricultural and Horticultural Supplies		155.28
Food Samples		25.85
Ice		106.30
Photographic Supplies		125.15
Automobile Oil		25.77
Miscellaneous Supplies		632.47
Fertilizers		1,009.46
Feeding Stuffs		524.49
Library (Books and Periodicals)		477.49
Library (Binding)		88.00
Tools, Machinery and Appliances		2,145.43
Tools, Machinery and Appliances (Repairs)		640.11
Furniture and Fixtures		122.90
Furniture and Fixtures (Repairs)		40.30
Scientific Apparatus		4.75
Scientific Apparatus (Repairs)		37.29
Live Stock		16.50
Traveling by the Board		146.33
Traveling by the Staff		1,053.66
Gasoline for Automobiles		673.12
Travel in connection with Adams Fund Investigations		103.26
Insurance		1,437.34
Insect Pest Appropriation to State Entomologist		7,500.00
Contingent		308.47
Buildings and Land (Betterments)		68.28
Buildings and Land (Repairs)		1,218.25
Buildings and Land (Grounds)		93.87
Total Disbursements		$75,116.34
Balance on hand, June 30, 1920 (Analysis Fees)		13.45
		$75,129.79

NEW HAVEN, CONN., Sept. 28, 1920.

THIS IS TO CERTIFY that we have audited the accounts of E. H. Jenkins, Treasurer of the Conn. Agricultural Experiment Station for the fiscal year ending June 30, 1920, and have found them correct.

WILLIAM P. BAILEY,
LEWIS W. PHELPS,
Auditors of Public Accounts.

Connecticut
Agricultural Experiment Station
NEW HAVEN, CONN.

BULLETIN 223 OCTOBER, 1920

Fertilizer Report for 1920

By E. H. JENKINS, *Director, and*
E. MONROE BAILEY, *Chemist in Charge of the Analytical Laboratory.*

CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

OFFICERS AND STAFF

October 31, 1920.

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A. E. Moss, M.F., *Assistant State and Station Forester.*
H. W. Hicock, M.F., *Assistant Forester.*
Miss Pauline A. Merchant, *Stenographer.*

Plant Breeding.
Donald F. Jones, S.D., *Plant Breeder.*
C. D. Hubbell, *Assistant.*

Vegetable Growing.

Press of
The Wilson H. Lee Company

Report on Commercial Fertilizers, 1920.

By E. H. Jenkins, *Director, and* E. M. Bailey,
Chemist in Charge of the Analytical Laboratory.

In 1920, sixty-seven individuals and firms registered for sale in this State 502 brands of commercial fertilizers, classified as follows:

Nitrogenous superphosphates	364
Cotton seed meal and castor pomace	103
Other chemicals and unmixed materials	41
	508

The law requires that a list of the registered brands shall be published annually.

The following is such a list of all brands of fertilizers registered for sale in this State between January 1 and December 31, 1920.

Brands Registered for the Fiscal Year Ending Dec. 31, 1920.

Alpha Portland Cement Co., Easton, Pa.
Alpha Potash-Lime Fertilizer

American Ag'l Chemical Co., 2 Rector St., New York City
14% Acid Phosphate
16% Acid Phosphate
Ammoniated Fertilizer A
Ammoniated Fertilizer AA
Ammoniated Fertilizer AAA
Ammoniated Fertilizer AAAA
Ammoniated Fertilizer VX
Basic Lime Phosphate
Bone-Phosphate and Potash
Castor Pomace
Cereal and Root Fertilizer
Double A Tobacco Fertilizer
Dry Ground Fish
Fine Ground Bone
Fish and Potash
Five Eight Fertilizer
Grass and Lawn Top Dressing
Grass and Oats Fertilizer
High Grade Acid Phosphate
High Grade Ground Bone
Monarch Potato Manure
Nitrate of Soda
Pulverized Sheep Manure
Special Vegetable Fertilizer
Sure Growth Phosphate Revised

Tobacco Special
Universal Phosphate
Bradley's Alkaline Bone with Potash
Bradley's B. D. Guano
Bradley's Corn Phosphate
Bradley's Half Century Fertilizer Revised
Bradley's New Method Fertilizer
Bradley's Patent Superphosphate Revised
Bradley's Potato Fertilizer
Bradley's Potato Manure
Bradley's Root Crop Manure
Bradley's Special Bay State
Bradleys Special Corn Phosphate without Potash
Bradley's Special Potato Fertilizer without Potash
Bradley's Special Potato Manure without Potash
Bradley's Unicorn
Bradley's Valley Tobacco Fertilizer
Bradley's X L Superphosphate of Lime
E. I. Black Hawk Potato and Truck Fertilizer
E. I. Corn King Revised
E. I. Economizer Phosphate
E. I. Mayflower
E. I. Tobacco Fertilizer
E. I. Unexcelled Fertilizer Revised
G. E. General
G. E. Northern Corn Special 1920
G. E. Potato Manure 1920
Packers' Union Animal Corn Fertilizer
Packers' Union Potato Manure 1920
Packers' Union Universal Fertilizer 1920
Quin. Ammoniated Dissolved Phosphate
Quin. Climax Phosphate
Quin. Corn Manure
Quin. Phosphate
Quin. Potato Phosphate
Quin. Potato Manure
Quin. Spl. Corn Manure without Potash
Quin. Spl. Potato Phosphate without Potash
Quin. Wrapper Leaf Brand Tobacco Manure Revised
Wheeler's Corn Fertilizer
Wheeler's Cuban Tobacco Grower
Wheeler's Potato Manure 1920
Williams & Clark's Americus Ammoniated Bone Superphosphate
Williams & Clark's Americus H. G. Spl. Revised
Williams & Clark's Americus Corn Phosphate
Williams & Clark's Americus Potato Manure
Williams & Clark's Matchless Fertilizer
Williams & Clark's Meadow Queen Fertilizer
Williams & Clark's Potato Phosphate
Williams & Clark's Prolific Fertilizer
Williams & Clark's Seed Leaf Tobacco Manure Revised
Williams & Clark's Spl. Americus Corn Phosphate without Potash
Williams & Clark's Spl. Americus Potato Manure without Potash

American Nitro-Phospho Corporation, 80 Lafayette St., New York City
Phosphogerm (Inoculated Organic)

Apothecaries Hall Co., Waterbury, Conn.
Acid Phosphate
Castor Pomace
Consolidated Rendering Co.'s Steamed Bone

Fish
Liberty Corn, Fruit and All Crops
Liberty Market Gardeners' Special
Liberty Market Gardeners' Special (Potash)
Liberty Potato and Vegetable Special
Liberty Sheep Manure
Liberty Tobacco Special
Liberty Tobacco Special (Potash)
Liberty Top Dresser for Grass and Grain
Nitrate of Soda
Raw Ground Phosphate Rock
Tankage

Armour Fertilizer Works, 305 Broadway, New York City.
Armour's Acid Phosphate Fertilizer
Armour's Bone Meal
Armour's Cereal Special No. 1 Fertilizer
Armour's Cereal Special No. 2 Fertilizer
Armour's Cereal Special No. 3 Fertilizer
Armour's Complete Potato Fertilizer
Armour's Crop Grower
Armour's 4-10-0 Fertilizer
Armour's 4-8-5 Fertilizer
Armour's Gardeners' Choice Fertilizer
Armour's General Crop Fertilizer
Armour's Grain Grower Fertilizer
Armour's Nitrate of Soda
Armour's Potato, Onion and Vegetable Fertilizer
Armour's Sheep Manure
Armour's Spl. Tobacco Grower No. 2 Fertilizer
Armour's Super-Grade Potato Mixture Fertilizer
Armour's Tobacco Special Fertilizer
Armour's Tobacco Special Fertilizer (5-4-3)
Armour's Wheat and Clover Fertilizer
Bidwell's Formula

Ashcraft-Wilkinson Company, Candler Building, Atlanta, Ga.
Paramount Brand Good Cotton Seed Meal

Atlantic Packing Co., New Haven, Conn.
Atlantic Fine Bone Meal
Atlantic Grain Fertilizer
Atlantic Potato Phosphate
Atlantic Special Vegetable
Atlantic 3-8-3
Atlantic Tobacco Grower
Atlantic Tobacco Special
Atlantic 2-8
Atlantic 2-8-3
Atlantic 4-8
Dry Ground Fish
Ground Tankage
Nitrate of Soda

Baker Castor Oil Co., 120 Broadway, New York City.
Castor Pomace

Barrett Company, 17 Battery Place, New York City.
Arcadian Sulphate of Ammonia

Berkshire Fertilizer Co., Bridgeport, Conn.
Berkshire Ammoniated Bone Phosphate
Berkshire Complete Fertilizer

Berkshire Complete Tobacco
Berkshire Dry Ground Fish
Berkshire Economical Grass Fertilizer
Berkshire Fine Ground Bone
Berkshire Grass Special
Berkshire Long Island Special
Berkshire Market Garden Fertilizer
Berkshire Potato and Vegetable Phosphate
Berkshire Tobacco Grower
Berkshire Tobacco Starter
Acid Phosphate
Castor Pomace
Nitrate of Soda
Sheep Manure

Boardman, F. E., Middletown, Conn.
Boardman's Fertilizer for General Crops

Bowker Fertilizer Company, 60 Trinity Place, New York City.
Bowker's All Round Fertilizer
Bowker's Conn. Valley Tobacco Fertilizer
Bowker's Corn, Grain and Grass Phosphate
Bowker's Fisherman's Brand Fish and Potash
Bowker's Four Ten Hill and Drill
Bowker's Fresh Ground Bone
Bowker's Hill and Drill Phosphate
Bowker's Lawn and Garden Dressing Revised
Bowker's Nitrate of Soda
Bowker's Potato and Vegetable Phosphate
Bowker's 16% Acid Phosphate
Bowker's Soluble Phosphate
Bowker's Square Brand Farm and Garden Phosphate
Bowker's Superphosphate with Ammonia 1%
Bowker's Superphosphate with Ammonia 2%
Bowker's Superphosphate with Ammonia 3%
Bowker's Superphosphate with Ammonia 4%
Bowker's Superphosphate with Ammonia 5%
Bowker's Sure Crop Phosphate Revised
Bowker's Three Ten All Round
Bowker's Tobacco Grower
Bowker's Two Ten Farm and Garden
Stockbridge Complete
Stockbridge Market Garden Manure
Stockbridge Tobacco Manure
Stockbridge Top Dressing and Forcing Manure

Breck, Joseph, & Sons, Corp'n, 51 North Market St., Boston, Mass.
Breck's Rams Head Brand Sheep Manure

Brodé, F. W., & Co., 119 Madison Ave., Memphis, Tenn.
Dove Brand Cotton Seed Meal
Jay Brand Cotton Seed Meal
Owl Brand High Grade Cotton Seed Meal

Buckeye Cotton Oil Company, Cincinnati, Ohio.
Buckeye Good Cotton Seed Meal
"Buco" Cottonseed Feed

Chicago Feed & Fertilizer Company, 809 Exchange Ave., Union Stock Yards, Chicago, Ill.
Magic Brand Pulverized Sheep Manure

Chittenden, E. D., Company, Bridgeport, Conn.
Chittenden's Complete Tobacco and Onion Grower
Chittenden's Complete Tobacco and Onion Grower without Potash
Chittenden's Tobacco Special with 5% Potash
Chittenden's Tobacco Special without Potash
Chittenden's Vegetable and Onion Grower without Potash

Clark, Everett B., Seed Company, Milford, Conn.
Special Mixture for General Use
Special Mixture with Potash

Coe-Mortimer Co., 51 Chambers St., New York City.
E. Frank Coe's Basic Fruit and Legume Phosphate (Basic Lime Phosphate) (Key-Plow Brand)
E. Frank Coe's Celebrated Special Potato Fertilizer Revised
E. Frank Coe's Columbian Corn and Potato Fertilizer
E. Frank Coe's Connecticut Wrapper Grower
E. Frank Coe's Corn King
E. Frank Coe's Dissolved Phosphate and Potash
E. Frank Coe's Gardeners' and Truckers' Special 1916
E. Frank Coe's Gold Brand Excelsior Guano Revised
E. Frank Coe's H. G. Ammoniated Superphosphate 1916
E. Frank Coe's New Englander Special
E. Frank Coe's Nitrate of Soda
E. Frank Coe's Prolific Crop Producer 1916
E. Frank Coe's 16% Superphosphate
E. Frank Coe's Special Grass Top Dressing
E. Frank Coe's Tobacco Leaf Fertilizer
E. Frank Coe's Tobacco Special
Fine Ground Bone

Columbia Guano Co., Munsey Building, Baltimore, Md.
Columbia Freedom Guano
Columbia Soluble Guano

Conn. Fat Rendering & Fertilizing Corp'n., P. O. Box 228, New Haven, Conn.
Tankage

Davis, S. P., Little Rock, Ark.
Good Luck Brand of Cottonseed Meal and Cracked Screened Cake

Dexter Portland Cement Co., Nazareth, Pa.
Dexter Potash Lime Fertilizer

Essex Fertilizer Company, 39 North Market St., Boston, Mass.
Essex Fish Fertilizer 3-8-3
Essex Market Garden 3-8-4
Essex Tobacco 5-5-4
Essex Tobacco 5-6
Essex Tobacco 5-7-2
Essex 1-10-1
Essex 2-8-2
Essex 3½-10
Essex 4-8-4

Fertile Chemical Company, Cleveland, Ohio.
Lime-Fertile
Nitro-Fertile

Frisbie, L. T., Co., New Haven, Conn.
Castor Pomace
Frisbie's Acid Phosphate 16%
Frisbie's Corn and Grain Fertilizer

Frisbie's Fine Bone Meal
Frisbie's 5-8
Frisbie's Special
Frisbie's Special Vegetable and Potato Grower
Frisbie's 3-8
Frisbie's 3-8-3
Frisbie's Tobacco 5-5-5
Frisbie's Tobacco 5-6
Frisbie's Tobacco Grower
Frisbie's Tobacco Special
Frisbie's 2-8
Frisbie's 4-10
Ground Tankage
Nitrate of Soda

Hall, W. D., Company, Atlanta, Ga.
Good Cotton Seed Meal

Hubbard Fertilizer Co., 802 Keyser Bldg., Baltimore, Md.
Hubbard's Excelsior Mixture
Hubbard's Farmers I X L
Hubbard's 5% Royal Seal
Hubbard's 4-10-0
Hubbard's New England Special
Hubbard's Nitrate of Soda
Hubbard's Noxall Guano
Hubbard's 16% Phosphate
Hubbard's Tobacco Fertilizer
Hubbard's Yellow Wrapper

Humphreys-Godwin Co., Memphis, Tenn.
Bull Brand Cottonseed Meal
Danish Brand Cottonseed Meal
Dixie Brand Cottonseed Meal
Forfat Brand Cottonseed Meal
Unit—1
Unit—2

Industrial Cotton Oil Properties, 65 Broadway, New York City.
"High Grade Cotton Seed Meal"

International Agricultural Corporation, Buffalo Fertilizer Works, Buffalo, N. Y.
Bone Meal
Buffalo Ammoniated Phosphate
Buffalo Economy
Buffalo Farmers Choice
Buffalo General Favorite
Buffalo High Grade Manure
Buffalo New England Special
Buffalo Onion, Vegetable and Potato
Buffalo Phosphate and Potash
Buffalo Three Ten
Buffalo Tobacco Grower
Buffalo Tobacco Producer
Buffalo Tobacco Special
Buffalo Top Dresser and Starter
I. A. C. Tobacco Crop

Joynt, John, Lucknow, Ont.
The Joynt Brand Canada Unbleached Hardwood Ashes

Koster, A. L., Suffield, Conn.
Dry Ground Fish
Hale Tobacco Mixture

Listers Agricultural Chemical Works, Newark, N. J.
Listers Ammoniated Dissolved Superphosphate Revised
Listers Bone Meal 1916
Listers Buyer's Choice Acid Phosphate
Listers Celebrated Ground Bone and Tankage Acidulated
Listers Celebrated Tobacco Fertilizer
Listers Complete Tobacco Manure
Listers Corn and Potato Fertilizer
Listers Eastern Pride Fertilizer
Listers H. G. Acid Phosphate
Listers King Bee Fertilizer
Listers Plant Food 1916
Listers Special Crop Producer
Listers Special Tobacco Fertilizer
Listers Standard Pure Superphosphate of Lime
Listers Success Fertilizer
Listers Superior Ammoniated Superphosphate 1916

Lovitt, L. B., & Co., Memphis, Tenn.
"Maloney's Pride No. 1" (7)
"Maloney's Pride No. 2" (6)
"Maloney's Pride No. 3" (8)

Lowell Fertilizer Co., 40 North Market St., Boston, Mass.
Acid Phosphate 16%
Lowell Animal Brand 3-8-4
Lowell Bone Fertilizer 2-8-2
Lowell Dissolved Bone Fertilizer 2-10
Lowell Empress Brand 1-10-1
Lowell 3½-10
Lowell 2-8-3
Lowell 3-8-3
Lowell 4-8-4
Lowell 5-8
Lowell 5-8-4
Lowell Ground Bone 2½-26
Lowell Lawn and Garden Dressing 4-7-2
Lowell Tobacco 5-5-4
Lowell Tobacco 5-6
Lowell Tobacco 5-7-2
Nitrate of Soda

Lyle & Lyle, Huntsville, Ala.
"Economy" C. S. Feed

Mapes Formula & Peruvian Guano Co., 143 Liberty St., New York City.
Mapes Corn Manure
Mapes C. S. Tobacco Manure
Mapes General Crop (1916 Brand)
Mapes General Tobacco Manure
Mapes General Truck Manure
Mapes Grain Brand
Mapes Potato Manure
Mapes Potato Manure (1916 Brand)
Mapes Tobacco Starter, Improved

National Fertilizer Co., 60 Trinity Place, New York City.
National Ammoniated Bone Phosphate
National Complete Grass Fertilizer

National Complete Tobacco Fertilizer
National Eureka Potato Fertilizer
National 5-4 Tobacco Manure
National Market Garden Fertilizer Revised
National Nitrogen Phosphate Mixture No. 1
National Nitrogen Phosphate Mixture No. 2
National Nitrogen Phosphate Mixture No. 3
National Nitrogen Phosphate Mixture No. 4
National Nitrogen Puosphate Mixture No. 6
National Pine Tree State Potato Fertilizer
National Potato Phosphate
National 16% Plain Superphosphate
National Soluble Bone and Potash
National Special Tobacco Revised
National Universal Phosphate
National XXX Fish and Potash

Natural Guano Co., Aurora, Ill.
"Sheep's Head" Pulverized Sheep Manure

New England Fertilizer Co., 40A North Market St., Boston, Mass.
N. E. Superphosphate 3-8-4
N. E. Tobacco 5-4
N. E. Tobacco 5-5-4
N. E. Tobacco 5-6
N. E. 1-10-1
N. E. 2-8-2
N. E. 2-8-3
N. E. 3-8-3
N. E. 3½-10
N. E. 5-8-7

Nitrate Agencies Co., 85 Water St., New York City.
N. A. C. Brand Acid Phosphate
N. A. C. Brand 8-6-5 Truckers Top Dresser
N. A. C. Brand 4-8-4 Potato Formula
N. A. C. Brand Ground Bone
N. A. C. Brand Muriate of Potash
N. A. C. Brand Nitrate of Soda
N. A. C. Brand 2-8-2 All Crop Formula

Nothern, W. C., Box 414, Memphis, Tenn.
Special No. 1 (Cotton Seed Meal)

Olds & Whipple, Hartford, Conn.
Acid Phosphate
Nitrate of Soda
O & W Complete Corn, Potato and Onion Fertilizer
O & W Complete Tobacco Fertilizer
O & W Dry Ground Fish
O & W Grass Fertilizer
O & W H. G. Tobacco Starter
O & W Special Corn, Onion and Potato Fertilizer
O & W Tobacco Special Fertilizer
Precipitated Bone Phosphate

Pacific Manure & Fertilizer Co., 429 Davis St., San Francisco, Calif.
Groz-It-Brand Pulverized Sheep Manure

Park & Pollard Co., Boston, Mass.
P. & P. Offcolored Cottonseed Meal
Upland Cottonseed Meal

Parmenter & Polsey Fertilizer Co., 41 North Market St., Boston, Mass.
P & P Plymouth Rock 3-8-4
P & P Tobacco 5-4
P & P Tobacco 5-5-4
P & P 1-10-1
P & P 2-8-2
P & P 2-8-3
P & P 2-10
P & P 3½-10
P & P 4-8-4 for Potatoes, Corn and Vegetables

Pawtucket Rendering Co., Pawtucket, R. I.
Ground Bone
2-8-2 Brand
3-8-4 Animal Brand
4-8-4 Brand
5-8-4 Brand

Piedmont-Mt. Airy Guano Co., Baltimore, Md.
Brown's Fertilizer for Corn and Grain
Brown's H. G. P. and General Crop Manure
Brown's Potato Fertilizer
Brown's Special Fertilizer
Brown's Special O & T and Market Garden
Brown's Tobacco Manure
Muriate of Potash
Nitrate of Soda
Piedmont 3-8-4 Fertilizer
Piedmont 4-8-6 Fertilizer
Piedmont 16% Acid Phosphate
Piedmont 3 50 Bone Meal
Piedmont 6 30 Tankage
Shay's Corn Fertilizer
Shay's Potato Fertilizer
Shay's Special Fertilizer

Pulverized Manure Co., 828 Exchange Ave., Union Stock Yards, Chicago, Ill.
Wizard Brand Manure

Quality Fertilizer Works, 52 Canal St., Stamford, Conn.
Bartlett Brand Special Tree Fertilizer

Robinson, George B., Jr., 18 Broadway, New York City.
"Robin" Brand Cotton Seed Meal

Rogers & Hubbard Company, Middletown, Conn.
Hubbard's "Bone Base" Fertilizer for Seeding Down
Hubbard's "Bone Base" Oats and Top Dressing
Hubbard's "Bone Base" Soluble Corn and General Crops Manure
Hubbard's "Bone Base" Soluble Potato Manure
Hubbard's Pure Raw Knuckle Bone Flour
Hubbard's Strictly Pure Fine Bone
R. & H.'s All Soils-All Crops Phosphate
R. & H.'s Climax Tobacco Brand
R. & H.'s Complete Phosphate
R. & H.'s Cottonseed Meal
R. & H.'s Potato Phosphate
R. & H.'s Soluble Tobacco Manure
R. & H.'s Tobacco Grower, Vegetable Formula

Royster, F. S., Guano Company, 1603 Munsey Bldg., Baltimore, Md.
Dry Ground Fish
Kainit

Muriate of Potash
Nitrate of Soda
Royster's Arrow Head Tobacco Formula
Royster's Banner Guano
Royster's Bully Guano
Royster's Dreadnought Guano
Royster's Fish and Potash
Royster's Fish, Flesh and Foul Guano
Royster's Landmark Brand
Royster's Perfecto Tobacco Formula
Royster's Prime Fish Brand
Royster's Purity Brand
Royster's Quality Trucker
Royster's 16% Acid Phosphate
Royster's Truckers' Delight
Royster's Valley Tobacco Formula
Stevens Formula

Sanderson Fertilizer & Chemical Co., New Haven, Conn.
Sanderson's Acid Phosphate
Sanderson's Atlantic Coast Bone, Fish and Potash
Sanderson's Complete Tobacco Grower
Sanderson's Corn Superphosphate
Sanderson's Fine Ground Bone
Sanderson's Formula A
Sanderson's Formula B
Sanderson's H. G. Ammoniated Phosphate
Sanderson's Kelsey's Bone, Fish and Potash
Sanderson's Nitrate of Soda
Sanderson's Phosphate without Potash
Sanderson's Potato Manure
Sanderson's Special without Potash
Sanderson's Tobacco Grower
Sanderson's Top Dressing for Grass and Grain
Sanderson's Top Dressing for Grass and Grain without Potash
South American Sheep and Goat Manure

Shoemaker, M. L., & Co., Inc., Venango St. and Delaware Ave., Philadelphia, Pa.
Swift-Sure Bone Meal
Swift-Sure Superphosphate for General Use
Swift-Sure Superphosphate for Potatoes No. 1
Swift-Sure Superphosphate for Tobacco
Swift-Sure Tankage

Soper, J. E., Co., 206 Chamber of Commerce, Boston, Mass.
Pilgrim Cottonseed Meal
Pioneer Cottonseed Meal
Puritan Cottonseed Meal
Soper's 5% Nitrogen C/S Meal
Soper's 6% Nitrogen C/S Meal
Soper's 7% Nitrogen C/S Meal

Southern Cotton Oil Company, Falls Building, 22 N. Front St., Memphis, Tenn.
Cotton Seed Meal

Springfield Rendering Co., 88 Liberty St., Springfield, Mass.
Springfield Animal Brand
Springfield Fine Ground Bone
Springfield Grain and Grass
Springfield Tobacco Special

Taylor Commission Co., Atlanta, Ga.
(Good Cotton Seed Meal) Taylor Brand

Union Seed & Fertilizer Co., 65 Broadway, New York City.
American Red Tag Cotton Seed Meal
Surety Brand Cotton Seed Meal
Yellow Tag Cotton Seed Meal

Virginia-Carolina Chemical Co., Equitable Building, 120 Broadway, New York City.
V-C Bone Meal
V-C Challenge Brand
V-C Champion Brand
V-C Cherokee Brand
V-C Fish and Potash Brand
V-C Indian Chief Brand
V-C Monarch Brand
V-C Owl Brand
V-C Pawnee Brand
V-C Plant Food for Vegetables, Lawns and Flowers
Virginia-Carolina Plow Brand

Wilcox Fertilizer Company, Mystic, Conn.
Acid Phosphate
Eldredge Fish and Potash
Nitrate of Soda
Wilcox Corn Special
Wilcox Dry Ground Fish
Wilcox Fish and Potash
Wilcox Grain Fertilizer
Wilcox Grass Fertilizer
Wilcox High Grade Fish and Potash
Wilcox Potato and Vegetable Phosphate
Wilcox Potato Fertilizer
Wilcox Tobacco Special

Witherbee, Sherman & Company, 393 Main St., Worcester, Mass.
Barium-Phosphate Grade A
Barium-Phosphate Grade B
Barium-Phosphate Grade C
Ground Phosphate Rock
Nitrate of Soda

Woodruff, S. D., & Sons, Orange, Conn.
Sheep Manure
Woodruff's Home Mixture

Worcester Rendering Co., Auburn, Mass.
Prosperity Brand Royal Worcester Corn and Grain Fertilizer
Prosperity Brand Royal Worcester Ground Steamed Bone
Prosperity Brand Royal Worcester Potato and Vegetable Fertilizer
Prosperity Brand Royal Worcester Special Grain Fertilizer

World's Fertilizer Process Co., Sharpsburg, Pa.
Shur-Gro

During the year Mr. Churchill, the Station's Agent, has visited 105 towns and villages in the State and gathered 547 samples, in the manner provided by law. Twenty of these registered brands have not been sold in the State, and seventy-eight, although reported to have been sold in Connecticut, could not be found by the sampling agent and therefore have not been examined.

In the following pages are given the analyses of all the brands which were sampled, as well as those sent for analysis by individuals. Of the latter the Station is not responsible for the accuracy of the sampling, although pains have been taken to secure from the senders certification that the Station's method of sampling was followed.

CLASSIFICATION OF FERTILIZERS ANALYZED.

	Number of samples.
1. *Containing nitrogen as the chief active ingredient:*	
Nitrate of soda	14
Sulphate of ammonia	1
Cotton seed meal	115
Castor pomace	3
2. *Containing phosphoric acid as the chief active ingredient:*	
Barium-phosphate	3
Raw rock phosphate	2
Precipitated bone phosphate	1
Basic lime phosphate	2
Dissolved rock phosphate or acid phosphate	20
3. *Containing potash as the chief active ingredient:*	
Cotton hull ashes	1
Potash salts and potash-lime	4
4. *Raw materials containing nitrogen and phosphoric acid:*	
Fish manures	16
Slaughter house tankage	15
Bone manures	19
Mixed bone and tankage	1
Garbage tankage	1
5. *Mixed fertilizers:*	
Nitrogenous superphosphates without potash	92
Nitrogenous superphosphates with potash	246
Home mixtures	16
6. *Miscellaneous fertilizers and waste products:*	
Tobacco stems, stalks and dust	4
Nitro-Fertile and Lime-Fertile	2
Sheep manure	9
Wood ashes	19
Lime and lime-kiln ashes	4
Other miscellaneous materials	15
Total	625

I. RAW MATERIALS CHIEFLY VALUABLE FOR NITROGEN.

NITRATE OF SODA.

Fourteen samples were analyzed as follows:

14484. Sold by the Berkshire Fertilizer Co., Bridgeport. Sampled at the factory.

14487. Sold by Apothecaries Hall Co., Waterbury. Stock of R. H. Morgan, West Cheshire.

14488. Sold by F. S. Royster Guano Co., Baltimore, Md. Stock of J. R. Reinhard & Sons, West Cheshire.

15149. Sold by Coe-Mortimer Co., New York. Stock of Conyer's Farm, Greenwich.

14479. Sold by Olds & Whipple, Hartford. Sampled at the factory.

14935. Sold by Piedmont-Mt. Airy Guano Co, Baltimore, Md. Stock of Farmers' Exchange, Woodstock.

15045. Sold by the Hubbard Fertilizer Co., Baltimore, Md. Stock of H. H. McKnight, Ellington.

14419. Sold by American Agricultural Chemical Co., New York. Stock of E. N. Austin, Suffield.

15205. Sold by the Atlantic Packing Co., New Haven. Sampled at the factory.

15206. Sold by L. T. Frisbie Co., New Haven. Stock of P. Schwartz Co., New London.

14477. Sold by Sanderson Fertilizer & Chemical Co., New Haven. Sampled at the factory.

14572. Sold by Wilcox Fertilizer Co., Mystic. Stock of G. R. Stannard, Branford.

15075. Sold by the Lowell Fertilizer Co., Boston. Stock of Litchfield County Coop. Association, Torrington.

14828. Sold by the Bowker Fertilizer Co., New York. Stock of F. B. Newton Est., Plainville.

TABLE I. ANALYSES OF NITRATE OF SODA.

Station No.	Per cent. of Nitrogen Guaranteed.	Found.	Cost per ton.	Nitrogen costs cents per pound.
14484	14.80	15.44	$70.00	22.6
14487	15.00	15.50	70.00	22.6
14488	15.00	15.54	74.75	24.0
15149	15.00	15.40	75.00	24.3
14479	15.00	15.34	75.00	24.4
14935	15.22	15.30	75.76	24.7
15045	15.22	15.24	76.15	24.9
14419	15.00	15.68	80.00	25.5
15205	15.00	15.16	80.00	26.4
15206	15.00	15.32	85.00	27.7
14477	15.00	15.42	86.75	28.1
14572	15.00	14.94	86.00	28.8
15075	15.00	15.28	90.00	29.4
14828	15.00	15.76	.....	....

The retail cash cost of nitrogen in nitrate of soda has ranged from 22.6 to 29.4 cents per pound, and has averaged 25.6 cents per pound.

SULPHATE OF AMMONIA.

One sample was examined.

14483. Sold by the Barrett Co., of New York City. Stock of Berkshire Fertilizer Co. Cost $100 per ton. It contained 20.92 per cent. nitrogen.

Nitrogen in this sample costs 23.9 cents per pound. Sulphate of ammonia and nitrate of soda have been altogether the cheapest forms of available nitrogen in our market.

COTTON SEED MEAL.

One hundred and fifteen samples have been examined, and their analyses appear in the following table.

The per cent of nitrogen has ranged from 5.10 to 8.11 per cent, the average being 6.50—very decidedly higher than in any season since 1916.

There has been considerable fluctuation in price during the winter and spring, the average being $79.55 per ton. Making no valuation of the phosphoric acid and potash in the meal, the average cost of nitrogen in meal has been 61.2 cents per pound.

If the phosphoric acid contained in the meal were credited at 7 cents per pound and potash at 12 cents per pound, the cost of nitrogen would be about 54½ cents per pound. Twenty-eight of the samples did not meet their guaranties, but eight of these were sold on a unit basis so that the buyer only paid for the actual amount of nitrogen received, which is altogether the most satisfactory basis of payment. The prices ranged from $70 to $90 per ton, following in some measure the fluctuations in the wholesale market.

TABLE II. ANALYSES OF COTTON SEED MEAL.

Station No.	Manufacturer or Jobber, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.	Cost per ton.
	American Cotton Oil Co., New York City.				
14807	American Red Tag, C. S. Meal	J. E. Phelps, Suffield	6.31	6.18	$68.12
	Ashcraft-Wilkinson Co., Atlanta, Ga.				
14512	Paramount Brand C. S. Meal	Station Agent from Rockville Milling Co	6.14	5.76	83.00
	F. W. Brodé & Co., Memphis, Tenn.				
14471	Owl Brand	A. D. Bridge's Sons, Inc., Hazardville	6.32	6.50	....
14491	Owl Brand, E. 74666	W. J. Reeves, Windsorville	6.18	6.50	75.10
14496	Owl Brand, C. & N. W., 180500	Spencer Bros., Suffield	6.90	6.85	79.19
14501	Owl Brand	E. H. Rollins, Granby	6.56	6.50	74.50
14715	Owl Brand	Station Agent from A. D. Bridge's Sons	6.27	6.50	87.00
14806	Owl Brand, N.Y. C., 230350	G. T. Soule, New Milford	6.64	6.50	80.00
14827	Owl Brand	Station Agent from G. E. Ackley Co., New Milford	6.63	6.50	80.00
14885	Owl Brand	S. F. Holcomb & Son, West Granby	6.89	6.50	77.00
14510	Jay Brand, S. P., 84389	Station Agent from A. D. Bridge's Sons, Hazardville	5.84	5.76	79.00
14443	.....	E. H. Rollins, Granby	6.58	6.50	75.00
14444	.....	E. H. Rollins, Granby	6.60	6.50	74.00
14490	G. E. T., 18543	William J. Reeves, Windsorville	6.68	6.50	81.20
14549	Soo L., 31488	G. T. Soule, New Milford	6.29	6.50	75.00
14551	Off Color, C. S. M., S. L. 104426	Ahern Bros., East Windsor Hill	6.65	6.50	.....
14852	Off Grade, C. S. M., N. Y. C. 230350	A. W. Camp, Danbury	6.60	6.50	80.00
	Cotton Seed Products Co., Louisville, Ky.				
14988	Prime C. S. Meal	Station Agent from Wybern Farms, Melrose	6.21	6.50	76.00
	S. P. Davis, Little Rock, Ark.				
14383	Good Luck Brand	L. P. Abbe, Hazardville	6.78	6.50	87.00
14825	Good Luck Brand	Station Agent from E. M. Waller, Gaylordsville	6.49	6.50	82.00

TABLE II. ANALYSES OF COTTON SEED MEAL—(*Continued*).

Station No.	Manufacturer or Jobber, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.	Cost per ton.
	DeSoto Oil Co., Memphis.				
14529	104426	R. H. Osborne, Warehouse Point	6.66	6.58	$78.00
	E. St. Louis Cotton Oil Co., National Stock Yards, Ill.				
15021	R. I. 56053	C. D. Cannon, Windsor Locks	6.73	6.64	77.50
	W. D. Hall Co., Atlanta, Ga.				
14434	Good C. S. Meal	A. D. Ellsworth, Broad Brook	5.32	5.76	76.00
14618	Good C. S. Meal	Station Agent from A. E. Hall, Wallingford	5.89	5.76	80.00
	Oscar Holway, Auburn, Me.				
14887	N. Y. C. 214957	William Gilligan, Windsor	6.80	6.70	86.28
	Humphreys-Godwin Co., Memphis, Tenn.				
14941	Bull Brand,	P. T. McCue, Windsor Locks	6.98	6.87	82.00
15076	Bull Brand	Station Agent from E. Manchester & Sons, Winsted	7.16	6.87	85.00
15192	Bull Brand	J. A. Sherwood, Long Hill	7.09	6.87	83.00
15222	Bull Brand	C. L. Luce, New Britain	6.92	6.87	....
14659	Danish Brand	Station Agent from G. S. Phelps, Thompsonville	5.45	5.75	80.00
15133	Danish Brand	The Coles Co., Middletown	5.84	5.75	82.00
15187	Danish Brand	W. E. Wheelock, Quinebaug	5.81	5.75	....
14507	Dixie Brand, 89546	Hartford Tobacco Corporation, Hartford	7.49	7.50	94.71
15134	Bright C. S. Meal, Penn. 32253	Jno. Sullivan & Son, Thompsonville	5.49	5.76	72.00
15135	Bright C. S. Meal, L. V. 82216	Jno. Sullivan & Son, Thompsonville	5.67	5.76	72.00
15164	Bright C. S. Meal, C. & N. W. 101624	Spencer Bros., Suffield	5.54	5.76	73.00
15341	26206	Coles Co., Middletown	6.16	5.76	74.00
14784	Off-Color C. S. Meal, W. B. 45334	G. S. Phelps & Co., Thompsonville	5.67	5.75	68.00
14872	Off-Color C. S. Meal, Pa. 63451	Spencer Bros., Suffield	6.31	6.58	76.16
14901	Off-Color C. S. Meal, C. M. & St. P. 75860	Spencer Bros., Suffield	5.53	5.58	73.00
15145	Off-Color C. S. Meal, 246729	The Coles Co., Middletown	6.83	6.88	75.25
14386	Off-Grade C. S. Meal, A. T. & S. F. 31182	G. T. Soule, New Milford	6.26	6.27	76.10
14403	C. S. Meal, C. & O. 8803	The Coles Co., Middletown	6.00	5.75	83.00
14473	C. S. Meal, 111209	G. S. Phelps & Co., Thompsonville	5.92	5.75	67.00
14508	C. S. Meal, B. & M. 62922	L. B. Haas & Co., Hartford	7.34	7.50	93.75

TABLE II. ANALYSES OF COTTON SEED MEAL—(*Continued*).

Station No.	Manufacturer or Jobber, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.	Cost per ton.
	Humphreys-Godwin Co., Memphis, Tenn. (*Continued*).				
14530	Off-Grade C. S. Meal, P. M. 70929	S. J. Orr, West Suffield	6.44	..	$72.81
14531	Off-Grade C. S. Meal, M. O. P. 34509	S. J. Orr, West Suffield	6.59	..	74.49
14532	Off-Grade C. S. Meal, G. T. 25226	S. J. Orr, West Suffield	6.17	..	69.75
14533	Off-Grade C. S. Meal, G. E. T. 2125	S. J. Orr, West Suffield	6.19	..	69.94
14534	Off Grade C. S. Meal, C. C. C. & S. T. L. 53951	S. J. Orr, West Suffield	6.06	..	68.54
14535	Off-Grade C. S. Meal, N. Y. C. 255143	S. J. Orr, West Suffield	6.12	..	69.19
14556	Dark C. S. Meal, Chi., St. P. 28404	H. C. Nelson, West Suffield	5.77	5.75	66.00
15285	C. S. Meal, 101182	Coles Co., Middletown	5.76	5.76	78.00
	L. B. Lovitt & Co., Memphis, Tenn.				
14464	Off Color C. S. Meal, M. C. 60060	Spencer Bros., Suffield	6.99	7.13	80.15
14662	Off -Color C. S. Meal	O. T. Cone, Warehouse Point	7.56	7.20	88.95
14754	Off-Color C. S. Meal	J. B. Parker, Poquonock	7.63	..	79.39
14800	Off-Color C. S. Meal, N. P. 19112	Spencer Bros., Suffield	7.64	7.57	92.24
14810	Off-Color C. S. Meal, K. C. S. 12532	Spencer Bros., Suffield	7.66	7.92	90.11
14401	Off-Color C. S. Meal, P. R. R. 48725	Spencer Bros., Suffield	7.02	6.87	80.44
14431	Off-Color C. S. Meal, C. B. Q. 105732	Spencer Bros., Suffield	7.23	7.25	82.51
14432	Off-Color C. S. Meal, St. Fe 30995	Spencer Bros., Suffield	6.30	6.29	72.23
14433	Off-Color C. S. Meal, M. C. 46667	Spencer Bros., Suffield	6.92	6.99	79.30
14438	Off-Color C. S. Meal, I. C. 24343	Spencer Bros., Suffield	6.89	6.89	78.92
14439	Off-Color C. S. Meal, Penn. 35562	Spencer Bros., Suffield	6.89	6.68	78.92
14459	Off-Color C. S. Meal, F. W. D 4635	Spencer Bros., Suffield	6.19	6.39	71.00
14462	Off-Color C. S. Meal, I. & G. N. 5507	Spencer Bros., Suffield	6.69	6.58	76.69
14463	Off-Color C. S. Meal, S. L. & S. F. 40673	Spencer Bros., Suffield	6.36	6.35	72.89

TABLE II. ANALYSES OF COTTON SEED MEAL—(*Continued*).

Station No.	Manufacturer or Jobber, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.	Cost per ton.
	L. B. Lovitt & Co., Memphis, Tenn. *(Continued).*				
14469	Off-Color C. S. Meal, P. L. 535715	John Edgar, Enfield	6.85	6.85	$78.54
14470	Off-Color C. S. Meal, N. Y. C. 229466	Spencer Bros., Suffield	6.78	6.87	79.75
14528	Off-Color C. S. Meal, L. E. & W. 12215	Spencer Bros., Suffield	6.80	6.82	82.01
14550	Off-Color C. S. Meal, L. V. 85869	Spencer Bros., Suffield	6.74	6.82	81.32
14801	Off-Color C. S. Meal, B. & M. 47599	Spencer Bros., Suffield	6.87	6.81	82.92
14829	Off-Color C. S. Meal, L. & N 7607	Spencer Bros., Suffield	6.60	6.50	75.62
14494	Off-Color C. S. Meal, B. & O. 89651	Spencer Bros., Suffield	8.11	8.00	97.90
14586	Off-Color C. S. Meal, A. T. & S. Fe 7460	Spencer Bros., Suffield	8.07	8.27	97.41
	Lyle & Lyle, Huntsville, Ala.				
14384	Economy Brand Sou 120566	G. T. Soule, New Milford	5.92	5.75	85.00
	W. C. Nothern, Memphis.				
14377	Special No. 1, T. P. 8055	G. S. Phelps, Warehouse Point	6.75	6.50	77.00
14415	Off-Color, 120719	J. W. Crowell, Burnside	6.39	5.75	77.00
	Park & Pollard Co., Boston.				
14571	Upland C. S. Meal	Station Agent from F. B. Newton Est., Plainville	5.67	5.75	83.00
		Rockville Milling Co	6.67	6.50	81.00
14297	Off-Color C. S. Meal	Ahern Bros., E. Windsor Hill	7.12	6.50	74.50
14335	B. & L. E. 81002	L. C. Daly, Warehouse Point	7.16	6.50	78.00
14337		Broad Brook Lumber & Coal Co	7.26	7.43	83.79
14460	B. & O. 85534	Broad Brook Lumber & Coal Co	7.03	7.28	81.13
14461	B-4 45144	Station Agent from Broad Brook L. & C. Co	7.15	5.76	82.55
14465	Off-Qual., C. C. C. & St. L. 9266	E. H. Rollins, Granby	6.44	6.58	75.25
14500	G. T. 10102	Broad Brook Lumber & Coal Co	7.58	7.36	87.50
14504	L. & N. 3460	Broad Brook Lumber & Coal Co	7.37	7.13	85.12
14505	C. of G. 60017	E. H. Rollins, Granby	6.42	6.58	74.50
14630	S. S. W. 7320	Station Agent from G. E. Ackley Co., New Milford	6.81	7.00	80.00
14826	Off-Grade				
	The Roger & Hubbard Co., Middletown.				
14466	C. & O. 3223	Station Agent from P. F. Chamberlain, Broad Brook	6.75	6.50	82.00

TABLE II. ANALYSES OF COTTON SEED MEAL—(*Concluded*).

Station No.	Manufacturer or Jobber, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.	Cost per ton.
	Sanderson Fertz. & Chem. Co., New Haven.				
14509		Benjamin Fenn, Milford	6.71	..	....
	J. E. Soper & Co., Boston.				
14351	Puritan C. S. Meal	J. B. Cannon, Granby	6.09	5.75	$78.50
15189	Puritan C. S. Meal	The Coles Co., Middletown	5.20	5.75	80.00
14661	Puritan C. S. Meal	Station Agent from P. Schwartz Co., New London	5.26	5.75	80.00
14493	Off-Color C. S. Meal	Spencer Bros., Suffield	7.36	7.38	86.63
14497	Off-Color C. S. Meal, C. P. 205692	Spencer Bros., Suffield	7.40	7.22	84.78
14393	Off-Color C. S. Meal, 138752	L. C. Seymour, Windsor Locks	5.10	5.76	74.00
14422	Off-Color C. S. Meal, 138752	Station Agent from L. C. Seymour	5.27	5.76	74.00
14831		H. F. Farnham, E. Windsor Hill	6.25	5.76	75.00
14411	Off-Color C. S. Meal, N. P. 38946	W. E. Bates, East Granby	5.84	5.76	74.00
14799		C. H. Northam, Hartford	5.49	5.76	77.00
14886	Off-Color C. S. Meal, Penn. 608298	J. T. O'Neill, Burnside	5.95	5.76	77.50
14870	Off-Color C. S. Meal	Station Agent from A. Manning, So. Manchester	5.24	5.76	69.50
15091	Off-Color C. S. Meal	Arthur Manning, Manchester	5.42	5.76	69.50
	Taylor Commission Co., Atlanta, Ga.				
14728		Station Agent from Meech & Stoddard, Middletown	5.99	5.76	78.50
	Terrell Cotton Oil Co.				
14495		E. T. Hurlburt & Son, Somers	7.16	6.75	87.50
	Texarkana Cotton Oil and Fertilizer Co., Texarkana, Ark.				
14416		Station Agent from E. N. Austin, Suffield	6.56	6.58	75.00
14511		Station Agent from Rockville Milling Co	6.50	..	81.00
	Union Seed & Fert'z'r Co., New York.				
14609	Surety Brand C. S. Meal	Station Agent from F. H. Rolf, Guilford	6.19	5.76	88.00
14938	Surety Brand, Erie 110567	Coles Co., Middletown	5.84	5.76	84.00
14660	Amer. Red Tag C. S. Meal	Station Agent from M. E. Thompson, Ellington	6.31	6.18	80.00
15088	Amer. Red Tag C. S. Meal	J. E. Phelps, Suffield	6.35	6.18	70.10
	Jobber Unknown.				
14830		L. J. Prior, East Hartford	6.59	..	....
15186		Arthur Manning, Manchester	6.65	6.88	90.00

CASTOR POMACE.

Three samples were analyzed as follows:

14421. Sold by American Agricultural Chemical Co., New York City. Stock of E. N. Austin, Suffield.

14515. Sold by the Apothecaries Hall Co., Waterbury. Sampled at the factory.

14481. Sold by Baker Castor Oil Co., New York City. Stock of Olds & Whipple, Hartford.

ANALYSES OF CASTOR POMACE.

Station No.	14421	14515	14481
Per cent. of			
Nitrogen guaranteed	4.50	4.52	4.50
Nitrogen found	5.29	5.73	5.72
Cost per ton	$60.00	$60.00	$57.00
Nitrogen costs per pound	**56.7**	**52.3**	**49.9**

II. RAW MATERIALS CHIEFLY VALUABLE FOR PHOSPHORIC ACID.

BARIUM-PHOSPHATE.

14977. Grade A. Sold by Witherbee, Sherman & Co., Port Henry, N. Y. Stock of J. H. Miller, Stamford. Guaranteed 28 per cent. phosphoric acid.

14932. Grade B. Sold by Witherbee, Sherman & Co., Port Henry, N. Y. Stock of Geo. S. Carter, Clinton. Guaranteed 16 per cent. phosphoric acid. Cost $25.00 per ton.

14933. Grade C. Sold by Witherbee, Sherman & Co., Port Henry, N. Y. Stock of C. E. Lyman, Middlefield. Guaranteed 14 per cent phosphoric acid. Cost $22.00 per ton.

ANALYSES OF BARIUM-PHOSPHATE.

Station No.	14977	14932	14933
Water-soluble phosphoric acid	**None**	**0.03**	**None**
Citrate-soluble phosphoric acid	3.18	0.59	0.24
Insoluble phosphoric acid	25.16	16.68	16.21
Total phosphoric acid	28.34	17.30	16.45
Phosphoric acid cost cents per pound		**7.2**	**6.7**

RAW ROCK PHOSPHATE.

Two samples were analyzed as follows:

15181. Tacco Ground Phosphate. Sold by Tennessee Agricultural Corporation, Centerville, Tenn. Sent by E. E. Burwell, New Haven.

15150. Raw Ground Phosphate. Sold by Apothecaries Hall Co., Waterbury. Stock of H. A. Edwards, Naugatuck.

ANALYSES OF RAW ROCK PHOSPHATE.

Station No.	15181	15150
Water-soluble phosphoric acid	0.16	0.04
Citrate-soluble phosphoric acid	2.31	3.12
Citrate-insoluble phosphoric acid	21.25	28.06
Total phosphoric acid	23.72	31.22
"Available" phosphoric acid found	2.47	3.16
Cost per ton	....	$17.00

15181 was ground phosphate which had been saturated with strong liquid manure, worked over and exposed to the action of air and frost for a year.

PRECIPITATED BONE PHOSPHATE.

One sample was analyzed as follows:

14480. Sold by Olds & Whipple, Hartford. Sampled at factory. Cost $1.50 per unit available phosphoric acid.

ANALYSIS OF PRECIPITATED BONE PHOSPHATE.

Station No.	14480
Water-soluble phosphoric acid	0.37
Citrate-soluble phosphoric acid	18.67
Citrate-insoluble phosphoric acid	8.26
Total phosphoric acid	27.30
"Available" phosphoric acid found	19.04
Cost of "available" phosphoric acid per pound	**7.5¢**

BASIC LIME PHOSPHATE.

Two samples were analysed as follows:

15117. Sold by American Agricultural Chemical Co., New York City. Stock of R. E. Morgan, Windsor. Guaranteed 13 per cent. "available" phosphoric acid, 14 per cent. total phosphoric acid. Cost $24.25 f.o.b. factory.

14978. Basic Fruit and Legume Phosphate. Sold by Coe-Mortimer Co., New York City. Stock of J. C. Jackson, Wilton. Cost $22.75 per ton. Guaranteed 13 per cent. "available" phosphoric acid, 14 per cent. total phosphoric acid.

ANALYSES OF BASIC LIME PHOSPHATE.

Station No.	15117	14978
Water-soluble phosphoric acid	2.67	3.10
Citrate-soluble phosphoric acid	11.27	10.38
Citrate-insoluble phosphoric acid	1.50	1.46
Total phosphoric acid	15.44	14.94
"Available" phosphoric acid	13.94	13.48
Cost of "available" phosphoric acid per pound		**8.4¢**

DISSOLVED ROCK PHOSPHATE OR ACID PHOSPHATE.

The analyses of twenty samples of this material are given in the table.

The prices charged have ranged from $27 to $40 per ton. The average cost of available phosphoric acid has been about 10.1 cents per pound.

Twenty samples were analyzed as follows:

14476. Sold by Sanderson Fertilizer & Chemical Co., New Haven. Sampled at factory.

14854. Sold by Piedmont-Mt. Airy Guano Co., Baltimore, Md. Stock of Farmers' Exchange, South Meriden.

15042. Sold by the Hubbard Fertilizer Co., Baltimore, Md. Stock of H. H. McKnight, Ellington.

15157. Sold by Olds & Whipple, Hartford. Stock of Haviland Tobacco Co., East Windsor Hill.

14707. Sold by National Fertilizer Co., New York City. Stock of R. Delaney, Somersville.

15207. Sold by Berkshire Fertilizer Co., Bridgeport. Stock of D. L. Clarke & Sons, Milford.

14482. Sold by Olds & Whipple, Hartford. Sampled at factory.

14417. Sold by American Agricultural Chemical Co., New York City. Stock of E. N. Austin, Suffield.

TABLE III. ANALYSES OF ACID PHOSPHATE.

Station No.	Water-soluble phosphoric acid.	Citrate-soluble phosphoric acid.	Citrate-insoluble phosphoric acid.	Total phosphoric acid.	"Available" phosphoric acid found.	"Available" phosphoric acid guaranteed.	Cost per ton.	"Available" phosphoric acid costs cents per pound.
14476	15.39	1.79	0.15	17.33	17.18	16.00	$30.00	8.7
14854	12.17	3.13	1.01	16.31	15.30	16.00	27.00	8.8
15042	14.20	1.87	0.27	16.34	16.07	16.00	29.00	9.0
15157	13.71	3.22	0.93	17.86	16.93	16.00	30.87	9.1
14707	11.16	5.25	0.55	16.96	16.41	16.00	30.90	9.4
15207	14.34	3.27	0.33	17.94	17.61	16.00	33.50	9.5
14482	12.29	3.47	0.15	15.91	15.76	16.00	30.64	9.7
14417	14.64	2.20	0.19	17.03	16.84	16.00	33.00	9.8
14934	11.36	4.64	2.01	18.01	16.00	16.00	32.00	10.0
14542	12.67	2.62	1.64	16.93	15.29	16.00	32.00	10.4
14971	13.26	2.92	0.36	16.54	16.18	14.00	35.00	10.8
15074	12.01	3.70	1.52	17.23	15.71	16.00	34.00	10.8
14499	13.33	1.89	0.90	16.12	15.22	16.00	33.00	10.8
14514	14.02	1.94	0.20	16.16	15.96	14.00	35.00	11.0
14795	13.50	3.32	0.22	17.04	16.82	16.00	38.00	11.3
15113	13.58	2.90	0.32	16.80	16.48	16.00	40.00	12.1
14478	13.55	3.37	0.26	17.18	16.92	16.00	.....	....
14813	14.41	3.19	0.14	17.74	17.60	16.00	.....	....
14879	12.61	2.96	1.39	16.96	15.57	16.00	.....	..
14986	9.52	5.55	1.14	16.21	15.07	16.00	.....	....

The percentage of available phosphoric acid in Sample 14542, Royster's Acid Phosphate, was not so high as guaranteed. A second sample 14879 of the same brand contained a higher percentage of available acid than the first, but still did not fully meet its guaranty.

14934. Sold by Coe-Mortimer Co., New York City. Stock of J. E. Stoddard, Abington.

14542. Sold by F. S. Royster Guano Co., Baltimore, Md. Stock of J. R. Reinhard & Sons, West Cheshire.

14971. Sold by Listers Agricultural Chemical Works, Newark, N. J. Stock of W. H. Carrier, Glastonbury.

15074. Sold by Lowell Fertilizer Co., Boston, Mass. Stock of H. B. Brownson, Shelton.

14499. Sold by Apothecaries Hall Co., Waterbury. Sampled at factory.

14514. Sold by American Agricultural Chemical Co., New York City. Stock of Spencer Bros., Suffield.

14795. Sold by Bowker Fertilzer Co., New York City. Stock of Geo. E. Ackley Co., New Milford.

15113. Sold by Listers Agricultural Chemical Works, Newark, N. J. Stock of B. C. Wooding, Yalesville.

14478. Sold by L. T. Frisbie Co., New Haven. Sampled at factory.

14813. Sold by Wilcox Fertilizer Co., Mystic. Sampled at factory.

14879. Sold by F. S. Royster Guano Co., Baltimore, Md. Stock of W. S. Brown, Trumbull.

14986. Sold by American Agricultural Chemical Co., New York City. Stock of W. H. Latimer & Son, Southington.

III. RAW MATERIALS OF HIGH GRADE CONTAINING POTASH.

COTTON HULL ASHES.

15171. Sent by Olds & Whipple, Hartford. Stock of Windsor Tobacco Growers' Corp., Windsor. It contained 19.42 per cent. of potash.

POTASH SALTS AND OTHER MATERIALS CONTAINING WATER-SOLUBLE POTASH.

14931. Kainit. Sold by F. S. Royster Guano Co., Baltimore, Md. Stock of Knowles, Lombard Co., Guilford. It contained 14.21 per cent. potash and cost $45.00 per ton, making the cost of actual potash 15.8 cents per pound.

14929. Muriate of potash. Sold by F. S. Royster Guano Co., Baltimore, Md. Stock of Knowles, Lombard Co., Guilford. It contained 56.68 per cent. potash and sold for $165 per ton, making the cost of actual potash 14.5 cents per pound.

14284. Nebraska Potash. Sold by Standard Potash Co., Lakeside, Neb. It contained 27.30 per cent. potash.

15023. Potash-Lime. Sent by Dexter Portland Cement Co., Nazareth, Pa. It contained 3.13 per cent. potash and 33.28 per cent. of lime.

IV. MATERIALS CONTAINING NITROGEN AND PHOSPHORIC ACID.

FISH MANURES.

Sixteen samples were examined, eleven of which were sampled by the Station Agent and five by purchasers. Analyses appear in Table IV.

Sample **14585** was stated to be bought by Mr. Fiske for his own use from the New England Fertlizer Co. It is not a brand registered by them.

Three of the samples, **15125**, Lowell Fertilizer Co.; **15114**, Atlantic Packing Co.; and **15136**, A. L. Koster, contained much less nitrogen than was guaranteed.

The average percentage of nitrogen, though with a wide range, is about 8.33; of available phosphoric acid, 6.01; and the cost per ton, ranging from $80 to $115, has averaged about $99.64.

Allowing 10 cents per pound for available phosphoric acid, the nitrogen in fish manures has had an average cost of 52.6 cents per pound.

TABLE IV. ANALYSES OF

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.
	Sampled by Station:	
14418	American Agr. Chem. Co.	E. N. Austin, Suffield.
14645	Apothecaries' Hall Co.	Wm. Reeves, Windsorville.
15114	Atlantic Packing Co.	John Helm, So. Windsor.
14574	Berkshire Fertz. Co.	Manufacturer.
14989	East Harbor Fertz. Co.	Wybern Farms, Melrose.
15130	A. L. Koster.	Michael Cannon, Rockville.
15125	Lowell Fertz. Co.	T. J. Coleman, Warehouse Pt.
14585		W. E. Fiske, Warehouse Pt.
14537	Olds & Whipple.	Manufacturer.
14930	F. S. Royster Guano Co.	C. R. Woodford & Sons, Avon.
14644	Wilcox Fertz. Co.	Bloomstein & Adler, Burnside.
	Sampled by Purchaser:	
15183[3]	"Fish Meal," East Coast Fisheries Products Co.	American Sumatra Tobacco Co., East Hartford.
15136	A. L. Koster.	Fassler & Silberman, Hartford.
14238	Wilcox Fertz. Co.	American Sumatra Tobacco Co., East Hartford.
14346	No. 2.	Silverherz Tobacco Co., Rockville.
14345	No. 1.	Silverherz Tobacco Co., Rockville.

[1] 0.39 per cent. nitrogen in nitrates. [2] 0.16 per cent. nitrogen in nitrates.
[3] Contains 0.76 per cent. chlorine.

SLAUGHTER HOUSE TANKAGE.

Table V, page 28.

Fifteen samples were examined. Six of these were sampled by the Station Agent, seven were submitted by purchasers, and two by a manufacturer for determinations of nitrogen availability. **14062**, Tankage base, prepared from slaughter-house tankage, contained 1.64 per cent. of water-insoluble organic nitrogen, 78.2 per cent. of which was in active form. **14063**, Bone Tankage, contained 2.79 per cent. of water-insoluble organic nitrogen, 87.0 per cent. of which was in active form. The neutral permanganate method was employed in both cases.

Analyses of the remaining samples appear in Table V.

One of the samples taken by the Station Agent, **15204**, Atlantic Packing Co., was far below its guaranty in nitrogen and phosphoric acid, and four others, **14475** and **14881**, Conn. Fat Rendering and Fertilizing Corp., **14855**, Piedmont-Mt. Airy Guano Co., and **14918**, M. L. Shoemaker & Co., were deficient in phosphoric acid.

FISH MANURES.

Nitrogen.				Phosphoric acid.			Total phosphoric acid.		
As ammonia.	As organic.	Total found.	Total guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Cost per ton.
0.23	8.92	9.15	8.23	....	....	....	8.66	6.00	$100.00
0.17	8.81	9.37[1]	8.20	0.50	5.92	1.52	7.94	5.50	115.00
0.18	7.28	7.46	7.81	0.50	5.31	0.43	6.24	5.50	80.00
0.60	7.69	8.29	8.23	0.75	4.52	0.95	6.22	6.00	100.00
0.52	8.48	9.00	8.23	0.70	3.78	0.91	5.39	6.00	95.00
3.90	5.13	9.03	8.23	0.33	5.85	1.60	7.78	3.00	.....
0.21	7.08	7.29	7.81	0.51	4.86	0.23	5.60	5.50	100.00
0.26	7.67	7.93	7.41	0.43	4.93	0.38	5.74	14.00	105.00
0.20	7.85	8.05	8.23	0.57	8.99	4.45	14.01	5.50	99.75
0.23	8.28	8.51	8.22	0.35	7.77	4.03	12.15	5.00	106.00
0.66	7.96	8.78[2]	8.24	1.56	4.49	0.77	6.82	5.00	.....
0.15	9.09	9.24	....	0.58	8.92	3.08	12.58	....	.....
1.16	5.13	6.29	8.23	0.50	6.40	0.58	7.48	3.00	96.00
0.46	8.10	8.56	....	2.38	2.35	0.83	5.56	....	.....
0.20	7.74	7.94	....	0.50	5.82	5.32	11.64	....	.....
0.92	7.78	8.70	....	1.23	4.51	1.33	7.07	....	.....

TABLE V. ANALYSES OF

Station No.	Manufacturer.	Dealer or Purchaser.
	Sampled by Station:	
14486	Apothecaries Hall Co	R. H. Morgan, West Cheshire
15204	Atlantic Packing Co	Manufacturer
14475	Conn. Fat Rend. & Fertz. Corp	Manufacturer
14881	Conn. Fat Rend. & Fertz. Corp	F. A. Forbes, East Haven
14855	Piedmont—Mt. Airy Guano Co	Minor Ives, South Meriden
14918	M. L. Shoemaker & Co	H. B. Cornwall, Meriden
	Sampled by Purchaser:	
15188	Apothecaries Hall Co	Barnes Bros. Nursery Co
14344		Chas. Johnson, Gaylordsville
15389	Apothecaries Hall Co	A. N. Pierson, Inc., Cromwell
15382	Godfrey Fertilizer & Chem'l Co., Newark, N.J.	A. N. Pierson, Inc., Cromwell
15383	Godfrey Fertilizer & Chemical Co., Newark, N. J.	A. N. Pierson, Inc., Cromwell
15384	Godfrey Fertilizer & Chemical Co., Newark, N. J.	A. N. Pierson, Inc., Cromwell
15774	Godfrey Fertilizer & Chemical Co., Newark, N. J.	A. N. Pierson, Inc., Cromwell

[1] 0.16 per cent. nitrogen in nitrates.

BONE MANURES.

Table VI, page 30.

The analyses of 19 samples, of which 15 were drawn by the Station Agent, are given in table VI.

14420 is not a brand registered in this State, but is stated to have been shipped by mistake to E. N. Austin by the Springfield Rendering Co., Springfield, Mass.

One sample, **15065**, from the Piedmont-Mt. Airy Guano Co., failed to meet its guaranty of nitrogen.

The average amounts of nitrogen and phosphoric acid found in these samples have been 3.43 and 23.45 per cent. respectively, and the average cost, ranging from $51.50 to $76, has been $63.15. Allowing 50 cents per pound for nitrogen, phosphoric acid has cost 6.1 cents.

GARBAGE TANKAGE.

14696 is tankage prepared from city garbage. Sent by the Health Dept., Bridgeport. It contained 2.30 per cent. of nitrogen and 3.30 per cent. of phosphoric acid. 78 per cent. of the material was in particles coarser than 1-50 inch.

SLAUGHTER HOUSE TANKAGE.

Nitrogen.				Phosphoric acid.		Mechanical analysis.		
As ammonia.	As organic.	Total found.	Total guaranteed.	Found.	Guaranteed.	Finer than 1-50 inch.	Coarser than 1-50 inch.	Cost per ton.
0.14	5.55	5.69	5.79	16.49	15.00	33.00	67.00	$65.00
0.61	.....	3.95	4.93	4.73	14.00	51.00	49.00	56.50
0.54	2.94	3.48	3.23	22.88	25.42	47.00	53.00	40.00
0.18	3.09	3.27	3.23	22.98	25.42	41.00	59.00	45.00
0.16	4.70	4.86	4.93	10.82	13.73	49.00	51.00	57.00
0.10	7.31	7.57[1]	7.40	9.81	15.00	65.00	35.00	75.50
0.23	5.82	6.05	6.34	14.24	12.20	34.00	66.00	60.49
0.12	7.02	7.14	.....	11.82	.....	.....	.....	.....
.....	.....	3.23	.....	25.57	.....	.....	.....	.....
.....	.....	3.92	.....	5.54	.....	.....	.....	.....
.....	.....	4.46	.....	12.45	.....	.....	.....	.....
.....	.....	4.23	.....	10.93	.....	.....	.....	.....
0.30	4.20	4.50	4.84	10.67	12.00	.....	.....	.....

MIXED BONE AND TANKAGE.

14866. Listers Celebrated Ground Bone and Tankage Acidulated, made by Listers Agricultural Chemical Works, Newark, N. J. Stock of S. J. Orr, West Suffield; cost $54 per ton.

PERCENTAGE COMPOSITION OF MIXED BONE AND TANKAGE.

Total nitrogen found	2.81
Total nitrogen guaranteed	2.67
Total phosphoric acid found	13.42
Total phosphoric acid guaranteed	12.00

AVERAGE COST OF PLANT FOOD IN FERTILIZER MATERALS

From the foregoing analyses of the various fertilizing materials sold in Connecticut during the present year, the following statement is prepared showing what has been the approximate average cost per pound of nitrogen, phosphoric acid and potash:

TABLE VI. ANALYSES OF

Station No.	Manufacturer and Brand.	Dealer or Purchaser.
	Sampled by Station:	
15056	Am. Agr. Chem. Co., Fine Ground Bone	Spencer Bros., Suffield
15060	Atlantic Packing Co., Fine Bone Meal	T. H. Eldredge, Norwich
15062	Berkshire Fertz. Co., Fine Ground Bone	Manufacturer
15057	Bowker Fertz. Co., Fresh Ground Bone	Israel Andrews, Milldale
15063	Coe-Mortimer Co., Fine Ground Bone	Morrison & Dunham, Bethel
15055	L. T. Frisbie Co., Fine Bone Meal	Stanley Svea Coal Co., New Britain
15064	Lowell Fertz. Co., Ground Bone 2½—26	S. T. Welden, Simsbury
14420	Manchester Rendering Co., Manchester, New Hampshire	E. N. Austin, Suffield
15061	Pawtucket Ren. Co., Ground Bone	Chas. A. Templeton, Inc., Waterbury
15065	Piedmont–Mt. Airy Guano Co., Bone Meal	Farmers' Exchange, Woodstock
15058	Rogers & Hubbard Co., Strictly Pure Fine Bone	Joseph Kincaid, Jr., Middletown
15124	Rogers & Hubbard Co., Pure Raw Knuckle Bone Flour	Cadwell & Jones, Hartford
15053	Sanderson Fertz. & Chem. Co., Fine Ground Bone	Manufacturer
15054	M. L. Shoemaker, Swift-Sure Bone Meal	Olds & Whipple, Hartford
15059	Worcester Rendering Co., Prosperity	
	Royal Worcester Ground Steamed Bone	G. M. Williams Co., New London
	Sampled by Purchaser.	
15209	Armour Fertz. Co., Bone Meal	Horace Homer, Cos Cob
14298	Berkshire Fertz. Co., Bone Meal	A. T. Henry, Wallingford
14341	L. T. Frisbie Co., Pure Fine Ground Bone	A. E. Plant Son's Co., Branford
14396		John H. Gasser, Bethel

	Cents per pound.
Nitrogen in nitrates	25.6
sulphate of ammonia	23.6
cotton seed meal	54.5* to 61.2
castor pomace	48.6* to 52.8
fish	52.5†
Total phosphoric acid in raw ground rock	2.7
in "barium-phosphate"	6.7 to 7.2
bone	6.1§
Available phosphoric acid in precipitated phosphate	7.5
basic lime phosphate	8.4
acid phosphate	10.1
Potash	(about) 16.0

* Allowing 7 cents and 12 cents, respectively, for the phosphoric acid and potash contained in it.

† Allowing 10.1 cents per pound for available phosphoric acid.

§ Allowing 50 cents per pound for the nitrogen.

BONE MANURES.

Nitrogen.		Phosphoric acid.		Mechanical analysis.		
Found.	Guaranteed.	Found.	Guaranteed.	Finer than 1-50 inch.	Coarser than 1-50 inch.	Cost per ton.
3.64	2.47	23.16	22.88	40	60	$58.00
2.72	2.05	26.38	25.00	62	38	63.00
4.20	3.30	20.24	20.00	46	54	60.00
2.59	2.47	26.17	22.88	64	36	61.00
2.51	2.47	25.13	22.83	69	31	60.00
3.24	2.47	26.02	20.00	48	52	64.00
3.32	2.05	24.82	27.00	43	57	52.00
2.85	2.50	25.38	26.00	52	48	.....
3.98	2.47	21.36	20.00	59	41	65.00
1.94	2.47	22.29	20.00	51	49	.....
3.67	3.29	23.41	20.59	60	40	73.00
3.84	3.82	24.69	24.70	76	24	76.00
3.39	2.47	23.67	22.88	45	55	51.50
4.72	4.53	24.69	20.00	65	35	70.00
2.90	2.47	23.97	20.00	54	46	68.00
2.18	....	27.03	.....	47	53	.....
4.63	4.11	18.86	.....	..	..	.....
3.57	2.47	24.46	20.00	44	56	.....
4.04	....	17.49	.....	..	..	60.00

It appears that mineral forms of nitrogen, in nitrates and sulphate of ammonia, have cost only half as much as in most organic forms. There is no question that they are more quickly and completely available than other forms, and under most conditions more economical to use at the present time. Moreover, in comparison with organic forms, they will have to be used in relatively larger amounts in the future. Organic materials, tankage, fish, cotton seed meal, and even bone to a smaller extent, are being used more and more as cattle feeds. Their prices have greatly increased and the supply for fertilizers greatly diminished.

In the brands of mixed fertilizers sold in the State, mineral forms of nitrogen in 1890 made 21.5 per cent. of the total nitrogen; in 1900, 22 per cent.; in 1910, 41 per cent.; and in 1919, 49 per cent.

Other forms of mineral nitrogen, such as nitrate of ammonia, nitrate of lime and phosphate of ammonia, obtained by the fixation of atmospheric nitrogen, will doubtless be put on the market in the near future.

The Stations and the users of fertilizers have the problem of determining which forms of mineral nitrogen are the most convenient and economical for use, mixed or unmixed, on our various crops.

V. MIXED FERTILIZERS.

NITROGENOUS SUPERPHOSPHATES WITHOUT POTASH.

In the following table are analyses of 92 samples, 89 of which were drawn by the Station Agent by the methods prescribed by law.

COMPOSITION AND COST OF THE BRANDS.

4	samples	have	a	guaranty	of	.82	per cent.	nitrogen.
16	"	"	"	"	"	1.65	"	"
8	"	"	"	"	"	2.47	"	"
21	"	"	"	"	"	3.25	"	"
28	"	"	"	"	"	4.11	"	"
12	"	"	"	still higher nitrogen guaranty.				
89								

This year 68% of the brands had 3.25 per cent. or more of nitrogen (equivalent to 4 per cent. ammonia). Last year the percentage was 58. This indicates that in general the brands sold this year have been of higher grade than last year. The National Fertilizer Association has urged on manufacturers the abandonment of low grade brands, and the Station has repeatedly pointed out the false economy of buying "cheap" or low grade goods.

The question for the buyer to decide is not what brands are cheapest, but in what brands available nitrogen, phosphoric acid and potash can be most cheaply bought.

The following average figures are taken from the table of analyses:

GUARANTY.

Nitrogen.	Available Phos. acid.	Cost per ton.	With available phos. acid worth 10 cents per lb. nitrogen costs, cents per lb.
0.82	10	$46.00	158.0
1.65	10	48.03	84.9
2.87	10	52.97	66.7
2.57	10	55.65	62.1
3.29	10	58.61	58.7
4.11	8	61.75	55.6

The lowest priced brand, .82-10, sells for $46, and the nitrogen in it costs over $1.50 per pound.

The highest priced brand, 4.11-8, sells for $61.75, but the nitrogen in it costs only about one-third as much as it does in the lowest priced brand.

GUARANTIES.

Two of the brands examined were deficient in nitrogen, 13 in available phosphoric acid, and 7 in both of these ingredients.

In most cases, however, a deficiency of one ingredient was made up in money equivalent by an overrun of the other ingredient.

Nine samples, however, failed to thus make good the money equivalent by the amounts named below, available phosphoric acid being valued at 10 cents and nitrogen at 50 cents per pound.

15119	A. A. C. Co.'s Special Vegetable Fertilizer	$3.30
15025	Armour's 4-10-0	3.80
14751	Atlantic Packing Co.'s 4-8	1.92
14546	Frisbie's 2-8	1.46
14651	" 5-8	5.62
15078	Lowell Fertz. Co.'s Tobacco 5-6	3.52
15010	Parmenter & Polsey Fertzr. Co.'s Tobacco 5-4	2.18
14945	Piedmont-Mt. Airy Guano Co.'s Brown's Special Fertilizer	6.88
14610	Royster Guano Co.'s Landmark	3.40

QUALITY OF THE NITROGEN.

The solubility of the organic nitrogen has been determined in all samples, and in no case was evidence found of the presence of inferior ammoniates.

ANALYSES NEEDING SPECIAL NOTICE.

14651. Frisbie's 5-8 was below its guaranteed composition in both nitrogen and "available" phosphoric acid. The firm wrote that it would endeavor to adjust the shortage with the purchaser, and believing that the analysis did not represent the average quality of the goods, asked that another sample be drawn. This was done and analysis No. **15163** of the same brand fully met the guaranty.

14610. Royster's Landmark was also below the guaranteed composition in both nitrogen and "available" phosphoric acid.

The firm asked to have another sample analyzed, but the sampling agent was unable to find it in stock in the state.

TABLE VII. NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.
	Sampled by Station:	
	American Agricultural Chem. Co., New York City.	
14949	Ammoniated Fertilizer A	North Haven
14794	Ammoniated Fertilizer AA	New Canaan
14952	Ammoniated Fertilizer AAA	Southport
14525	Ammoniated Fertilizer AAAA	Southport
14875	Ammoniated Fertilizer AAAA	New Haven
15115	Five Eight Fertilizer	Windsor
15119	*Special Vegetable Fertilizer	Rockville
14862	Tobacco Special	Simsbury
14688	Bradley's Special Corn Phosphate without Potash	Norwich
14689	Bradley's Special Potato Fertz. without Potash	Norwich
	Apothecaries Hall Co., Waterbury, Conn.	
14957	Liberty Corn, Fruit and All Crops	Waterbury
14796	Liberty Market Gardeners' Special	Cheshire
14958	Liberty Potato and Vegetable Special	Waterbury
14747	Liberty Tobacco Special	Windsorville
14858	Liberty Top Dresser for Grass and Grain	Waterbury
	Armour Fertilizer Works, Chrome, N. J.	
15025	*4-10-0	Waterbury
	Atlantic Packing Co., New Haven, Conn.	
14797	Atlantic 2-8	New Britain
14751	*Atlantic 4-8	Norwich
	Berkshire Fertilizer Co., Bridgeport, Conn.	
14873	Economical Grass Fertilizer	Ellington
15024	Grass Special	Chester
14792	Long Island Special	Milford
14590	Tobacco Grower	Ellington
14904	Tobacco Starter	Suffield
	F. E. Boardman, Middletown, Conn.	
14859	Fertilizer for General Crops	Middletown
	Bowker Fertilizer Co., New York City.	
15035	Superphosphate with Ammonia 2%	Watertown
14597	Superphosphate with Ammonia 3%	Milldale
14744	Superphosphate with Ammonia 4%	Milldale
14909	Superphosphate with Ammonia 5%	South Manchester
14640	Tobacco Grower	Thompsonville

* See note, page 33.

WITHOUT POTASH

Dealer's cash price per ton.	Nitrogen. In nitrates.	Nitrogen. In ammonia.	Nitrogen. Organic, water-soluble.	Nitrogen. Organic, water-insoluble.	Nitrogen. Total. Found.	Nitrogen. Total. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. So-called "Available." Found.	Phosphoric Acid. So-called "Available." Guaranteed.	Station No.
$50.00	none	0.26	0.37	0.41	1.04	0.82	7.50	3.24	0.82	11.56	11.00	10.74	10.00	14949
50.00	0.17	0.54	0.63	0.87	2.21	1.65	4.27	5.53	1.45	11.25	11.00	9.80	10.00	14794
63.00	0.18	0.85	0.25	1.39	2.67	2.47	5.94	4.30	1.32	11.56	11.00	10.24	10.00	14952
58.00	0.55	0.66	0.86	1.60	3.67	3.29	6.00	3.62	2.85	12.47	11.00	9.62	10.00	14525
55.00	0.52	0.67	0.80	1.58	3.57	3.29	5.89	4.10	2.61	12.60	11.00	9.99	10.00	14875
....	1.58	0.12	1.30	1.50	4.50	4.11	4.86	3.75	1.93	10.54	9.00	8.61	8.00	15115
58.00	1.15	1.00	0.04	0.83	3.02	3.29	5.89	3.81	1.39	11.09	11.00	9.70	10.00	15119
76.25	1.20	0.04	0.09	3.03	4.36	4.11	1.08	3.84	0.27	5.19	5.00	4.92	4.00	14862
48.00	none	0.45	0.47	0.92	1.84	1.65	5.84	4.40	2.53	12.77	11.00	10.24	10.00	14688
48.00	0.13	0.46	0.18	0.99	1.76	1.65	6.36	3.98	2.53	12.87	11.00	10.34	10.00	14689
43.20	none	0.33	0.73	0.84	1.90	1.65	7.23	3.06	1.30	11.59	11.00	10.29	10.00	14957
....	none	1.67	0.44	1.27	3.38	3.29	8.97	2.54	0.14	11.65	11.00	11.51	10.00	14796
48.60	none	1.09	0.67	0.80	2.56	2.47	8.69	2.59	0.78	12.06	11.00	11.28	10.00	14958
72.20	0.19	0.87	0.13	3.13	4.32	4.11	3.06	1.87	0.55	5.48	5.00	4.93	4.00	14747
66.50	0.12	3.02	0.42	1.40	4.96	4.94	6.99	1.83	0.72	9.54	9.00	8.82	8.00	14858
59.00	0.10	1.28	0.33	1.17	2.88	3.29	7.91	2.24	1.18	11.33	10.50	10.15	10.00	15025
48.00	0.07	0.54	0.43	0.59	1.63	1.64	4.38	3.42	0.29	8.09	9.00	7.80	8.00	14797
39.75	0.57	0.98	0.69	1.10	3.34	3.28	3.32	3.42	1.83	8.57	9.00	6.74	8.00	14751
82.50	5.62	0.66	0.45	0.53	7.26	7.40	2.23	3.65	0.61	6.49	8.00	5.88	4.00	14873
72.00	2.46	0.99	1.21	0.47	5.13	5.00	2.69	1.85	0.45	4.99	5.00	4.54	4.00	15024
56.50	1.80	0.18	0.27	1.26	3.51	3.30	3.04	5.43	0.61	9.08	9.00	8.47	8.00	14792
70.50	0.34	0.54	0.31	3.32	4.51	4.11	1.27	3.90	0.13	5.30	4.00	5.17	4.00	14590
....	3.05	0.46	0.40	1.38	5.29	5.00	1.37	3.52	0.33	5.22	5.00	4.89	4.00	14904
50.00	1.25	0.58	0.08	1.70	3.61	3.29	3.17	3.86	0.97	8.00	...	7.03	7.00	14859
47.00	0.22	0.20	0.32	0.97	1.71	1.65	5.18	4.85	1.75	11.78	11.00	10.03	10.00	15035
54.75	none	1.04	0.27	1.50	2.81	2.47	6.46	3.72	1.70	11.88	11.00	10.18	10.00	14597
60.75	0.97	1.22	0.09	1.28	3.56	3.29	6.55	3.94	1.19	11.68	11.00	10.49	10.00	14744
....	0.89	1.07	0.60	1.71	4.27	4.11	8.04	2.69	1.01	11.74	9.00	10.73	8.00	14909
70.00	0.72	0.53	none	3.16	4.41	4.11	1.42	3.88	0.20	5.50	5.00	5.30	4.00	14640

TABLE VII. NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.
	Sampled by Station:	
	E. D. Chittenden Co., Bridgeport, Conn.	
14906	Complete Tobacco & Onion Grower without Potash..	Suffield
14908	Tobacco Special without Potash	Enfield
14976	Vegetable and Onion Grower without Potash	Greens Farms
	E. B. Clark Seed Co., Milford, Conn.	
14815	Special Mixture for General Use	Milford
	The Coe-Mortimer Co., New York City.	
14775	Gardeners' and Truckers' Special 1916	Greenwich
14814	High Grade Ammoniated Superphosphate 1916	Milford
14774	Prolific Crop Producer 1916	Greenwich
14973	Tobacco Special	South Windsor
	The Essex Fertilizer Co., Boston, Mass.	
14914	3½–10	Wallingford
15083	Tobacco 5–6	East Granby
	The L. T. Frisbie Co., New Haven, Conn.	
14546	*2–8	New Britain
14913	5–6	Glastonbury
14651	*5–8	East Hartford
15163	5–8	Branford
	The Hubbard Fertilizer Co., Baltimore, Md.	
15044	4–10–0	Ellington
	International Agricultural Corp., Buffalo, N. Y.	
14772	Buffalo Ammoniated Phosphate	Ansonia
14863	Buffalo Three Ten	Tariffville
15128	Buffalo Tobacco Grower	West Suffield
14820	Buffalo Tobacco Special	East Granby
15009	Buffalo Top Dresser and Starter	East Granby
14821	I. A. C. Tobacco Crop	Tariffville
	Lister's Agricultural Chemical Works, Newark, N. J.	
14823	Plant Food 1916	Danbury
14822	Superior Ammoniated Superphosphate 1916	Danbury
	Lowell Fertilizer Co., Boston, Mass.	
15082	3½–10–0	Bloomfield
14943	5–8	Wallingford
15051	Dissolved Bone Fertilizer 2–10	Shelton
15078	*Tobacco 5–6	South Manchester

*See note, page 33.

WITHOUT POTASH—(*Continued*).

Dealer's cash price per ton.	Nitrogen. In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Total. Found.	Total. Guaranteed.	Phosphoric Acid. Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total. Found.	Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	Station No.
....	1.37	1.01	0.08	0.67	3.13	3.29	9.46	1.38	0.20	11.04	11.00	10.84	10.00	14906
$63.00	2.14	0.06	0.18	2.09	4.47	4.11	4.14	1.60	0.32	6.06	5.00	5.74	4.00	14908
....	1.33	0.52	none	0.64	2.49	2.47	7.32	3.38	0.79	11.49	11.00	10.70	10.00	14976
45.00	0.10	2.40	0.14	0.84	3.48	3.29	8.15	2.17	0.64	10.96	10.50	10.32	10.00	14815
59.75	0.97	1.80	0.37	1.07	4.21	4.11	4.57	3.82	0.87	9.26	9.00	8.39	8.00	14775
51.00	none	1.06	0.26	1.22	2.54	2.47	6.82	3.87	1.54	12.23	11.00	10.69	10.00	14814
81.00	0.82	1.07	0.51	0.95	3.35	3.29	6.78	3.58	1.20	11.56	11.00	10.36	10.00	14774
....	none	0.06	1.29	2.85	4.20	4.11	1.02	4.00	0.15	5.17	5.00	5.02	4.00	14973
55.00	0.13	1.18	0.47	1.02	2.80	2.87	6.03	3.83	0.78	10.64	11.00	9.86	10.00	14914
70.00	0.98	0.08	0.88	1.72	3.66	4.11	1.77	3.24	2.06	7.07	7.00	5.01	6.00	15083
48.00	none	0.48	0.59	0.58	1.65	1.65	4.20	3.07	0.37	7.64	9.00	7.27	8.00	14546
65.00	1.09	0.07	0.84	1.61	3.61	4.10	2.51	3.23	2.15	7.89	7.00	5.74	6.00	14913
59.75	1.24	0.10	0.81	1.50	3.65	4.10	2.93	4.51	2.92	10.36	9.00	7.44	8.00	14651
65.75	0.78	1.74	1.82		4.34	4.10	4.85	3.21	0.31	8.37	9.00	8.06	8.00	15163
....	1.59	none	1.01	0.47	3.07	3.28	9.35	1.96	0.43	11.74	11.00	11.31	10.00	15044
49.00	0.39	0.07	0.63	0.51	1.60	1.60	8.63	3.80	1.68	14.11	13.00	12.43	12.00	14772
51.50	0.79	0.07	0.76	0.74	2.36	2.50	4.45	6.19	1.33	11.97	11.00	10.64	10.00	14863
....	1.98	none	0.56	1.50	4.04	4.10	1.69	3.02	0.46	5.17	5.00	4.71	4.00	15128
63.42	1.62	0.06	0.21	1.33	3.22	3.30	1.34	2.46	0.90	4.70	4.00	3.80	3.00	14820
....	0.37	1.91	1.51	1.86	5.65	5.80	4.03	2.54	1.39	7.96	7.00	6.57	6.00	15009
73.75	2.19	0.07	0.49	1.33	4.08	4.10	2.53	2.53	1.27	6.33	5.00	5.06	4.00	14821
43.00	none	0.11	0.38	0.44	0.93	0.82	7.21	3.32	0.93	11.46	11.00	10.53	10.00	14823
60.75	1.06	1.26	0.35	0.84	3.51	3.29	7.00	2.95	1.61	11.56	11.00	9.95	10.00	14822
57.00	0.12	0.84	0.91	1.03	2.90	2.87	7.20	3.70	2.00	12.90	11.00	10.90	10.00	15082
....	0.74	1.38	0.91	1.16	4.19	4.10	5.59	3.41	0.70	9.70	9.00	9.00	8.00	14943
....	0.16	0.62	0.39	0.60	1.77	1.64	4.32	4.64	1.29	10.25	11.00	8.96	10.00	15051
73.00	1.28	none	0.92	1.54	3.74	4.10	2.12	2.92	2.12	7.16	6.00	5.04	5.00	15078

TABLE VII. NITROGENOUS SUPERPHOSPHATES

WITHOUT POTASH—(*Continued*).

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.	Nitrogen. In nitrates.	Nitrogen. In ammonia.	Nitrogen. Organic, water-soluble.	Nitrogen. Organic, water-insoluble.	Nitrogen. Total. Found.	Nitrogen. Total. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. So-called "Available". Found.	Phosphoric Acid. So-called "Available". Guaranteed.	Station No.
	Sampled by Station:																
	The Mapes Formula and Peruvian Guano Co., New York City.																
14741	General Crop 1916	Windsor Locks	$46.00	0.93	0.07	0.09	0.72	1.81	1.65	4.73	3.71	2.38	10.82	10.00	8.44	8.00	14741
	National Fertilizer Co., New York City.																
14588	5–4 Tobacco Manure	South Manchester	70.50	1.17	0.07	0.07	2.78	4.09	4.11	1.08	4.66	0.38	6.12	5.00	5.74	4.00	14588
14516	Nitrogen Phosphate Mixture No. 1	Guilford	45.00	none	0.23	0.56	0.37	1.16	0.82	7.65	4.03	0.73	12.41	11.00	11.68	10.00	14516
14540	Nitrogen Phosphate Mixture No. 2	Guilford	50.00	none	0.42	0.86	0.74	2.02	1.65	5.80	4.29	1.16	11.25	11.00	10.09	10.00	14540
14652	Nitrogen Phosphate Mixture No. 3	Silver Lane	....	0.71	0.60	0.61	1.59	3.51	2.47	6.12	3.75	2.35	12.22	11.00	9.87	10.00	14652
14740	Nitrogen Phosphate Mixture No. 4	Guilford	65.00	0.55	0.67	0.67	1.63	3.52	3.29	5.72	4.30	2.49	12.51	11.00	10.02	10.00	14740
	New England Fertilizer Co., Boston, Mass.																
14833	3½–10	Hamden	55.00	0.15	0.81	0.65	1.29	2.90	2.87	6.71	3.59	2.72	13.02	11.00	10.30	10.00	14833
14643	Tobacco 5–4	Warehouse Point	72.00	0.64	0.45	0.79	1.52	3.40	4.10	0.86	2.34	1.34	4.54	5.00	3.20	4.00	14643
	Olds & Whipple, Hartford, Conn.																
15148	Grass Fertilizer	Hartford	61.27	2.88	0.12	0.81	1.74	5.55	4.95	3.42	5.64	0.82	9.88	8.00	9.06	8.00	15148
14840	High Grade Tobacco Starter	Simsbury	71.25	3.23	0.21	0.20	4.59	8.23	8.23	2.28	2.17	0.46	4.91	3.00	4.45	3.00	14840
15156	High Grade Tobacco Starter	East Windsor Hill	97.38	..	..	...	...	8.04	8.23	...	...	...	5.65	3.00	...	...	15156
14990	Tobacco Special Fertilizer	Hartford	....	0.86	0.11	0.11	3.25	4.33	4.11	2.10	3.14	0.41	5.65	4.00	5.24	4.00	14990
14709	Tobacco Special Fertilizer	East Windsor Hill	....	0.66	0.11	none	3.63	4.40	4.11	0.73	5.28	0.58	6.59	4.00	6.01	4.00	14709
	Parmenter and Polsey Fertilizer Co., Boston, Mass.																
15077	2–10	Plainville	50.00	0.20	0.25	0.49	0.64	1.58	1.64	6.85	3.42	1.50	11.77	11.00	10.27	10.00	15077
14839	3½–10	Rocky Hill	55.60	0.16	0.81	0.29	1.68	2.94	2.87	6.84	3.27	2.85	12.96	11.00	10.11	10.00	14839
15010	*Tobacco 5–4	Glastonbury	64.50	1.35	0.11	0.94	1.56	3.96	4.10	0.63	2.98	1.56	5.17	5.00	3.61	4.00	15010
	Piedmont-Mt. Airy Guano Co., Baltimore, Md.																
14945	*Brown's Special Fertilizer	Woodstock	49.50	1.08	0.21	0.59	0.61	2.49	3.29	7.07	3.49	1.20	11.76	...	10.56	10.00	14945
	F. S. Royster Guano Co., Baltimore, Md.																
14610	*Landmark	Waterbury	60.00	0.21	1.40	0.25	1.23	3.09	3.29	6.88	2.42	1.54	10.84	10.50	9.30	10.00	14610
14880	Perfecto Tobacco Formula	Granby	73.00	0.37	0.63	0.07	2.43	3.50	4.11	3.04	1.94	0.41	5.39	4.50	4.98	4.00	14880
14727	Prime Fish Brand	Shelton	45.00	0.42	0.64	0.03	0.62	1.71	1.65	5.64	2.36	0.88	8.88	8.50	8.00	8.00	14727
15004	Purity	Plantsville	....	0.08	0.43	none	0.49	1.00	0.82	4.41	3.70	0.92	9.03	8.50	8.11	8.00	15004
15127	Stevens' Formula	Glastonbury	....	0.44	0.75	0.01	2.52	3.72	4.11	2.46	1.85	0.22	4.53	4.50	4.31	4.00	15127
	Sanderson Fertilizer and Chemical Co., New Haven, Conn.																
14776	High Grade Ammoniated Phosphate	Highwood	....	0.56	0.66	0.87	1.52	3.61	3.29	5.41	4.45	3.02	12.88	11.00	9.86	10.00	14776
14573	Phosphate without Potash	New Haven	....	none	0.43	0.76	0.71	1.90	1.65	5.65	4.17	1.23	11.05	11.00	9.82	10.00	14573
14923	Special without Potash	Middlefield	49.00	none	0.23	0.77	1.64	2.64	2.47	7.58	2.30	1.60	11.48	11.00	9.88	10.00	14923
14718	Tobacco Grower	East Hartford	71.00	0.81	0.08	none	3.60	4.49	4.11	1.51	4.09	0.32	5.92	5.00	5.60	4.00	14718
14581	Top Dressing for Grass and Grain wihout Potash	Milford	....	0.56	1.13	0.63	1.76	4.08	4.11	7.19	2.84	1.59	11.62	11.00	10.03	10.00	14581
14635	Top Dressing for Grass and Grain without Potash	Meriden	56.40	0.79	0.94	0.65	1.65	4.03	4.11	7.40	2.69	1.50	11.59	11.00	10.09	10.00	14635

* See note, page 33.

TABLE VII. NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.
	Sampled by Station:	
	M. S. Shoemaker & Co., Philadelphia, Pa.	
14583	Swift-Sure Superphosphate for Tobacco	Windsor Locks
14877	Swift-Sure Superphosphate for Tobacco	Meriden
	Virginia-Carolina Chemical Co., New York City.	
15073	Monarch Brand	North Haven
15140	Pawnee Brand	Granby
	Wilcox Fertilizer Co., Mystic, Conn.	
14722	Grain Fertilizer	Mystic
	Sampled by Purchasers:	
15052	National Fertilizer Co.'s Tobacco Manure 5–4–0	Thompsonville: Henry Davis
14373	Rogers and Hubbard's Climax Tobacco Brand	Windsor: F. H. Thrall
	Manufacturer's Sample:	
14308	L. T. Frisbie's 2–8	New Haven

NITROGENOUS SUPERPHOSPHATES CONTAINING POTASH.

In the following table are given 246 analyses of brands belonging to this class, 226 of which were sampled by the Station Agent.

The number of brands containing potash is twice as great as it was the year before.

Only seven brands contained six per cent. or more but 138 contained between three and five per cent. of potash.

COMPOSITION AND COST OF THE BRANDS.

The cost of nitrogen per pound has been calculated in all the brands having the composition given below, allowing 10 cents per pound for available phosphoric acid and 16 cents per pound for potash.

Formula.	No. of Analyses.	Average cost.	Nitrogen costs per pound.
.82-8-2	7	$50.66	$1.91
1.65-8-2	25	53.06	.93
2.47-8-4	15	62.87	.68
3.29-8-4	21	65.79	.56
4.11-4-3	12	82.96	.80

WITHOUT POTASH—(*Concluded*).

Dealer's cash price per ton.	Nitrogen.						Phosphoric Acid.							Station No.
	In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Total. Found.	Total. Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total. Found.	Total. Guaranteed.	So-called "Available". Found.	So-called "Available". Guaranteed.	
$58.00	none	0.99	0.71	1.85	3.55	3.29	3.85	5.18	3.84	12.87	12.00	9.03	10.00	**14583**
52.00	0.12	1.38	0.52	1.60	3.62	3.29	5.89	4.88	3.34	14.11	12.00	10.77	10.00	**14877**
44.00	0.13	0.16	0.47	0.95	1.71	1.65	8.76	2.63	1.24	12.63	12.00	11.39	11.00	**15073**
74.25	0.28	0.58	1.55	1.63	4.04	4.11	3.31	1.07	0.69	5.07	5.00	4.38	4.00	**15140**
....	0.18	0.30	0.19	1.15	1.82	1.64	6.33	3.27	2.60	12.20	11.00	9.60	10.00	**14722**
....	..	..	...	...	4.42	...	...	...	...	5.94	...	...	...	**15052**
....	..	..	...	...	4.02	4.11	...	...	...	5.87	5.00	...	...	**14373**
....	none	..	...	...	1.65	...	...	...	...	9.11	...	...	...	**14308**

Here again it appears that nitrogen in low grade mixtures costs more than twice as much as in the higher grades in spite of their somewhat lower price and that their purchase is wasteful.

GUARANTIES

Ninety-five out of the 226 analyses do not fully meet their guaranty in every particular. In most cases the deficiency is in one ingredient only, and is more than made good by an overrun in the other two.

In 26 cases there is a deficiency in two or three ingredients, and in the following brands this results in a deficiency in money value.

That is, the value of the amount of plant food guaranteed in a ton of goods, but not supplied, is the sum given in the following statement. For this calculation nitrogen is valued at 50 cents, available phosphoric acid 10 cents, and potash at 16 cents per pound, respectively, which is about their retail selling price. See page 56.

TABLE VIII. NITROGENOUS SUPERPHOSPHATES WITH POTASH.

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.	Nitrogen. In nitrates.	Nitrogen. In ammonia.	Nitrogen. Organic, water-soluble.	Nitrogen. Organic, water-insoluble.	Nitrogen. Total. Found.	Nitrogen. Total. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. So-called "Available." Found.	Phosphoric Acid. So-called "Available." Guaranteed.	Potash. As muriate.	Potash. Total.	Potash. Guaranteed.	Station No.
	Sampled by Station:																			
	American Agricultural Chemical Co., New York City.																			
14611	Double A Tobacco Fertilizer	Suffield	$85.00	1.14	0.07	1.53	1.74	4.48	4.11	0.92	4.35	0.19	5.46	5.00	5.27	4.00	1.50	4.78	5.00	14611
15116	Fish and Potash	Windsor	....	0.67	0.08	0.43	1.43	2.61	2.47	5.87	4.57	2.48	12.92	11.00	10.44	10.00	2.01	2.01	3.00	15116
14786	Grass and Lawn Top Dressing	New London	95.00	2.03	1.16	1.08	0.73	5.00	4.94	4.62	2.80	1.16	8.58	7.00	7.42	6.00	3.82	3.82	4.00	14786
14947	Grass and Oats Fertilizer	Southington	....	..	..	..	..	0.65	..	6.65	5.32	0.86	12.83	13.00	11.97	12.00	0.82	2.44	2.00	14947
14953	Monarch Potato Manure	Southport	68.00	0.13	1.75	0.06	1.56	3.50	3.29	5.41	3.02	1.04	9.47	9.00	8.43	8.00	4.23	4.23	4.00	14953
14692	Sure Growth Phosphate Revised	Thompsonville	62.00	0.70	0.52	0.39	0.94	2.55	2.47	4.23	4.97	1.71	10.91	10.00	9.20	9.00	0.45	1.92	2.00	14692
14684	Universal Phosphate	New London	55.00	0.25	0.31	0.02	0.43	1.01	0.82	3.82	4.23	0.93	8.98	9.00	8.05	8.00	1.54	1.79	2.00	14684
15120	Bradley's Alkaline Bone with Potash	Rockville	42.00	..	..	..	..	..	..	6.37	5.21	0.83	12.41	13.00	11.58	12.00	2.04	2.04	2.00	15120
14951	Bradley's B. D. Guano	North Haven	47.25	0.11	0.24	0.34	0.53	1.22	0.82	5.01	2.73	0.58	8.32	9.00	7.74	8.00	4.81	4.81	4.00	14951
14686	Bradley's Corn Phosphate	Norwich	52.00	none	0.50	0.50	0.84	1.84	1.65	3.87	4.19	1.56	9.62	9.00	8.06	8.00	1.18	1.91	2.00	14686
15118	Bradley's Half Century Fertilizer Revised	Granby	....	0.25	0.16	0.10	0.99	1.50	1.65	5.44	3.95	1.23	10.62	9.00	9.39	8.00	3.55	3.55	3.00	15118
14793	Bradley's New Method Fertilizer	Norwalk	50.00	0.07	0.13	0.32	0.57	1.09	0.82	4.75	4.02	0.63	9.40	9.00	8.77	8.00	1.82	2.36	2.00	14793
14518	Bradley's Patent Superphosphate Revised	Hamden	51.00	0.22	0.46	0.54	0.84	2.06	1.65	4.64	4.39	1.27	10.30	10.00	9.03	9.00	1.30	1.30	1.00	14518
14687	Bradley's Potato Fertilizer	Norwich	55.00	0.50	0.18	0.47	0.62	1.77	1.65	5.04	3.04	1.60	9.68	9.00	8.08	8.00	2.69	2.69	3.00	14687
14517	Bradley's Potato Manure	Hamden	62.00	0.40	0.13	0.76	1.13	2.42	2.47	3.90	5.20	1.38	10.48	9.00	9.10	8.00	3.06	4.40	4.00	14517
14693	Bradley's Unicorn	Thompsonville	54.00	0.14	0.72	0.38	0.61	1.85	1.65	4.79	3.54	1.55	9.88	9.00	8.33	8.00	2.06	2.06	2.00	14693
14980	Bradley's Valley Tobacco Fertilizer	New Milford	90.00	0.97	none	0.37	3.04	4.38	4.11	1.91	3.88	0.37	6.16	5.00	5.79	4.00	0.48	2.97	3.00	14980
15139	Bradley's XL Superphosphate of Lime	Mansfield	59.00	0.91	0.83	0.22	0.69	2.65	2.47	3.99	5.33	0.74	10.06	10.00	9.32	9.00	2.33	2.33	2.00	15139
15122	East India Black Hawk Potato and Truck Fertz	Gaylordsville	65.75	0.73	0.06	0.77	0.96	2.52	3.29	6.74	3.39	0.49	10.62	9.00	10.13	8.00	5.11	5.11	4.00	15122
14950	East India Economizer Phosphate	North Haven	58.00	0.19	0.43	0.35	0.84	1.81	0.82	3.94	4.33	1.24	9.51	9.00	8.27	8.00	2.71	2.71	2.00	14950
15034	East India Mayflower	Watertown	....	0.11	0.59	0.21	0.98	1.89	1.65	6.18	3.30	2.05	11.53	9.00	9.48	8.00	2.24	2.24	2.00	15034
15121	East India Tobacco Fertilizer	Gaylordsville	81.00	0.85	0.10	0.56	2.61	4.12	4.11	1.22	4.44	0.33	5.99	5.00	5.66	4.00	0.43	2.87	3.00	15121
14954	Great Eastern General	Waterford	52.00	0.31	0.05	0.08	0.32	0.76	0.82	5.46	2.84	0.22	8.52	9.00	8.30	8.00	5.56	5.56	4.00	14954
15031	Great Eastern North Corn Special 1920	Warehouse Point	50.00	0.44	0.09	0.19	1.70	2.42	1.65	4.65	4.42	1.41	10.48	9.00	9.07	8.00	2.04	2.04	2.00	15031
14981	Great Eastern Potato Manure, 1920	New Milford	53.00	0.09	0.60	0.25	0.72	1.66	1.65	5.64	2.71	0.78	9.13	9.00	8.35	8.00	3.27	3.27	3.00	14981
15046	Packer's Union Animal Corn Fertilizer	Litchfield	58.00	0.59	0.84	0.26	0.74	2.43	2.47	6.14	3.07	0.91	10.12	10.00	9.21	9.00	2.31	2.31	2.00	15046
14965	Packer's Union Potato Manure 1920	Southington	....	0.17	0.31	0.37	0.94	1.79	1.65	5.68	4.58	1.01	11.27	11.00	10.26	10.00	3.99	4.35	4.00	14965
14791	Quinnipiac Ammoniated Dissolved Phosphate	Milford	47.00	0.24	0.44	0.10	1.09	1.87	1.65	3.84	4.77	0.82	9.43	9.00	8.61	8.00	1.50	2.19	2.00	14791
14524	Quinnipiac Climax Phosphate	Southport	45.00	0.14	0.70	0.41	0.86	2.11	0.82	5.55	2.44	1.39	9.38	9.00	7.99	8.00	2.22	2.22	2.00	14524
14657	Quinnipiac Corn Manure	New London	60.00	0.76	0.49	0.22	0.53	2.00	1.65	4.72	4.05	0.33	9.10	9.00	8.77	8.00	2.67	2.67	2.00	14657
14790	Quinnipiac Phosphate	Milford	50.00	0.30	0.80	0.15	1.39	2.64	2.47	4.35	5.08	1.28	10.71	10.00	9.43	9.00	0.90	2.02	2.00	14790
14545	Quinnipiac Potato Manure	Southport	61.00	0.40	0.18	0.73	1.26	2.57	2.47	4.11	4.70	1.73	10.54	9.00	8.81	8.00	2.90	3.79	4.00	14545
14598	Quinnipiac Wrapper Leaf Brand Tobacco Manure Revised	Windsor	79.50	1.08	0.04	0.52	2.73	4.37	4.11	0.94	5.47	0.37	6.78	5.00	6.41	4.00	0.65	3.03	3.00	14598
15032	Wheeler's Cuban Tobacco Grower	Warehouse Point	86.00	0.79	0.05	0.91	2.56	4.31	4.11	1.15	4.19	0.54	5.88	5.00	5.34	4.00	0.58	5.10	5.00	15032
14787	Williams and Clark's Americus H. G. Special Revised	Waterbury	72.00	1.20	1.01	0.54	0.68	3.43	3.29	5.54	3.00	1.02	9.56	9.00	8.54	8.00	3.87	3.87	4.00	14787
14788	Williams and Clark's Americus Potato Manure	Waterbury	57.50	0.14	0.55	0.29	0.97	1.95	1.65	2.36	6.31	1.30	9.97	9.00	8.67	8.00	1.82	2.96	3.00	14788
14869	Williams and Clark's Matchless Fertilizer	South Manchester	49.50	0.43	0.60	0.68	1.53	3.24	1.65	5.02	3.99	1.83	10.84	9.00	9.01	8.00	2.00	2.00	2.00	14869
15048	Williams and Clark's Prolific Fertilizer	New Britain	58.00	0.26	0.22	0.27	0.69	1.44	0.82	4.36	3.70	1.05	9.11	8.00	8.06	7.00	0.68	1.80	1.00	15048
14910	Williams and Clark's Seed Leaf Tobacco Manure Revised	South Manchester	82.00	0.15	0.96	0.82	2.34	4.27	4.11	0.36	5.40	0.12	5.88	5.00	5.76	4.00	1.22	3.29	3.00	14910
	Apothecaries Hall Co., Waterbury, Conn.																			
15040	Liberty Market Gardeners' Special	Waterbury	64.80	0.24	0.95	0.67	1.67	3.53	3.29	5.30	2.93	0.97	9.20	9.00	8.23	8.00	3.58	3.58	4.00	15040
14649	Liberty Tobacco Special	Windsorville	82.00	0.16	0.75	0.31	3.07	4.29	4.11	2.85	1.72	0.43	5.00	5.00	4.57	4.00	0.31	2.41	3.00	14649

TABLE VIII. NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station:		
	Armour Fertilizer Works, Chrome, N. J.		
14750	Cereal Special No. 1	New Haven	$67.00
14944	Complete Potato Fertilizer	Rockville	85.00
14907	Gardeners' Choice Fertilizer	Thompsonville	62.00
14710	General Crop Fertilizer	New Haven	44.00
14694	Grain Grower Fertilizer	New Haven	56.00
14683	Potato, Onion and Vegetable Fertilizer	New London	63.00
14912	Super-Grade Potato Mixture Fertilizer	Rockville	75.00
15160	Tobacco Special Fertilizer	South Manchester	85.00
14748	*Wheat and Clover Fertilizer	New Haven	55.00
15033	Bidwell's Formula	Windsor Locks	64.00
	Atlantic Packing Co., New Haven, Conn.		
14860	3–8–3	New Britain	65.00
14690	*Grain Fertilizer	Willimantic	60.00
14685	Potato Phosphate 3–8–4	Norwich	53.00
14861	Special Vegetable	New Britain	75.00
15050	*Tobacco Grower	Hockanum	84.00
14691	Tobacco Special	East Hartford	71.76
	Berkshire Fertilizer Co., Bridgeport, Conn.		
14789	Ammoniated Bone Phosphate	Waterbury	54.00
14647	Complete Fertilizer	Ellington	56.00
14650	Complete Tobacco	Hazardville	82.00
14743	Market Garden Fertilizer	Ellington	65.00
14591	Potato and Vegetable Phosphate	Ellington	47.25
	Bowker Fertilizer Co., New York City.		
14594	All Round Fertilizer	Hazardville	61.00
14641	Connecticut Valley Tobacco Fertilizer	Thompsonville	80.00
14655	Corn, Grain and Grass Phosphate	New London	60.00
14593	Fisherman's Brand Fish and Potash	Hazardville	60.00
14615	Hill and Drill Phosphate	Hazardville	56.00
14843	Lawn and Garden Dressing Revised	New Haven	66.00
14703	Potato and Vegetable Phosphate	Norwich	62.00
14638	Square Brand Farm and Garden Phosphate	Milldale	53.00
14656	Sure Crop Phosphate Revised	New London	55.00
15080	Stockbridge Complete	Uncasville	80.00
14619	Stockbridge Market Garden Manure	Milldale	70.75
15126	Stockbridge Tobacco Manure	Granby	88.00
	E. D. Chittenden Co., Bridgeport, Conn.		
15110	†Complete Tobacco and Onion Grower	Suffield	63.00
14905	Tobacco Special with 5% Potash	Suffield	83.00

*See note, page 56. †See note, page 57.

WITH POTASH—(*Continued*).

Nitrogen.						Phosphoric Acid.							Potash.			
				Total.					Total.		So-called "Available."					
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As muriate.	Total.	Guaranteed.	Station No.
none	0.44	0.42	0.64	1.50	1.65	8.23	1.95	0.90	11.08	10.50	10.18	10.00	6.55	6.55	6.00	14750
0.71	0.23	0.04	0.73	1.71	1.65	6.76	1.72	0.59	9.07	8.50	8.48	8.00	3.90	3.90	4.00	14944
0.26	0.80	0.45	0.91	2.42	2.47	6.16	2.37	0.96	9.49	8.50	8.53	8.00	3.84	3.84	4.00	14907
0.10	0.57	none	0.26	0.93	0.82	5.77	1.60	0.27	7.64	7.50	7.37	7.00	1.05	1.05	1.00	14710
0.16	1.04	0.08	0.43	1.71	1.65	5.64	2.19	0.73	8.56	8.50	7.83	8.00	1.88	1.88	2.00	14694
0.44	1.86	0.42	0.59	3.31	3.29	6.22	2.11	0.52	8.85	8.50	8.33	8.00	3.71	3.71	4.00	14683
none	2.45	0.60	1.07	4.12	4.11	6.54	1.95	0.90	9.39	8.50	8.49	8.00	4.83	4.83	5.00	14912
0.85	none	0.22	3.01	4.08	4.11	2.78	2.24	0.23	5.25	4.50	5.02	4.00	0.31	3.11	3.00	15160
..	..	..	..	0.22	..	7.91	1.18	0.36	9.45	10.50	9.09	10.00	3.88	3.88	5.00	14748
0.18	1.24	0.09	1.11	2.62	2.47	6.94	1.30	0.29	8.53	8.50	8.24	8.00	0.20	4.87	5.00	15033
0.06	0.95	0.57	0.91	2.49	2.40	4.43	3.77	0.63	8.83	9.00	8.20	8.00	3.12	3.12	3.00	14860
0.15	0.41	0.32	0.56	1.44	1.64	4.34	2.79	0.47	7.60	9.00	7.13	8.00	2.06	2.06	2.00	14690
0.37	0.70	0.58	0.82	2.47	2.46	5.00	3.44	0.59	9.03	9.00	8.44	8.00	4.02	4.02	4.00	14685
0.16	1.80	0.19	1.03	3.18	3.28	4.46	3.91	0.92	9.29	9.00	8.37	8.00	3.91	3.91	4.00	14861
1.55	0.03	0.81	1.45	3.84	4.10	0.67	3.30	2.43	6.40	6.00	3.97	5.00	0.96	4.48	4.00	15050
1.38	0.07	0.75	1.94	4.14	4.10	1.70	3.18	2.23	7.11	6.00	4.88	5.00	0.78	1.97	2.00	14691
0.09	0.70	none	0.30	1.09	0.80	6.61	3.83	0.40	10.84	11.00	10.44	10.00	2.10	2.10	2.00	14789
0.22	1.00	0.17	1.42	2.81	2.50	4.35	3.66	1.41	9.42	9.00	8.01	8.00	3.22	3.22	3.00	14647
1.03	0.16	0.81	2.26	4.26	4.11	0.76	4.02	0.41	5.19	4.00	4.78	4.00	1.59	4.06	4.00	14650
0.47	0.92	0.14	1.77	3.30	3.30	1.72	5.86	1.54	9.12	9.00	7.58	8.00	3.93	3.93	4.00	14743
0.11	0.57	0.12	1.04	1.84	1.70	6.79	3.85	1.16	11.80	9.00	10.64	8.00	2.29	2.29	2.00	14591
0.45	0.24	0.62	1.28	2.59	2.47	3.54	5.12	1.41	10.07	9.00	8.66	8.00	4.19	4.19	4.00	14594
1.17	0.09	0.55	2.71	4.52	4.11	0.94	4.37	0.23	5.54	5.00	5.31	4.00	0.76	3.00	3.00	14641
0.71	0.41	0.23	0.56	1.91	1.65	4.97	3.66	0.82	9.45	9.00	8.63	8.00	2.06	2.29	2.00	14655
0.85	0.59	0.09	0.98	2.51	2.47	5.35	4.90	1.07	11.32	11.00	10.25	10.00	3.02	3.02	3.00	14593
0.43	0.76	0.68	0.77	2.64	2.47	2.45	6.61	1.37	10.43	10.00	9.06	9.00	0.57	1.93	2.00	14615
0.32	0.80	0.18	1.34	2.64	2.47	4.25	5.16	1.32	10.73	10.00	9.41	9.00	0.88	2.07	2.00	14843
0.56	0.12	0.19	0.95	1.82	1.65	3.38	5.15	1.65	10.18	9.00	8.53	8.00	3.37	3.37	3.00	14703
0.56	0.14	0.23	0.98	1.91	1.65	3.31	4.96	0.95	9.22	9.00	8.27	8.00	1.21	2.12	2.00	14638
0.25	0.30	none	0.38	0.93	0.82	3.61	3.97	0.90	8.48	9.00	7.58	8.00	1.71	1.99	2.00	14656
1.29	1.34	0.12	1.34	4.09	4.11	4.40	3.94	0.50	8.84	9.00	8.34	8.00	4.26	4.26	4.00	15080
1.26	0.96	0.36	0.72	3.30	3.29	4.16	4.04	1.13	9.33	9.00	8.20	8.00	3.95	3.95	4.00	14619
0.30	0.79	0.55	2.84	4.48	4.11	0.82	4.80	0.55	6.17	5.00	5.62	4.00	0.58	4.57	5.00	15126
2.56	none	0.16	0.57	3.29	3.29	4.15	3.84	0.61	8.60	9.00	7.99	8.00	4.06	4.06	4.00	15110
2.34	0.05	0.24	1.67	4.30	4.11	3.29	2.73	0.40	6.42	5.00	6.02	4.00	0.51	4.76	5.00	14905

TABLE VIII. NITROGENOUS SUPERPHOSPHATES WITH POTASH—(*Continued*)

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.	Nitrogen. In nitrates.	Nitrogen. In ammonia.	Nitrogen. Organic, water-soluble.	Nitrogen. Organic, water-insoluble.	Nitrogen. Total. Found.	Nitrogen. Total. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. So-called "Available." Found.	Phosphoric Acid. So-called "Available." Guaranteed.	Potash. As muriate.	Potash. Total.	Potash. Guaranteed.	Station No.
	Sampled by Station:																			
	Everett B. Clark Seed Co., Milford, Conn.																			
14802	Special Mixture with Potash	Orange	$53.00	0.14	2.54	0.13	0.85	3.66	3.29	8.08	2.05	0.72	10.85	...	10.13	10.00	3.31	3.31	3.00	14802
	The Coe-Mortimer Co., New York City.																			
14745	Celebrated Special Potato Fertz. Revised	Poquonock	66.00	0.71	0.75	0.63	1.23	3.32	3.29	3.88	5.07	1.22	10.17	9.00	8.95	8.00	3.87	4.10	4.00	14745
14599	Columbian Corn and Potato Fertilizer	Poquonock	51.50	0.36	0.12	0.18	0.82	1.48	1.65	3.74	5.02	1.36	10.12	9.00	8.76	8.00	2.91	2.91	3.00	14599
14915	Corn King	Abington	55.00	0.53	0.65	0.41	1.01	2.60	2.47	5.51	3.48	1.83	10.82	10.00	8.99	9.00	2.33	2.33	2.00	14915
14639	Connecticut Wrapper Grower	Poquonock	82.00	0.99	0.08	0.53	2.54	4.14	4.11	0.82	4.49	0.31	5.62	5.00	5.31	4.00	1.50	4.94	5.00	14639
15081	Dissolved Phosphate and Potash	Gilead	32.00	..	..	..	..	..	..	7.69	4.50	0.32	12.51	13.00	12.19	12.00	2.11	2.11	2.00	15081
14654	Gold Brand Excelsior Guano Revised	Wethersfield	63.00	0.64	0.59	0.38	1.03	2.64	2.47	2.84	5.65	1.27	9.76	9.00	8.49	8.00	0.84	3.83	4.00	14654
14700	New Englander Special	Poquonock	46.00	0.14	0.08	0.02	0.76	1.00	0.82	4.33	4.66	0.87	9.86	9.00	8.99	8.00	2.08	2.08	2.00	14700
15026	Special Grass Top Dressing	Plantsville	78.00	1.79	2.04	0.32	1.13	5.28	4.94	3.40	3.18	0.37	6.95	7.00	6.58	6.00	3.88	3.88	4.00	15026
14972	Tobacco Leaf Fertilizer	Glastonbury	81.00	1.07	none	0.60	2.61	4.28	4.11	0.62	4.86	0.14	5.62	5.00	5.48	4.00	0.80	3.09	3.00	14972
	Columbia Guano Co., Baltimore, Md.																			
15030	*†Freedom Guano	Melrose	....	0.31	1.53	0.25	1.07	3.16	3.30	5.00	2.68	1.52	9.20	8.50	7.68	8.00	3.74	3.74	4.00	15030
15029	Soluble Guano	Melrose	....	0.09	0.85	0.15	0.60	1.69	1.65	5.05	2.62	1.39	9.06	8.50	7.67	8.00	1.83	1.83	2.00	15029
	Essex Fertilizer Co., Boston, Mass.																			
14704	Fish Fertilizer 3–8–3	South Manchester	70.00	0.78	0.45	0.53	0.78	2.54	2.47	5.42	3.13	1.25	9.80	9.00	8.55	8.00	2.96	2.96	3.00	14704
14705	Market Garden 3–8–4	South Manchester	71.00	0.96	0.12	0.56	0.67	2.31	2.46	6.39	1.79	0.61	8.79	9.00	8.18	8.00	3.99	3.99	4.00	14705
15027	*Tobacco 5–5–4	Hartford	....	1.30	0.06	0.85	1.81	4.02	4.10	1.62	3.40	2.14	7.16	6.00	5.02	5.00	0.82	3.83	4.00	15027
14746	1–10–1	South Manchester	50.00	none	0.09	0.53	0.40	1.02	0.82	7.47	2.89	1.27	11.63	11.00	10.36	10.00	1.20	1.20	1.00	14746
14874	*2–8–2	South Manchester	58.00	0.25	0.12	0.60	0.67	1.64	1.64	3.75	3.93	1.15	8.83	9.00	7.68	8.00	1.55	1.84	2.00	14874
15028	*4–8–4	Broad Brook	61.25	0.07	1.49	0.66	0.82	3.04	3.29	4.78	3.48	0.45	8.71	9.00	8.26	8.00	3.88	3.88	4.00	15028
15005	5–7–2	Weatogue	83.00	1.45	0.05	0.90	1.60	4.00	4.10	3.03	3.83	2.16	9.02	8.00	6.86	7.00	0.84	2.04	2.00	15005
	L. T. Frisbie Co., New Haven, Conn.																			
15109	Complete Manure	Simsbury	70.00	0.46	0.92	0.65	1.10	3.13	3.29	3.55	4.17	0.95	8.67	9.00	7.72	8.00	6.42	6.42	6.00	15109
14582	*Corn and Grain Fertz. 2–8–2	New Britain	55.00	0.05	0.38	0.46	0.54	1.43	1.65	2.93	3.98	0.46	7.37	9.00	6.91	8.00	2.10	2.10	2.00	14582
14539	Special	Guilford	60.00	0.49	0.46	0.64	0.78	2.37	2.46	4.95	3.34	0.58	8.87	9.00	8.29	8.00	4.00	4.00	4.00	14539
14595	Special Vegetable and Potato Grower 4–8–4	North Haven	69.00	0.62	1.10	0.76	0.89	3.37	3.28	3.94	3.42	1.25	8.61	9.00	7.36	8.00	4.35	4.35	4.00	14595
14882	Special Vegetable and Potato Grower 4–8–4	Milford	58.70	0.11	1.73	0.69	0.99	3.52	3.28	4.28	3.92	1.01	9.21	9.00	8.20	8.00	3.80	3.80	4.00	14882
14948	Tobacco Grower	Silver Lane	78.00	1.18	0.06	1.16	1.67	4.07	4.10	1.17	3.72	2.53	7.42	6.00	4.89	5.00	1.04	3.98	4.00	14948
14911	*Tobacco Special	Rockville	80.00	1.27	0.09	0.83	1.64	3.83	4.10	1.35	3.53	2.46	7.34	6.00	4.88	5.00	0.92	1.79	2.00	14911
14658	*Tobacco 5–5–5	East Hartford	78.00	1.07	0.05	0.71	1.97	3.80	4.10	1.78	2.77	1.87	6.42	6.00	4.55	5.00	0.73	5.47	5.00	14658
14620	3–8–3	Plantsville	68.00	none	0.98	0.71	0.78	2.47	2.46	4.52	3.76	1.30	9.58	9.00	8.28	8.00	3.14	3.14	3.00	14620
	Hubbard Fertilizer Co., Baltimore, Md.																			
15043	*‡Noxall Guano	Ellington	59.43	2.00	none	0.40	0.67	3.07	3.28	5.34	3.21	0.24	8.79	9.00	8.55	8.00	1.14	3.81	4.00	15043
	International Agricultural Corporation, Buffalo, N. Y.																			
14773	Buffalo Economy	Ansonia	51.00	0.40	0.08	0.52	0.63	1.63	1.60	5.45	2.72	1.36	9.53	9.00	8.17	8.00	2.20	2.20	2.00	14773
15014	Buffalo Farmers' Choice	Ellington	....	0.27	0.08	0.52	0.39	1.26	0.80	5.92	4.62	1.34	11.88	11.00	10.54	10.00	2.35	2.35	2.00	15014
15007	Buffalo General Favorite	East Granby	....	none	0.21	0.45	0.52	1.18	0.80	5.20	4.63	0.99	10.82	9.00	9.83	8.00	0.70	1.29	1.00	15007

*See note, page 56. †See note, page 57. ‡See note, page 59.

TABLE VIII. NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station:		
	International Agricultural Corporation, Buffalo, N. Y. *(Continued)*		
15079	Buffalo High Grade Manure	East Haven	$65.50
15006	Buffalo New England Special	Tariffville	57.50
14711	Buffalo Onion, Vegetable and Potato	Shelton	60.00
15008	Buffalo Tobacco Producer	East Granby	....
	A. L. Koster, Suffield, Conn.		
14974	Hale Tobacco Mixture	Windsor Locks	....
	Lister's Agricultural Chemical Works, Newark, N. J.		
14864	Celebrated Tobacco Fertilizer	Burnside	81.00
14865	*Complete Tobacco Manure	Burnside	86.00
14970	Corn and Potato Fertilizer	Glastonbury	61.00
15011	Eastern Pride Fertilizer	Rockville	....
15111	King Bee Fertilizer	Yalesville	....
15112	Special Crop Producer	Yalesville	....
14979	Special Tobacco Fertilizer	Brookfield	60.00
14824	Standard Pure Superphosphate of Lime	Burnside	54.75
15047	Success Fertilizer	East Canaan	53.00
	Lowell Fertilizer Co., Boston, Mass.		
14520	Animal Brand 3–8–4	Southington	70.00
14543	Bone Fertilizer 2–8–2	Southington	58.00
14522	Empress Brand 1–10–1	New Britain	54.00
15049	*Lawn and Garden Dressing	Hartford	....
14706	Tobacco 5–5–4	Warehouse Point	84.00
14819	Tobacco 5–7–2	Granby	82.00
14702	2–8–3	Saybrook	60.00
14975	4–8–4	Westport	65.75
14817	*5–8–4	Wethersfield	72.00
	Mapes' Formula and Peruvian Guano Co., New York City.		
14548	Corn Manure	Windsor Locks	56.00
14614	C. S. Tobacco Manure	Rockville	62.00
14701	General Tobacco Manure	Hartford	85.00
14742	†General Truck Manure	Windsor Locks	72.00
15013	*Grain Brand	Rockville	50.00
14527	Potato Manure	Windsor Locks	71.00
14653	†Potato Manure, 1916 Brand	Glastonbury	....
14584	Tobacco Starter Improved	Windsor Locks	61.00

* See note, page 56. †See note, page 59.

WITH POTASH—*(Continued)*.

Nitrogen.						Phosphoric Acid.							Potash.			
				Total.					Total.		So-called "Available."					
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As muriate.	Total.	Guaranteed.	Station No.
0.89	0.09	1.03	1.12	3.13	3.30	3.76	4.77	1.64	10.17	9.00	8.53	8.00	3.61	4.30	4.00	15079
none	0.15	1.05	0.72	1.92	1.60	5.42	4.86	1.45	11.73	11.00	10.28	10.00	3.59	3.82	4.00	15006
0.97	0.07	0.61	0.77	2.42	2.50	5.86	2.68	1.46	10.00	9.00	8.54	8.00	3.07	3.07	3.00	14711
2.21	0.06	0.75	1.24	4.26	4.10	0.89	3.61	1.45	5.95	5.00	4.50	4.00	0.94	2.11	2.00	15008
1.00	0.94	0.36	2.80	5.10	4.94	1.06	5.76	1.15	7.97	...	6.82	5.00	2.18	4.81	4.00	14974
0.73	0.09	none	3.24	4.06	4.11	2.28	3.57	0.33	6.18	5.00	5.85	4.00	1.04	2.85	3.00	14864
2.83	0.19	0.49	0.61	4.12	4.11	1.84	2.42	1.15	5.41	5.00	4.26	4.00	4.33	4.33	5.00	14865
0.13	0.13	0.76	0.68	1.70	1.65	3.62	4.06	2.06	9.74	9.00	7.68	8.00	2.79	2.79	3.00	14970
0.90	0.22	0.76	0.59	2.47	2.47	6.41	2.02	1.43	9.86	9.00	8.43	8.00	3.76	3.76	4.00	15011
0.10	0.66	0.51	0.53	1.80	1.65	5.21	3.36	1.74	10.31	11.00	8.57	10.00	5.63	5.63	4.00	15111
0.11	0.11	0.26	0.44	0.92	0.82	4.61	2.82	0.73	8.16	8.00	7.43	7.00	0.51	2.16	1.00	15112
0.08	0.22	0.85	0.72	1.87	1.65	7.10	2.93	2.12	12.15	11.00	10.03	10.00	3.66	3.66	4.00	14979
1.14	0.24	0.56	0.58	2.52	2.47	4.57	4.43	1.52	10.52	10.00	9.00	9.00	0.62	1.90	2.00	14824
0.92	0.20	0.24	0.49	1.85	1.65	7.78	1.48	0.50	9.76	9.00	9.26	8.00	1.86	1.86	2.00	15047
0.07	0.92	1.22	0.71	2.92	2.46	6.12	2.44	0.83	9.39	9.00	8.56	8.00	3.58	3.58	4.00	14520
0.20	0.16	0.57	0.85	1.78	1.64	3.89	3.95	1.37	9.21	9.00	7.84	8.00	1.74	2.03	2.00	14543
0.16	0.28	0.39	0.54	1.37	0.82	6.89	3.21	0.90	11.00	11.00	10.10	10.00	1.96	1.96	1.00	14522
0.07	2.93	0.14		3.14	3.28	5.62	1.50	1.73	8.85	8.00	7.12	7.00	1.88	1.88	2.00	15049
1.22	0.09	1.12	1.72	4.15	4.10	1.49	3.08	2.15	6.72	6.00	4.57	5.00	0.90	4.22	4.00	14706
1.19	0.09	1.06	1.85	4.19	4.10	2.63	4.14	1.87	8.64	8.00	6.77	7.00	0.70	1.98	2.00	14819
0.56	0.13	0.39	0.65	1.73	1.64	5.63	2.97	1.05	9.65	9.00	8.60	8.00	3.15	3.15	3.00	14702
0.18	1.67	0.61	0.79	3.25	3.28	3.79	4.29	0.96	9.04	9.00	8.08	8.00	3.98	3.98	4.00	14975
1.01	1.01	0.68	0.91	3.61	4.10	5.23	3.11	1.20	9.54	9.00	8.34	8.00	3.78	3.78	4.00	14817
1.49	none	0.18	0.90	2.57	2.47	3.58	3.74	2.94	10.26	10.00	7.32	8.00	3.33	3.33	3.00	14548
1.44	0.09	0.65	2.07	4.25	4.12	0.49	4.38	1.25	6.12	4.00	4.87	4.00	0.70	1.45	1.00	14614
1.19	0.09	1.00	2.11	4.39	4.12	0.41	4.59	0.28	5.28	4.00	5.00	4.00	1.30	5.41	5.00	14701
2.96	0.10	0.04	1.40	4.50	4.12	2.05	4.20	1.92	8.17	8.00	6.25	6.00	5.13	5.13	5.00	14742
0.84	0.16	0.15	0.57	1.72	1.65	1.65	4.85	3.99	10.49	10.00	6.50	8.00	1.99	1.99	2.00	15013
3.12	none	0.11	0.45	3.68	3.71	3.75	3.29	1.61	8.65	8.00	7.04	7.00	4.91	4.91	5.00	14527
3.35	0.05	0.03	0.28	3.71	3.71	4.25	2.75	0.96	7.96	8.00	7.00	8.00	0.65	1.53	1.00	14653
1.85	0.07	0.86	1.77	4.55	4.12	1.82	4.27	3.67	9.76	8.00	6.09	6.00	0.54	1.50	1.00	14584

TABLE VIII. NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station:		
	National Fertilizer Co., New York City.		
14818	Complete Tobacco Fertilizer	Simsbury	$80.00
14575	Eureka Potato Fertilizer	West Cheshire	64.75
14589	Market Garden Fertilizer Revised	South Manchester	62.75
14596	Potato Phosphate	Meriden	53.00
14708	Soluble Bone and Potash	Somersville	37.60
14921	Special Tobacco, Revised	Hartford	83.00
14612	Universal Phosphate	South Manchester	45.60
14541	XXX Fish and Potash	West Cheshire	58.00
	New England Fertilizer Co., Boston, Mass.		
14648	*Corn Phosphate 2–8–2	Rockville	55.00
14592	Standard Phosphate1–10–1	Rockville	48.00
14816	Superphosphate 3–8–4	Hamden	67.00
14832	Tobacco 5–5–4	Warehouse Point	85.00
14526	2–8–3	Meriden	55.00
14876	2–8–3	East Wallingford	53.00
14547	3–8–3	Meriden	60.00
	Olds & Whipple, Hartford, Conn.		
14841	Complete Corn, Potato and Onion Fertilizer	Simsbury	....
14766	Complete Tobacco Fertilizer	Hazardville	....
14991	Complete Tobacco Fertilizer	Scitico	....
15155	Complete Tobacco Fertilizer	East Windsor Hill	76.95
14842	Special Corn, Onion and Potato Fertilizer	Simsbury	....
	Parmenter & Polsey, Boston, Mass.		
14767	Plymouth Rock 3–8–4	Plantsville	63.00
15151	Tobacco 5–5–4	Bloomfield	78.00
15107	1–10–1	Plantsville	45.00
14964	*2–8–2	West Hartford	50.00
	Pawtucket Rendering Co., Pawtucket, R. I.		
14959	2–8–2	Brooklyn	....
	Piedmont-Mt. Airy Guano Co., Baltimore, Md.		
14856	*Brown's H. G. Potato and Gen. Crop Manure	South Meriden	60.00
14871	Brown's Potato Fertilizer	South Meriden	54.00
14857	Brown's Special O. & T. Dresser and Market Garden	Meriden	66.00
14963	*Shay's Corn Fertilizer	Chester	64.00
14962	*Shay's Potato Fertilizer	Groton	....
14961	Shay's Special Fertilizer	Groton	....
	Quality Fertilizer Works, Stamford, Conn.		
15208	Bartlett Brand Special Tree Fertilizer	Stamford	60.00

*See note, page 56.

WITH POTASH—(*Continued*).

Nitrogen.						Phosphoric Acid.							Potash.			
				Total.					Total.		So-called "Available."					
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As muriate.	Total.	Guaranteed.	Station No
0.20	0.73	0.66	2.65	4.24	4.11	0.90	4.84	0.36	6.10	5.00	5.74	4.00	0.82	4.41	5.00	14818
0.80	1.13	0.64	0.94	3.51	3.29	0.13	7.84	1.68	9.65	9.00	7.97	8.00	0.74	4.08	4.00	14575
0.49	0.16	0.60	1.19	2.44	2.47	3.92	5.14	1.33	10.39	9.00	9.06	8.00	3.39	4.24	4.00	14589
0.48	0.17	0.22	0.98	1.85	1.65	3.87	4.72	1.39	9.98	9.00	8.59	8.00	3.29	3.29	3.00	14596
..	..	..	..	..	..	7.10	4.68	0.90	12.68	13.00	11.78	12.00	2.05	2.05	2.00	14708
1.01	0.05	0.65	2.62	4.33	4.11	0.54	4.85	0.14	5.53	5.00	5.39	4.00	0.90	3.17	3.00	14921
0.08	0.11	0.25	0.59	1.03	0.82	5.15	3.13	0.99	9.27	9.00	8.28	8.00	2.02	2.02	2.00	14612
0.79	0.87	0.25	0.73	2.64	2.47	4.74	5.31	1.20	11.25	11.00	10.05	10.00	0.93	2.88	3.00	14541
0.13	0.17	0.62	0.73	1.65	1.64	3.55	3.75	1.41	8.71	9.00	7.30	8.00	1.49	1.84	2.00	14648
0.11	0.10	0.35	0.48	1.04	0.82	7.48	3.35	1.05	11.88	11.00	10.83	10.00	1.12	1.12	1.00	14592
0.11	1.01	0.69	0.73	2.54	2.46	5.64	2.48	0.68	8.80	9.00	8.12	8.00	3.57	3.57	4.00	14816
1.46	0.06	0.89	1.90	4.31	4.10	1.28	3.27	1.97	6.52	6.00	4.55	5.00	0.90	3.65	4.00	14832
0.46	0.14	0.49	0.57	1.66	1.64	5.56	2.83	0.82	9.21	9.00	8.39	8.00	2.83	2.83	3.00	14526
0.59	0.10	0.32	0.58	1.59	1.64	5.31	3.19	0.81	9.31	9.00	8.50	8.00	3.04	3.04	3.00	14876
0.96	0.12	0.65	0.77	2.50	2.46	5.21	2.76	1.46	9.43	9.00	7.97	8.00	2.83	2.83	3.00	14547
0.98	0.08	0.65	1.66	3.37	3.30	2.06	5.60	1.32	8.98	8.00	7.66	8.00	4.98	4.98	4.00	14841
0.44	0.16	0.58	3.19	4.37	4.11	0.57	4.20	0.65	5.42	4.00	4.77	4.00	0.90	4.52	4.00	14766
0.79	none	0.44	3.15	4.38	4.11	0.71	4.03	0.22	4.96	4.00	4.74	4.00	0.56	4.29	4.00	14991
..	..	..	..	4.30	4.11	..	..	..	4.84	4.00	...	...	..	4.07	4.00	15155
0.82	0.16	0.55	0.92	2.45	2.45	2.83	5.61	1.60	10.04	8.00	8.44	8.00	2.69	2.69	2.00	14842
0.12	1.24	0.54	0.77	2.67	2.46	5.54	2.49	0.69	8.72	9.00	8.03	8.00	4.13	4.13	4.00	14767
1.47	0.06	0.96	1.73	4.22	4.10	0.49	5.14	1.78	7.41	6.00	5.63	5.00	0.98	3.92	4.00	15151
0.13	0.04	0.30	0.45	0.92	0.82	6.88	3.50	1.11	11.49	11.00	10.38	10.00	1.03	1.03	1.00	15107
0.25	0.39	0.54	0.63	1.81	1.64	2.30	3.98	1.43	7.71	9.00	6.28	8.00	2.02	2.02	2.00	14964
0.20	0.34	0.27	0.96	1.77	1.64	5.77	3.19	0.47	9.43	8.00	8.96	7.00	2.35	2.35	2.00	14959
0.22	0.90	0.60	1.20	2.92	3.29	4.37	3.34	0.86	8.57	...	7.71	8.00	4.00	4.00	4.00	14856
0.09	0.67	0.58	1.56	2.90	2.47	6.10	3.23	1.48	10.81	...	9.33	8.00	3.53	3.53	4.00	14871
0.12	0.65	0.71	1.47	2.95	4.53	6.07	3.38	1.50	10.95	...	9.45	8.00	3.50	3.50	3.00	14857
0.95	0.15	0.12	0.85	2.07	2.47	6.06	1.93	0.68	8.67	...	7.99	8.00	2.99	2.99	3.00	14963
1.10	0.20	0.42	1.01	2.73	3.29	5.09	2.73	0.84	8.66	...	7.82	8.00	4.18	4.18	4.00	14962
0.11	0.21	0.54	0.54	1.40	1.65	5.15	2.99	0.97	9.11	...	8.14	8.00	2.60	2.60	2.00	14961
0.73	1.41	0.53	0.68	3.35	4.00	6.05	2.24	0.60	8.89	8.50	8.29	8.00	3.95	3.95	4.00	15208

TABLE VIII. NITROGENOUS SUPERPHOSPHATES WITH POTASH—(*Continued*).

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton	Nitrogen. In nitrates.	Nitrogen. In ammonia.	Nitrogen. Organic, water-soluble.	Nitrogen. Organic, water-insoluble.	Nitrogen. Total. Found.	Nitrogen. Total. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. So-called "Available." Found.	Phosphoric Acid. So-called "Available." Guaranteed.	Potash. As muriate.	Potash. Total.	Potash. Guaranteed.	Station No.
	Sampled by Station:																			
	Rogers and Hubbard Co., Middletown, Conn.																			
14924	Hubbard's Bone Base Fertilizer for Seeding Down	Newington	$61.00	none	0.27	0.34	2.17	2.78	2.46	0.08	7.75	8.26	16.09	15.00	7.83	6.00	4.35	4.35	4.00	14924
14616	Hubbard's Bone Base Oats and Top Dressing	Hazardville	85.00	6.64	0.08	0.44	0.88	8.04	8.22	0.54	4.92	2.92	8.38	8.00	5.46	3.00	4.00	4.00	4.00	14616
14883	*Hubbard's Bone Base Oats and Top Dressing	Hamden	86.50	6.22	0.04	0.77	1.21	8.24	8.22	0.07	5.06	2.37	7.50	8.00	5.13	3.00	4.50	4.50	4.00	14883
14716	Hubbard's Bone Base Soluble Corn and General Crop Manure	Hazardville	62.00	1.50	0.18	0.14	0.51	2.33	2.46	1.69	7.07	1.82	10.58	10.00	8.76	8.00	4.49	4.49	4.00	14716
14884	Hubbard's Bone Base Soluble Potato Manure	Hamden	79.75	2.92	0.18	0.58	0.61	4.29	4.11	1.64	6.71	1.48	9.83	10.00	8.35	8.00	1.22	6.27	6.00	14884
14617	Hubbard's Bone Base Soluble Potato Manure	Hazardville	79.00	2.25	0.25	0.68	0.78	3.96	4.11	0.12	8.49	2.75	11.36	10.00	8.61	8.00	1.57	5.94	6.00	14617
14834	R. and H. All Soils-All Crops Phosphate	Hamden	74.00	1.45	0.59	0.45	0.58	3.07	3.29	3.28	5.56	1.43	10.27	9.00	8.84	8.00	6.50	6.50	6.00	14834
15015	R. and H. Climax Tobacco Brand	Glastonbury	....	2.17	none	0.51	1.63	4.31	4.11	0.76	2.90	2.19	5.85	5.00	3.66	4.00	0.78	2.96	3.00	15015
14719	R. and H. Complete Phosphate	Middletown	50.00	0.32	0.11	0.01	0.36	0.80	0.82	4.19	4.69	1.42	10.30	9.00	8.88	8.00	2.14	2.14	2.00	14719
14726	R. and H. Potato Phosphate	Hazardville	53.00	0.84	0.16	0.13	0.50	1.63	1.64	3.23	5.47	1.30	10.00	9.00	8.70	8.00	4.35	4.35	4.00	14726
14838	R. and H. Soluble Tobacco Manure	Gildersleeve	80.00	2.24	0.26	0.56	1.70	4.76	4.93	1.17	7.70	2.99	11.86	10.00	8.87	8.00	1.08	4.44	4.00	14838
14837	R. and H. Tobacco Grower, Vegetable Formula	Gildersleeve	100.00	1.07	0.09	0.41	3.42	4.99	4.93	0.76	4.41	0.68	5.85	5.00	5.17	4.00	1.10	3.94	4.00	14837
	F. S. Royster Guano Co., Baltimore, Md.																			
14777	Arrow Head Tobacco Formula	New Milford	93.00	0.50	0.83	0.05	2.70	4.08	4.11	2.28	1.67	0.35	4.30	4.50	3.95	4.00	0.24	2.88	3.00	14777
14946	Banner Guano	Putnam	76.00	0.08	0.90	0.14	0.50	1.62	1.65	6.41	2.06	1.24	9.71	8.50	8.47	8.00	8.91	8.91	10.00	14946
14544	†Bully Guano	Waterbury	65.00	0.26	0.68	0.13	0.52	1.59	1.65	5.55	1.94	0.95	8.44	8.50	7.49	8.00	4.72	4.72	5.00	14544
14867	Dreadnought Guano	Naugatuck	59.00	0.05	0.91	0.28	0.50	1.74	1.65	5.96	1.85	0.90	8.71	8.50	7.81	8.00	2.00	2.00	2.00	14867
14771	‡Fish, Flesh and Fowl Guano	Shelton	54.00	0.31	0.67	none	0.56	1.54	1.65	6.25	1.49	1.05	8.79	8.50	7.74	8.00	2.54	2.54	3.00	14771
15358	Fish, Flesh and Fowl Guano	Branford	54.00	..	..	..	..	1.58	1.65	6.41	2.20	0.31	8.92	8.50	8.61	8.00	2.83	2.83	3.00	15358
14578	Fish and Potash	Waterbury	55.00	0.12	0.95	0.09	0.71	1.87	1.65	5.86	1.45	1.38	8.69	8.50	7.31	8.00	1.00	1.00	1.00	14578
14927	†Quality Trucker	Putnam	79.00	0.11	2.02	0.46	0.47	3.06	3.30	5.72	2.71	1.29	9.72	8.50	8.43	8.00	5.78	5.78	7.00	14927
14868	†Truckers' Delight	Glastonbury	....	0.15	1.74	0.44	0.71	3.04	3.30	5.53	2.46	1.18	9.17	8.50	7.99	8.00	3.64	3.64	4.00	14868
14878	Valley Tobacco Formula	Glastonbury	....	0.53	0.82	0.06	2.46	3.87	4.11	2.33	2.05	0.40	4.78	4.50	4.38	4.00	0.30	5.20	5.00	14878
	Sanderson Fertilizer and Chemical Co., New Haven, Conn.																			
14637	Atlantic Coast Bone, Fish and Potash	Meriden	46.53	0.07	0.15	0.58	0.99	1.79	1.65	3.45	4.98	2.03	10.46	9.00	8.43	8.00	3.08	3.08	3.00	14637
14768	Complete Tobacco Grower	Glastonbury	85.00	0.97	0.07	0.11	3.38	4.53	4.11	0.91	4.40	0.23	5.54	5.00	5.31	4.00	1.00	4.15	5.00	14768
14634	Corn Superphosphate	Meriden	43.71	0.26	0.37	0.62	0.82	2.07	1.65	4.67	3.96	1.16	9.79	9.00	8.63	8.00	1.88	1.88	2.00	14634
14720	Formula "A"	Guilford	65.00	0.16	1.32	0.99	1.24	3.71	3.29	4.47	3.92	1.56	9.95	9.00	8.39	8.00	3.17	3.17	4.00	14720
15129	Formula "B"	Milford	....	1.14	none	0.96	1.77	3.87	3.29	6.75	3.09	1.02	10.86	9.00	9.84	8.00	4.52	4.52	4.00	15129
14580	Potato Manure	Milford	....	0.58	0.42	0.64	0.84	2.48	2.47	5.08	3.72	1.11	9.91	9.00	8.80	8.00	3.81	3.81	4.00	14580
14636	Potato Manure	Meriden	54.75	0.75	0.13	0.64	1.13	2.65	2.47	5.22	2.90	1.78	9.90	9.00	8.12	8.00	4.05	4.05	4.00	14636
14925	Top Dressing for Grass and Grain	Glastonbury	....	0.07	0.91	1.30	1.76	4.04	4.11	6.34	3.01	2.00	11.35	9.00	9.35	8.00	4.19	4.19	4.00	14925
14917	South American Sheep and Goat Manure	New Canaan	50.00	none	0.18	1.25		1.43	1.23	0.05	1.00	0.13	1.18	1.00	1.05	.....	2.27	3.12	3.00	14917
14922	Kelsey's Bone, Fish and Potash	Clinton	59.00	0.53	0.76	0.49	1.83	3.61	2.47	6.30	2.99	1.56	10.85	11.00	9.29	10.00	4.68	4.68	3.00	14922
	M. L. Shoemaker and Co., Philadelphia, Pa.																			
14835	Swift-Sure Superphosphate for General Use	Meriden	55.00	0.61	none	0.47	1.44	2.52	2.46	4.94	3.63	2.53	11.10	11.00	8.57	8.00	3.72	3.72	3.00	14835
14836	Swift-Sure Superphosphate for Potatoes No. 1	Meriden	67.00	0.63	0.12	0.73	1.63	3.11	3.30	7.47	2.71	1.64	11.82	11.00	10.18	8.00	4.44	4.44	5.00	14836

*See note, page 59. †See note, page 56. ‡See note, page 57.

TABLE VIII. NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.	Nitrogen. In nitrates.	Nitrogen. In ammonia.	Nitrogen. Organic, water-soluble.	Nitrogen. Organic, water-insoluble.	Nitrogen. Total. Found.	Nitrogen. Total. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. So-called "Available." Found.	Phosphoric Acid. So-called "Available." Guaranteed.	Potash. As muriate.	Potash. Total.	Potash. Guaranteed.	Station No.
	Sampled by Station:																			
	Springfield Rendering Co., Springfield, Mass.																			
14642	Animal Brand	Thompsonville	$62.00	none	0.84	1.24	0.68	2.76	2.46	4.92	3.31	0.88	9.11	9.00	8.23	8.00	4.38	4.38	4.00	14642
14919	Grain and Grass	Suffield	50.00	0.25	0.35	0.68	0.53	1.81	1.64	5.26	3.19	0.40	8.85	9.00	8.45	8.00	2.39	2.39	2.00	14919
14920	Tobacco Special	Hazardville	88.00	1.41	0.08	1.08	1.75	4.32	4.10	1.50	3.40	1.88	6.78	6.00	4.90	5.00	0.80	4.03	4.00	14920
	Virginia-Carolina Chemical Co., New York City.																			
14724	Challenge Brand	Hartford	56.00	0.08	0.15	0.26	0.48	0.97	0.82	7.07	2.26	1.28	10.61	...	9.33	9.00	3.04	3.04	3.00	14724
14725	Champion Brand	Hartford	70.00	0.16	1.07	0.67	1.30	3.20	3.29	5.47	3.02	1.18	9.67	...	8.49	8.00	4.19	4.19	4.00	14725
14966	Cherokee Brand	Glastonbury	78.00	0.26	0.86	0.35	3.23	4.70	4.11	1.84	1.95	0.20	3.99	...	3.79	4.00	0.30	3.33	3.00	14966
14968	Indian Chief Brand	Glastonbury	83.00	0.19	1.09	0.35	2.73	4.36	4.11	2.29	1.70	0.32	4.31	...	3.99	4.00	0.51	7.18	5.00	14968
14967	Owl Brand	Glastonbury	....	1.06	0.08	0.37	0.27	1.78	1.65	5.97	1.67	0.65	8.29	...	7.64	8.00	2.57	2.57	3.00	14967
15084	Plant Food for Vegetables, Lawns and Flowers	Waterbury	....	0.24	3.27	0.13	1.40	5.04	4.94	5.26	3.22	1.92	10.40	...	8.48	8.00	0.90	1.77	2.00	15084
	Wilcox Fertilizer Co., Mystic, Conn.																			
14577	Corn Special	Branford	64.00	0.33	0.65	none	2.80	3.78	3.29	3.42	5.24	3.89	12.55	9.00	8.66	8.00	0.45	2.67	2.00	14577
15123	*Fish and Potash	Branford	56.00	0.19	0.27	0.34	1.76	2.56	2.46	6.36	2.60	0.51	9.47	9.00	8.96	8.00	1.33	1.33	1.00	15123
14721	Grass Fertilizer	Mystic	65.50	1.87	0.16	0.25	1.73	4.01	4.12	5.64	2.38	0.40	8.42	9.00	8.02	8.00	2.23	2.23	2.00	14721
14717	High Grade Fish and Potash	Burnside	....	0.86	0.29	0.30	1.37	2.82	2.46	6.27	2.42	0.24	8.93	9.00	8.69	8.00	3.26	3.26	3.00	14717
14576	Potato Fertilizer	Branford	53.00	0.37	0.13	0.23	1.46	2.19	1.65	6.58	2.20	2.41	11.19	9.00	8.78	8.00	2.44	2.44	2.00	14576
14723	*Potato and Vegetable Phosphate	Jewett City	68.00	1.40	0.21	0.20	1.48	3.29	3.29	5.80	2.37	1.68	9.85	9.00	8.17	8.00	3.90	3.90	4.00	14723
15012	Tobacco Special	Ellington	81.00	0.87	0.11	0.35	2.84	4.17	4.12	0.50	2.73	2.25	5.48	5.00	3.23	3.00	0.41	4.18	4.00	15012
	S. D. Woodruff and Sons, Orange, Conn.																			
14498	Home Mixture	Orange	58.00	0.58	0.07	2.49		3.14	3.29	2.79	3.63	1.50	7.92	8.00	6.42	...	1.34	4.24	3.00	14498
	Worcester Rendering Co., Auburn, Mass.																			
14928	Prosperity Brand Royal Worcester Corn and Grain Fertz.	Putnam	48.00	0.28	0.45	0.61	0.44	1.78	1.64	6.08	3.04	0.73	9.85	9.00	9.12	8.00	2.26	2.26	2.00	14928
14926	†Prosperity Brand Royal Worcester Potato and Vegetable Fertz	Willimantic	66.00	0.10	0.92	0.96	1.14	3.12	3.29	4.16	3.88	1.00	9.04	9.00	8.04	8.00	4.08	4.08	4.00	14926
14960	Prosperity Brand Royal Worcester Special Grain Fertz.	Greenville	48.00	none	0.06	0.51	0.38	0.95	0.82	7.12	3.25	1.14	11.51	11.00	10.37	10.00	1.04	1.04	1.00	14960
	The World's Fertilizer Process Co., Sharpsburg, Pa.																			
14769	Shur-Gro	Hartford	....	..	..	..	..	0.13	..	0.62	6.81	0.54	7.97	5.50	7.43	5.00	0.40	2.00	2.00	14769
	Sampled by Purchaser:																			
15330	American Ag'l Chem'l Co. 5–8–7	Winsted	80.25	0.98	1.27	0.60	0.59	3.44	4.13	5.57	3.77	1.01	10.35	...	9.34	8.00	5.54	6.12	7.00	15330
14783	Apothecaries Hall Co.'s Liberty Brand 4–8–4	Branford	65.75	0.28	1.07	0.72	1.51	3.58	3.29	5.55	2.62	0.82	8.99	...	8.17	8.00	3.86	3.86	4.00	14783
15143	Atlantic Packing Co.'s Potato Phosphate 3–8–4	Westville	....	..	..	..	..	2.44	2.47	..	..	..	8.16	9.00	...	...	...	4.06	4.00	15143
15089	‡Berkshire Tobacco Starter	Suffield	98.75	3.00	0.02	1.96		4.98	5.00	0.54	2.99	0.09	3.62	5.00	3.53	4.00	1.71	7.56	8.00	15089
14752	Frisbie's 4–8–4	Milford	58.70	..	..	..	..	3.09	3.28	..	..	1.11	9.17	9.00	8.06	8.00	..	3.68	4.00	14752
14804	Frisbie's 5–5–4	Somers	....	..	..	..	..	..	..	..	..	..	...	...	...	...	0.70	4.00	4.00	14804
14682	Frisbie's Bone Base 4–8–4	Woodmont	....	..	..	..	..	3.40	3.29	4.19	3.51	1.15	8.85	...	7.70	8.00	..	4.26	4.00	14682
15087	Mapes' Corn Manure	Hartford	....	..	..	..	..	2.66	2.47	..	..	..	10.29	10.00	...	...	..	3.10	3.00	15087

*See note, page 59. †See note, page 56. ‡See note, page 57.

WITH POTASH—(*Continued*).

TABLE VIII. NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.
	Sampled by Purchaser:		
15068	Mapes' General Tobacco Manure	Hartford	....
15069	Mapes' Potato Manure 1916	Hartford	....
15067	Mapes' Tobacco Starter, Improved	Hartford	....
15022	Olds & Whipple's Complete Tobacco Fertilizer	Tariffville	$84.00
14506	Rogers & Hubbard's Oats and Top Dressing	Winsted	86.50
15036	Rogers & Hubbard's Soluble Tobacco Manure	Glastonbury	72.50
15070	Sanderson's Bone Fish and Potash	Branford	55.50
	Sampled by Manufacturer:		
14307	Frisbie's 2–8–2	New Haven	....
14306	Frisbie's 3–8–4	New Haven	....
14305	Frisbie's Complete Fertilizer 3–8–4	New Haven	....
14379	Frisbie's 3–8–4	New Haven	....
14380	Frisbie's 4–8–4	New Haven	....

		Deficiency.
14748	Armour's Wheat and Clover Fertilizer	$5.40
14690	Atlantic Packing Co.'s Grain Fertilizer	3.55
15050	Atlantic Packing Co.'s Tobacco Grower	3.12
15030	Columbia Guano Co.'s Freedom Guano	2.87
15027	Essex Fertilizer Co.'s Tobacco 5-5-4	1.30
14874	Essex Fertilizer Co.'s 2-8-2	1.15
15028	Essex Fertilizer Co.'s 4-8-4	2.36
14582	L. T. Frisbie Co.'s 2-8-2	4.06
14911	L. T. Frsibie Co.'s Tobacco Special	3.61
14658	L. T. Frisbie Co.'s Tobacco 5-5-5	2.40
15043	Hubbard Fertilizer Co.'s Noxall Guano	1.61
14865	Lister's Agl. Chem'l Works, Complete Tobacco Manure	1.52
15049	Lowell Fertilizer Co.'s Lawn and Garden Dressing	1.54
14817	Lowell Fertilizer Co.'s 5-8-4	4.92
15013	Mapes F. & G. P. Co.'s Grain Brand	2.33
14648	New England Fertilizer Co.'s Corn Phosphate 2-8-2	1.81
14964	Parmenter & Polsey's 2-8-2	1.68
14856	Piedmont-Mt. Airy Guano Co.'s Brown's H. G. Potato and General Crop	4.28
14963	Piedmont-Mt. Airy Guano Co.'s Shay's Corn Fertilizer	4.00
14962	Piedmont-Mt. Airy Guano Co.'s Shay's Potato Fertilizer	5.88
14544	F. S. Royster Guano Co.'s Bully Guano	2.52
14927	F. S. Royster Guano Co.'s Quality Trucker	5.44
14868	F. S. Royster Guano Co.'s Trucker's Delight	3.75
14926	Worcester Rendering Co.'s Prosperity Brand Potato and Vegetable Fertilizer	1.36

WITH POTASH—(*Concluded*).

Nitrogen.						Phosphoric Acid.							Potash.			
				Total.					Total.		So-called "Available."					
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As muriate.	Total.	Guaranteed.	Station No.
..	..	..	..	3.95	4.12	..	..	..	4.89	4.00	...	...	..	5.01	5.00	15068
..	..	..	..	3.81	3.71	..	..	..	10.07	8.00	...	...	...	1.40	1.00	15069
..	..	..	..	4.19	4.12	..	..	..	9.07	8.00	...	...	...	1.51	1.00	15067
..	..	..	..	4.53	4.11	..	..	..	5.16	4.00	...	...	...	4.18	4.00	15022
6.71	0.03	1.58		8.32	8.22	0.41	4.75	2.69	7.85	8.00	5.16	3.00	4.30	4.30	4.00	14506
..	..	..	..	4.64	4.93	..	..	..	10.76	10.00	...	...	1.10	4.80	4.00	15036
0.09	0.45	2.22		2.76	1.65	5.18	3.33	1.84	10.35	...	8.51	8.00	4.18	4.18	3.00	15070
..	..	..	..	2.01	..	..	..	..	10.73	...	...	...	..	2.01	..	14307
..	..	..	..	2.47	..	..	..	..	8.79	...	...	...	...	4.32	..	14306
..	..	..	..	2.52	..	..	..	...	9.26	...	...	...	...	3.90	..	14305
..	..	..	..	3.03	..	..	..	1.02	10.17	...	9.15	...	..	3.84	..	14379
..	..	..	..	3.72	..	..	..	1.10	9.43	...	8.33	...	..	3.78	..	14380

QUALITY OF THE NITROGEN.

The solubility of the nitrogen was tested in every sample examined, and in none was evidence found of the use of inferior ammoniates.

ANALYSES REQUIRING SPECIAL NOTICE.

15110 Chittenden's Complete Tobacco and Onion Grower was tagged Potato Special with Four Per Cent. Potash through an error at the factory which was corrected.

15030 Columbia Guano Co.'s Freedom Guano was deficient in all three guaranteed ingredients. It is suggested that two brands were mixed through a mistake in tagging. All the packages sampled by our agent bore the above brand.

14771 Royster's Fish, Flesh and Fowl Guano was deficient in all three guaranteed ingredients. The manufacturer felt that this sample did not fairly represent the composition of this brand. A second sample was therefore analyzed, **15358** which while defficient in potash more nearly met the guaranty.

15089 A special mixture with 8 per cent. of potash guaranteed. This sample was sent by J. E. Phelps, Suffield. As it failed to meet its guaranty, at the request of the manufacturer, the Station agent drew a sample in October

from 12 bags remaining in T. F. Devine's stock. He found the bags wet on the outside, and the resulting analysis, No. **15444,** showing nitrogen 4.44, phosphoric acid 3.16, and potash 7.61 per cent., could not have represented the quality of the goods as sold.

Borax in Commercial Fertilizers.

Injury to farm crops caused by borax in the fertilizers used was first brought to serious attention by the experience of corn growers in Indiana in 1917. Later the same trouble was reported from the potato districts of Maine and cotton districts in the South. Evidence indicated that injury followed the use of fertilizers containing potash with considerable amounts of borax. The damage was greatest where the largest amount of potash had been applied; and also in fields where the fertilizer was drilled in with the seed and conditions resulted which left the seed in contact with the fertilizer too long.

The explanation of how borax acts to cause the effects noted is largely speculative at the present time. It has been suggested, and it appears quite plausible, that borax unites with some constituent of the nutrient juices in plants in such a way as to prevent or hinder the ready diffusion of food material to the various parts of the plant system. Interference with enzyme action and other causes have been suggested.

There are no data upon which to base an accurate statement as to the limits of tolerance to borax exhibited by plants. If such limits were definitely established they would be modified by varying field conditions. It was with a view to insuring an ample margin of safety that the Secretary of Agriculture issued an order[1] concerning borax in mixed fertilizers which limited the amount of boron, expressed as anhydrous borax, in any fertilizer or fertilizer ingredient sold for application to the soil to one-tenth of one per cent. unless the goods so sold were plainly marked to show the amount present.

During the past season all mixed fertilizers and potash and nitrate salts inspected by this Station have been examined for borax. Preliminary qualitative tests were made and these were followed by quantitative determinations in suspicious cases.

The qualitative test employed was substantially that proposed by Bartlett[2] but modified in this laboratory[3] in that the fertilizer suspension was more strongly acidified and the turmeric strips were dried out at room temperature to avoid the charring due to hydrochloric acid at the temperature of boiling water.

[1] S. R. A., Bureau of Soils, Dec. 23, 1919.
[2] Maine Experiment Station.
[3] By Mr. C. E. Shepard.

Our procedure is as follows:

Digest about 5 grams of fertilizer with 10cc of water for 10 minutes on a steam bath. Acidify with 2cc of concentrated hydrochloric acid, stir thoroughly and allow to settle. Moisten a strip of turmeric paper with the supernatant liquid and allow to dry at room temperature or in a desiccator if the atmosphere is humid. Color due to boric acid is generally indicated in about 10 minutes and results may be noted within an hour.

For the quantitative determination of borax the methods of Ross and Deemer[1] and of J. M. Bartlett[2] have been used with about equally satisfactory results.

None of the brands examined at this Station during the past season contained borax in an amount likely to be injurious to crops unless applied close to the seed in large amounts, say 2,000 pounds per acre.

The brands in which more than one-tenth per cent. of borax was found were the following:

		Per cent. Borax.
15043	Hubbard's Noxall Guano	0.22
14742	Mapes' General Truck Manure	0.17
14653	Mapes' Potato Manure 1916 Brand	0.12
14883	R. & H.'s Hubbard's Bone Base Oats and Top Dressing	0.19
15123	Wilcox Fertilizer Co.'s Fish and Potash	0.14
14723	Wilcox Fertilizer Co.'s Potato and Vegetable Phosphate	0.18

During the winter and spring the Stations in the Northeastern States co-operated in carrying out elaborate potato experiments with corn, beans and potatoes, to study the action of borax on the growth of these crops. This experiment was conducted at the Vermont Station through the co-operation of Dr. J. L. Hills, Director, and was in direct charge of Mr. J. R. Neller.

A full account of this work is not yet ready for publication. Some of the more important results are briefly as follows:

Borax-containing fertilizers applied below the seed are much more liable to injure them than applied above the seed or broadcast.

One or two pounds of borax in the fertilizer were not harmful to either crop, whether broadcast or applied in the drill, but it was not conclusively shown that the five-pound application in the drill was harmless. Ten and twenty pounds of borax per acre were certainly injurious or ruinous.

Lime and gypsum, as well as manure, seemed partially to neutralize the poisonous action.

HOME-MIXED NITROGENOUS SUPERPHOSPHATES.

14782. Mixed by the Apothecaries Hall Co., Waterbury, to order of the A. E. Plant Sons Co., Branford. 200 lbs. nitrate of soda, 900 lbs. tankage, 900 lbs. phosphate.

[1] Respectively, Bureau of Soils and Bureau of Plant Industry Washington, D. C.
[2] Maine Experiment Station.

15142. Mixed by the Apothecaries Hall Co., Waterbury, to order of Paul Cavanna, South Glastonbury. 2,800 lbs. nitrate of soda, 2,800 lbs. bone tankage (3-50), 4,200 lbs. acid phosphate, 4,200 lbs. cottonseed meal.

15092, 15094, 15095, 15097, 15099, 15101, 15102 and 15103. Mixed by A. L. Koster, Suffield, to order of the American Sumatra Tobacco Co., Hartford. Each analysis represents a sample taken from a car lot.

14713. Made by V. E. Lucchini, Meriden. Acid phosphate, nitrate of soda and tankage.

14714. Made by V. E. Lucchini, Meriden. Acid phosphate, nitrate of soda and tankage.

14427. Mixed by Olds & Whipple, Hartford, to order of American Sumatra Tobacco Co., Hartford.

15096. Mixed by Olds & Whipple, Hartford, to order of American Sumatra Tobacco Co., Hartford.

15098. Mixed by Olds & Whipple, Hartford, to order of American Sumatra Tobacco Co., Hartford.

15100. Mixed by Olds & Whipple, Hartford, to order of American Sumatra Tobacco Co., Hartford.

TABLE IX. ANALYSES OF HOME-MIXED NITROGENOUS SUPERPHOSPHATES.

Station No.	Nitrogen					Phosphoric Acid.					Potash.	
	In nitrates.	In ammonia.	Organic water-soluble.	Organic water-insoluble.	Total found.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total found.	So-called "Available" found.	As muriate.	Total found.
14782	1.83	0.14	0.74	1.30	4.01	6.36	3.79	4.23	14.38	10.15	.....	.....
15142	2.39	None	2.31		4.70	2.28	4.81	0.59	7.68	7.09	0.62	0.86
15092	None	1.08	4.26		5.34	0.92	4.83	0.92	6.67	5.75	1.73	4.31
15094	0.81	1.01	3.62		5.44	1.01	5.44	1.43	7.88	6.45	1.62	4.17
15095	0.91	0.80	3.17		4.88	1.10	5.89	1.73	8.72	6.99	2.13	3.80
15097	0.70	1.00	3.33		5.03	0.81	5.26	1.82	7.89	6.07	1.42	3.98
15099	0.97	0.77	3.62		5.36	0.82	5.51	0.96	7.29	6.33	1.62	4.58
15101	0.80	0.72	3.77		5.29	0.88	5.17	0.83	6.88	6.05	1.20	3.58
15102	0.69	1.00	3.15		4.84	0.86	5.12	1.89	7.87	5.98	1.46	4.24
15103	0.90	0.75	3.08		4.73	0.72	4.98	1.45	7.15	5.70	1.54	4.40
14713	.....	.....	.....	.....	5.33	4.63	4.07	4.63	13.33	8.70	.....	.....
14714	.....	.....	.....	.....	4.19	4.68	4.49	5.00	14.17	9.17	.....	.....
14427	.....	.....	.....	.....	5.99	0.50	5.61	0.17	6.28	6.11	.....	1.37
15096	0.77	0.07	5.56		6.40	1.30	4.37	0.19	5.86	5.67	0.52	1.33
15098	0.57	0.07	5.34		5.98	1.17	4.51	0.23	5.91	5.68	0.70	1.40
15100	0.72	0.04	5.34		6.10	1.29	4.52	0.20	6.01	5.81	0.53	1.45

VI. MISCELLANEOUS FERTILIZERS AND WASTE PRODUCTS.

TOBACCO STEMS AND DUST.

Four samples were analyzed as follows:

14382. Tobacco Stems. Sent by the Everett B. Clark Seed Co., Milford.

14309. Stem Butts. Sent by Morgan & Dickinson, Windsor.

14310. Tobacco Dust. Sent by J. N. Root, W. Suffield.

14429. Tobacco Stems. Sent by Gordon Scholes, Warehouse Point.

ANALYSES OF TOBACCO STEMS AND DUST.

Station No.	14382	14309	14310	14429
Nitrogen	2.28	1.59[1]	2.20[2]	3.13
Phosphoric acid	0.32	0.40	0.47	....
Potash (total)	4.86	4.50	2.14	7.86

[1] 0.47 nitrogen in nitrates.
[2] 0.66 nitrogen in nitrates.

LIME-FERTILE AND NITRO-FERTILE.

14485. Lime-Fertile, made by Fertile Chemical Co., Cleveland, Ohio. Stock of A. R. Brewer, Hartford.

14538. Nitro-Fertile, made by Fertile Chemical Co., Cleveland, Ohio. Stock of Church & Morse, Meriden.

ANALYSES OF LIME-FERTILE AND NITRO-FERTILE.

Station No.	14485		14538	
	Found	Guaranteed	Found	Guaranteed
Nitrogen as nitrates	....	....	1.12	....
Nitrogen (total)	....	....	2.08	2.00
Phosphoric acid	3.17	3.00	3.48	3.00
Potash calculated as sulphate	....	....	1.71	....
Potash calculated as muriate	....	....	2.60	....
Potash (total)	....	....	4.31	3.00
Lime	28.65	....	....	....

Nitro-fertile is a solution for use on potted plants, costing 35 cents per half-pint, and Lime-fertile is also sold in small packages, five pounds for 25 cents. The plant food in a package, at the ordinary rates for fertilizers, is worth at most about 2½ cents.

SHEEP MANURE.

Nine samples were analyzed as follows:

14519. Pulverized Sheep Manure. Sold by American Agricultural Chemical Co., New York City. Stock of Southington Lumber Co., Southington.

14521. Liberty Brand Sheep Manure. Sold by Apothecaries Hall Co., Waterbury. Sampled at factory.

15159. Sheep Manure. Berkshire Fertz. Co., Bridgeport. Sampled at factory.

15108. Rams Head Brand. Sold by Joseph Breck & Sons Corp., Boston. Stock of G. M. Williams Co., New London.

14613. Magic Brand Pulverized Sheep Manure. Sold by Chicago Feed & Fertz. Co., Chicago, Ill. Stock of Blish Hardware Co., South Manchester.

14770. "Sheep's Head" Pulverized Sheep Manure. Sold by Natural Guano Co., Aurora, Ill. Stock of Cadwell & Jones, Hartford.

15041. Groz-It Brand Sheep Manure. Sold by Pacific Manure and Fertilizer Co., San Francisco, Calif. Stock of F. M. Cole, Putnam.

14523. Wizard Brand Sheep Manure. Sold by Pulverized Manure Co., Chicago, Ill. Stock of S. P. Strople, New Britain.

14579. Sheep Manure. Sold by S. D. Woodruff & Sons, Orange. Stock of Rackliffe Bros Co., New Britain.

TABLE X. ANALYSES OF SHEEP MANURE.

Station No.	14519	14521	15159	15108	14613	14770	15041	14523	14579
Per cent. of									
Nitrogen as nitrates	None	0.14	0.12	.....	0.14	None	0.17	None	0.11
" " ammonia	0.45	0.09	0.18	0.50	0.09	0.40	0.05	0.10	0.19
" organic	2.25	1.32	1.91	2.09	1.47	2.10	1.28	1.65	1.31
" total found	2.70	1.55	2.21	2.59	1.70	2.50	1.50	1.75	1.61
" " guaranteed	2.06	1.50	1.70	1.84	1.85	2.25	1.84	1.80	1.50
Phosphoric acid, water-soluble	0.98	0.26	0.13	0.94	0.06	0.95	0.11	0.34	0.24
Phosphoric acid, citrate-soluble	0.55	0.45	1.70	0.77	0.67	0.84	0.73	0.77	0.57
Phosphoric acid, citrate-insoluble	0.12	0.17	0.10	0.09	0.19	0.13	0.03	0.14	0.14
Phosphoric acid, total found	1.65	0.88	1.93	1.80	0.92	1.92	0.87	1.25	0.95
Phosphoric acid, total guaranteed	1.25	1.00	1.00	1.25	1.43	1.25	1.25	1.00	1.00
Water-soluble potash found	2.37	3.36	2.14	2.43	3.57	2.60	3.39	2.17	3.20
Water-soluble potash guaranteed	1.00	2.00	1.00	3.00	1.25	1.50	3.00	1.00	2.50
Chlorine	0.89	1.58	.....	0.84	2.30	0.53	1.73	0.44	1.86
Cost per ton	$33.00	35.00	40.00	65.00	50.00	48.00	48.00	57.00	55.00

14613. Magic Brand, and **15041** Groz-It Brand, fail to meet their guaranties of nitrogen and phosphoric acid.

Sheep manure, being fine and dry, is well adapted to greenhouse work and for a dressing for lawns.

A comparison with New York horse manure is as follows:

Pounds of the ingredients named in one ton.

	Sheep Manure	Horse Manure
Organic matter	1426	540
Nitrogen	40	13
Phosphoric acid	27	9
Potash	56	12

Three and one-half tons of horse manure contain on the average as much plant food as does one ton of sheep manure.

The prices quoted by dealers range from $33 to $65 per ton, the higher prices probably are quoted for sales in small quantities.

It is doubtful if sheep manure will promote bacterial activity in the soil as effectively as fresh manures, but if the cost of fresh manure rises much further the dried manures may come into use on the farm where it is felt that manure must be used.

LIME AND LIME-KILN ASHES.

14235. Agricultural Lime. Sold by Grangers' Agricultural Lime Co., West Stockbridge, Mass. Sent by E. H. Ocain, Falls Village.

14629. Lime. Sent by Raymond Bros., South Norwalk.

14803. Ground Limestone. Sold by the Stearns Lime Co., Danbury. Sent by C. R. Treat, Orange.

15161. Lime-Kiln Ashes. Sent by A. B. Smith, Clintonville.

ANALYSES OF LIME AND LIME-KILN ASHES.

Station No.	14235	14629	14803	15161
Water-soluble potash	.....	.....	.....	2.17
Lime	39.74	37.50	38.56	41.34
Insol. in acid	13.58	.....	25.68	14.71

14803 was stated by Mr. Treat to have a guaranty of 45 per cent. calcium oxide and 75 per cent. to pass a 100-mesh screen. Only 60 per cent. of the sample passed such a screen.

The manufacturers state that the hard winter and the great demand for lime made it necessary to fill orders as best they could, and some lime of inferior quality like **14803** got shipped out which was quite inferior to the normal product.

In the last ten years ten analyses of lime from this firm show percentages of lime ranging from 43.44 to 47.36 and averaging 45.43 per cent. of lime, equivalent to 81.1 per cent. of calcium carbonate, with 3.23 per cent. of magnesia.

WOOD ASHES.

In a table, page 65, are given analyses of wood ashes.

15106 is from the furnace of the Cheshire Mill.

14646 was sent by R. S. Griswold, who stated that the ashes were bought of A. E. Dickenson & Co., of Essex, with a guaranty that they should be as good as those bought the year before.

This sample contained 32.18 per cent. of insoluble matter and only 1.31 per cent. of water-soluble potash.

Later the sampling agent of the Station drew a sample of these ashes at Mr. Griswold's request, the analysis of which appears as No. **15086.**

Ten car lots of ashes from John Joynt, Lucknow, Can., six of them sold to the American Sumatra Tobacco Co., Nos. **14844** to **14848** and **15093**, and four other car lots, Nos. **14252, 14467, 14985** and **15017,** were of excellent quality.

But three other samples from the same dealer were of very inferior composition, **14513, 14888** and **14984.**

15367 from Geo. Stevens, Peterborough, Can., is not *unleached* hard wood ashes.

At $5.50 per unit, potash in wood ashes costs 27 cents per pound, at $6.00 per unit, potash costs 30 cents per pound. This is about double the cost in potash salts mentioned on page 25. Ashes, however, contain 1.5 to 2.0 per cent. of phosphoric acid and about 30 per cent. of lime in form of carbonate, which add considerably to their value.

14987. Phos-Pho-Germ. Made by the American Nitro-Phospho Corporation, 80 Lafayette St., New York City.

It is claimed to be a mixture of humus, raw phosphate, lime, wood ashes, sulphur and various bacterial foods, and inoculated with many strains of vigorous, beneficial soil bacteria.

The sample drawn by a Station agent from stock of George Yuengling, New Canaan, had a guaranty of 0.82 per cent. nitrogen, 8.00 per cent phosphoric acid, of which 0.25 is available, and 0.15 per cent. of potash.

The analysis is as follows:

Per cent. of	
Nitrogen	0.50%
Available phosphoric acid	1.16
Total phosphoric acid	17.27
Potash	0.22
Cost per ton	$45.00

It fails to meet its guaranty of nitrogen. The plant food in a ton of it is, liberally estimated, worth about $15. Whether the "vigorous, beneficial soil bacteria" in a ton of it are worth $30, the difference between the value of the plant food and the ton price, may well be doubted.

A sample stated to be Cocoon Dust, **15214,** sent by the National Spun Silk Co. of New Bedford, Mass., contained 8.99 per cent. of nitrogen in fairly soluble and available condition, 1.41 per cent. of phosphoric acid and 0.25 per cent. of potash with 83.13 per cent. of organic matter; apparently an excellent nitrogenous fertilizer.

15210. Wool Waste from A. B. Smith, Clintonville. Contained 1.35 per cent. nitrogen, probably in inert form.

TABLE XI. ANALYSES OF WOOD ASHES.

Station No.	Car No. and Dealer or Purchaser.	Insoluble in acid (sand).	Water-soluble, potash.	Lime.	Phosphoric acid.	Cost per ton.
14808	Car C. G. R. No. 250022 Frank Bailey, Barre, Vt. Frank N. Brockett, Suffield	21.78	4.20	25.85	1.47	$25.00
15106	Conn. Brass & Mfg. Corp., Waterbury	7.96	4.72	43.76	2.70	.....
14646	E. E. Dickenson & Co. R. S. Griswold, Wethersfield,	32.18	1.31	16.37	1.54	.....
15086	E. E. Dickenson & Co. R. S. Griswold, Wethersfield	.....	1.84	16.82	1.71	.....
14844	Car No. 201591. John Joynt, Lucknow, Ont. American Sumatra Tobacco Co., Bloomfield..	20.50	6.05	30.24	2.02	(1)
14845	Car No. 19698. John Joynt, Lucknow, Ont. American Sumatra Tobacco Co., Bloomfield..	10.40	5.63	36.98	2.24	(1)
14846	Car No. 16567. John Joynt, Lucknow, Ont. American Sumatra Tobacco Co., Bloomfield..	12.90	7.18	34.80	2.26	(1)
14847	Car No. 6920. John Joynt, Lucknow, Ont. American Sumatra Tobacco Co., Bloomfield..	16.69	6.50	31.74	2.19	(1)
14848	Car No. 4067. John Joynt, Lucknow, Ont. American Sumatra Tobacco Co., Bloomfield..	15.12	6.63	32.00	2.41	(1)
14252	Car No. 11609. John Joynt, Lucknow, Ont. John Wolf, Windsor	10.04	4.79	31.67	1.00	(2)
14467	Car No. 80633. John Joynt, Lucknow, Ont. J. N. Lasbury, Broad Brook	12.65	4.96	28.03	1.59	.....
14513	John Joynt, Lucknow, Ont. A. D. Bridge Sons Co., Hazardville	25.41	1.42	18.55	0.58	22.00
14888	Car No. 243740. John Joynt, Lucknow, Ont. Geo. T. Soule, New Milford	27.58	0.52	21.21	1.66	26.00
14984	John Joynt, Lucknow, Ont. Geo. T. Soule, New Milford	21.34	0.85	28.70	1.33	26.00
14985	Car No. 84738. John Joynt, Lucknow, Ont. N. Jones, South Windsor	13.30	5.72	31.64	2.02	(1)
15017	Car No. 50110. John Joynt, Lucknow, Ont. N. Jones, South Windsor	23.35	4.63	26.18	2.26	(1)
15093	Car No. 10301. John Joynt, Lucknow, Ont. American Sumatra Tobacco Co., Hartford	13.34	6.56	34.27	2.06	.....
15367	Geo. Stevens, Peterborough, Can. F. W. Judson, Waterbury	16.22	0.88	.....	3.99	15.00
15381	From Chase Metal Works, Waterbury. Sent by A. F. Greene, Woodbury	9.08	5.49	.....	1.61	.....

[1] $5.50 per unit of water-soluble potash. [2] $6.00 per unit of water-soluble potash.

14753. Stated to be "a factory waste." Sent by F. A. Jordan, Woodstock. Contained 7.63 per cent. of nitrogen, .40 per cent. of which was in form of ammonia and all of which appeared to be in available form.

14939. Stated to be Chili Saltpeter. Guaranteed 15.50 per cent. nitrogen and 17.20 per cent. potash.

It contained 11.38 per cent. of nitrogen, 17.05 per cent. of potash, and 0.38 per cent. of borax. It is apparently a waste product from the refining of nitrate of soda.

14940. Stated to be a residue from a Welsbach burner factory and sent by Prof. Browning of Yale University. It contained:

Water-soluble phosphoric acid	0.50%
Citrate-soluble phosphoric acid	16.90
Citrate-insoluble phosphoric acid	10.78
Total phosphoric acid	28.18

14916. Stated to be a solution in which refuse rubber is heated under steam pressure.

It had a sp. gr. of 1.017, contained 2.86 per cent. of solid matter, 1.21 per cent. of potash and a little combined sulphur. Of no value as an insecticide or fungicide.

13575. Thought to be wood ashes, contained 33.63 per cent. of insoluble matter, 0.77 per cent. of phosphoric acid and 0.45 of potash.

14937. A sample of fresh menhaden fish. They contain an average of water 77.0 per cent., oil 4.00 per cent., nitrogen 1.5, phosphoric acid 1.5, and potash 0.3 per cent.

14399. A mixture of several brands of fertilizer. Sent by F. J. Harrison, Waterbury. Contained 0.88 per cent. nitrogen, 14.90 of phosphoric acid and 0.07 of potash.

Five other samples were examined qualitatively, but have no general interest of importance.

DIRECTIONS FOR PREPARING INSECTICIDES AND FUNGICIDES.

FORMULAS FOR INSECTICIDES.

LEAD ARSENATE.

3 lbs. (Paste) or 1½ lbs. (Dry) Lead Arsenate and 50 gals. Water.

Spray upon foliage to kill all chewing insects. May be used with Bordeaux or with lime-sulphur mixture.

PARIS GREEN.

1 lb. Paris Green. 3 lbs. Lime.
100 gals. Water.

Spray upon foliage to kill potato beetle, elm leaf beetle, and all chewing insects. Commonly used with Bordeaux mixture on potatoes, largely superseded by lead arsenate.

CALCIUM ARSENATE.

1½ lbs. Dry Calcium Arsenate. 1½ lbs. Dry Air-Slaked Lime.
50 gals. Water.

Applied as dust or spray on potatoes. May be used in Bordeaux mixture. Not safe on fruit trees.

POISONED BRAN MASH.

5 lbs. Wheat Bran. 4 oz. White Arsenic or Paris Green.
1 pint Cheap Molasses. 1 Lemon. 7 pints Water.

Mix to form a dry mash and scatter around in field to kill cut-worms, army worms and grasshoppers.

HELLEBORE.

Dust on the plants, or mix with water, 1 oz. in 2 gals. and spray. For currant-worm and other saw-fly larvae.

LIQUID LIME-SULPHUR.

Winter Spray.
1 part Lime and Sulphur. 9 parts Water.
Summer Spray.
1¼ to 1½ parts Lime and Sulphur. 45 to 50 parts Water.

Use winter spray for San José scale and peach leaf curl; summer spray for fungi, to which, as needed, add lead arsenate to kill chewing insects.

NICOTINE SOLUTION.

½-¾ pint in 50 gals. Water. Dissolve a 1 inch cube of Laundry Soa and add for a Spreader.

Several solutions are now sold containing 40% or more of nicotin Excellent for killing aphids and other sucking insects.

KEROSENE EMULSION.

2 gals. Kerosene. 1 lb. Common Soap. 1 gal. Water.

Dissolve the soap in hot water, add the kerosene, and churn togeth with pump until a white creamy mass is formed which thickens on coolin Dilute *nine* times before using for most aphids, but may be used strong or weaker.

MISCIBLE OILS.

Several miscible oils are on the market, such as "Scalecide" and "Jarvi Compound," for killing San José scale, especially on old apple tree mix 1 part in 15 parts water.

COMMON LAUNDRY SOAP.

Spray 1 lb. dissolved in 8 gals. water upon foliage to kill red spide aphids, and other sucking insects.

CARBON DISULPHIDE.

To kill insects infesting stored grain, in tight bins, use 1 lb. for abou 100 cubic feet of space. Expose for about 36 hours.

PARADICHLOROBENZENE.

A granular solid chemical which gives off fumes fatal to insect lif Has recently been used successfully to control the peach borer.

NAPHTHALENE.

Used in the form of moth-balls and "flakes" to keep clothes moth out of clothing. "Flakes" scattered around the borders of floors an shelves will drive away ants.

FORMALIN FLY POISON.

1 tablespoonful Commercial Formalin. ½ cup Sweet Milk.
½ cup Water.

Mix and expose in a shallow plate with a slice of bread in it. Flies wi drink the liquid, especially if no other moisture is accessible, and be killed

ANT POISON.

Arsenate Soda 125 grains. Sugar 1 pound. Honey 1 tablespoonful.
Water 1 quart.

Add arsenate soda and sugar to water. Boil until both are dissolved, then add honey. When cool, place in shallow dishes with a crust of bread or bits of sponge.

HYDROCYANIC ACID GAS.

1 oz. Sodium Cyanide. 2 oz. Sulphuric Acid. 4 oz. Water.
For each 100 cu. ft. space.

For fumigating dormant nursery stock or buildings, place the acid and water in an earthen jar in the house, drop in the cyanide and close the house at once for half an hour. Ventilate for ten minutes before entering. In greenhouse use 1 oz. of cyanide for each 1000 cu. ft. of space; avoid sunlight; excessive moisture; driving winds. Fumigate, between 52° and 70°F.

FORMULAS FOR COMMON FUNGICIDES.

LIQUID LIME-SULPHUR.

Winter Spray.
1 part Lime and Sulphur. 9 parts Water.
Summer Spray.
1¼ to 1½ parts Lime and Sulphur. 45 to 50 parts Water.

Use winter spray for San José scale and peach leaf curl; summer spray for fungi, to which, as needed, add lead arsenate to kill chewing insects.

DRY LIME-SULPHUR.

There are now on the market several forms of lime-sulphur or similar fungicides, such as B. T. S., that because of convenience in shipping and handling are replacing somewhat the more bulky liquid fungicides. Where experience has shown that spray injury does not result from their use, they may well be substituted for the latter. Use according to directions given by the manufacturers.

SELF-BOILED LIME-SULPHUR.

8 lbs. Fresh Whitewash Lime.
8 lbs. Fine Sulphur. 45 to 50 gals. Water.

Start the lime slaking, sift and thoroughly stir in the sulphur, using just enough water to prevent burning and allow to boil from heat of lime for fifteen minutes. Then dilute and apply.

A very excellent substitute for this fungicide is the commercial article called "Atomic Sulphur," especially on peaches where it should be used without lead arsenate at the rate of 8 lbs. to 50 gallons water.

SULPHUR DUST.

Dusting with special grades of very fine sulphur, about 90 parts thoroughly mixed with 10 parts lead arsenate for apples and 80 parts sulphur and 20 parts air-slaked lime for peaches, or with special material prepared by manufacturers, has attained some prominence as a combined fungicidal and insecticidal treatment for fruit trees. Experience so far in this state seems to show that such treatment is much more effective in controlling insects than fungous troubles of the apple. Good results in controlling peach scab and fair results for brown rot are claimed by some authorities. Dusting is much quicker and so cheaper as regards labor, but the cost of material used is considerably greater.

BORDEAUX MIXTURE.

4 lbs. Copper Sulphate.
4 lbs. Fresh Lime. 40 to 50 gals. Water.

Dissolve the copper sulphate in hot water or from a coarse bag suspended in cold water; slake the lime separately and strain. Dilute the latter to about 20 gals., into which pour the copper sulphate, diluted to about 20 gals., stirring the mixture; dilute further to form the forty-five or fifty gallons; or dilute each to 25 gals., and pour together into barrel.

Stock solutions of the copper sulphate and lime, rate 1 lb. to 1 gal. water, can be made separately and used as needed. In this case four gallons of the stock lime is strained into the spray barrel while half filling it with water and then the four gallons of copper sulphate solution are gradually poured in as the barrel is filled to 50 gallons.

FORMALIN.

A. 1 pt. (1 lb.) formalin in 50 gals. water, for sprinkling grain to kill smut. See Smut under Oats.

B. 1 pt. undiluted formalin is *sprayed* directly on 50 bushels of grain as it is shoveled over and then heaped in a pile and covered for four hours.

C. 1 pt. formalin in 30 gals. water; soak uncut tubers 1 hour to prevent potato scab.

D. 1 pt. formalin in 12½ gals. water, for soil treatment. Use two-thirds to 1 gal. for each square foot of surface treated; cover for 24 hours after treatment; air afterwards and stir soil: allow 7-10 days before seeding and 10-14 days before transplanting in this soil.

CORROSIVE SUBLIMATE.

4 oz. Corrosive Sublimate. 30 gallons Water.

Dissolve the corrosive sublimate at first in a small amount of hot water and then dilute. Soak uncut seed potatoes in this for ½ to 1 hour. After each treatment renew strength by adding 1 oz. of corrosive sublimate and water as needed to retain the 30 gallons. Use in wooden containers and mark *Poison*. Good for both scab and black scurf.

FORMULAS FOR LESS-USED FUNGICIDES.

OTHER BORDEAUX MIXTURES.

Dilute Bordeaux Mixture. Use 1 lb. copper sulphate, 4 of lime, and make as above directed. For second and third sprayings of apples to lessen russeting of the fruit.

Soda Bordeaux Mixture. 4 lbs. copper sulphate, 1⅛ to 1½ lbs. soda lye, 50 gals. water. Use only enough lye to make the solution alkaline to test paper. Used sometimes for late spraying of grapes, etc., where spray sediment is objectionable. Care needed in making to avoid spray injury.

Resin Bordeaux Mixture. Melt 5 lbs. resin with 1 pt. fish oil, cool slightly, add 1 lb. soda lye, sitrring. Add 5 gals. water and boil till the mixture will dissolve in cold water. Mix 2 gals. with 48 of Bordeaux mixture. Used sometimes on such glaucous plants as asparagus, cabbage, onions, etc., to make a more adhesive spray.

POTASSIUM SULPHIDE.

3 ozs. Potassium Sulphide. 10 gals. Water.

Used chiefly in greenhouses, or for powdery mildews.

AMM. SOL. COP. CARBONATE.

5 ozs. Copper Carbonate. 3 pts. Ammonia. 45-50 gals. Water.

Use *just enough* ammonia (if strong, dilute with several volumes of water) to dissolve the copper carbonate; then dilute to final volume. This fungicide is not as good as Bordeaux, but is used to avoid sediment on the foliage or fruit.

COPPER SULPHATE.

2 to 3 lbs. Copper Sulphate. 45-50 gals. Water.

Used chiefly as a winter spray. 1 lb. to 250 gals. water is sometimes though rarely used on foilage.

COPPER LIME-SULPHUR.

2 lbs. Copper Sulphate. 1½ gals. liquid Lime-Sulphur. 45-50 gals. Water.

Dissolve copper sulphate in part of the water, and then add with the lime-sulphur to the remainder. Apparently a good fungicide but likely to russet apples as does strong Bordeaux.

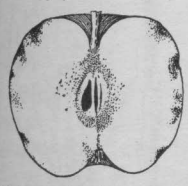
FORMALIN FUMES.

3 pts. Formalin. 23 ozs. Potassium Permanganate.
For each 1000 cu. ft. Space.

Place bulbs or tubers in 6 to 12 in. crates so fumes can get at them. To prevent injury to potatoes, fill space at rate of 167 bu. Place formalin in large pail in cleared central space and drop in the crystals of potassium permanganate. Close room air-tight for 24 to 48 hours.

as the bark, the latter light gray or whitish. Spray with nicotine solution; soap and water; or kerosene emulsion, about the second week in June. Bull. 143; Rept. 1903, p. 225.

Fungi, etc.



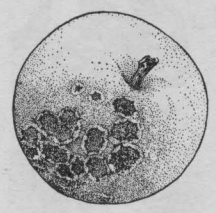
Baldwin Spot—Shows as small diseased masses of brownish tissue, usually a short distance beneath the skin; finally may appear at the surface as small, discolored, shrunken areas, then very similar in appearance to some of the fruit speck troubles. Not a fungous, but apparently a physiological disease. Thought by some to be due to unusual local loss of water; similar troubles may start from punctures of rosy aphis or other puncturing insects. No remedy known, except possibly irrigation in the west.

Cankers—Occur on branches and are caused chiefly by European canker fungus which eventually forms a cavity surrounded by concentric elevated rings of wood extending to bark, which each year is killed a little further, adding another ridge. Cut off infected branches, or cut out infected wood and bark; paint over cut surfaces. Keep orchard well sprayed and trimmed. Rept. 1903, p. 299.

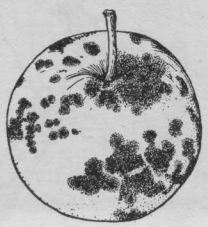
Black Rot—Causes mature fruit to rot, eventually turning it black; forms small brown spots on leaves; does some damage through cankers on branches, which are eventually killed. Treat as for scab; prune and burn all dead limbs and twigs; cut out and paint over large cankers when found. Rept. 1909–10, p. 590.

Fruit Specks—Form more or less numerous, small, brown or black spots, starting at surface of fruit and slowly working inward; the Brooks fruit spot often has a pinkish or purplish border in light-skinned varieties. Usually controlled by spraying as for scab. Late spraying is important. Rept. 1909–10, p. 590.

Rust—Shows as orange-colored blotches on leaves, eventually producing minute fringed clustered-cups imbedded on the under side; less frequent on fruit. Rust spreads to the apple from the *cedar-apples*, which appear in the early spring on the red cedar. All cedars near the orchard should be destroyed. There is great difference in the susceptibility of different varieties to this disease. Spraying is only partially successful in this state, as the leaves must be well coated continuously with spray from the time they begin to unfold, until the end of July. Repts. 1891, p. 161; 1909–10, p. 591.



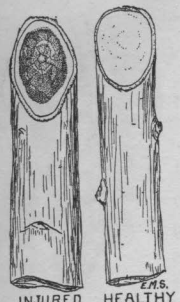
Scab—Produces "scabby spots" on fruit and leaves; rarely on twigs. Spray the unfolding leaves before the blossoms open, again after the petals fall, and follow with a third spraying about four weeks later. For first treatment, use strong Bordeaux, for second and third, weak Bordeaux or lime-sulphur or the latter for all three treatments. Very susceptible varieties sometimes need four treatments, the last two at intervals of about two weeks. Rept. 1909–10, p. 591.



Sooty Blotch—Forms on fruit an olive-black superficial growth in distinct round colonies, or often merging together. Spray with Bordeaux as for scab, or with lime-sulphur 1½ to 50. The sprayings after blossoming are the more important. Rept. 1909–10, p. 592; 1911, p. 367.

Blight—See *Pear*.

Spray Injury—Takes the form usually of burn on leaves and russeting on fruit. Is most likely to occur after second and later sprayings. Worst in wet seasons. Spraying in bright sunshine may cause some scorch of fruit on sunny side. Varies greatly with different sprays. Avoid those known to be injurious or injurious combinations (as soap and lead arsenate); use Bordeaux only for *first* summer treatment or on varieties not especially subject to russeting. Rept. 1911, p. 360.



Winter Injury—Takes various forms from different conditions, such as imperfect fertilization or russeting of fruit following late spring frosts; sun scorch of trunks due to mild winter weather followed by sudden cold; bud and twig killing, frost cracks in trunks, blackened woods, dead roots, etc., following unusually cold winters or unfavorable environment. Set out only hardy varieties; avoid planting in wet ground or on hillsides with extreme south or southwest slopes. Head trees low; avoid late fertilization and cultivation; keep earth tight around trunks; use cover crops. Rept. 1903, p. 303; 1906, p. 310; 1914, p. 6.

Storage Rots—Are troubles caused by a variety of fungi. Store fruit, in a dry condition, in a cool, well-aired place. Do not store in too deep piles or too tight receptacles. Use poorer keeping varieties first, and sort over if necessary. Apples from well sprayed trees keep best. Rept. 1915, p. 426.

General Treatment for Apple Orchards.

For the general control of fungi and insects on apples in Connecticut we make the following recommendations:

(1) Winter treatment (spraying dormant trees) is necessary only in the case of the presence of the San José scale, or leaf-blister mite, when commercial lime-sulphur, 1–9, or miscible oils, 1–15, may be used.

(2) As a rule, three summer treatments with a fungicide are necessary to control fungous diseases, and the last two of these should contain an insecticide. These sprayings should be made as follows: 1st, just before the blossoms open, on the young unfolding leaves (April 27th to May 10th, according to the season and variety); 2nd, as soon as all the blossoms have fallen (May 10th to 30th); 3d, about one month later (usually June 10th to 25th).

(3) Where fungi are not prevalent, especially scab, the first summer treatment may be omitted. Occasionally, perhaps in alternative years, where fungi are quite inconspicuous, the fungicide may be entirely omitted, and only the two sprayings with lead arsenate for insects given. With certain fungi and insects a fourth summer spraying is desirable.

(4) For fungicides, we recommend Bordeaux mixture of the 4–4–50 strength for the first spraying, and of the 1–4–50 strength or lime-sulphur for the later sprayings; or lime-sulphur, used at a strength of 1¼ to 1½ gallons per fifty gallons of water, for all three sprayings. The former has better fungicidal value, and the latter is less likely to produce spray injury, especially russeting of the fruit. Where fungi are prevalent, the former might be used, while with varieties russeting badly, as Baldwin, the latter is likely to prove more satisfactory in the second and third summer treatments.

(5) For the insecticide in the above, use lead arsenate, if in the paste form at the rate of three pounds per fifty gallons of the mixture, or if in the powder form one and one-half pounds per fifty gallons.

(6) If canker worms, tent-caterpillar, bud-moth, or brown-tail moth are causing damage, add lead arsenate to the first

Buy healthy stock only; keep infected plants by themselves and give them plenty of room; keep leaves as dry as possible and pick off and burn worst infected. Rept. 1915, p. 455.

BIRCH

Insects.

Tussock Moths—See Apple, Hickory, and Horse Chestnut.

Birch Leaf-Skeletonizer or **Birch Bucculatrix**—Small greenish-yellow larvae feed upon both sides of the leaves in late summer, often entirely defoliating the trees. Spray with lead arsenate in July. Rept. 1910, p. 701.

Bronze Birch Borer—Grub makes spiral tunnel just beneath bark of upper main branches, ridges showing on outside. Cut and burn infested trees before May 1st.

BLACKBERRY.

Insects.

Blackberry Crown Borer—Larva tunnels in roots and at base of stem. Dig out and destroy.

Red-Necked Cane Borer—Larva tunnels in canes causing an irregular swelling or gall, often three inches in length. Cut and burn all infested canes in winter or early spring.

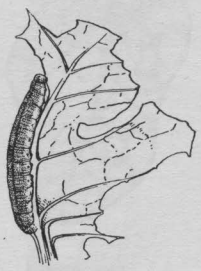
Blackberry Sawfly—Larvae devour leaves in June and first part of July. Spray with lead arsenate when young larvae appear. Rept. 1912, p. 236.

Fungi, etc.

Crown Gall—Forms hard galls or irregular excrescences on roots and lower parts of stems of blackberries, raspberries and several other hosts. Dig out and burn affected plants as soon as discovered. Never use infected stock for transplanting. A bacterial trouble. Rept. 1903, p. 354.

Leaf Spot—Forms on leaves small circular spots with whitish center and purplish border; also occurs on dewberry and raspberry. Not usually serious but where necessary it probably can be controlled by Bordeaux applied to the leaves, beginning before they have reached their full size. Rept. 1903, p. 309.

Orange Rust—Breaks out in spring or early summer as dusty masses of bright orange spores over the under side of the leaves. The fungus is perennial in the underground parts of the host, so that the disease appears year after year. Dig up and burn infected plants. Rept. 1903, p. 309.

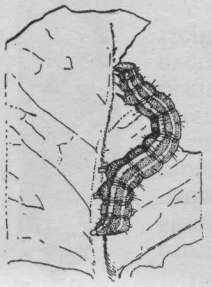


BOX.

Insects.

Leaf-Miner—A small two-winged fly lays eggs in the leaf and the larvae tunnel between the upper and lower surfaces. Destroy infested leaves.

Oyster-Shell Scale—See Apple.

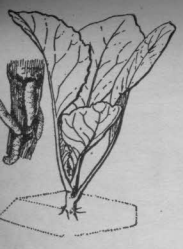


CABBAGE-CAULIFLOWER.

Insects.

Cabbage Worm—Green worms feed upon leaves all through season. Spray unheaded plants with lead arsenate. Use insect powder or hellebore on headed plants. Bull. 190, p. 9; Rept. 1903, p. 271.

Cabbage Looper—Smooth looping caterpillars feed with cabbage worms late in



summer, and require same treatment. Bull. *190, p. 12; Rept. 1910, p. 706.*

Cabbage Maggot—Infests stems of early-set plants near surface of ground checking growth and often killing them. Practice crop rotation. Place hexagonal tarred paper disks around stems at setting time. Treat with carbolic acid emulsion. Bull. 190, p. 3; Repts. 1908, p. 832; 1914, p. 142; 1915, p. 114.

Cabbage Aphis — Sucks sap from the leaves. Spray with nicotine solution and soap or with kerosene emulsion. Bull. 190, p. 14.

Fungi, etc.

Black (Bacterial) Rot—Forms black lines in veins of leaves. In time leaves turn yellow and easily drop off, and interior of head develops a general soft rot. As the germs can be carried on the seed, avoid seed from infected fields. If in doubt, treat seed in formalin, 1 part to 240 of water for 15 minutes. Keep refuse from diseased plants out of manure; practice rotation; make seed bed in new soil if disease appears in old one. Rept. 1912, p. 345.

Club Root—Causes knob-like enlargements on the roots of cabbage and allied plants. The germ often becomes established in the soil; when possible avoid such land and the use of refuse from old plants on the soil. Be especially careful that the seed bed is not infected. Infected land, if used, should be treated in the fall with lime broadcast at the rate of 80 bushels per acre and worked in. Rept. 1903, p. 310.

Soft Rot—See Salsify. Report 1903, p. 311.

CARNATION.

Insects.

Green Fly or **Aphis**—Sucks sap from young leaves and buds. Fumigate greenhouse with tobacco, or spray with nicotine solution and soap, or with soap and water.

Fungi.

Leaf Mold and **Leaf Spot**—Are two troubles much alike in appearance, producing grayish spots with colored borders on stem, leaves and calyx. Treat as for Rust.

Rust—Produces small dusty pustules, more or less confluent, on the leaves and stems. Select, if feasible, only rust-resisting varieties. Spray in field with Bordeaux, adding 1½ lbs. soap to each 50 gallons (helps mixture to adhere to plants). Select for transplanting only hardy and rust-free specimens. Keep air of greenhouse as dry as is consistent with good growth. One or two sprayings with Soap- or Resin-Bordeaux, after transplanting in greenhouse, may be given if desired; for repeated sprayings use potassium sulphide or weak copper sulphate. Rept. 1903, p. 312.

Stem Rot and **Wilt**—Cause the lower leaves first to turn yellow and dry up; then as the stem gradually rots off at its base, the whole plant becomes affected and finally dies. Select cuttings only from perfectly healthy plants, and if necessary start these in sterilized soil and replant out of doors in new land, avoiding excessive use of manure. If disease appears after setting out in the greenhouse, pull up infected plants upon appearance of first symptoms, make liberal application of lime, avoid over-watering, and see that roots are properly aerated. Repts. 1897, p. 175; 1903, p. 312.

CEDAR.

Insects.

Web-Worm—Small brown caterpillars feed upon the leaves which they web together. Spray with lead arsenate.

Fungi.

Cedar-Apple Rust—Appears in spring as conspicuous rounded galls with jelly-like horns bearing spores that carry the fungus to apple and related hosts. Cut off and burn all *cedar-apples* if undesirable to destroy the trees. See Apple Rust.

CELERY.

Insects.

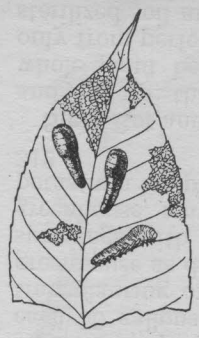
Celery Caterpillar—Feeds upon the leaves of celery, parsley, fennel, carrot and parsnip. On the latter two plants lead arsenate may be used. On celery and parsley hand picking is perhaps the best remedy.

Fungi.

Leaf Blight and **Leaf Spot** — Are two diseases showing "rusty" spots on leaves and petioles; the latter trouble distinguished by the very minute black dots in the discolored spots (fig.), often progressing in stalks after storage. Spray the plants thoroughly in the seed bed with Bordeaux, as infected plants are often the means of introducing the trouble in the field. If necessary, continue the spraying after transplanting at intervals of about two weeks up to the middle of September. Before covering for bleaching, if leaf spot is abundant, dust with sulphur, and before final storage remove infected leaves and dust again. Rept. 1897, p. 167.

Soft (Heart) Rot—Shows as a soft rot of the tissues often confined to the heart. Do not plant in too wet soil, avoid land with green cover crops recently plowed in; in banking allow for proper aeration. See Salsify. Rept. 1914, p. 10.

CHERRY.



Insects.

Cherry or **Pear Slug**—Larvae eat away the green tissue from upper side of leaf. Spray or dust with lead arsenate and sulphur.

Canker Worms—See Apple.

Cherry Maggots or **Fruit Flies**—Larvae of two species infest maturing fruit. Sprinkle foliage with sweetened lead arsenate in early June to kill the adult flies.

Plum Curculio—See Plum..

Cherry Aphid—A brown aphid which sucks sap from under side of leaves causing them to curl. Spray with nicotine solution and soap, soap and water, or kerosene emulsion.

Fungi.

Black Knot—Forms knot-like excrescences, usually several inches long, on twigs and branches. When planting, use only trees free from this trouble; in the orchard, cut off and burn all infected branches in late fall or winter, painting over large cut surfaces. Cutting *out* knots is rarely advisable, as new outbreaks usually result. In cutting off, cut several inches below the knot, to insure removal of the mycelial threads in the tissues. Remove all knots each year until they fail to reappear. Spraying in spring and early summer with self-boiled lime-sulphur or atomic sulphur helps to keep

new knots from fruiting, but is entirely secondary in importance to the removal of the knots. Rept. 1911, p. 399.

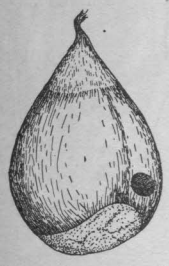
Brown Rot—See Plum. Rept. 1911, p. 402.

Leaf Spot—Shows as numerous, closely placed, purplish spots on leaves, which often have "shotholes." Spraying, if begun on young leaves early in May, is effective but use the dilute Bordeaux, or better still, self-boiled lime-sulphur or atomic sulphur to avoid injury to the foliage. Give several sprayings at intervals of two weeks. This helps to keep down the brown rot also. Repts. 1895, p. 188; 1911, p. 401. Also known as anthracnose.

Powdery Mildew—Develops a cobweb-like growth over the leaves; in fall forms numerous, minute, black fruiting-bodies, especially on under surfaces. Usually worst in young trees; controlled by spraying if necessary.

CHESTNUT-CHINQUAPIN.

Insects.



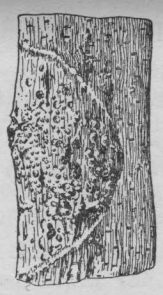
Canker Worms—See Apple.

Nut Weevils—Long-nosed snout beetles lay eggs in developing fruit and the grubs infest the nuts. Destroy all infested nuts. Fumigate nuts with carbon disulphide as for beans.

Two-lined Chestnut Borer—Long, slender, flat-headed larvae make sinuous tunnels under bark of weakened chestnut and oak trees. Badly infested trees should be removed and burned, or the bark removed before the insects mature and spread to other trees.

Fungi.

Bark Disease (Blight)—Forms cankers in the bark that eventually girdle infected limb and cause death of parts above. Spreads over tree so that usually it dies within two to five years.



Rarely shade trees can be saved by carefully cutting out and painting over the cankers. For forest trees it is best to let the disease take its course, and remove at least the larger trees within a year or two after their death to prevent deterioration of the wood. Most of the chestnuts in the state have been already killed. Rept. 1912, p. 359; Bull. 178.

CHRYSANTHEMUM.

Insects.

Black Fly or **Aphis**—Sucks the juice from the young leaves and flower stems. Fumigate the house with tobacco; dip the plants in or spray them with soap and water or nicotine solution and soap.

Gall Midge—Larvae form cone-shaped galls on leaves and new shoots. Spray plants about three times each week with nicotine solution and soap. Rept. 1919, p. 161.

Fungi.

Powdery Mildew—Develops a white mealy or cobweb coating on leaves. Use good judgment in airing and watering, and if necessary, spray from time to time with potassium sulphide or paint heating pipes with sulphur.

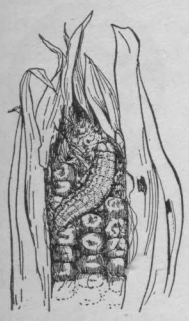
Rust—Appears as dusty reddish-brown outbreaks, about the size of a pin head, chiefly on under sides of leaves. Avoid worst rusting varieties. Start with cuttings free from rust. Destroy rusted leaves, especially on cuttings. Early sprayings with dilute copper sulphate, potassium sulphide, etc., may help to prevent the trouble from getting a start. Rept. 1903, p. 315.

CINERARIA.

Insects.

Aphis or **Green Fly**—Sucks sap from the leaves and stems. Use nicotine solution and soap, or soap and water, as a spray or dip.

CORN.



Insects.

Cut Worms—See Tomato.

Army Worm—See Grass.

Stalk Borer—See Dahlia.

White Grubs—See Grass.

Corn Ear Worm—Eats the immature kernels at the end of the ear. Dust the silk with equal parts sulphur and powdered lead arsenate. Rept. 1919, p. 188.

European Corn Borer—Imported into eastern Massachusetts, New York and Canada. Larvae tunnel in all parts of plant above ground. Destroy all infested plants. Rept. 1918, p. 316.

Fungi.

Leaf Blight—Kills parts of the leaves in August and September much like an early frost. Most injurious in wet late seasons. Plant early maturing varieties and stimulate growth by good fertilization and cultivation. Rept. 1903, p. 317.

Root and **Ear Rots**—Injures roots and base of stalk with a reddish-brown rot. Stalks are easily broken off and often fail to produce good ears, the worst infected showing a moldy, white or pinkish growth. Plant only vigorous, disease-free seed, practice yearly rotation and do not let corn follow other grains. Bull. 222, p. 427.

Smut—Forms black dusty outbreaks that appear on various parts of the plant. It is especially injurious to certain varieties of sweet corn. Avoid the use of fresh manure on the land. Seed treatment is ineffective. The removal and destruction of spore masses is recommended by some writers.

CRANBERRY.

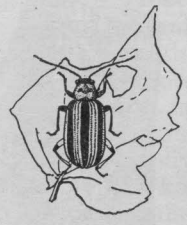
Insects.

Fireworm or **Black-headed Cranberry Worm**—Small, pale green, black-headed caterpillars web the leaves and new shoots together and feed inside the nest. Spray with lead arsenate to kill the caterpillars. Flood the bog for three days to kill the pupae.

Yellow-headed Cranberry Worm—Small, green yellow-headed caterpillars injure plants in same manner as the preceding. Spray with lead arsenate. Keep bogs flooded until about May 20.

Cranberry Fruit Worm—Pale green larvae infest the berries. Flood the bog for about two weeks as soon as the fruit has been harvested. Destroy all infested berries.

CUCUMBERS.



Insects.

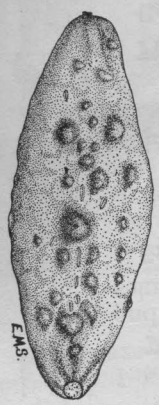
Striped Cucumber Beetle—Attacks young plants, eating the leaves. Larvae infest the main root or stem under ground, often killing the plant. Dust leaves with dry lead arsenate. Cover plants with screens. Bull. 216, p. 34; Rept. 1908, p. 807.

Melon Aphid—See Melon.

Fungi, etc.

Anthracnose—*Produces prominent discolored spots, more or less merged, on leaves; occurs occasionally on fruit.* Treatment is the same as for mildew. See Watermelon.

Downy Mildew—Forms discolored spots as in preceding, but beneath shows a minute thin growth of upright threads bearing dark colored spores. Repeated sprayings with Bordeaux about every 10 to 14 days during the season, beginning at least by middle of July, usually keeps this disease in check. The same fungus occurs on Melons. Rept. 1904, p. 329.



Mosaic and **White Pickle**—Are two very similar, if not identical, physiological diseases, showing in the former on the leaves as mottling of lighter or yellow-green areas scattered among the normally green tissues, and in the latter causing the fruit to become irregularly shaped, knobbed, and often mottled or whitish in color. Keep down sucking insects that may spread the disease, as it is infectious; pull up and destroy vines first showing it. Rept. 1915, p. 430.

Wilt—See Squash.

CURRANT.

Insects.

Currant Fruit Fly—Small maggots infest the berries, which color prematurely and drop. Destroy infested fruit.

Currant Worm—Devours foliage in May. Spray with hellebore or lead arsenate. Rept. 1902, p. 170.

Currant Borers—The larvae of two species of insects tunnel in the pith of the stems, causing the leaves to droop and wilt. Destroy infested canes during May.

Currant Stem Girdler—Adults cut or girdle tip of new shoots after laying eggs in them. Cut and burn these tips at any time of year. Rept. 1896, p. 238.

Currant Aphids—Yellowish-green aphids on under side of leaves causing them to curl. Underspray with nicotine solution or kerosene emulsion.

Four-Lined Leaf-Bug—A yellow and black striped bug sucking sap from the leaves. Spray with nicotine solution and soap. Bull. 208, p. 118.

San José Scale—See Peach.

Scurfy Scale—A conspicuous pear-shaped light-gray scale on bark, the insect sucking sap from twigs. Spray about second week in June with kerosene emulsion or nicotine solution and soap. Bull. 143; Rept. 1903, p. 227.

Fungi.

Anthracnose and **Leaf Spots**—Cause spots on the leaves and usually their premature shedding; the former also spots the fruit of certain varieties. Spray with Bordeaux as the leaves unfold, and repeat at intervals of 10 to 14 days until fruit begins to turn. If necessary continue spraying after harvest. Rake up and burn leaves in fall.

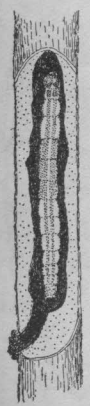
Blister Rust—Shows first as dusty orange-colored outbreaks about size of pinhead on lower surface of leaves, and later as short hair-like growths. Worst on black currants. Alternate host is white pine. Report presence to the Experiment Station. Rept. 1911-12, p. 347. See Pine.

CYCLAMEN.

Insects.

Leaf-Mite—Transparent microscopic mites cause leaves to curl, and plants do not blossom. Syringe under leaf surface strongly with water. Spray with, or dip plants in nicotine solution and soap, 1 part in 400 parts of water. Avoid excessive moisture in house. Rept. 1914, p. 176.

DAHLIA.



Insects.

Tarnished Plant Bug—Sucks the sap from the stems and buds causing them to fall. Spray with nicotine solution and soap. Rept. 1904, p. 218.

Stalk Borer—Larva tunnels up and down inside the main stem, the top portion usually wilting and dying. Carefully make longitudinal slit in the stem and kill the borer. Bull. 208, p. 111; Rept. 1919, p. 180.

EGG-PLANT.

Insects.

Flea Beetle—See Potato.

Colorado Potato Beetle—See Potato.

Fungi.

Fruit Rots—Caused by several fungi, the gray mold producing the most extensive rot. Spray with Bordeaux; pick off and carry away the rotting fruit.

ELM.

Insects.

Spiny Elm Caterpillar—Clusters of black spiny caterpillars often strip certain branches of elm, willow, and poplar. Remove and destroy entire cluster, or spray with lead arsenate. Rept. 1906, p. 260.

Elm Leaf Beetle—Adult beetles eat holes through the leaves in May, and in June and July the larvae or grubs eat away the green tissues from the under surface. Spray with lead arsenate early in May to kill egg-laying beetles, or spray under surface of leaves with same mixture about June 1st, to kill the larvae. Yellow pupae at base of trees may be killed with kerosene emulsion or soap and water. Bull. 155; Rept. 1908, p. 815.

Canker Worms—See Apple.

White-Marked Tussock Moth—See Horse Chestnut.

Leopard Moth—Larvae tunnel in branches under the bark, cutting deep galleries, often girdling the branch, which later breaks off and falls to the ground. Small trees may be examined and borers killed by injecting carbon disulphide, or by inserting a wire. Bull. 169; Rept. 1911, p. 317.

Elm Scale—A large brown soft scale, oval in shape with cottony marginal fringe, located especially in the cracks of the bark of trunk and lower branches, sucking the sap. Spray with kerosene emulsion. Bull. 151; Rept. 1905, p. 235.

White Elm Scale—A whitish pear-shaped scale on twigs. Spray about June 10th with kerosene emulsion.

Elm Woolly Aphids—Several species curl the leaves, or form in cottony masses on the bark. Spray with kerosene emulsion.

Fungi.

Leaf Spot—Shows as black slightly elevated specks more or less thickly imbedded in the leaves and causing their premature fall. Not usually so injurious as to merit the expense of spraying with Bordeaux, which should start on the immature leaves. Rept. 1909-10, p. 717.

EUONYMUS.

Insects.

Euonymus Scale—The various species of Euonymus are attacked and often injured by this scale, which has narrow white (male) or pear-shaped gray or brown (female) shells. Cut and burn infested twigs. Cover and fumigate with hydrocyanic acid gas. Spray with nicotine solution or kerosene emulsion during June to kill young. Bull. 151; Rept. 1905, p. 240.

FERN.

Insects, etc.

Woolly Bears—Several kinds of light brown hairy caterpillars devour the fronds in late summer. Spray with lead arsenate.

Hemispherical Scale—Brown, oval convex scales on fronds of plants under glass. Apply soap and water or nicotine solution as a dip or spray. Bull. 151, p. 9; Rept. 1905, p. 239.

Leaf-Blight Eelworm—See Begonia.

GERANIUM.

Insects.

Greenhouse Leaf-Tyer—Small green wriggling caterpillars feed upon the leaves of plants under glass. Spray with lead arsenate.

White Fly—See Tomato.

Leaf Mite—See Cyclamen.

Fungi.

Gray Mold Rot—Produces dead spots on leaves and blasts blossoms. Worst in poorly lighted and leaky greenhouses. Keep drippage off plants; avoid watering in cloudy or muggy weather; ventilate. Attacks as a semi-parasite a variety of greenhouse plants. Rept. 1903, p. 322.

GOOSEBERRY.

Insects.

Currant Worm—Devours foliage. Apply hellebore or lead arsenate early in season. Rept. 1902, p. 170.

Gooseberry Fruit-Worm—Feeds inside the berry. Destroy infested berries.

Currant Fruit Fly—See Currant.

Fungi.

Mildew—Forms a felt-like growth on fruit and leaves of young shoots. Worst on European varieties, also attacks currant, especially young shoots. Spray with potassium sulphide or other sulphur spray as soon as buds break, and repeat about every ten days until the end of June.

Blister Rust—Not common as yet on cultivated varieties. See Currant.

GRAPE.

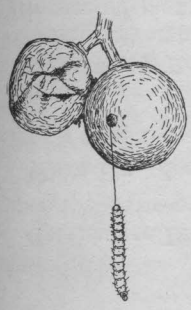
Insects.

Grape Vine Flea Beetle—Adults and larvae devour the leaves. Spray with lead arsenate the latter part of June.

Rose Chafer—Long-legged brown beetles appear about June 15th and feed upon leaves, flowers and newly set fruit, often doing great damage. Cover choice plants with netting. Spray heavily with lead arsenate just before blossoms open and if necessary again after fruit has set. Rept. 1916, p. 111.

Grape Plume Moth—Small green spiny caterpillars web together the newly formed leaves at the tips of new shoots. Damage more apparent than

real. Crushing by pinching these leaves is the best remedy. Rept. 1914, p. 190.



Grape Berry Moth—Larva feeds and develops inside the berries and is the cause of most wormy grapes. Spray with lead arsenate soon after fruit sets, and repeat twice at intervals of about ten days. Bag the clusters soon after the fruit sets.

Grape Root Worm—Adult beetles eat chain-like holes in leaves in July, and larvae or grubs devour the small feeding roots and eat channels in the bark of the larger roots and main stem underground, often causing great injury. Spray leaves with lead arsenate.

Sphinx and **Other Caterpillars**—Several species of horn worms as well as other kinds of caterpillars feed upon the leaves. Spray with lead arsenate or practice hand picking.

Grape Leaf-Hopper—Small, yellow and red-marked leaf-hoppers sucking sap from under side of leaves. Spray under surface with nicotine solution and soap.

Grape Phylloxera—Sucks sap from roots and leaves, forming galls, and causing serious injury to European varieties. Graft on native species.

Fungi.

Black Rot—Causes reddish-brown spots on leaves; more rarely on stems; especially bad in rotting the berries, which finally become hard, shrunken and wrinkled, black mummies. This is one of the worst diseases of the grape and often difficult to control by spraying, which must be thorough, especially the first season. Begin spraying before blossoming time, about the last of May, with second application just after blossoming and subsequent sprayings at intervals of about 10-14 days. Use Bordeaux up to the last of July and then change to Soda Bordeaux or Amm. Sol. Cop. Carbonate, though usually the 4 or 5 sprayings with Bordeaux are sufficient. Repts. 1889, p. 174; 1890, p. 100.

Downy Mildew—Develops usually dense white patches of fruiting threads on under side of leaves and causes more or less discoloration on the upper; also occurs somewhat on stems and fruit. Treat as for black rot. Rept. 1893, p. 77.

Gray Mold—Causes rotting of ripening greenhouse grapes, covering them with a more or less conspicuous grayish mat of fruiting threads. Remove rotting grapes from the house. Use care in ventilating and watering. If necessary spray bunches several times with potassium sulphide.

Powdery Mildew—Produces a cobweb-like growth over upper surface of leaves; most conspicuous in the fall, when the minute, round, yellowish to black fruiting-bodies are found scattered over surface. Treat as for black rot. Potassium sulphide is also used effectively against this fungus. Repts. 1895, p. 185.

Insects.

GRASS.

White Grubs—White grubs are the larvae of June beetles, and when abundant in the soil and approaching maturity, cause much damage, especially in seasons following drought, by eating off the roots of grass, corn, strawberries, etc. Plow just before October 1st to expose insects. Harrow very thoroughly before planting. Repts. 1912, p. 288; 1915, p. 179.

Fall Army Worm—Attack similar to that of army worm but occurs in September instead of July, and is more apt to be confined to lawns and millet. The worm does not migrate in such great numbers from one field to another. Same remedies apply. Also practice late fall plowing. Rept. 1912, p. 284.

Army Worm—In certain seasons grasses and grains are stripped of leaves and heads during July by brown striped caterpillars, which when abundant move like armies from one field to another often causing great damage. Spray with lead arsenate, strips of grass or grain to protect fields not attacked. Plow deep furrows across line of march, turning the furrow towards the line. Sprinkle migrating worms with kerosene. Use poisoned bran mash. Rept. 1914, p. 157.

HICKORY.

Insects.

Fall Web-Worm—See Pear.

Walnut Caterpillar—See Walnut.

Hickory Tussock Moth—White and black hairy caterpillars feed upon the leaves in late summer. Spray with lead arsenate. Repts. 1907, p. 332; 1917, p. 325.

Hickory Bark-Beetle—Small black beetles breed under bark and the galleries soon girdle the tree. Adults emerge, leaving numerous round holes as if the bark had received a charge of bird shot. Beetles also feed at base of compound leaf stems causing them to break and fall in midsummer. Has killed thousands of trees in Atlantic States. Badly infested trees should be removed before May 1st, and burned or at least the bark removed. Spray healthy and slightly infested trees about June 1st, with strong lead arsenate and nicotine solution. Repts. 1901, p. 267; 1914, p. 198.

Hickory Borer—Larvae tunnel deep into solid wood of trunk. Hunt for sawdust, find the burrow, inject carbon disulphide, and plug the entrance.

Nut Weevils—Larvae infest the fruit or nuts. See Chestnut.

Hickory Gall Aphid—Curious galls on the leaf stems often cause the leaves to fall in midsummer. Galls contain large numbers of aphids. Spray with nicotine solution just as new growth starts in spring. Rept. 1916, p. 145.

HOLLYHOCK.

Fungi.

Rust—Appears as small, compact, reddish-brown outbreaks on both leaves and stems. After their death in fall, cut off the plants close to the ground, carefully gather up these and any rubbish that may contain spores, and destroy them. Spraying with Bordeaux is recommended by some as helpful in checking the rust; begin as plants push through ground. Rept. 1895, p. 188.

HOP.

Insects.

Hop-Vine Borer—Larva tunnels in tip, checking growth, and later in the stem above and below the surface of the ground. Crush larvae in the tips, remove soil from the base, and after leaving the main roots exposed for a week, apply wood ashes or ammoniated phosphate and hill up. The plants will make new roots.

Hop-Vine Snout Moth—Green, white-striped larvae feed upon the leaves in June. Spray with lead arsenate while the larvae are small.

Hop-Merchants—Brown, spiny caterpillars of two species of tortoise-shell butterflies feed upon the leaves. Spray with lead arsenate.

Hop Aphid—Green aphids suck the sap from the under leaf surface. Spray with kerosene emulsion.

Fungi.

Powdery Mildew—Coats leaves and stems with whitish powdery growth, the mature fruiting bodies finally showing as loosely imbedded blackish specks. Found here so far only on ornamental varieties. Make several sprayings with commercial lime-sulphur. Rept. 1911-12, p. 349.

HORSE CHESTNUT.

Insects.

White-Marked Tussock Moth—Tufted caterpillars devour leaves in midsummer. Spray with lead arsenate. Repts. 1905, p. 230; 1916, p. 105.

Fungi.

Leaf Spot—Forms extended reddish-brown areas on the leaves, frequently resembling sun scorch, but showing the fruiting stage as minute black dots in the dead tissues. This trouble can no doubt be controlled by spraying with Bordeaux. The first application is made on the unfolding leaves and is followed by one or two subsequently at intervals of about 2 weeks.

HORSE RADISH.

Insects.

Flea Beetle—Adults feed on the leaves, and larvae tunnel in the petioles. Spray with Bordeaux mixture and lead arsenate.

IRIS.

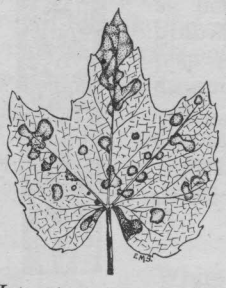
Insects.

Iris Root Borer—Larva tunnels in the rootstocks injuring many plants. Destroy infested rootstocks. In bad infestations burn over the beds in winter to destroy the eggs. Repts. 1915, p. 189; 1918, p. 331.

Fungi, etc.

Leaf Blight—Forms elliptical spots with purplish border; if abundant causes leaves to turn yellow and die prematurely; worst on German Iris. Keep foliage coated with Bordeaux or lime-sulphur, beginning early; gather and burn infected rubbish in late fall.

Soft Rot—Attacks rootstocks destroying lower parts so that leaves turn yellow and die. Same bacterial disease described under Salsify. Propagate only from healthy stock; plant in well drained soil; use only well rotted manure; prevent winter injury of roots. Rept. 1903, p. 327.



IVY, BOSTON.

Fungi.

Leaf Spot—Forms conspicuous brownish spots with purplish borders, which run together if abundant. Leaf stage of black rot of grape. Give several sprayings with commercial lime-sulphur, beginning on unfolding leaves. Burn leaves in fall.

KALE.

Insects.

Turnip Aphid—See Turnip.

Fungi.

Black Rot—Rept. 1915, p. 431. See Cabbage.

LARCH.

Insects.

Larch Sawfly—Larvae defoliate trees in midsummer. Spray with lead arsenate. Rept. 1915, p. 125.

Woolly Aphid—White cottony tufts on the bark and at the leaf whorls. Spray with kerosene emulsion.

LETTUCE.

Insects.

Aphid or **Green-Fly**—Sucks sap from leaves. Fumigate with tobacco or hydrocyanic acid gas. Spray with soap and water.

Fungi.

Drop—Causes sudden wilting of plants by infecting and rotting off leaves at surface of soil; often shows a white moldy growth over the basal parts. This may develop into a serious trouble in the greenhouse, as the fungus often becomes established in the soil, when the best remedy is to change the soil entirely or sterilize it by steam or formalin (formula D). Treat some days before using. Parsley is also subject to this disease in the greenhouse. Rept. 1908, p. 863.

Leaf Mold and **Mildew**—The first produces a brownish and the second a white moldy growth in spots on the leaves. These diseases are held in check by sub-irrigation or care in watering and ventilating to keep plants and atmosphere as free from moisture as is consistent with good growth.

LILAC.

Insects.

Lilac Borer—A white larva tunnels in the twigs. Cut and burn infested twigs. Rept. 1905, p. 260.

Oyster-Shell Scale—See Apple.

San José Scale—See Peach.

Fungi.

Powdery Mildew—Forms whitish cobwebby coating on leaves, with mature stage finally abundant as black dots. Conspicuous and common, but hardly demands preventive treatment.

LILY.

Insects.

Aphid—Yellow plant lice with red markings, on under side of leaves. Spray with nicotine solution and soap.

Stalk Borer—See Dahlia.

LINDEN.

Insects.

Canker Worm—See Apple.

White-Marked Tussock Moth—See Horse Chestnut.

Linden Borer—A white larva tunnels in wood at base of trunk. Dig out borer, or inject carbon disulphide. Rept. 1915, p. 186.

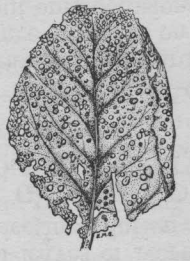
LOCUST.

Insects.

Locust Borer—Larvae tunnel in solid wood of trunk. When new leaves appear, spray bark of trunk and larger branches with mixture made by dissolving ¼ lb. sodium arsenite in 5 gallons water to which 1 quart of miscible oil is added and the whole thoroughly agitated.

MANGEL.

Insects.



Leaf Miner—See Beet.

Fungi.

Leaf Blight—Shows as grayish circular spots with purplish borders; when abundant causes premature death of leaves. Rotate; keep refuse out of manure piles; if necessary spray with Bordeaux before disease gets started. Rept. 1915, p. 432.

Root Rot—Rots off roots below ground, turning foliage yellow and often killing it. Not common, but injurious occasionally in low wet fields. Avoid wet ground; keep rotted plants out of manure. Rept. 1915, p. 433.

Insects.

MAPLE.

Maple Borer—Larva tunnels in spiral course upward around trunk or larger branches of sugar maple working in sapwood and cambium, often girdling the trees. Examine trees in September for sawdust. Find the burrow, inject carbon disulphide and plug the opening. Rept. 1907, p. 336.

White-marked Tussock Moth—See Horse Chestnut.

Other Tussock Moths—See Apple.

Canker Worms—See Apple.

Woolly Maple Leaf Scale—Cottony or woolly masses of wax, containing the females, eggs and sometimes larvae, appear on the under side of the leaves in midsummer; insects suck out the sap causing leaves to fall prematurely. Males and larvae enter crevices of bark of trunk and branches; larvae make cases here and pass the winter. Attacks only sugar maples. Spray dormant trees with nicotine solution and soap. Burn all infested leaves. Bull. 151; Repts. 1905, p. 226; 1911, p. 345.

Cottony Maple Scale—Large, oval, brown soft scales on bark of branches of silver and red maples. Each scale in early summer develops a large cotton-like tuft of wax, nearly half an inch long, and soon after the young appear. Spray with miscible oils. Bull. 151; Repts. 1905, p. 237; 1913, p. 252.

Terrapin Scale—Small reddish-brown soft scales on small twigs of silver and red maples, sometimes killing the branches. Spray with kerosene emulsion. Bull. 151; Rept. 1905, p. 238.

Oyster-Shell Scale—See Apple.

Maple Aphids—Green aphids are common on under surface of leaves of Norway and Sycamore maples in June. Spray with nicotine solution and soap, or with kerosene emulsion.

Gall Mites—Disfigure leaves by forming galls on upper surface. Destroy infested leaves.

Fungi, etc.

Anthracnose—Causes more or less extended dead areas in the leaves, often hard to distinguish from the leaf scorch. Its appearance depends on character of season and is difficult to foretell, but only occasionally serious. For this reason spraying is of doubtful value in the long run, but when made should start on the unfolding leaves. Repts. 1903, p. 329; 1915, p. 436, unusual form.

Black (Tar) Spot—Forms slightly thickened black spots on the leaves, resembling finger prints. Cut-leaf maples are especially susceptible. Rake up and burn all leaves in the fall. Rept. 1908, p. 852.

Leaf Scorch—Causes more or less extended and irregular dead areas to appear suddenly, usually from the leaf margins inward. A physiological trouble due to sudden or excessive evaporation beyond the supply of water furnished by the roots, which is in turn due to abrupt changes in atmospheric conditions, drought, injury to roots, etc. Pruning, when necessary, watering or mulching, and stimulating root growth by nitrogenous fertilizers are probably best remedial measures. Rept. 1905, p. 267.

Stag-head—Kills trees at the top or large central branches gradually die. Due to various agents or unfavorable environment such

as parasitic or semiparasitic toadstools and shelf-fungi, escaping gas in soil, winter injury, etc. Cut off dead and dying branches, clean out decaying wood, treat with a wood preservative and if necessary fill cavities. Stimulate new growth by nitrogenous fertilizers.

Insects.

MARGUERITE.

Marguerite Fly or **Leaf Miner**—A maggot tunnels between upper and lower leaf surfaces. Spray every ten or twelve days with nicotine solution. Rept. 1915, p. 188.

Insects.

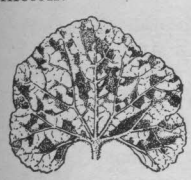
MELON (MUSK).

Melon Aphid—Sucks the sap from the under side of the leaves, and when abundant causes much damage. Underspray the leaves with nicotine solution and soap. Bull. 216, p. 47; Rept. 1908, p. 813.

Striped Cucumber Beetle—See Cucumber.

Fungi.

Anthracnose—Appears occasionally. See Cucumber and Watermelon.



Downy Mildew—Forms angular, eventually brown spots in the leaves, often stunting or killing vines; most prominent just before melons ripen, later ones often not maturing or worthless because lacking flavor. It is questionable whether this trouble can be controlled effectively and profitably by spraying during a very moist season. During dry or semi-moist seasons, however, results are satisfactory, so we recommend spraying as one of the regular operations of melon growing. It should be started soon after the vines begin to run, at least by the middle of July, and the vines should be kept covered with the Bordeaux to the end of the season. Rept. 1904, p. 329.

Leaf Mold—Develops dead spots on the leaves very similar to those caused by downy mildew. Spray with Bordeaux on the first running vines and repeat every 10 to 14 days, making 4 or 5 applications according to season. Repts. 1895, p. 186; 1898, p. 225.

Wilt—See Squash.

Insects.

MILLET.

Fall Army Worm—See Grass.

Insects.

NASTURTIUM.

Aphid—Brown aphids cluster on stems and leaves sucking the sap. Spray with nicotine solution and soap.

Insects.

OAK.

Canker Worms—See Apple.

Brown-Tail Moth—See Pear.

Orange-striped Oak-Worm—Black and orange striped caterpillars feed upon the leaves late in summer. Spray with lead arsenate.

Fungi.

White Heart Rot—Forms on trunks shelf-fungi, often somewhat hoof-shaped, eventually with dark, creased and cracked, upper surface and rusty-brown, porous, fruiting, lower surface. Gains entrance through wounded and dead branches; causes white rot of heart wood and slow death of sapwood and bark. Break off and burn fruiting bodies; if feasible cut out diseased bark and sapwood, and dig out dead heartwood and fill cavity with cement. Occurs in other deciduous trees. Bull. 222, p. 446.

Insects.

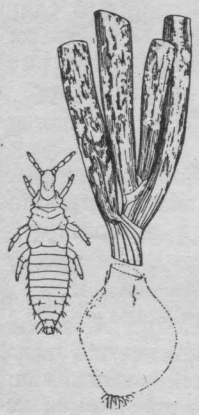
OATS.

Army Worm—See Grass.

Fungi.

Black Stem Rust—Forms, chiefly on leaf sheaths and stems, first the II stage as reddish pustules and later the III stage as elongated black outbreaks. Also occurs on wheat, rye, and other grasses as different strains. The I stage appears in spring on barberry leaves as cluster-cups but the fungus can skip this stage. Quite serious in regions where grain is grown extensively, and difficult to control. This and several related species are becoming more important here as more grain of various kinds is grown. Cut out barberries in vicinity of fields.

Smut—Destroys the grain, turning it into a black dusty mass of spores. Seed treatment will prevent this smut. Either soak the seed 8 to 10 minutes in water at 132–5° F., or sprinkle thoroughly with formalin (formula A), stirring the grain so that it is thoroughly wet, and leave in piles for several hours before drying out. A less cumbersome treatment coming into general use is that given under formula B. Buy seed from smut-free fields.



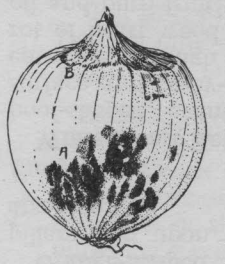
ONION.

Insects.

Thrips or **"White Blast"**—Very small insects which feed upon the surface of the leaves, giving the field a whitish appearance. Burn all tops and refuse; burn over the grass land around the field to kill over-wintering insects. Spray with nicotine solution and soap, or kerosene emulsion. Repts. 1903, p. 266; 1913, p. 233.

Maggot—Infests the bulb of the young plant. Practice rotation of crops. Spray plants here and there over the field with sweetened lead arsenate to kill the adult flies. Rept. 1911, p. 286.

Fungi, etc.



Anthracnose (Black Spot)—Produces black circular spots on the bulbs, usually on white varieties after storing in the barn. Store onions as dry as possible and keep barn dry and cool. Avoid piling too deeply in bins. Possibly air-slaked lime mixed with sulphur scattered over them at time of storing may prove beneficial. See Stem Rot for treatment with formalin fumes. Fig. (A). Rept. 1889, p. 163.

Smut—Forms black dusty outbreaks on various parts of plants raised from seed; especially injurious to the very young seedlings. This fungus becomes established in the soil, hence infected land should be avoided or used only for transplanted onions. If, however, it is seeded, apply with the seed in drills per acre, 100 lbs. sulphur thoroughly mixed with 50 lbs. air-slaked lime. Formalin (1 lb. or 1 pt. to 12 or 15 gallons water) thoroughly sprinkled over the seed, before covered, by drip attachment to the seeder, is an even more desirable remedy. Repts. 1889, p. 129; 1895, p. 176.

Stem Rot—Causes rotting of bulbs at stem end, where they become soft and shrunken, sometimes showing beneath the layers a dense olive-brown growth of mold. This fungus in a moist season occurs on various parts of the plant in

the field (possibly responsible for "blast" of seed onions), but does not usually appear as a serious trouble with the bulbs until some time after they have been placed in the barn. Treat as for black spot. Late field spraying with Bordeaux shortly before pulling and again while lying in the field, combined with treatment by formalin fumes (See Fungicides) after storing, has given some indications of benefit. See Fig. (B) under anthracnose. Repts. 1903, p. 334; 1904, p. 321.

PALMS.

Insects.

Scales—Several kinds of white and brown scales infest the species of palms grown in greenhouses. Apply nicotine solution or soap and water as a spray or as a dip.

Fungi.

Anthracnose—Frequently causes leaves to die at tip. Fungus inconspicuous, may show as small black imbedded specks oozing pinkish masses of spores. Avoid infected stock or isolate it; pick off and burn worst infected leaves; keep leaves dry and house well ventilated. Rept. 1913, p. 18.

PARSLEY-PARSNIP.

Insects.

Celery Caterpillar—On both hosts. See Celery.

Parsley Stalk Weevil—Larva tunnels in crown of plant. No remedy other than to destroy infested plants. Rept. 1913, p. 252.

Fungi.

Drop—On Parsley. See Lettuce.

Soft Rot—On Parsnip. See Salsify.

PEA.

Insects.

Green Pea Aphid—Attacks the plants early in June and sucks the sap from the leaves and stems, often causing great injury. Early peas may mature a crop before aphids injure them. Spray vines with nicotine solution and soap. Brush the vines just before cultivating. Repts. 1899, p. 240; 1913, p. 235.

Pea Weevil—The adult lays eggs in the pods in the field and the larvae develop in the seed, emerging through round holes. Fumigate with carbon disulphide. Bull. 195, p. 5.

Fungi.

Leaf Spot and **Powdery Mildew**—The former shows as roundish spots on both pods and leaves; the latter, as a mealy or cobweb-like coating on same. Neither seems to be sufficiently injurious here to warrant the expense of spraying.

Root-Rot—Kills tops of roots and base of vines, causing parts above to turn yellow, wilt and die prematurely. Caused by various soil fungi of which the downy mildew was especially prominent in 1919. Practice rotation, use *well-rotted* manure and give frequent cultivation in wet years to hasten the drying of the top soil. Bull. 222, p. 450.

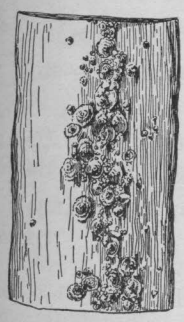
PEACH.

Insects.

Peach Saw-Fly—Larvae feed upon leaves in June and July. Spray with lead arsenate. Rept. 1907, p. 285.

Peach Borer—Larva tunnels in the base of the trunk. Dig out in late fall and early spring. Paint base of trunk with lead arsenate and lime-sulphur. Remove top soil and sprinkle powdered paradichlorobenzene around the trunk, using about 1 ounce per tree and cover with soil. Rept. 1909, p. 359.

Fruit Bark-Beetle or **Shot-Hole Borer**—Makes minute tunnels under the bark of branches and trunk. Burn infested trees and keep others thrifty. Rept. 1896, p. 240.



Plum Curculio—See Plum.

San José Scale—Minute scale insects, with circular shell, which suck the sap from twigs, fruit and leaves. On fruit a red spot surrounds each insect. Spray dormant trees with lime-sulphur. Bull. 165; Rept. 1901, p. 240.

Black and **Green Aphids**—Suck the sap from the leaves and shoots. Spray with nicotine solution.

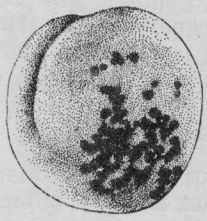
Fungi, etc.

Brown Rot—Occurs on the young twigs, etc., but causes most serious injury to the fruit, rotting it about the time of its maturity. The rotten areas usually become covered with numerous pustules of dusty brownish spores; eventually the diseased fruits form hard mummies. These carry the fungus over the winter, and if half buried in the soil develop in early spring the mature stage, which causes infection of the blossoms, etc. Certain early varieties, like the Champion, are especially subject to rot. Spraying these apparently pays in this state. See general directions for treatment. This fungus occurs on plums and cherries and less commonly on pears and apples. Repts. 1909-10, pp. 607, 612; 1911, pp. 374, 391.

Crown Gall—See Plum.

Leaf Curl—Causes young leaves to become irregularly curled and swollen and finally to drop off; rarely on fruit. In April as soon as buds begin to swell, spray the trees thoroughly with commercial lime-sulphur 1-9. If more convenient this may be done in late fall and is claimed to be just as effective. Same treatment takes care of San José scale. Repts. 1909-10, pp. 608, 612; 1911, p. 374; 1914, p. 19.

Powdery Mildew—Forms a grayish felt on young twigs and leaves. Prune off infected twigs. Give winter treatment as for leaf curl, and, if necessary, summer treatment as for scab and brown rot.



Scab—Produces roundish, olive-black spots on the fruit, discolored areas on the young twigs, and rarely "shot-holes" in the foliage. Two treatments with self-boiled lime-sulphur or atomic sulphur upon the fruit after setting and when half grown (about the middle of May and June) will control this trouble. Repts. 1896, p. 269; 1909-10, pp. 608, 614; 1911, pp. 375, 391.

Spray Injury—Is more likely to occur than with same treatment on apple, *q. v.* Avoid Bordeaux altogether. See (3) under general treatment following. Repts. 1900, p. 219; 1911, p. 372.

Winter Injury—Shows in various ways. In severe winters, especially when the ground is bare, the roots may be killed without injury to parts above the ground. In spring such trees put forth a scanty sickly foliage that soon drops. Often the injury occurs in the form of a "collar girdle" in the bark at the base of the tree. Sometimes it occurs above ground in the wood (shown by

its blacker color), with or without injury to the bark. When the bark is not injured, severe pruning in spring will often save the trees. Nursery trees can sometimes be cut back to the snow line, below the injury, and an entirely new healthy trunk started. Avoid late applications of nitrogenous fertilizers and cultivation after middle of July. Mulch base of young trees in late fall with earth. Secure good drainage. See Apple. Repts. 1903, p. 341; 1908, p. 872.

Yellows—Causes premature ripening and red spotting of fruit with yellowish curled leaves, and in time spindling sprout growths in bunches on the trunk. This is claimed to be a contagious disease, but it is apparently physiological in nature. Little peach in this state is scarcely to be distinguished from yellows, showing chiefly in the small backward fruit. Root out and burn all trees as soon as found; prevent winter injury; be careful in selecting stock for planting. Nurserymen should use especial care in selecting their stock for budding. Repts. 1893, p. 92; 1908, p. 872.

General Treatment for Peach Orchards.

(1) Spraying of peaches while dormant is of value only in checking San José scale, mites and leaf curl. One application of commercial lime-sulphur, 1-9, either in late fall or early spring, will take care of all of these troubles at the same time. If the scale and the leaf curl are unusually prevalent, both applications will prove of value in controlling them.

(2) For the prevention of scab and rot of peaches, it is as a rule desirable to give three sprayings, as follows: 1st, shortly after the blossoms have fallen (May 15th to May 25th); 2nd, about three or four weeks later (June 5th to June 15th); and 3d, about one month later (July 5th to July 15th). If only two sprayings can be given, omit the first if spraying only for rot, and the last if spraying only for scab.

(3) On the whole, self-boiled lime-sulphur of the 8-8-50 formula or atomic sulphur seem to be the safest and most reliable peach sprays. Fair results have been obtained with some of the commercial lime-sulphurs, and they are much more easily handled. There is, however, some danger of spray injury, especially with certain brands. If commercial lime-sulphur is used, a strength of not greater than 1-150, without poison, is recommended.

(4) As lead arsenate has done little to prevent curculio injury, and as it seems to increase the danger of spray injury, we advise leaving it out unless there is considerable danger from the sawfly, when it can be added in the second spraying the same as for apples.

PEAR.

Insects, etc.

Pear or **Cherry Slug**—See Cherry.

Codling-Moth—See Apple.

Brown-Tail Moth—Occurs in the United States only in eastern New England. Brown hairy caterpillars feed on leaves, and make winter nests on twigs, maturing about the middle of June. Cut and burn winter nests. Spray foliage as soon as blossoms fall, and also in August, with lead arsenate. Rept. 1910, p. 683; Bull. 182.

Fall Web-Worm—Makes nests on ends of branches of many kinds of trees in late summer, the brown, hairy caterpillars feeding inside the nests. Clip off and burn nests when small. Spray with lead arsenate. Repts. 1901, p. 270; 1917, p. 319.

San José Scale—See Peach.

Pear Psylla—Small jumping plant lice suck sap from leaves and twigs, causing leaves to fall in midsummer. Spray with lime-

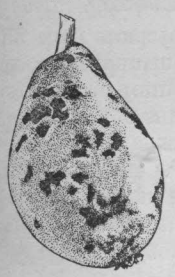
sulphur in spring just before buds open. Spray infested trees with nicotine solution and soap in July. Rept. 1903, p. 262.

Pear Thrips—A minute insect which feeds upon the unopened fruit buds destroying them so that fruit does not set. Spray with nicotine solution and soap just as buds open, and again after blossoms fall.

False Tarnished Plant Bug—Punctures developing fruit causing it to be irregular and knotty. Spray with nicotine solution and soap.

Leaf Blister Mite—Attacks unfolding leaves of apple and pear; forms galls or blisters which become red and later brown. Causes many leaves to fall in July. Spray dormant trees with lime-sulphur in late fall or in spring. Rept. 1910, p. 700.

Fungi, etc.



Scab—Forms olive-black scabby spots on fruit and leaves, often causing the former to become distorted and cracked. The fungus lives over winter on the twigs. Certain varieties are not much injured, others, like Flemish Beauty, are very susceptible. Spray with Bordeaux on unfolding leaves before blossoms open, again after petals fall, and give the third spraying about two weeks later, using weak Bordeaux in last two treatments. Repts. 1894, p. 135; 1904, p. 323; 1911, p. 396.

Blight—Kills young twigs, the leaves suddenly turning black; also produces sunken dead areas on trunks. This is a bacterial disease chiefly spread by bees during blossoming time, or by sucking insects. Winter-prune all diseased branches, cutting off several inches below the diseased area. Cut out cankered areas and swab with disinfectant, paint exposed wood when dry. Several times after blossoming remove all young dead twigs. Use knife sterilized from time to time by wiping with a cloth saturated with carbolic acid or with corrosive sublimate (1-1000). This disease occurs also on apple and quince. Rept. 1894, p. 113.

Leaf Blight—See Quince.

Insects.

PEONY.

Rose Chafer—Adult beetles feed upon blossoms of white varieties. See Grape.

Insects.

PHLOX.

Red Spider—Injures leaves causing them to turn yellow. Clean culture. Spray clear water with force from hose, and in severe infestations, with kerosene emulsion, or with nicotine solution and soap.

Fungi.

Powdery Mildew—Covers more or less completely leaves and young stems with grayish coating within which are finally imbedded numerous, small, blackish fruiting-bodies. Give several sprayings with commercial lime-sulphur, starting before mildew gains much headway.

Insects.

PINE.

Sawflies—Larvae of several native and imported species feed upon the leaves. Spray with lead arsenate. Rept. 1917, p. 273.

White Pine Weevil—Adult snout beetle lays eggs on leader in May and grubs feed and develop in it, causing it to wilt and die in midsummer. Leaders of ornamental trees may be protected by spraying them with lead arsenate or lime-sulphur. Jarring the adults into a net once a week during month of May, serves to greatly reduce the damage. Infested leaders should be cut and destroyed. Repts. 1911, p. 307; 1919, p. 144.

Pine Leaf Scale—Whitish pear-shaped shells on leaves; small trees sometimes killed. *Spray with nicotine solution or kerosene*

emulsion about the second week in June. Bull. 151; Rept. 1905, p. 240.

Pine Bark Aphid—White cottony or woolly objects on bark and sometimes on leaves, sucking out the sap. Spray with kerosene emulsion. Repts. 1911, p. 343; 1919, p. 155.

Fungi, etc.

Blight (so-called)—Stunts the leaves and kills their tips inward, often suddenly, so that the tissues for a greater or less distance are reddish-brown. This is a physiological disease; not contagious; due to adverse weather conditions. Chief among these are severe winters, killing the leaves directly or indirectly through injury to roots; warm days, in late winter or early spring when ground is frozen, causing transpiration of water from the leaves that cannot be replaced; very late spring frosts, killing tips of new leaves; sudden changes, in summer from moist or muggy weather to bright sunshine resulting in excessive transpiration and injury; very dry summers. No effective remedy. Rept. 1907, p. 353.

Dampening Off—Caused here chiefly by Rhizoctonia fungus rotting base of the stem, the seedling falling over. Sometimes it creeps up the stem invading the base of the leaves which wither. Certain conifers are more subject to attack then others. Avoid unnecessary watering; provide good ventilation; infected soil often can be helped by treatment with formalin before seeding (see Fungicides, formalin D); spraying with Bordeaux is effective in some cases. Repts. 1912, p. 348; 1915, p. 450.

Stem Rusts—Form on the swollen stems temporary, but conspicuous, white, blisterlike spore cups filled with a dusty orange-colored spore mass. The white pine blister rust, an imported species, spreads to the gooseberries and currants, and forms other less conspicuous leaf stages on these (*q. v.*). A very similar native species on two and three needle pines spreads to the leaves of the sweet fern. In either case infected pines should be destroyed,

and watch kept of the alternate hosts, if they occur in the neighborhood. Seed beds should never be made in the vicinity of the alternate hosts, as infection takes place easily in the young pine seedlings. Spray beds with Bordeaux if liable to infection. In white pine plantations pull out all currants and gooseberries including those in the immediate neighborhood (500 feet). Send any suspicious white pines or their alternate hosts to this Station for examination. Rept. 1912, p. 347; Bull. 214, p. 428.

Insects.

PLUM.

Plum Aphids—Suck sap from leaves. Spray with kerosene emulsion, nicotine solution and soap, or with soap and water.

San José Scale—See Peach.

Plum Curculio—Grub infests the growing fruit, causing it to fall. Jar the trees each morning for six weeks after blooming and catch the beetles on sheets and destroy them. Spraying with lead arsenate during the same period is also advised. Rept. 1910, p. 609.

Fruit Bark-Beetle or **Shot-Hole Borer**—See Peach.

Fungi.

Black Knot—See Cherry.

Brown Rot—Thin fruit so it does not touch. Gather and destroy all mummies after harvest. Rather difficult to control

by spraying, as spray does not readily adhere to the smooth fruit. First treatment with self-boiled lime-sulphur, should be made on half grown fruit, others at intervals of two weeks, and the last one 10-14 days before picking. See Peach.

Crown Gall—Forms hard roundish knots one-half inch or more in diameter, near crown or on roots, less frequently on lower part of trunk. Do not plant infected trees. Remove knots when found and paint over cut surface. This is said to be very troublesome in some states, but here, as yet, little damage has resulted from it except possibly on blackberries and imported roses. It also occurs on peach, apple, raspberry, and various ornamental plants.

POPLAR.

Insects.

Poplar Tent-maker—Larvae feed on leaves and fold them together near ends of branches, forming nests. Spray with lead arsenate. Rept. 1911, p. 310.

Spiny Elm Caterpillar—See Elm.

Tussock Moths—See Apple, Hickory and Horse Chestnut.

Poplar Borer—Larvae make large galleries in wood of trunk. Dig out, or inject carbon disulphide into the burrow and close the opening. Rept. 1907, p. 336.

Poplar and **Willow Curculio**—Larva tunnels in smaller trunk and branches. Destroy badly infested trees. Cut out borers; inject carbon disulphide. Rept. 1907, p. 335.

Oyster-Shell Scale—See Apple.

Fungi.

European Canker—Forms sunken dead areas of varying extent in the bark. Importation from Europe; showing here most commonly on Lombardy and white poplars. If trees are badly injured cut down and burn; otherwise cut out diseased areas going into the healthy bark, scraping and painting over exposed wood if surface is extended. Bull. 222, p. 461.

Rusts—Show on leaves as minute, powdery, yellow-orange pustules in II stage, and as slightly elevated reddish blisters in III stage. Have I stage, for different species, on larch and hemlock. Avoid planting near these hosts in nursery; rake up and burn infected leaves in the fall. Rept. 1915, p. 440.

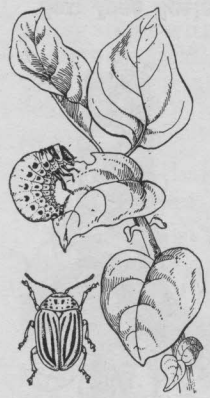
POPPY.

Insects.

Aphids—Black aphids suck sap from stems and leaves. Spray with nicotine solution and soap.

POTATO.

Insects.



Flea Beetle—Small black jumping beetles eat holes through the leaves. Spray heavily both upper and under leaf surfaces with lead arsenate or calcium arsenate. Bull. 208, p. 103; Rept. 1906, p. 271.

Colorado Beetle—Adults and larvae devour the leaves. Spray with lead arsenate as soon as injury is apparent. May be used in Bordeaux mixture. Bull. 208, p. 106; Rept. 1911, p. 311.

Three Lined Potato Beetle—Larvae feed upon the leaves and carry their black excrement on their backs. Spray with lead arsenate. Bull. 208, p. 109.

Stalk Borer—Larva tunnels inside the stalk. Burn infested vines. See Dahlia. *Bull. 208, p. 111.*

Potato Aphid—*Green and pink aphids appearing in large numbers suck the sap from shoots and stems, causing much damage in 1917.* Spray with soap and nicotine solution. Bull. 208, p. 115.

Fungi, etc.

Black Leg—Causes a black rot of stem below ground; plants more or less stunted with yellowish curled foliage; occasionally rots tubers. Usually only scattered plants appear in the field, not spreading to the healthy. Soaking seed in formalin as for scab said to be helpful. Rept. 1914, p. 21.

Blight or **Downy Mildew**—Causes a sudden blackening of the leaves, and often death of vines, from July to September in moist seasons; usually shows a slight whitish growth of fungus on the under side of the leaves; rots tubers. Spray with Bordeaux before the trouble appears, about July 1st, and keep vines well covered to the end of the season. Three to five sprayings by hand or five to seven by power sprayer are necessary. After last cultivation thoroughly ridge up the rows to help keep the spores from washing down to the tubers. Early varieties often escape blight by maturing before its appearance. Repts. 1904, p. 363; 1905, p. 304; 1909–10, p. 739; 1915, p. 470; 1916, p. 355; Bull. 214, p. 411.

Mosiac—Shows as a more or less conspicuous yellow-green mottling of the leaves. A physiological disease not well understood. New here but apparently not so injurious as in some other places. Do not save tubers for planting from hills showing this trouble. Bull. 222, p. 464.

Scab—Produces the common scabby appearance on surface of tubers. Soak uncut seed-tubers one hour in formalin (formula C). Formalin fumes (see Less-Used Fungicides) are often used when large quantities are treated. Care in filling space sufficiently, however, is necessary to avoid injury by "pitting" from absorption of fumes. Corrosive sublimate is again recommended by some investigators especially where the black scurf (Rhizoctonia fungus) also occurs on the tubers, as this treatment seems more effective against the latter. Hot corrosive sublimate or formalin for short periods has also been recommended for potato tuber diseases. Avoid planting on infected land, by systematic rotation. The use of lime, wood ashes, and various barnyard manures will increase the amount of scab. The same trouble occurs on beets and turnips. Fig. (B). Repts. 1890, p. 81; 1891, p. 153; 1894, p. 118; 1895, p. 166; 1896, p. 246; 1909–10, p. 744.

Tip Burn—Causes leaves to die at tip and margins and roll up; often mistaken for true blight. This is a physiological trouble due to drought or sudden change from moist to very hot bright weather. Cultivate thoroughly and often to conserve moisture. Spray with Bordeaux as for blight, as this often helps to increase yield by lengthening life of leaves. Rept. 1909-10, p. 742.

PRIVET.

Insects.

Privet Leaf Folder—Larvae web together terminal leaves and feed inside. Clip off and destroy infested shoots. Spray with lead arsenate. Rept. 1913, p. 223.

Privet or **Lilac Borer**—See Lilac.

Fungi, etc.

Anthracnose—Forms small cankers on stems causing parts above to wilt and die. Usually found in nurseries on recently transplanted European privet. Prune off and burn infected branches; if bad spray with Bordeaux. Rept. 1914, p. 22.

Winter Injury—Shows in spring by stems usually being killed down to base or snow line. Cut off dead stems below injury and a vigorous new growth will result if roots are not injured. Rept. 1904, p. 326.

QUINCE.

Insects.

Round-Headed Borer—See Apple.

Quince Curculio—Grubs infest growing fruit and adults feed upon it causing it to be knotty. Jar the trees same as for plum curculio. Spray with lead arsenate.

Aphid—See Apple.

Fungi, etc.

Black Rot—Rots the fruit, often beginning at the blossom end; also kills twigs and branches. In the fall or spring cut off and burn all dead branches. Give three sprayings, as for leaf blight, with Bordeaux mixture.

Blight—See Pear.

Leaf Blight—Forms rounded, often confluent, reddish-brown spots with central black dots on leaves and fruit, the former often shedding prematurely and the latter cracking irregularly. Spray with Bordeaux just before blossoms open, again soon after they fall, and follow with 1 or 2 additional treatments at intervals of about 2 weeks, according to the weather. This fungus also occurs on pear. Repts. 1890, p. 99; 1891, p. 150.

Rust—Produces small clustered cups, with fringed borders and filled with orange spores, on fruit, young twigs and less frequently on leaves. Cut off and burn infected twigs and fruit. Look for infected cedars in neighborhood. See Apple Rust.

RADISH.

Insects.

Maggot—See Cabbage.

Aphid—See Turnip.

Fungi.

Club Root—See Cabbage.

RASPBERRY.

Insects.

Raspberry Sawfly—Larvae devour leaves. Spray with lead arsenate or hellebore. Rept. 1918, p. 329.

Cane Borer—Larva tunnels inside the canes. Cut and burn infested canes.

Raspberry Fruit-Worm—Brown beetles feed upon buds, leaves and blossoms, and white larvae adhere to berries at picking time. Spray with lead arsenate when beetles first appear.

Fungi, etc.

Anthracnose—Shows as more or less confluent whitish spots, with purplish borders, on the stems. In spring, before buds swell, cut out and burn all badly infected canes and then spray with Resin-Bordeaux. If disease is very bad, spray again when young shoots are about six inches high, and repeat in 10 to 14 days. Aim chiefly to cover the young shoots with the spray. After fruit is gathered, again remove any badly infected canes. Cultivate ground thoroughly to promote vigorous growth of canes. Rept. 1899, p. 274.

Crown Gall—See Blackberry.

Rust—See Blackberry.

Wilt—*Forms cankered areas on the canes causing the parts above to wilt. In the old canes and near the pruned ends, the fungus often develops a brownish coating of spores around each small imbedded fruiting receptacle. The green berries often dry up without apparent cause, due to inoculation by insects. Spraying has not proved very satisfactory. Old and diseased canes should be removed and burned after the fruiting season and again early in spring. Rept. 1906, p. 321.

Yellows—Causes foliage to become more or less crinkled, and mottled with a sickly yellowish color. Plants gradually become worthless. Spraying does not seem to help this trouble, which apparently is of similar nature to peach yellows. Dig out plants with the yellows. Propagate only from perfectly healthy ones.

RHODODENDRON.

Insects.

Rhododendron Lace Bug—This bug sucks the sap from the under side of the leaves, which are usually colored brown by its excrement. Spray with nicotine solution or kerosene emulsion. Rept. 1910, p. 708.

Fungi, etc.

Leaf Scorch—Shows as dead marginal areas of varying width usually appearing suddenly. Plant in shade; keep ground mulched; water if necessary in dry weather by soaking ground beneath mulch. Rept. 1914, p. 23.

ROSE.

Insects.

Rose Slug—Eats away the green portion of the leaves. Spray with hellebore, lead arsenate or nicotine solution.

Rose Midge—Larvae distort young leaves and flower buds in greenhouses. Apply tobacco dust to the soil and fumigate nightly with tobacco stems or nicotine paper.

Rose Chafer—See Grape.

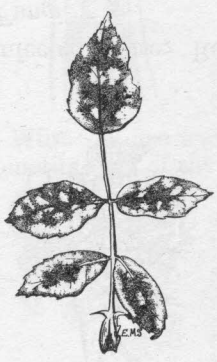
Leaf-Hopper—Sucks the sap from the under side of the leaves. Spray with nicotine solution and soap.

Rose Scale—Whitish circular shells on the stems contain insects which suck the sap. Cut and burn worst infested canes. Spray with nicotine solution and soap. Bull. 151, p. 11; Rept. 1905, p. 241.

Aphid or **Green Fly**—Sucks sap from the leaves and stems. Spray with nicotine solution.

Fungi, etc.

Crown Gall—Occurs very frequently on rose roots, especially those of Manetti stock. There is some question how much infected plants eventually suffer. See Plum. Rept. 1911-12, p. 355.



Leaf Blotch—Forms large purple-black blotches on leaflets, which often turn yellow and fall off. For greenhouse treatment paint hot water pipes with mixture of sulphur and oil. Potassium sulphide or commercial lime and sulphur can be sprayed on the foliage. Spraying out of doors can be done with Bordeaux, if there is no objection to the sediment on leaves. Rept. 1903, p. 355.

Mildew—Develops a white powdery or cobweb-like growth on the young leaves, which become more or less distorted and fall off; occasionally blasts blossoms of certain varieties. Tea roses especially susceptible. Treat same as for leaf blotch; or dust flowers of sulphur over the leaves; be careful in airing greenhouses. Rept. 1903, p. 356. Bull. 222, p. 474.

RUTABAGA, See **TURNIP.**

RYE.

Insects.

Army Worm—See Grass.

Wheat Midge—See Wheat.

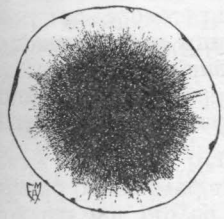
Fungi.

Ergot—Forms conspicuous, elongated, purplish sclerotia, usually one in the spike, most common in volunteer rye, but occasionally in cultivated fields. Keep these sclerotia out of cattle feed as they may cause abortion and other troubles.

Powdery Mildew—Shows as a thick grayish felt on the leaves with fruiting bodies as blackish embedded specks. Causes premature death of leaves; often associated with rust. No practical remedy. Rept. 1909-10, p. 735.

SALSIFY.

Fungi, etc.



Soft Rot—Forms a soft rot of the interior tissues of the roots running down from the crown and turning them a darker color. Usually occurs after storage. Same bacteria cause soft rots in a variety of plants. Avoid contaminated manure and too much rotting humus in the fields; store under dry cool conditions, allowing sufficient ventilation. Rept. 1914, p. 25.

SNAPDRAGON.

Insects, etc.

Leaf Mites—Cause leaves to curl and plants do not blossom. Spray with nicotine solution and soap, same as for Cyclamen. Rept. 1914, p. 176.

Root-Knot Eelworm—Causes irregular swellings on the roots where the eelworms are present, with resulting premature decay and sickly appearance of parts above ground. Worst in greenhouses and hot-beds as this far north the nematodes are killed in unprotected ground over winter. Attacks roots of a great variety of cultivated plants. Purchase only healthy plants; change infected soil if possible, dry out thoroughly in summer, leave out doors over winter or sterilize with steam; avoid contamination of soil with infected refuse. Rept. 1915, p. 452.

Fungi.

Anthracnose—Shows as whitish spots with distinct purplish border on leaves and stems; spots often running together. Select seed and cuttings only from healthy stock; pick off and burn infected leaves. Spray with Bordeaux.

Rust—Forms reddish-brown, roundish pustules chiefly on under side of leaves causing tissues above to become yellow spotted. Appearing in greenhouses and causing more or less injury according to prevalence. Treat as for anthracnose. Rept. 1915, p. 443.

SNOWBALL.

Insects.

Aphids—Suck sap from the leaves causing them to curl. Use nicotine solution and soap as a spray or dip.

SOY BEAN.

Fungi, etc.

Bacterial Leaf Spot—Forms small, dark, reddish-brown angular spots frequently merging into larger areas. Certain varieties appear more susceptible than others, Ito San being one of the

worst. Grow least susceptible varieties and if possible purchase seed from uninfected fields.

Crinkling Chlorosis—Shows as crinkling or yellowish-green mottling of leaves, or both together. Plants less vigorous than normal ones. Hollybrook variety apt to show trouble most. Treatment same as in preceding.

SPINACH.

Insects.

Spinach or **Beet Leaf-Miner**—See Beet.

SPIRAEA.

Insects.

Aphids—Suck sap from the new shoots. Use nicotine solution and soap as a spray or dip.

SPRUCE.

Insects.

Spruce Gall Aphid—Forms galls at the base of the new growth on Norway and other spruces. Spray in the late fall or early spring with nicotine solution and soap or with kerosene emulsion. Rept. 1906, p. 302.

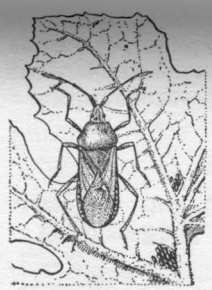
Spruce Bud Moth—Larva feeds on leaves of terminal shoots of the branches causing much damage. Spray with lead arsenate. Rept. 1912, p. 291.

SQUASH-PUMPKIN.

Insects.

Squash Lady-Beetle—Both adults and larvae devour the leaves. Spray with lead arsenate. Bull. 181, p. 11; 216, p. 42; Rept. 1908, p. 810.

Striped Cucumber Beetle—See Cucumber.



Squash Bug or **"Stink Bug"**—A brown bug three-fourths of an inch in length sucks the sap from the under side of the leaves, causing them to wilt and die. Spray with kerosene emulsion to kill the young. The old bugs may be trapped by placing boards or shingles on the ground, which should be visited each morning and the bugs killed. Bull. 216, p. 44; Rept. 1908, p. 811.

Squash-Vine Borer—Larva tunnels in the base of the stem, causing decay. Cut slits lengthwise in the stem and kill borers. Cover the joints of the vine with earth so that new shoots may be formed to support the plant. Grow a few early plants for traps, and destroy them. The main crop should be planted rather late. Bull. 216, p. 39; Rept. 1908, p. 806.

Fungi.

Anthracnose—See Watermelon.

Storage Rots—Caused by various fungi that are best held in check by storage under conditions with minimum of heat and moisture.

Wilts—Cause leaves of the plants to wilt and then dry up, sometimes all of the vine thus suddenly dying. If a cross section of the stem shows a slight milky and sticky exudation, it is caused by bacteria that clog up the water ducts. Fungi in the ducts or insects at the roots may cause similar trouble. Heavy manuring often develops these troubles. Spraying is of little value except as it may keep off insects which inoculate the plants with the

bacteria. Use enough seed to allow for loss by wilt and pull up and destroy all the wilted vines as they appear. Rept. 1903, p. 359.

STRAWBERRY.

Insects.

Strawberry Sawflies—Larvae devour leaves. Spray with lead arsenate or hellebore.

Strawberry Weevil—Small snout beetles; females cut off blossom buds of staminate varieties when ovipositing. Plant pistillate varieties in part. Dust heavily with lead arsenate and sulphur (1–5.)

Strawberry Crown Borer—Grub tunnels and feeds in crown of plant. Practice crop rotation. Burn over infested field in fall.

Strawberry Flea Beetle—Adults eat holes through the leaves. Spray with lead arsenate.

Strawberry Leaf Roller—Larva rolls leaf and feeds inside. Spray with lead arsenate. Burn fields and plow abandoned fields as soon as crop is harvested.

Strawberry Root Aphid—Sucks sap from leaves and roots, killing plants. Set clean plants on land not infested. Spray with nicotine solution and soap.

Strawberry White Fly—Sucks sap from leaves. Underspray with nicotine solution and soap.

White Grubs—See Grass.

Fungi.

Leaf Spot and **Blotch**—Cause conspicuous discolored spots, the former usually with whitish centers and purplish borders, and the latter with dark centers. Glen Mary sometimes severely injured by latter fungus. Renew the beds frequently. In the late fall or early spring cut off leaves with mower, add a little straw where necessary, and burn over beds. Spray with Bordeaux two or three times before blossoming, beginning last of April and repeating weekly, and once after blossoming is over. Repts. 1903, p. 360; 1914, p. 5.

Powdery Mildew—Covers leaves (more frequently on under, but more conspicuously, when present, on upper surface) with cobweb-like growth, often causing them to become stiff and curled inward. When necessary, this can probably be controlled with Bordeaux if sprayed before abundant. Rept. 1905, p. 276.

SWEET PEA.

Insects.

Aphids—See Pea.

White Fly—See Tomato.

Fungi.

Dampening Off—Rots off stem just below ground causing vines to turn yellow and finally die. Plant in well drained soil; place well rotted manure deep in ground below the seed; avoid excessive watering; spray base of vines and ground with Bordeaux; change beds if appearing yearly. Rept. 1907, p. 359.

SWEET POTATO.

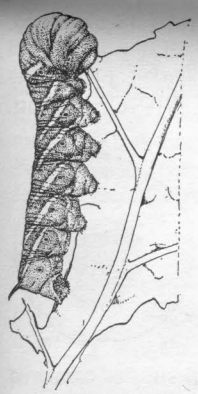
Insects.

Tortoise-Shell Beetles—Feed upon leaves. Spray with lead arsenate. Bull. 208, p. 110.

SYCAMORE.

Fungi.

Anthracnose—Kills young leaves in the spring; causes dead areas of irregular shape in tissues of older ones often following veins. If thought advisable to spray, use Bordeaux on the leaves as soon as showing and repeat when half grown.



TOBACCO.

Insects.

Tobacco or **Tomato Horn-Worms**—Large green caterpillars with horn on the tail devour the leaves. Practice hand picking or spray the plants with lead arsenate. Rept. 1906, p. 269.

Flea Beetle—Adults eat holes through the leaves. Spray upper and under surface heavily with lead arsenate. Bull. 208, p. 103; Rept. 1906, p. 271.

Cut Worms—See Tomato.

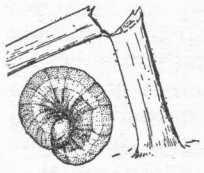
Fungi, etc.

Calico—Causes the leaves to become irregularly mottled with a lighter green color and makes a very inferior tobacco. Frequently infected leaves finally show numerous, irregular, often merging, brown spots known as "rust." While calico is a physiological disease, due to injurious enzymes, it can be communicated to a healthy plant through contact with a very small amount of juice from a diseased plant. Care, therefore, is necessary after handling diseased plants in touching healthy ones. Never use tobacco water or tobacco stems on the seed beds. If calico shows in a seed bed, pull up all suspicious plants and those surrounding them. If troubled year after year, sterilize the seed beds or change them, and never make them on land used for tobacco the year before. When transplanting, wash the hands occasionally with soap and water. Repts. 1898, p. 242; 1899, p. 252; 1914, p. 357; Bull. 166, p. 10.

Dampening Off—Due to various fungi which rot off the seedlings close to the ground, and cause them to fall over. Keep air of beds as dry as consistent with good growth by care in watering and ventilating. If trouble starts in spots, take out all infected plants and refuse there.

Root Rot—Shows in seed beds by dwarfed "rosette" plants whose roots have been largely rotted off. Occasionally it does more or less damage in fields, especially in alkaline or water soaked soils; a short rotation is advisable in such cases. Sterilize seed beds with steam or treat with formalin (formula D). Repts. 1906, p. 342; 1907, p. 363.

Wild Fire—Shows first in lower leaves as small, roundish, yellow spots. In time these grow larger, turn darker, and irregular dead areas appear more or less prominently. This disease is caused by bacteria, is favored by wet weather and is apparently new to the state. It is carried on the seed and later may be readily transferred from infected places in the field by certain insects and the wind. Care should be used to select seed only from disease-free fields and sow this seed in sterilized seed beds. Where doubtful seed is used this should be soaked for 15 minutes in 1 pint of water to which is added 1 oz. of formalin, stirring the seed during the treatment. Drain off the liquid, wash seed in pure water several times and dry before storing. Old cloth used previously on infected beds should be boiled in water before used again.



TOMATO.

Insects.

Cut Worms—Eat off plant near ground or climb the plant and devour the leaves. Place around field poisoned bait or bran mash containing arsenic. Trap cut worms with small

piece of board. Rept. 1906, p. 264; Bulls. 190, p. 18; 208, p. 112; 216, p. 43.

Tomato or **Tobacco Horn-Worm**—See Tobacco.

Flea Beetle—See Potato or Tobacco.

Potato Aphid—See Potato.

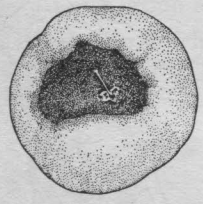
Stalk Borer—See Dahlia.

White Fly—Sucks the sap from under side of leaves. Spray under side of leaves with soap and water. Fumigate greenhouses with hydrocyanic acid gas (1 oz. to 1000 cubic ft.). Bulls. 140; 216, p. 50; Rept. 1902, p. 148.

Fungi, etc.

Mosaic—Rept. 1908, p. 857. See Calico of Tobacco.

Leaf Spot—Produces on leaves and stems numerous, small, dark spots, often with white centers. Begin spraying with Bordeaux about the middle of July, making 3 or 4 applications at intervals of 10-14 days. This usually develops too late in the season here to cause serious damage.



Point Rot—Causes the green fruit to rot at bloom end, showing a large, firm, dark-brown area. Claimed to be a physiological trouble. Frequently bad in very dry seasons. In greenhouses sub-irrigation is said to prevent it. Spraying, apparently, is of little value. Considerable difference exists in varieties as to susceptibility.

Scab—Occurs most commonly in greenhouses, covering under surface of leaves more or less abundantly with an olive-brown growth which finally kills the tissue above. Spray with Bordeaux, picking ripe fruit before each of the later treatments.

Wilt—Occurs here chiefly in greenhouses; plants turn yellow and slowly wither up; fungus may finally show on dead stem and fruit as pinkish growth. Caused by fungus clogging ducts and cutting off water supply to leaves; in young stage presence shown by blackened bundles where stems are cut across. Change soil if appearing yearly; do not sow seeds from infected plants as they can carry the disease. Spraying of no value. Rept. 1903, p. 366.

TULIP TREE.

Insects.

Tulip Tree Scale—Large brown hemispherical soft scales on bark, sucking the sap, especially on lower branches. Spray with lime-sulphur when trees are dormant. Bull. 151; Repts. 1905, p. 239; 1912, p. 294.

TURNIP-RUTABAGA.

Insects.

Cut Worms—See Tomato.

Cabbage Maggot—See Cabbage.

Turnip Aphid—Green aphids on under side of leaves sucking the sap. Underspray with soap and water or nicotine solution. Rept. 1916, p. 98.

Fungi, etc.

Club Root—See Cabbage.

Soft Rot—Causes an interior soft decay of roots, etc., of a variety of vegetables, such as turnips, salsify, parsnips, carrots, celery. Very wet seasons and imperfect storage conditions are usually the starting point of these troubles. Store under best possible conditions for keeping down heat and moisture. Keep contaminated refuse out of manure pile. Rept. 1914, p. 25.

Phoma Rot—Appears usually after storage, causing conspicuous, dry, sunken, subcircular, black spots scattered over roots. Fruiting pustules show as black dots. Store roots in cool dry place and not too deeply in the piles. Practice yearly rotation and keep refuse from manure pile. If necessary, use only artificial fertilizers. Rept. 1912, p. 355.

VIOLET.

Insects, etc.

Violet Midge—Larvae in curled edges of new leaves. Fumigate every other night with hydrocyanic acid gas (½ oz. to 1000 cu. ft.)

Violet Sawfly—Larvae devour leaves. Spray with lead arsenate or hellebore.

Eelworms—Form galls on the roots. Plant in new soil or sterilize the old soil by steam. Add plenty of air-slaked lime to the soil. See Snapdragon.

Fungi.

Spot Disease—Shows as whitish round spots on the leaves. Spray field plants early in fall with Bordeaux. Select only best stock for greenhouse; remove *all* affected leaves before transplanting. When plants become established, spray again with Bordeaux. Be careful about watering plants, and, by proper ventilation and heat during September to November, keep atmosphere of house from ever becoming too moist.

WALNUT.

Insects.

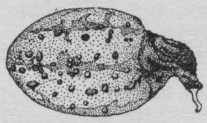
Walnut Caterpillar—Clusters of black caterpillars covered with whitish hairs strip the branches and finally the trees in August. Spray with lead arsenate. Clip off twigs when caterpillars are small, and kill by crushing. Repts. 1914, p. 191; 1917, p. 326.

Walnut Weevil or **Curculio**—Adults feed at base of leaf stems. Larvae tunnel in new shoots and infest the fruit of Persian and Japanese walnuts. Spray with lead arsenate. Rept. 1912, p. 240.

Walnut Bud Moth—Larvae feed upon tender leaves and shoots, webbing them together. Spray with lead arsenate. Rept. 1912, p. 253.

WATERMELON.

Fungi.



Anthracnose—Shows as more or less abundant, dark, sunken spots or areas on the fruit. Also infects leaves in spots. Usually appears here too near end of season to cause sufficient injury to warrant spraying; spray also fails to adhere well to the fruit. Rotation and removal of rotting melons from field may possibly be helpful restrictive measures.

WHEAT.

Insects.

Army Worm—See Grass.

Hessian Fly—Maggots burrow in sheath of a leaf at base of stem, causing the stalks to turn yellow and die. Plant rather late—say about September 1st.

Wheat Midge—The fly lays eggs on the chaff and the maggots feed upon the developing kernels, so that the heads ripen early and produce no grain. Burn stubble before plowing. Plow infested fields deeply in the fall. Rept. 1917, p. 366.

Green Bug or **Aphid**—Green aphids suck the sap from leaves. Destroy in early fall all volunteer wheat and oats. Practice crop rotation.

Fungi.

Black Stem Rust—See Oats.

Leaf Rusts—Form small, dusty, orange-colored outbreaks on leaves, etc., and later darker and firmer mature stage. Severe

closely related species on barley, rye, and wheat but quite distinct from the black stem rust. Some varieties are more resistant than others to these various grain rusts. No effective treatment.

Loose Smut—Destroys entire head turning it into a dusty olive-black mass that is dissipated in time. Severe hot water treatment partially effective. See Oats.

Stinking Smut—Fills the apparently scarcely changed seeds with a dusty mass of spores. Spores often found more or less abundantly in middlings and other feeds containing wheat, and their presence in amount indicates poor quality, and may have some connection with complaints of injury to stock fed on these. Use formalin treatment. Rept. 1909-10, p. 736.

Insects.

WILLOW.

Fall Web Worm—See Pear.

Spiny Elm Caterpillar—See Elm.

Poplar Tent-Maker—See Poplar.

Poplar and **Willow Curculio**—See Poplar.

Sawflies—Larvae devour leaves. Spray with lead arsenate.

Aphids—Large reddish aphids congregate on twigs in fall, and suck the sap. Spray with kerosene emulsion or nicotine solution and soap.

Oyster-Shell Scale—See Apple.

Fungi.

Rusts—Occur on the leaves; similar in appearance and closely related to those on poplar. The alternate host for one species is the larch and apparently there is another whose alternate host is not yet determined. Rept. 1915, p. 450.

MANUFACTURERS AND DEALERS IN SPRAY APPARATUS AND SUPPLIES.

Prospective purchasers should write to these firms for catalogues and prices.

MANUFACTURERS OF SPRAYING MACHINES.

Aspinwall Manufacturing Co., Jackson, Mich. (Hand and power potato sprayers.)
Barnes Mfg. Co., Mansfield, Ohio. (Hand and power sprayers.)
Bateman Mfg. Co., Grenloch, N. J. (Iron Age sprayers for hand and power.)
Bean Spray Pump Co., Lansing, Mich. (Hand and power outfits.)
Brackett, Shaw & Lunt Co., Somersworth, N. H., 62 No. Washington St., Boston, Mass. (Hand and power outfits.)
Brown Co., E. C., Rochester, N. Y. (Compressed air, hand and power outfits.)
Church, Stephen B., Seymour, Conn., 64 Pearl St., Boston, Mass. (Power and hand sprayers.)
Crestline Mfg. Co., Crestline, Ohio. (Sprayers.)
Cushman Sprayer Co., St. Joseph, Mo. (Power outfits.)
Dayton Manufacturing Co., 2240 East Third St., Dayton, Ohio. (Hand sprayers.)
Deming Co., Salem, Ohio. (Hand and power outfits.)
Douglas, W. & B., Middletown, Conn., (Hand and power pumps.)
Field Force Pump Co., Elmira, N. Y. (Hand and power pumps.)
Fitzhenry-Guptill Co., 135 First St., Cambridge, Mass. (Power sprayers.)
Friend Mfg. Co., Gasport, N. Y. (Power and hand pumps.)
Goulds Mfg., Co., 58 Pearl St., Boston, Mass.; 16 Murray St., New York. (Hand and power sprayers.)
Hardie Mfg. Co., Hudson, Mich.; Hagerstown, Md. (Hand and power pumps.)
Hayes Pump and Planter Co., Galva, Ill. (Spray pumps.)
Humphryes Mfg. Co., Mansfield, Ohio. (Hand and power pumps.)
Hurst Mfg. Co., H. L. Greenwich, Ohio.
Leggett & Brother, 301 Pearl St., New York. (Hand and power dusting machines.)
Myers & Brother, F. E., Ashland, Ohio. (Hand and power pumps.)
Niagara Sprayer Co., Middleport, N. Y. (Dusting machines.)
Rumsey Pump Co., Ltd., 49 Federal St., Boston, Mass. (Hand and power pumps.)
Spramotor Co., 107-109 Erie St., Buffalo, N. Y. (Hand and power outfits.)
Ward-Love Pump Corporation, Rockford, Ill. (Pumps for all purposes.)

MANUFACTURERS OF INSECTICIDES AND FUNGICIDES.

Blanchard Co., Jas. A., Hudson Terminal Bldg., 30 Church St., New York. (Insecticides and fungicides.)
Bowker Insecticide Co., 43 Chatham St., Boston, Mass. (Insecticides and fungicides.)
Devoe & Raynolds Co., Inc., 101 Fulton St., New York. (Arsenical poisons.)
Frost Insecticide Co., 20 Mill St., Arlington, Mass. (Spray chemicals and apparatus).
General Chemical Co., 25 Broad St., New York. (General insecticides and fungicides, atomic sulphur and B. T. S.)
Glidden Co., Cleveland, Ohio. (Insecticides and fungicides.)
Grasselli Chemical Co., 80 Maiden Lane, New York. (Insecticides and fungicides.)
Heil Chemical Co., Henry, St. Louis, Mo. (Spray chemicals.)
Hemingway & Co., Inc., Bound Brook, N. J. (Arsenical poisons.)
Interstate Chemical Co., 12-20 Bay View Ave., Jersey City, N. J. (Insecticides and fungicides.)
Kentucky Tobacco Product Co., Louisville, Ky. (Nicotine solution.)
Kil-Tone Co., The, Vineland, N. J. (Insecticides and fungicides.)
Lavanburg Co., Fred L., 100 William St., New York. (Arsenical poisons.)
Leggett & Brother, 301 Pearl St., New York. (Insecticides and fungicides.)
Mechling Bros. Mfg. Co., Line St., Camden, N. J. (Insecticides and fungicides.)
Merrimac Chemical Co., 33 Broad St., Boston, Mass. (Lead arsenate.)

National Color and Chemical Works, Selling Agents for Taylor Chemical Co., 59th St. & 11th Ave., New York. (Carbon disulphide.)
Niagara Sprayer Co., Middleport, N. Y. (Dusting materials.)
Nitrate Agencies Co., 85 Water St., New York. (Arsenical poisons.)
Pratt Co., B. G., 50 Church St., New York. (Miscible oils.)
Riches, Piver & Co., 30 Church St., New York. (Arsenical poisons.)
Robertson Co., The J. T., 147 Richmond Ave., Syracuse, N. Y. (Miscible oils.)
Roessler & Hasslacher Chemical Co., 100 William St., New York. (Cyanide.)
Sherwin-Williams Co., 601 Canal Road, Cleveland, Ohio. (Lime-sulphur and arsenical poisons.)
Smith Co., H. J., Utica, N. Y. (Insecticides and Fungicides.)
Thum Co., O. & W., Grand Rapids, Mich., 15 India St., Boston, Mass. (Tanglefoot.)
Vreeland Chemical Mfg. Co., 50 Church St., New York. (Insecticides and fungicides.)

CONNECTICUT DEALERS IN SPRAYING SUPPLIES.

Dealers in spraying materials can usually be found in each town. Some of the larger firms are mentioned below.

Apothecaries Hall Co., 24 Benedict St., Waterbury. (Wholesale druggists.)
Barnes Bros., Yalesville. (Insecticides and fungicides.)
Cadwell & Jones, 1084 Main St., Hartford. (Pumps, insecticides and fungicides.)
Grasselli Chemical Co., River St., New Haven. (Insecticides and fungicides.)
Henry & Son, W. A., Blue Hills Farm, Wallingford. (Friend sprayers.)
Jewell, Harvey, Cromwell. (Agent for Hardie hand and power sprayers.)
Leete Co., The Chas. S., 299 State St., New Haven. (Wholesale druggists.)
Lightbourn & Pond Co., 39 Broadway, New Haven. (Pumps, insecticides and fungicides.)
Platt Co., The Frank S., 450 State St., New Haven. (Pumps, insecticides and fungicides.)
Sisson Drug Co., 729 Main St., Hartford. (Spraying machines and insecticides.)
Whittlesey Co., The Chas. W., 259-271 State St., New Haven. (Wholesale druggists.)

Connecticut Agricultural Experiment Station

E. H. JENKINS, Director

SPRAY CALENDAR

W. E. BRITTON, Entomologist

NEW HAVEN, CONN.

BULLETIN 224

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CONNECTICUT
Agricultural Experiment Station
NEW HAVEN, CONN.

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ENTOMOLOGICAL SERIES, No. 28

A STUDY OF THE BULB MITE.

By Philip Garman.

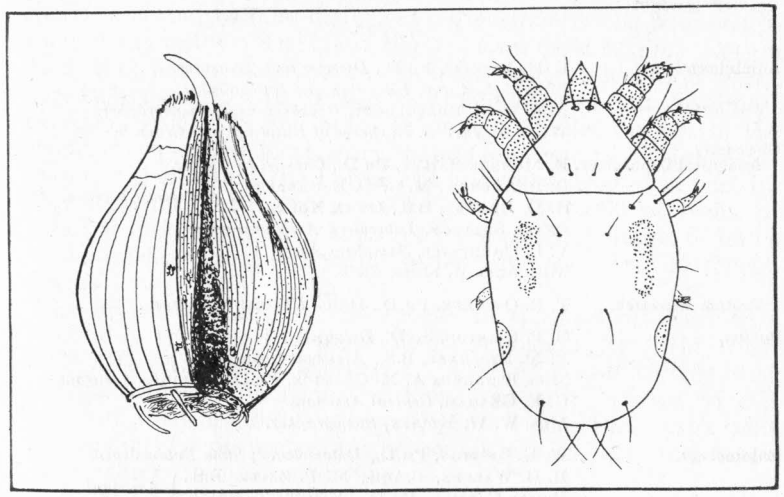

Figure 1. Section of infested bulb, and a mite greatly enlarged.

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Press of The Wilson H. Lee Company.

A Study of the Bulb Mite.

(*Rhizoglyphus hyacinthi Banks.*)

By Philip Garman, Ph.D.

Inspection of over a million bulbs in Connecticut during 1919 brought to light the significant fact that nearly all shipments contained the bulb mite *R. hyacinthi* Banks. In many shipments only a few infested bulbs were found, but in others as high as fifteen to twenty per cent. were apparently destroyed. Shipments were, however, frequently delayed in transit according to reports, a state of affairs doubtless responsible for the poor condition of many bulbs when they arrived at their destination. Rotten bulbs, too, are not always the result of mite infestation alone, there being several other causes of rot and disease—but the almost universal presence of the mites in decayed bulbs has led to the present study of the life history, habits and control of the pest.

Woods[1] claims that the Bermuda lily disease, caused in part by mite infestation, results in a yearly loss of 20 to 60 per cent. of the entire crop where the plants are forced. Destruction of bulbs has also been noted by many other American and European workers.

The injurious effects of the species in Connecticut were first described in the report of the State Entomologist for 1915[2], when 3000 Easter lilies were destroyed. Since then, no specific case in which extensive damage was done, has been reported to this office, but there is doubtless a small per cent. of loss each year which should be prevented by proper inspection, care and treatment of the mite-infested bulbs.

Distribution of the Species.

The bulb mite has been reported in foreign shipments to various states and to Canada. Shipments of bulbs to Connecticut come mostly from France, Belgium and Holland, but what is apparently the same species was found in one shipment received from Japan. It has also been reported in shipments of bulbs from the Bermuda Islands and thus seems to have a fairly wide distribution.

The Name of the Bulb Mite.

Banks[3] in 1906, listed under the name of *Rhizoglyphus hyacinthi* Boisduval a species of mite which he found in bulbs. Since that

[1] U. S. Dept. Agr. Div. Veg. Phy. & Path. Bul. 14: 1897.
[2] Conn. Agr. Exp. Sta. Rep. 190: 1915.
[3] Banks, N., Revision of the Tyroglyphidae, U.S.D.A. Bur.Ent.Tech. Ser.13: 21: 1906.

time Americans have religiously followed the name *hyacinthi* in preference to the name *echinopus* of European authors. Michael[1], however, places *hyacinthi* as a synonym of *echinopus*, with the remark that *hyacinthi* of Boisduval is a *nomum nudum* being listed without description. Michael is correct in this statement, since the original description given by Boisduval is very meager and is not sufficient for purposes of identification. However, the description of *echinopus* given by Fumouze and Robin[2] shows that the latter may also have considered a different species; for the species in hand differs from it (and also Michael's description) in important particulars.

The most striking of these characters are the chitinous thickenings on the fourth pair of legs, which occur both in normal and heteromorphic males. Michael states that the only species bearing this character is *R. crassipes* Haller, which was originally described as an American species[3], but *crassipes* differs (in other particulars), from our species, and we are forced to conclude that either the chitinous thickenings have been overlooked or the species may be different from all described species. Inasmuch as Michael (l. c., p. 83) says emphatically that "there are not any suckers on the leg of the male of any species except *R. crassipes* Haller" we are able to conclude that he must have examined the species which he described, for this particular character. Examination of material from the U. S. National Museum shows chitinous thickenings on the fourth pair of legs in *R. hyacinthi* and *R. rhizophagus*. The rather frequent presence of the dimorphic male excludes the species in hand from *rhizophagus* and refers it to *hyacinthi*. As already intimated, a search through Boisduval's works has revealed no adequate description of this species and either his name *hyacinthi* must be disregarded or the authority changed from Boisduval to Banks. The latter course is to be preferred and the name *Rhizoglyphus hyacinthi* Banks instead of *Rhizoglyphus hyacinthi* Boisduval should be used, since Boisduval's name cannot be connected with any known species.

For convenience the description given by Boisduval is quoted herewith. Bank's description of the species is found in Bur. Ent. Tech. Ser. Bul. 13, p. 21, 1906 (pl. V fig. 49).

Description by Boisduval.

Entomologie Horticole p. 86: 1867.

"Nous ne trouvons mentionnè nulle part l'acarus de la Jacinthe, nous ne savons pa s'il n'a pas deja ete observé par quelque naturaliste. Nous lui donnons le nom provisoire d'acarus des Jacinthes *Acarus hyacinthi.*"

---

[1] Michael, A. D., British Tyroglyphidae II: p. 85: 1903.
[2] Jour. Anat. Phys , V: 287: 1868.
[3] Haller, Archiv Naturgeschichte, 50: 218: 1884.

General Description.

Egg (Fig. 2, No. 6),—The egg is ellipsoidal, white and semitransparent; .12 by .07 mm. in size.

Larva (Fig. 2, No. 2),—Small, white, somewhat ovoid in shape; genital suckers absent. Cephalo-thorax with two long setae on the frontal margin above, and two near the caudo-lateral angle; no minute bristles between the latter as in the adult; venter of the thorax with a clavate sense organ (Fig. 2, No. 3) between the bases of the first and second coxae on each side and small setae mesad of these; front tarsi with strong spines as in the adult, but the clavate hair much longer than the spine immediately beyond it; tip of the tarsus with three slender setae; front tibiae with the usual long setae on the dorsum, the patella (3rd segment from end beginning with tarsus) each with two shorter setae on the dorsum as in the adult. Abdomen with one pair of legs, the tarsi of each of which bears a long heavy spine and longer seta on the dorsal surface and three spines on the ventral; tarsal claw very stout; tibiae each bearing a single long seta on the dorsal surface; lateral margins of the abdomen with four setae on each side and a pair near the anal opening.

Size shortly after emergence from the egg, .15-.2 by .1 mm., full grown, .25 by .15 mm.

Protonymph (Fig. 2, No.1),—Similar to the larva in size and shape but larger and provided with four pairs of legs instead of three; rostrum as in adult; cephalo-thorax as in adult; with two long setae on the frontal margin of the dorsum and two near the caudo-lateral angle; no minute setae between the latter; the front tarsi have, in common with the adult, a minute clavate hair at the base and to one side of the large clavate hair; and between the larger clavate hair and the spine (immediately beyond) is a smaller spine about one-fifth the length of the latter; tip of front tarsi with three slender setae each. The fouth pair of legs has only one seta at the tip of the tarsus and there is no dorsal spine on that segment; however, there is a strong lateral spine and a ventral spine. Judging from the spines and setae on the tarsi of leg three in the larva and the protonymph, the fourth pair of legs of the protonymph must grow in behind the third pair of the larva.

This stage is most easily distinguished from the tritonymph, which it resembles more closely than other stages, by the appearance of the genital suckers. In the protonymph only two make their appearance while in the tritonymph there are three or four (see Fig. 2, No. 5). There is also some difference in the tarsi of the fourth pair of legs, the latter possessing no dorsal spine in this stage.

Length full grown, about .4 mm., width about .2 mm.

Deutonymph or **hypopus** (Fig. 2, No. 11),—Oval in shape, dorsum convex; venter flat; color brown, the body heavily reinforced throughout with chitin. Rostrum apparently reduced to a small cylindrical projection entirely covered by the cephalo-thorax; distal end of rostrum with two long setae, and a smaller one at the base of each. Mouth parts wanting; cephalo-thorax with two long setae on the front margin placed closely together, and about the same length as the long setae of the rostrum; legs for the most part without the heavy spines of the adult, the latter replaced in most cases by setae; tarsal claws long, curved rather sharply; tarsi of first pair of legs with four slender setae at tip and two near middle of ventral surface. There is also a heavy spine on the ventral surface; a large clavate hair nearly half as long as the segment, and a smaller clavate hair and small seta on caudal surface near the larger one. In front of the larger clavate hair there is also a long seta; front tibia with a long seta on dorsum and a single spine on each side; patella with a single seta at tip instead of two, as in all other stages. Abdomen with conspicuous expulsory vesicles on either side; margin composed of thick heavy chitin, which shows prominent striations under magnification; venter with conspicuous suckers as in Fig. 2, No. 11, one on each side of the

anal opening, two caudad of this, then a row of four, and finally two more Surrounding the eight caudal suckers is a squarish ring which is thickened at each of its four corners, making it appear as if four additional suckers were present; conspicuous lines of chitin on the venter, extending cephalo-mesad from the anal opening and each coxa of legs III and IV; third and fourth pair of legs short and usually hidden by the overhanging body wall when viewed from above; tarsi with four setae and two heavy spines at tip; tibiae with a long seta near tip, on dorsum; margin of abdomen with four, minute marginal setae.

Length, .2-.3 mm. Width .13-.18 mm.

Tritonymph (Fig. 2, No. 9),—Color white, translucent or semiopaque, legs brown or tinged with pink.

Rostrum and cephalo-thorax agreeing in nearly all particulars with the adult female. Abdomen as in the adult as regards setae; but the genitalia undeveloped; the genital suckers consist of four indistinct suckers closely approximated (Fig. 2, No. 9).

Length .5-.6 mm, width .3-.3.5 mm.

Adult (Fig. 3, Nos. 12-15; Fig. 2, Nos. 4, 5, 7 and 8),—Color white, body somewhat transparent; legs epimera and rostrum brown, sometimes with a pinkish hue.

Rostrum with large mandibles, which are chelate, maxillary palpi with two distinct segments closely joined to the rostrum and a very small projection at the tip, which may represent a third segment. Each of the longer segments with a minute seta, and a longer seta on each maxilla; cephalo-thorax narrowed rapidly in front, the sides gently curved, the front margin with two long setae extending beyond the rostrum and placed closely together; near the caudo-lateral angles of the dorsum are also two long setae between which are two usually minute hairs; venter of cephalo-thorax with conspicuous epimera, the front epimera being united on the mesal line; between the first and second epimera on each side there is usually a small seta; first two pairs of legs thicker than the last two, 5-segmented, the tarsi of the first pair provided with spines and setae as follows: a large clavate sense organ, near the proxima lmargin on the dorsum, and a large heavy spine just distad of this; a much smaller clavate hair at one side of the larger sense organ, about half its length; between the larger clavate sense organ first mentioned and the spine distad of it is a smaller spine about one-third its length; at the tip of the tarsus above there is also a large spine with three setae surrounding it, one of which is much smaller than the rest; ventrad of the tarsal claw there are usually three or four heavy spines, grouped together and another proximad of these; there is a long seta near the proximal spine and a very inconspicuous one on the opposite surface of the tarsus; tarsal claw not sharply curved; tibia with a long seta on the dorsum near the distal end which is often as long or longer than the tarsal segment; there is a single stout spine on the caudal and ventral surface of this segment; the patella has two closely placed setae near the distal margin of the dorsum and the femur has a single long seta on the ventral surface; the second tarsus is essentially the same as the first, except that the smaller clavate hair or sense organ, and the small spine (between the larger hair and the spine immediately distad) are wanting; one seta is also lacking from the tip; the third and fourth pairs of legs lack the clavate sense organs and are different in the two sexes. In the female and normal male the third pair of legs are similar; there is a long thick spine at the tip of the tarsus, above and below which is a long slender seta; on the caudal surface of this segment there is also one seta and there is a spine on the opposite surface; the ventral surface has a spine shortly distad of the middle and a group of about four ventrad of the tarsal claw; the latter is sharply hooked. The third pair of legs of the dimorphic male are much thicker than the third pair of the female or normal male. There are four long setae at the tip, and the tarsal claw seems to be fused with the

tarsal segment (Fig. 2, No. 10); the fourth pair of legs differ in the two sexes but are the same in dimorphic and normal males. In the female there is a distal spine on the tarsal segment just above the claw and one lateral (caudal surface) and one ventral spine in addition, besides a group of three just beneath the claw. There are usually three setae, one above and another below the distal spine and one lateral seta; in the male the distal dorsal spine is wanting, being replaced by a chitinous thickening sometimes called a sucker; proximad of this is still another thickening and between the two a single seta; the segment possesses the usual number of spines below the claw on lateral and ventral surfaces (Fig. 2, No. 7).

In the female the lateral surfaces of the abdomen are provided with about five setae on each side; the ventral surface with three minute setae on each side of the genital opening and one between the third and fourth coxae, a small one in front of and to one side of the third coxae and a long one on each side of the anal opening; the genital opening forms an inverted V-shaped figure with two genital suckers on each side (Fig. 3, No. 14); the dorsum has five setae on each side, of which the caudal pair are the longest.

In the male there are the usual five setae on lateral and caudo-lateral surfaces of the abdomen and one minute seta between the third and fourth pairs of legs on ventral surface, and a smaller one in front of and to one side of the third coxae; genital opening as in Fig. 3, No. 12 with two genital suckers on each side. Caudad of the genital opening are found two larger disc-like suckers, with a minute seta, caudad and cephalad, and usually a row of four longer ones caudad of the suckers; setae of the dorsum as in female.

Variations—There seems to be some variation both in the length of the setae of the legs and body and also in the thickness of the tarsal segments. Of seventeen individuals, however, measured with micrometer the ratio of width to length of tarsus IV ranged from 1-1.6 to 1-2.5, both sexes being examined. There is also a great variation in the depth of the depressions on the dorsum of the adult, they being almost obliterated in some individuals.

Length, female .47-.95 mm; male .5-.6 mm. Width, female .3-.4 mm; male .25-.3 mm.

Host Plants Infested and the Injury Resulting from the Infestation.

Narcissus (Plate I, b; II, a; III, b), hyacinth, tulip, crocus and Easter lily bulbs, are infested by the bulb mite. In the laboratory it has been reared on onions and potatoes, and is probably capable of subsisting on almost any tuber or bulb. Its common occurrence in narcissus and lily bulbs may be due to the fact that these bulbs offer least resistance to attack since the scales are loose and the mites find it easy to penetrate to the interior. Tulips are least injured, owing to their outer skin and tight-fitting scales which have no place for the mites to enter. Hyacinths seem to be less easy to penetrate than narcissus, while onions, artificially infested with mites, were not injured unless they were partly rotten or bruised in the beginning.

That the mites are able to feed on healthy tissue seems evident both from numerous references to this particular ability by various writers and from the experience of those connected with this office in the case of the Bermuda lilies already mentioned. A small

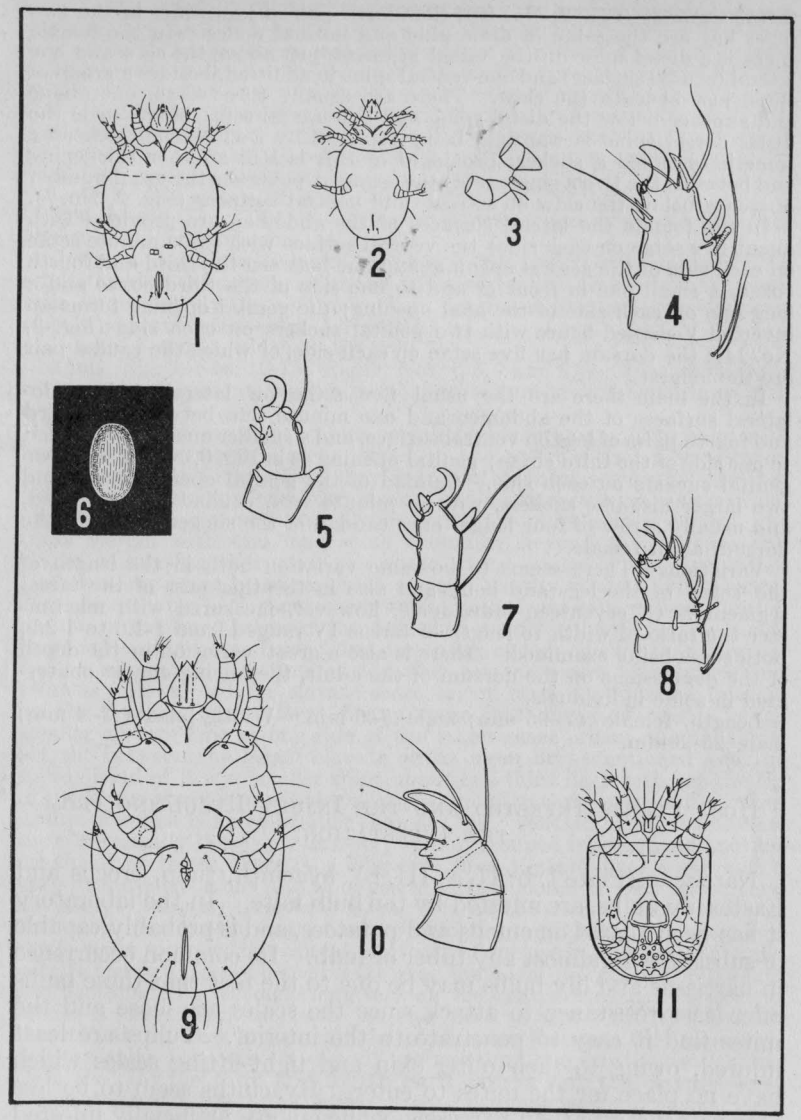


Figure 2. The bulb mite (*Rhizoglyphus hyacinthi* Banks). 1. Protonymph, enlarged about 80 times. 2. Larva, enlarged about 80 times. 3. Larva, sense organ of the ventral surface of the cephalothorax. 4. Front tibia and tarsus of the female. 5. Fourth tibia and tarsus of male. 6. Egg, enlarged about 80 times. 7. Fourth tibia and tarsus of the female. 8. Front tibia and tarsus of the female. 9. Tritonymph, enlarged about 80 times. 10. Fourth tibia and tarsus of dimorphic male. 11. Deutonymph or hypopus, enlarged about 80 times.

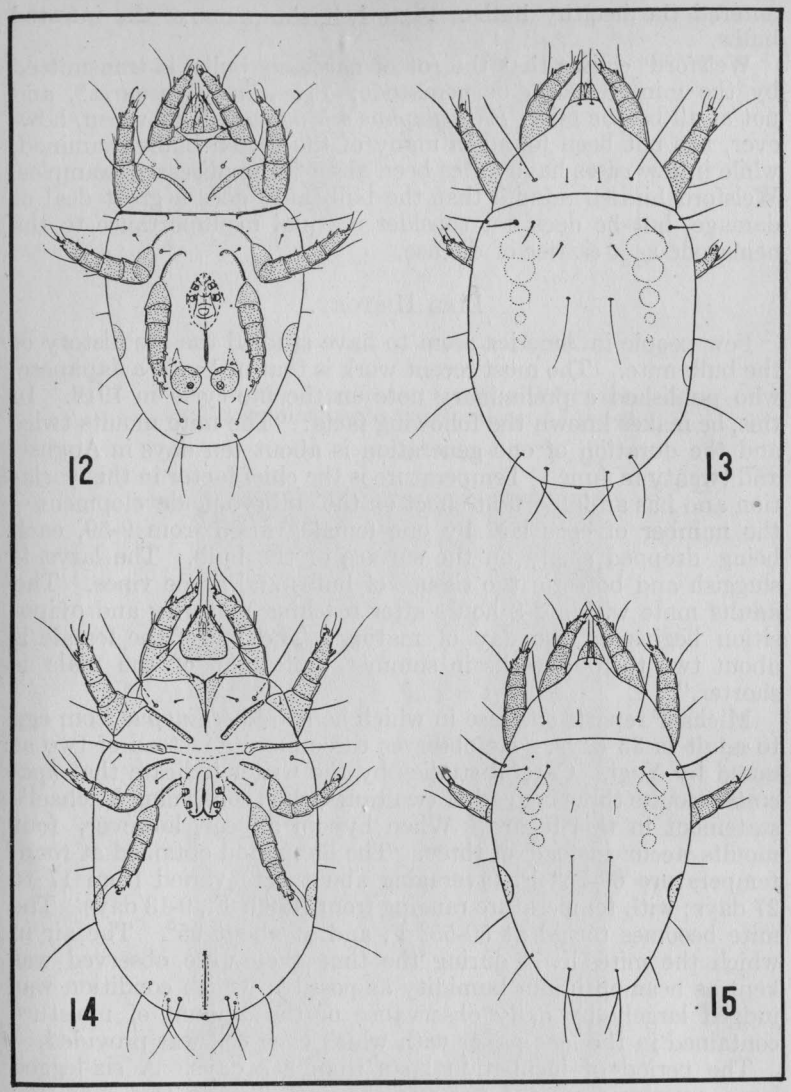


Figure 3. Adult bulb mite (*Rhizoglyphus hyacinthi* Banks), enlarged 80 times. 12. Male, ventral view. 13. Female, dorsal view. 14. Female, ventral view. 15. Male, dorsal view.

number of tests have been conducted by the writer in which mites entered and fed on growing narcissus bulbs. In these tests rotten bulbs containing mites were placed in pots of soil just below the healthy ones and the mites readily left the rotten and

entered the healthy bulbs. Plate I, b, shows one of the infested bulbs.

Welsford[1] claims that the rot of narcissus bulbs is transmitted by the minute worm or nematode, *Tylenchus devastatrix**, and not at all by the mite, *Rhizoglyphus echinopus*. This worm, however, has not been found in many of the rotten bulbs examined, while in few cases have mites been absent from diseased examples. Welsford himself admits that the bulb mite does a great deal of damage, but he does not consider it equal in importance to the nematode as a carrier of disease.

Life History.

Few people in America seem to have studied the life history of the bulb mite. The most recent work is that of Yagi[2], a Japanese, who published a preliminary note on the life cycle in 1919. In this, he makes known the following facts: "The mite moults twice and the duration of one generation is about ten days in August, and twenty in June. Temperature is the chief factor in this variation and has an important effect on the embryonic development—the number of eggs laid by one female varied from 9-59, each being dropped singly on the surface of the bulb. The larva is sluggish and bores in the tissues of bulbs and grape vines. The adults mate within 2-8 hours after reaching maturity and oviposition begins on the day of mating. The life of the female is about two to four weeks in summer while that of the male is shorter."

Michael[3] reports one case in which he reared *echinopus* from egg to adult in 33 days. He observes three moults instead of two as noted by Yagi. Careful studies by the writer indicate that *hyacinthi* moults three instead of two times, thus confirming Michael's statement in this regard. When hypopi appear, however, four moults accur instead of three. The life period obtained at room temperature 60-75° F. (averaging about 68°) varied from 17 to 27 days; with temperature ranging from 70-80° F., 9-13 days. The mite becomes torpid at 50-55° F. and at about 95°. The air in which the mites lived during the time they were observed was kept as near optimum humidity as possible, which condition was judged largely by daily observance of the amount of moisture contained in the lens paper with which each cell was provided.

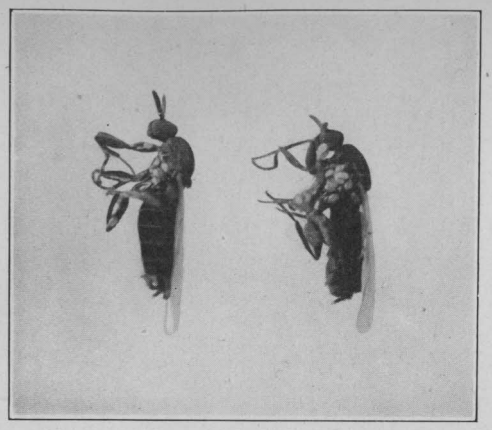
The period of incubation lasts from 4-7 days. A six-legged larva emerges from the egg and the mite lives in this condition 3 to 8 days. The last day or so of this period, sometimes two

* Now *T. dipsaci* Kühn.

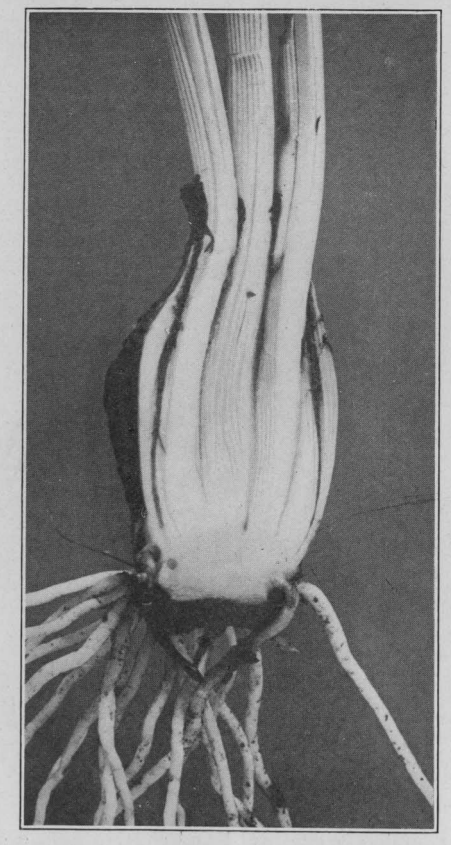
[1] Welsford, E. J. Investigation of bulb rot of narcissus. Ann. Appl. Biol. 82: 36-46: 1917.

[2] Yagi, N. Berichte Ohara Inst. Landwirtsch. Forschungen I: 349-360: 1918 Abstract in Rev. Appl. Ent., VII: 439-440: 1919.

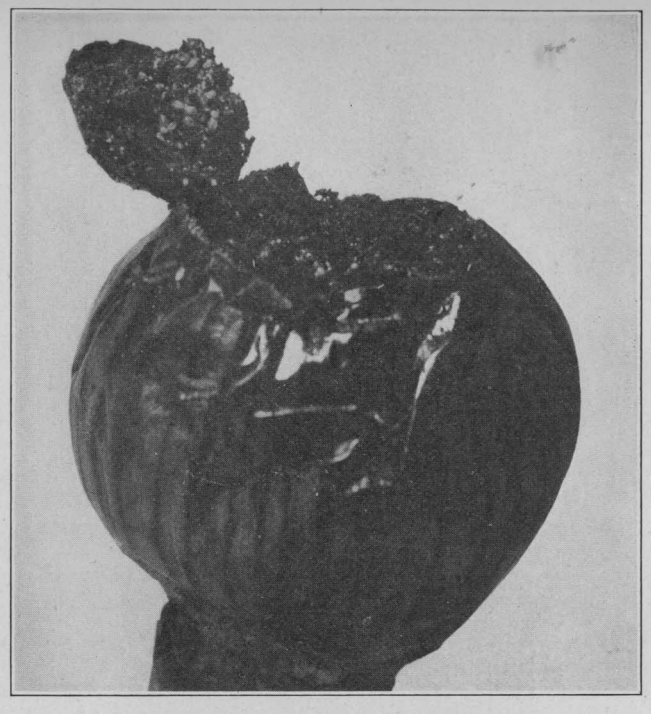
[3] Michael, A. D. British Tyroglyphidae. Vol. II: 92-93: 1903.



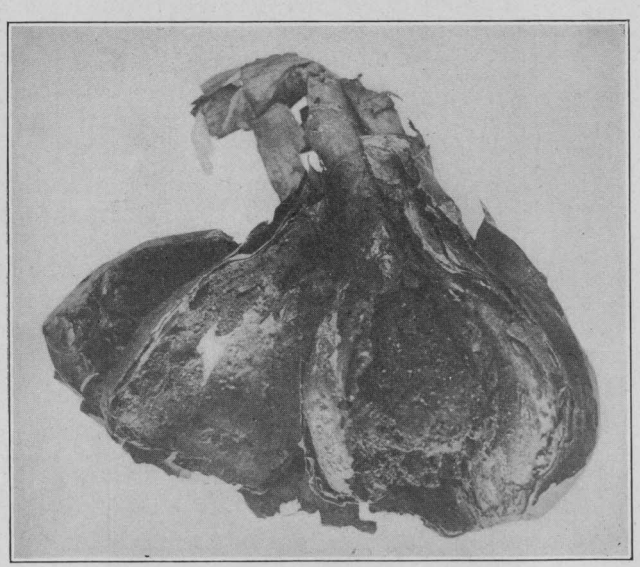
a. Flies, (*Scatopse pulicaria* Loew) with hypopi of the bulb mite clinging to them, enlarged 7 times.



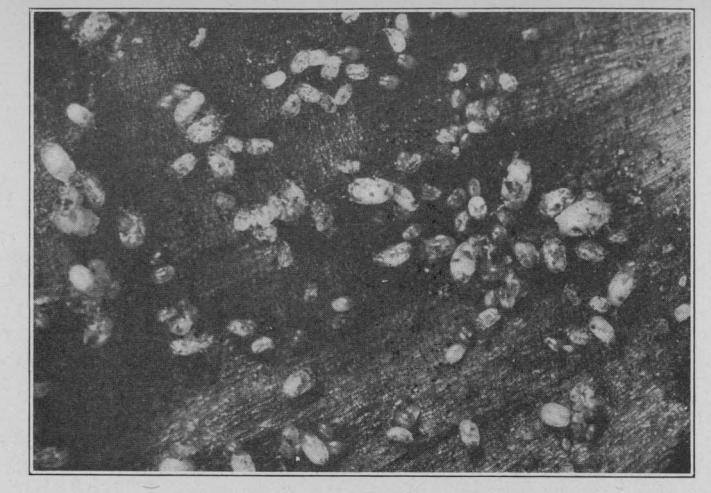
b. Mite infestation just beginning in a growing bulb. Its progress is indicated by the dark lines between the scales, natural size.



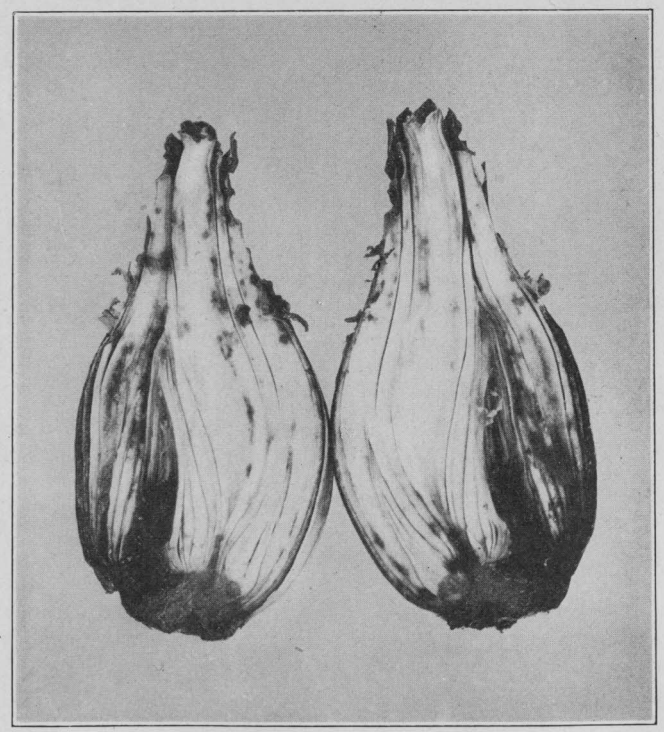
a. Rotten bulb with base removed showing mites, twice natural size.



b. Bulb completely destroyed and containing a great many mites, natural size.



a. Mites from a rotten bulb, enlarged 8 times.



b. Infestation just beginning in a healthy bulb, natural size.

days, is spent in a torpid or quiescent condition and at this time the larva swells so that the separating line between the thorax and abdomen is lost. On moulting the larva acquires two additional legs, making eight in all. The next period, which may be known as the protonymph* lasts two to four days, after which follows a second quiescent period of about two days and a second moult takes place. This time there is no increase in the number of legs or much change in form unless a hypopus or resting stage is produced. If normal in form the mite, now known as the tritonymph*, again goes into the quiescent state which lasts 1-2 days; and moults. The adult mite then emerges. If, however, the hypopial state appears after the second moult, the mite may rest for one or two weeks or more, afterwards moulting and giving rise to the tritonymph. The latter then moults and the adult mite emerges as before.

Adults mate a day or so after becoming mature and the eggs are soon laid, beginning with a few daily at first and later increasing in number up to six or eight. Two females observed laid ten eggs per day for four successive days, but this is rather unusual. The number of eggs laid has been found to vary considerably, some females laying more than one hundred, others laying only a few. One individual laid 130 eggs in all, while one other laid 81, and still another 59. The males usually die shortly after mating, but if kept separate have been observed at this laboratory to live for more than two months. Females also live from one to two months or more if properly fed and cared for.

The following shows the course of the life history:

Cycle in which hypopial stage is skipped.

Egg—larva—first nymph—third nymph—adult female.
Egg—larva—first nymph—third nymph—dimorphic male adult,
normal male adult.

Cycle with hypopial stage.

Egg—larva—first nymph—hypopus—third nymph—adult female.
Egg—larva—first nymph—hypopus—third nymph—dimorphic male adult,
normal male adult.

The Dimorphic or Heteromorphic Male.

The dimorphic male with enlarged third pair of legs (Fig. 2, No. 10) has been thought by some to be a distinct species, but it has been definitely proven by others to be merely a form of more or less infrequent occurrence. In one lot of mites examined 36 males were seen without encountering a single dimorphic form. In other lots the males with and without enlarged legs appeared in about equal numbers. The dimorphic males breed freely and the offspring consists of both females and normal and heteromorphic

* The hypopus is regarded as the deutonymph, and is frequently interpolated between protonymph and tritonymph.

males. One specimen was seen with an enlarged third leg on one side and a leg of normal size on the other. The exact function of the dimorphic male is not clearly understood, nor do we understand the causes which bring about such remarkable differences in this sex.

The Hypopus.

Rather complete studies of the hypopus of *echinopus* have been made by Michael and other European authorities, and it is now regarded as a normal period in the life history of the mite. Briefly explained, it is a form similar to some of its ancestors which is produced from time to time from no apparent reason other than a strong tendency to revert to type and "is a provision of nature for the distribution of the species occurring irrespective of adverse conditions[1]". Notwithstanding, the fact remains that is often impossible to distinguish between favorable and unfavorable conditions and it seems certain that conditions promoting their development are not always at hand. The following notes relate to the development of the hypopus.

First of all it has appeared that hypopi are much more numerous in jars where the bulbs are rotted enough to leave them in a wet, sticky condition. Hypopi are produced in dry as well as moist cells, but more rapidly and frequently more abundantly in the moist cells. This was demonstrated by use of a moisture gradient consisting of four hanging drop slides with small cells, clamped to a larger piece of glass and with a sheet of lens paper between; one end of the gradient being placed in moist sand, and each cell provided with a single pair of mites and the necessary food. The following shows the results of three tests with the gradient described. Cell No. 1 in each case was in contact with moist sand, 2, 3 and 4 further away in the order mentioned. These tests were then repeated with similar results.

No. of cell.	No. of mites.	Per cent. of hypopi.	Food used.	Date Begun.	Examined.
1	111	27	Unfermented dry narcissus.	May 14	July 7
3	83	7	"	" "	" "
4	90	0	"	" "	" "
			Fermented		
2	39	82	hyacinth.	" "	" "
3	14	50	"	" "	" "
4	105	0	"	" "	" "
			Fresh		
1	213	25	narcissus.	July 24	Sept. 9
2	60	10	"	" "	" "
3	21	0	"	" "	" "
4	60	0	"	" "	" "

[1] Michael, A. D. The hypopus question, or the life-history of certain Acarina. Jour. Linn. Soc., Zool., XVII; 389; 1884.

On April first a small tightly corked bottle was provided with about an inch of moist sand and a number of slices of potato previously infested with the bulb mite. These mites did not multiply rapidly but reproduced fairly well and on June 8, 100 individuals were counted without encountering a single hypopus. Little or no fermentation took place in the bottle until after this date and most of the eggs were laid on the outside of the potato and were fairly dry. However, where the potatoes were in contact with the sand there was considerable moisture surrounding the developing mites. Only one hypopus was seen in the bottle until July 1. During the latter part of July mold obtained a foothold on the potato but the mites continued to breed, many of them being covered with a wet sticky film. However, even under such conditions less than one per cent. of hypopi developed—as was seen by examination on September 9. In order to test the natural ability of the strain on potato to produce hypopi, mites were transferred to glass cells with narcissus or hyacinth at several different periods during the course of the experiment. Hypopi were produced abundantly in practically every case the percentage varying from 10 to 80%. In this bottle and five other similar ones made from it hypopi did not begin to appear in numbers until about October 25, making a period of some six months when they did not develop. It is difficult to explain the appearance of the hypopus in small cell transfers, but it seems as if some necessary change in conditions must have taken place.

Hypopi developed in light and dark, when fed on decayed and sound food, in moist and dry cells and apparently when warm and cold. They also developed about equally well when the food was covered with small amounts of sugar, alcohol (2%) and acetic acid (1%).

Michael used many experiments to try to induce certain species of Tyroglyphids to develop without producing hypopi, but failed; and he concluded that hypopus is a normal stage in their development. Notwithstanding, in the case of mites like the bulb mite in which all individuals do not pass through the hypopus stage, it seems hazardous to ascribe such a phenomenon entirely to the inherent atavistic tendency or natural habit of the individuals. It is well known that in a somewhat similar life cycle found in aphids, reversion to the sexual forms which are more commonly skipped are induced largely by changes of weather and food. Some species of aphids, moreover, may be reared continuously without reversion, when proper conditions of moisture, temperture, etc., are maintained, and it seems as if something similar must be true of the mites under investigation, caused by factors which we have not yet learned to recognize.

The length of the hypopus stage under favorable conditions is usually about one to two weeks.

Migration of the Species.

The hypopus is much more active than the remaining stages in the life cycle of the mite, and has a tendency to wander from place to place. It will also attach itself to any moving object. At the time when hypopi become numerous, the bulbs are commonly well rotted and infested by numerous small fly larvae, one of which (*Scatopse pulicaria* Loew) (Plate I, a) was found in large numbers. The flies of this species were frequently found to be literally covered with hypopi attached by means of their ventral suckers. Other hypopi were seen riding peacefully on the backs of predaceous mites, and still others have been found attached to lepidopterous larvae. The mite is thus afforded an admirable means of transportation, of which it is capable of taking full advantage because of its structure and habits.

The tables below show the length of the various stages as determined at this laboratory.

Tabular Life History of the Bulb Mite

LENGTH OF EGG STAGE.

Length of stage days.	Number observed.	Dates.
		1919.
	Temperature 60°-75° F.	
7	8	Sept. 29-Oct. 6.
6½	3	Oct. 10-Oct. 17.
7	4	Oct. 10-Oct. 17.
6½	4	Oct. 10-Oct. 17.
		1920.
	Temperature 70°-80° F.	
4	2	July 15-July 19.
3	2	July 16-July 19.
4	3	July 16-July 20.
4	8	July 16-July 20.

LENGTH OF LARVAL STAGE.

Length of stage days.	Number observed.	Dates.
		1919.
	Temperature 60°-75° F.	
8	1	Oct. 3-Oct. 10.
6	1	Oct. 6-Oct. 11.
7	2	Oct. 6-Oct. 12.
6	2	Oct. 17-Oct. 21.
6	1	Oct. 17-Oct. 22.
6	2	Oct. 17-Oct. 22.
6½	2	Oct. 16-Oct. 21.
		1920.
	Temperature 70°-80° F.	
2	2	July 19-July 21.
3	8	July 20-July 23.
3	2	July 18-July 21.
4	1	July 19-July 23.
5	3	July 19-July 24.

LENGTH OF FIRST NYMPHAL STAGE (PROTONYMPH).

Length of stage days.	Number observed.	Dates.
		1919.
	Temperature 60°-75° F.	
3	1	Nov. 10-Nov. 13.
3	1	Nov. 12-Nov. 15.
4	1	Nov. 11-Nov. 15.
3	1	Nov. 8-Nov. 11.
4	1	Nov. 8-Nov. 12.
8	1	Nov. 16-Nov. 24.
5	1	Nov. 19-Nov. 24.
3	1	Nov. 20-Nov. 23.
2	1	Nov. 20-Nov. 22.
		1920.
	Temperature 70°-80° F.	
2	1	July 21-July 23.
2	1	July 21-July 23.
2	1	July 21-July 23.
1	2	July 21-July 22.
2	2	July 21-July 23.

LENGTH OF HYPOPUS STAGE (DEUTONYMPH).

Length of stage days.	Number observed.	Dates.
		1920.
	Temperature 65°-75° F.	
12	1	March 15-March 27.
7	1	March 29-April 5.
5	1	April 17-April 22.
7	1	April 10-April 17.
13	1	April 10-April 23.

LENGTH OF THIRD NYMPHAL STAGE (TRITONYMPH).

Length of stage days.	Number observed.	Dates.
		1919.
	Temperature 60°-75° F.	
4	1	Nov. 15-Nov. 19.
3	1	Nov. 11-Nov. 14.
4	1	Nov. 12-Nov. 16.
3	1	Nov. 24-Nov. 27.
3	1	Nov. 23-Nov. 26.
4	1	Nov. 22-Nov. 26.
		1920.
	Temperature 70°-80° F.	
3	1	July 23-July 26.
3	1	July 24-July 27.
2	1	July 25-July 27.
3	1	July 24-July 27.
2	1	July 23-July 25.
2	2	July 22-July 24.
2	1	July 23-July 25.

Variations obtained in length of life cycle 9-29 days (with hypopus absent from the cycle); with hypopus included 14-42 days.

Other Species of Mites and Predaceous Enemies.

Several predaceous mites (Parasitidae) and the Tyroglyphid, *Histiostoma rostro-serratus* have been found frequently, but the

Tests of Various Oils.

Insecticide used.	Strength of material used.	Length of exposure.	Number alive.	Number dead.	Per cent. killed	Dates. 1919.	Notes.
Fir tree oil*	1 pt.**—320 pts. water	2 min.	23	143	86.1	10/17	All stages included.
Scalecide	1 pt.—25 pts. water	2 min.	400	3	.7	10/17	" " "
"	1 pt.—15 pts. water	10 min.	500	0	0	11/20	" " "
Lemon oil	1 pt.—100 pts. water	½ hr.	149	1	.6		
" "	1 pt.—10 pts. water	½ hr.	10	0	0		Hypopi only.
" "	1 pt.—25 pts. water	2 hrs.	48	2	4.0	12/13	" "
Schnarr's Insecticide	1 pt.—100 pts. water	2 min.	100	0	0	10/17	
" "	1 pt.—50 pts. water	10 min.	200	2	.9	11/20	
Check (soaked in tap water)		10 min.	135	5	3.5	11/20	

Tests of Fumigants.

Carbon disulphide	1 oz.—100 cu. ft.	24 hrs.			50	11/17	Room temperature.
" "	1 oz.—100 cu. ft.	48 hrs.	4	106	96.0	11/20-22	" "
" "	1 oz.—100 cu. ft.	48 hrs.	36	11	23.4	11/20-22	Room temperature; hypopi only.

Tests of Heat, Nicotine, Formalin and Combinations Thereof.

Insecticide used.		Strength of Insecticide.	Length of exposure.	Number alive.	Number dead.	Per cent. killed	Dates 1919.	Notes.
Heat	70° C.		1 hr.	0	200	100	11/30	Mites put in stoppered bottles and heated in an oven with gas. All hypopi and mites on interior of bulb were dead at end of period.
"	49° C.		1 hr.	98	2	2	12/2	
"	49° C.		1 hr.	8	2	20	12/2	
Hot water	50° C.		1 hr.	0	140	100	12/2	No hypopi seen.
" "	50° C.		10 min.	0	100	100	12/3	" " "
" "	50° C.		10 min.	8	2	20	12/3	Hypopi only.
" "	55° C.		10 min.	0	50	100	12/16	
" "	55° C.		10 min.	0	10	100	12/16	Hypopi only.
" "	60° C.		10 min.	0	200	100	12/5	Temperature fell from 60° at beginning to 52° at end of period.
" "	60° C.		20 min.	0	200	100		Hypopi and all mites on interior of bulb were killed.
40% Formalin	50° C.	1-20 (2%)	2 min.	16	38	70.3	12/23	Hypopi and normal mites observed alive.
40% "	50° C.	1-20 (2%)	10 min.	0	32	100	12/23	Hypopi only.
Nicotine sulphate	R*	1-800	2 min.	500	50	9.0	11/17	Some of mites on interior of bulb were dead.
Nicotine sulphate and soap	R	1-400 soap, 2 lbs. 50 gals.	10 min.	64	11	14.6	11/20	
Nicotine sulphate and soap	R	" " "	24 hrs.	221	17	7.1	11/20 1920.	
Nicotine sulphate	51° C.	1-400	5 min.	0	110	100	1/17	Hypopi only.
" "	50° C.	1-400	10 min.	10	131	92.9	11/26	No hypopi. Many mites on interior of bulb killed.
Nicotine oleate	R	Moore's** formula	10 min.	2	14	87.5	1/14	Very few hypopi.
Nicotine oleate	50° C.	Moore's formula	5 min.	2	48	96	1/14	Hypopi only.
" "	50° C.	" "	5 min.	0	50	100	1/14	Normal mites only.
" "	50° C.	½ strength of above.	5 min.	0	21	100	1/15	Hypopi only.
" "	50° C.	Same as above.	5 min.	0	100	100	1/15	Normal mites.
Check (no treatment)				60	0	0	1/19	Hypopi only counted.

* This insecticide is now difficult to obtain on the market.
** Pt. equals part.

*R = room temperature. Tap water used at about 20° C.
**Nicotine oleate made by combining 10 parts kerosene with 1¼ parts commercial oleic acid, and then 2½ parts of 40% nicotine solution. 10 parts of water were added and the whole quantity then mixed with 480 parts of tap water. See Jour. Econ. Ent. XI: 342, 1918. The oleic acid from which nicotine oleate is prepared is difficult to obtain.

latter seems to flourish best in wet rotten bulbs and has not been observed to feed on healthy tissue. The small hypopus of this species is produced abundantly and frequently attaches itself to *Rhizoglyphus* or any insect which lives within the bulbs. *Histiostoma* is much smaller than *Rhizoglyphus* as is also the hypopus, compared with that of the bulb mite. When observed feeding the adult is much lighter in color and the caudal margins of the abdomen are less rounded. The predaceous species (Laelaptini) are very active brown mites slightly larger than the true bulb mite. In one box of bulbs containing about one-fourth bushel, these enemies became very numerous and were seen running about over the bulbs like ants. Doubtless they had destroyed many bulb mites. In another case a Mason jar containing many bulb mites was entirely cleared of *Rhizoglyphus* in about a month after the predaceous species was first noticed in the jar.

The small Cecidomyid fly *Lestodiplosis* sp.* was also found feeding upon the bulb mite. The larva is a small, pinkish maggot about one mm. in length, which crawls about among the mites and feeds on them.

Control Measures.

Morphological studies show that the mite has no tracheal system and cannot be killed, theoretically, by ordinary fumigants. Ewing[1] demonstrated that 4.1 oz. of potassium cyanide per 5470 cu. ft. or 1 oz. per 133 cu. ft. of air space was insufficient to kill the bulb mite. Fumigation at this laboratory with carbon disulphide in an air tight container, 1 oz. to 100 cu. ft. required 48 hours to obtain a good kill. Mites on the interior of the bulbs were not killed even with this length of exposure. Sorauer[2] recommends for use against the mite, *R. echinopus*, the use of a 48 hour carbon disulphide fumigation or immersion in tobacco extract. 40% nicotine sulphate 1-400 with the addition of soap killed only 7.1% in tests conducted here. Fir tree oil was considerably more efficient, killing 60-90% in some instances, while in bulbs soaked in water heated to 55° C. nearly 100% were killed. Woods[3] treated bulbs with mercuric chloride 1-1000 and 1-2000, formalin 1-1000 and 1-2000 without success. A good kill, however, was obtained by the writer with formalin heated to 50° C. (122° F.), the bulbs being left for a period of ten minutes. Nicotine sulphate 1-400 heated to 50° C. (122° F.) and nicotine oleate heated to 50° were also very successful acaricides.

In all cases careful observations were made on the hypopus because of its greater resistance, and the mites were examined daily for three days after treatment to be sure of results.

* Determined by Dr. E. P. Felt.

[1] Ewing, H. E. Oregon Agr. Exp. Sta. Bul. 121: 70: 1914.

[2] Sorauer P. Pflanzenkrankheiten III: 109: 1913.

[3] Woods, A. F. U. S. Dep. Agr., Div. Veg. Phy. & Path., Bul. 14: 1897.

For convenience, the different treatments and practices for control of the pest, will be enumerated.

Unsuccessful Treatments.

1. Hydrocyanic acid gas (HCN) fumigation, the gas obtained by using potassium cyanide 1 oz. to 133 cu. feet of air space[1].
2. Carbon disulphide 1 oz.-100 cu. feet—24 hr. fumigation.
3. Formalin 1 part-1000 parts water and 1 part-2000 parts water—cold[2].
4. Nicotine sulphate 1 part-400 parts water plus soap 2 lbs.-50 gals.—cold.
5. Schnarr's insecticide 1 part-100 parts water.
6. Scalecide 1 part-15 parts water.
7. Mecuric chloride 1 part-1000 parts water and 1 part-2000 parts water[2].

Partly or Entirely Successful Treatments.

1. Carbon disulphide 1 oz.-100 cu. feet—48 hour fumigation.
2. Nicotine sulphate 1-400 heated to 50° C. (122° F.)—bulbs immersed for 10 min. Also nicotine oleate at the same temperature.
3. Formalin (2%) heated to 50° C; bulbs immersed for 10 minutes.
4. Hot water 55° C. (131° F.)—bulbs immersed for 10 minutes.

Practices of Value in Getting Rid of the Mite.

1. Selection of bulbs to be planted; all soft and rotten bulbs to be discarded.
2. Proper care and fertilization of the growing plants.
3. Cold storage 33-35° F. (any temperature below 50° F.) to prevent multiplication of the mites while stored.

Tests of Treatments for Narcissus Bulbs to Determine what Injury if any Results Therefrom.

Insecticide Used	Temperature of Insecticide	Period of Treatment	Date of Treatment	Amount of Injury	Date of Examination	No. of bulbs per Treatment
Nicotine Sulphate 1-400 Soap (2 lbs.—50 gals.)	50° C.	10 min.	1920 Aug. 31	None	1920 Nov. 28	10
Nicotine Sulphate 1-400 Soap (2 lbs.—50 gals.)	50° C.	5 min.	Aug. 31	None	Nov. 28	10
Formalin 2%	50° C.	10 min.	Aug. 31	None	Nov. 28	10
Nicotine Sulphate 1–400	50° C.	10 min.	Aug. 31	None	Nov. 28	10
Nicotine Sulphate 1-400 Soap (2 lbs.—50 gals.)	45° C.	10 min.	Aug. 31	None	Nov. 28	9
Nicotine Sulphate 1-400 Soap (2 lbs.—50 gals.)	45° C.	5 min.	Aug. 31	None	Nov. 28	10
Check, no treatment	....	....	Aug. 31	None	Nov. 28	10

[1] Ewing, H. E. Oregon Agr. Exp. Sta., Bul. 121: 70: 1914.

[2] Woods, A. F. U. S. Dep. Agr., Div. Veg. Phys. and Path., Bul. 14: 1897.

A few tests were conducted with narcissus bulbs in order to be sure that no injury results from the more successful treatments. Ten narcissus bulbs were first heated to 59-65° C. in hot water and left for a period of one-half hour. Two bulbs were retained as checks. All treated bulbs were killed, but the checks remained healthy and grew. Shortly after, two narcissus bulbs were treated with hot water at a temperature of 50° C. for ten minutes. These bulbs had fresh roots about one inch in length. Two bulbs were retained as checks. All bulbs grew, but the untreated were seen to be in better condition at time of blooming and on removing from the pots, the original roots of the treated were found to be dead and a new lot in their place. The table above is a continuation of these tests and shows that a temperature of 50° C. is non-injurious to narcissus, if the bulbs are without fresh roots and the period of immersion is not great.

Paper white narcissus were used in these tests and none of the bulbs had any fresh roots. Some of the treated bulbs grew better and were more vigorous than the checks. All bulbs grew and the plants were approximately the same height at the conclusion of the test.

Conclusions.

1. The bulb mite is capable of injuring healthy growing bulbs.
2. It is spread from place to place chiefly by means of the hypopus, which clings to small flies emerging from the decayed bulbs.
3. The life cycle may be completed in less than a month (9-29 days), or may be extended to a month and a half if the hypopial stage develops or if adverse conditions prevail.
4. One of the most satisfactory means of killing the mites was found to be that of dipping the bulbs in nicotine sulphate 1-400 or nicotine oleate, heated to 50° C. Hot water (50° C.) also kills a good percentage.
5. The authority commonly given for the scientific name should be changed to Banks and the name should read *Rhizoglyphus hyacinthi* Banks.

TWENTIETH REPORT

OF THE

STATE ENTOMOLOGIST

OF

CONNECTICUT

FOR THE YEAR 1920

(Being Bulletin 226 Connecticut Agricultural Experiment Station)

BY

W. E. BRITTON, Ph. D.

State Entomologist

New Haven, Conn.

1921

CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

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Miss Gladys M. Finley, *Stenographer.*

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Walter O. Filley, *Forester, also State Forester and State Forest Fire Warden.*
A. E. Moss, M.F., *Assistant State and Station Forester.*
H. W. Hicock, M.F., *Assistant.*
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Donald F. Jones, S.D., *Plant Breeder.*
C. D. Hubbell, *Assistant.*

Vegetable Growing.

Press of The Wilson H. Lee Company.

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NOTE REGARDING AUTHORSHIP.

For bibliographical purposes, all matter in this Report (Bulletin 226) except where otherwise indicated, should be credited to W. E. Britton.

BULLETIN 226

TWENTIETH REPORT

OF THE

State Entomologist of Connecticut

To the Director and Board of Control of the Connecticut Agricultural Experiment Station:

I transmit, herewith, my twentieth report as State Entomologist of Connecticut, covering the activities of the year of 1920. The financial statements are for the state fiscal year ending June 30, 1920. This report contains an account of the various lines of work placed upon the office by Statute such as inspecting nurseries and apiaries, and suppressing the gipsy moth, and articles dealing with the mosquito work of the year, the European red mite and the apple and thorn skeletonizer, two new orchard pests, life history notes on the false apple red bug, a sawfly feeding upon Austrian pine and miscellaneous notes on various economic insects.

Respectfully submitted,

W. E. BRITTON,
State and Station Entomologist.

REPORT OF THE RECEIPTS AND EXPENDITURES OF THE STATE ENTOMOLOGIST FROM JULY 1, 1919, TO JUNE 30, 1920.

RECEIPTS.

From E. H. Jenkins, Treasurer	$7,500.00	
Account of 1919, Balance	1,889.75	
State Comptroller, Gipsy Moth Account	729.21	
M. P. Zappe, Automobile Mileage	10.68	
W. E. Britton, Automobile Mileage	5.10	
Interest on Bank Deposits	40.06	
Sale of old paper	3.45	
		$10,178.25

EXPENDITURES.

For Field, Office and Laboratory Assistance:		
B. H. Walden,* salary	$1,499.97	
M. P. Zappe, salary	1,750.00	
Philip Garman, salary	1,666.62	
K. F. Chamberlain,† salary	800.00	

*For nine months: remainder paid from mosquito appropriation.
†For eight months: resigned March 1, 1920.

Gladys M. Finley, salary	$704.00	
George D. Stone, salary	359.78	
Other assistance	217.60	
		$6,997.97
Printing and Illustrations		36.10
Postage		80.46
Stationery		21.69
Telegraph and Telephone		1.80
Office Supplies		82.24
Library		183.46
Laboratory Supplies		611.65
Express, Freight and Cartage		26.40
Rental and Storage		1.45
Traveling Expenses		719.23
Insurance		65.85
Automobile tires and repairs		499.51
Balance, Cash on Hand		850.44
		$10,178.25

Memorandum:—This account of the State Entomologist has been audited by the State Auditors of Public Accounts. The item of $729.21, credited as having been received from the State Comptroller is really a transfer from the appropriation for suppressing gipsy and brown-tail moths and for inspecting imported nursery stock, and covers the time and automobile mileage of members of the department staff while engaged in inspecting imported nursery stock.

Summary of Inspection and Office Work.

256 samples of insects received for identification.
95 nurseries inspected.
92 regular certificates granted.
35 parcels of nursery stock inspected and certified.
65 orchards and gardens examined.
17 shipments, containing 87 cases, 814,491 plants imported nursery stock inspected.
11 shipments, or 64 per cent. found infested with insects or fungi.
762 apiaries, containing 4,797 colonies, inspected.
33 apiaries, containing 72 colonies, found infested with European foul brood.
9 apiaries, containing 12 colonies, found infested with American foul brood.
2,576 letters written on official work.
646 circular letters.
454 post cards.
17 reports of inspection to Federal Horticultural Board.
1,007 bulletins, etc., mailed on request or to answer inquiries.
66 packages, sent by mail or express.
25 lectures and addresses at institutes, granges, etc.

Publications of Entomological Department, 1920.

By W. E. Britton:

Nineteenth Report of the State Entomologist (Bulletin 218), 100 pages, 5 figures, 24 plates, 10,500 copies distributed in May, 1920.
Insects Attacking Squash, Cucumber and Allied Plants in Connecticut (Bulletin 216), 21 pages, 9 figures, 8 plates; 10,000 copies distributed in February, 1920.
Report of Committee on Injurious Insects, Report of Connecticut Vegetable Growers' Association for 1919, page 51, 1920.

Report of Committee on Injurious Insects, Proceedings Twenty-Eighth Annual Meeting Connecticut Pomological Society, page 15, 1920.
Some Phases of Beekeeping in Connecticut, Journal of Economic Entomology, Vol. 13, page 91, February, 1920.
A Connecticut Cornfield Injured by *Crambus præfectellus* Zinck, Journal of Economic Entomology, Vol. 13, page 222, April, 1920.
More About the Cyclamen Mite, Florists' Exchange, Vol. XLIX, page 285, February 7, 1920.

Department Staff and Work.

W. E. Britton, Ph.D., *State and Station Entomologist.*
B. H. Walden, B.Agr., *Photographic and General Work.*
Irving W. Davis, B.Sc.* *Deputy in Charge of Moth Work.*
M. P. Zappe, B.S., *Inspection and General Work.*
Kenyon F. Chamberlain,† *Inspection and General Work.*
Philip Garman, Ph.D., *Research Work.*
John T. Ashworth,‡ *Acting Deputy in Charge of Moth Work.*
Samuel T. Sealy,§ *Deputy in Charge of Mosquito Work.*
Assistant Entomologists.
Miss Gladys M. Finley, *Clerk and Stenographer.*

H. W. Coley, Westport,
A. W. Yates, Hartford,
Apiary Inspectors.

There have been a few changes in the department staff during the year. Mr. Chamberlain resigned March 1, after a year's service. Mr. Davis, who for nearly seven years has been in charge of the work of suppressing the gipsy and brown-tail moths, resigned June 10 to accept a position with the Danielson Trust Company, of Danielson. Mr. Davis was very successful in his work and it was with much regret that we accepted his resignation. Mr. Ashworth has been placed temporarily in charge of the gipsy moth work.

Mr. Sealy was appointed deputy to the Director in charge of mosquito drainage work and began his duties April 19. Mr. Sealy formerly was employed in this kind of work by the Nassau County, N. Y., Mosquito Extermination Association.

Mr. Walden, who has been in charge of mosquito work for about four years, has this season been engaged in photographic work, inspection, and general work, and has been in charge of the department in the absence of the Entomologist. He has made photographic illustrations for the plates of the Connecticut Hemiptera and has collected an excellent series of leafhoppers from various hosts in different parts of the state.

Mr. Zappe has been in charge of the inspection of nurseries and of imported nursery stock. He has also aided in some orchard spraying and dusting experiments, and has studied the life histories of the false apple red bug, a leafhopper on apple, and a sawfly, (*Itycorsia zappei* Rohwer) feeding on Austrian pine.

*Resigned June 10.
†Resigned March 1.
‡Beginning June 10.
§Beginning April 19.

Dr. Garman has been engaged in studying the life history of the bulb mite, the results of which have been published as Bulletin No. 225. He has also commenced an interesting study of the life history of the frog hoppers or spittle insects (family Cercopidae) and is also at work on the mites of Connecticut and the Odonata or dragonflies of Connecticut, the results of which will be published by the Geological and Natural History Survey of the State.

The Entomologist has spent considerable time in revising manuscript and reading proof on the Check List of the Insects of Connecticut, which has appeared as Bulletin 31 of the Geological and Natural History Survey, and in editing and writing a portion of the manuscript of the Hemiptera of Connecticut which will also be published as a later bulletin of the Survey.

Miss Finley has continued as clerk and stenographer, and during a part of May when on her vacation, the necessary work was done by a substitute, Miss Marion D. Pickett.

Messrs. Coley and Yates as heretofore have inspected the apiaries, working by the day.

From August 7 to September 11, Mr. Edward R. Barton and Mr. F. D. Luddington were employed to assist in inspecting nurseries.

All members of the staff have rendered efficient and faithful services.

INSPECTION OF NURSERIES.

Mr. Zappe was placed in charge of this work and began on August 5. There was much rainy weather and the spraying and dusting experiments required that the dropped fruit be scored, as well as the picked fruit later. The work somewhat interfered with the inspection of nurseries. Nevertheless all was finished on October 18. Messrs. Zappe and Walden did most of this inspection work but were assisted at times by Messrs. Garman, Britton and Sealy, and Mr. F. D. Luddington and Mr. E. R. Barton were employed from August 7 to September 11, and helped inspect the larger nurseries. No one from the gipsy moth force was pressed into service inspecting nurseries, except that Mr. Ashworth helped the Entomologist inspect two nurseries in Windham County on September 2.

The same system of inspection in vogue in preceding years was continued in 1920, and most of the inspection trips were made in the department automobile.

In 46 nurseries no pests were found.

The principal pests, with the number of nurseries infested by each are as follows:

Insects:—Oyster-shell scale 38; San José scale 11; Scurfy scale 7; pine leaf scale 7; tulip tree scale 3; rose scale 2; spruce gall aphid 21; *Chermes cooleyi* 2; green apple aphid 2; woolly apple aphid 2; elm scale, euonymus scale, pine weevil, lilac borer, peach borer and Rhododendron lace bug, one each.

Plant Diseases:—Poplar canker 13; fire blight 6; crown gall 1.

On the whole about the same pests were found as last year though the oyster-shell scale and the San José scale were not present in as many nurseries, and 46 nurseries were found uninfested as against 32 last year.

Two new nurseries started in the spring and were inspected then and again inspected in the fall. These are marked (2) after the name on the list. Five nurseries have gone out of business, two have changed in name, and eight new ones have started during the year. Five old ones did not clean out the infested stock in time to obtain certificates and consequently were not on the list last year. Two nurseries have not cleaned out the infested stock, this year, and consequently have not received certificates.

Thirty-five separate parcels of nursery stock have been inspected and certificates granted.

The list for the season contains 90 names as follows:

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1920.

Name of Firm	Address.	Acreage.	Certificate Issued.	No. of Certificate.
Barnes Bros. Nursery Co.	Yalesville	150	Sept. 23	1115
Barnes Nursery & Orchard Co.	Wallingford	12	Aug. 30	1073
Beattie, Wm. H.	New Haven	1	Sept. 13	1091
Bertolf Bros.	Sound Beach	25	Sept. 18	1106
Brainard Nursery & Seed Co	Thompsonville	6	Sept. 15	1094
Braley & Co.	Burnside	1	Sept. 17	1102
Bretschneider, A.	Danielson	1	Sept. 3	1081
Bristol Nurseries, Inc.	Bristol	5	Oct. 13	1132
Burr & Co., C. R.	Manchester, Ellington and Durham	500	Aug. 20	1075
Burroughs, Thos. E.	Deep River	3	Oct. 5	1129
Chapman, C. B.	Groton	1	Sept. 21	1110
Chapman, C. E.	North Stonington	4	Sept. 16	1098
Coari & Co.	Norwalk	2	Sept. 9	1085
Conine Nursery Co.	Stratford	50	Oct. 8	1131
Conley, L. D.	Ridgefield	8	Oct. 2	1124
Conn. Agricultural College (Prof. S. P. Hollister)	Storrs	1	Aug. 7	1072
Conn. Agr. Experiment Station (W. O. Filley, State Forester)	New Haven	1	Oct. 18	1140
Crofut & Knapp Farm.	Norwalk	20	Dec. 30	1159
Cross Highway Nurseries	Westport	6	Nov. 27	1151
Dallas, Inc., Alexander	Waterbury	1	Nov. 23	1149
Dowd, F. C.	Madison	1	Sept. 22	1112
Elm City Nursery Co., Woodmont Nurseries, Inc	Woodmont and New Haven	155	Sept. 7	1082
Evergreen Nursery Co.	South Wilton	1	Sept. 10	1088
Fairfield Landscape & Nurseries Co	Cannondale	5	Dec. 31	1160
Falcon's Flight Farms Nursery (B. Austin Cheney, Prop.)	Litchfield	1	Oct. 2	1123
Gardner's Nurseries	Cromwell	5	Aug. 31	1078
Geduldigs Greenhouses	Norwich	1	Nov. 5	1147
Glenn Terrace Ornamental Nursery (James H. Everett, Prop.)	Mount Carmel	4	Oct. 29	1146
Goodwin Associates, Inc., the James L.	Hartford	1	Sept. 29	1122

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1920—*Cont'd.*

Name of Firm.	Address.	Average.	Certificate Issued.	No. of Certificate.
Hartford Park Commissioners	Hartford	1	Dec. 31	1161
Heath & Co.	Manchester	5	Aug. 20	1077
Hilliard, H. J.	Sound View	1	Sept. 16	1100
Hiti Nurseries (J. H. Bowditch, Prop.)	Pomfret Center	8	Sept. 3	1080
Holcomb, Irving	Simsbury	1	Sept. 15	1092
Horan & Son, Jas.	Bridgeport	1	Sept. 9	1086
Houstons' Nurseries	Mansfield	4	Dec. 23	1157
Hoyt's Sons Co. Inc., The Stephen	New Canaan	300	Oct. 19	1141
Hunt & Co., W. W.	Hartford	10	Sept. 28	1119
Intravaia, Joseph	Middletown	1	Aug. 31	1079
Isselee, Charles	Darien	10	Nov. 30	1152
Kelley, James J.	New Canaan	1	Sept. 9	1084
Kellner, Herman H.	Danbury	1	Oct. 2	1126
Keso Nursery (J. J. Kelsey, Prop.)	Clinton	1	Sept. 22	1113
Ladd & Nichols, Inc.	Greenwich	2	Nov. 23	1150
Laddin's Rock Nursery (W. L. Marks, Prop.)	Stamford	5	Oct. 13	1133
Larkin Bros., The	New London	2	Sept. 15	1095
Long, Mrs. J. A.	East Haven	1	Oct. 23	1144
Mallett Co., George A.	Bridgeport	1	Oct. 28	1145
Maplewood Nurseries (T. A. Peabody, Mgr.)	Norwich	1	Sept. 16	1099
Marigold Farm (H. Kelley, Prop.)	New Canaan	2	Sept. 21	1111
Meier & Gillette	West Hartford	2	Oct. 16	1136
Millane Tree Expert Co.	Middletown	1	Sept. 15	1093
New Haven Nurseries	New Haven	10	Nov. 30	1153
New Haven Park Commissioners (G. X. Amrhyn, Supt.)	New Haven	30	Dec. 29	1158
New London Cemetery Association (Ernest E. Rogers, Pres.)	New London	1	Sept. 15	1096
New London County Nurseries (W. J. Schoonman, Prop.)	New London and Stonington	5	Dec. 3	1154
North-Eastern Forestry Co.	Cheshire	20	Sept. 9	1083
Oakland Nurseries	Manchester	5	Aug. 20	1076
Ouwerkerk & Van der Stam (2)	Yalesville	1	Oct. 16	1137
Palmer, Est. of L. M.	Stamford	5	Sept. 28	1120
Park Gardens	Bridgeport	1	Sept. 21	1107
Pequod Nursery Co.	Yalesville	15	Sept. 23	1116
Phelps, J. Wesson	Bolton	1	Sept. 17	1103
Phelps & V. T. Hammer Co., The J. W.	Branford	2	Dec. 13	1155
Pierson, A. N., Inc.	Cromwell	50	Sept. 11	1089
Polish Orphanage (Rev. L. Bojnowski, Mgr.)	New Britain	1	Oct. 13	1134
Pomeroy, Edwin C.	Northville	1	Oct. 2	1127
Quality Seed Store	Stamford	1	Oct. 5	1128
Reck, Julius	Bridgeport	1	Sept. 21	1109
Rockfall Nursery Co. (P. Marotta, Prop.)	Rockfall	2	Aug. 30	1074
Saxe & Floto	Waterbury	1	Oct. 16	1139
Scheepers, Inc., John (2)	Sound Beach	6	Sept. 28	1121
Schleichert, F. C.	Bridgeport	1	Sept. 21	1108
Scott, J. W.	Hartford	5	Nov. 11	1148
Seely, C. H.	Darien	1	Oct. 20	1142

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1920—*Cont'd.*

Name of Firm.	Address.	Average.	Certificate Issued.	No. of Certificate.
Sierman, C. H.	Hartford	5	Oct. 22	1143
South Wilton Nurseries	South Wilton	5	Sept. 10	1087
Stannard Hill Greenhouses (J. E. Brooks, Prop.)	Westbrook	1	Sept. 22	1114
Steck, Charles A.	Bethel	2	Oct. 2	1125
Stratfield Nursery Co.	Bridgeport	4	Dec. 21	1156
Traendly & Schenck	Rowayton	2	Sept. 24	1117
Upson, R. E.	Marion	1	Oct. 16	1135
VanWilgen & Co.	Branford	3	Sept. 18	1105
Verkades Nurseries	New London	8	Sept. 15	1097
Vidbourne & Co., J.	Hartford	7	Oct. 7	1130
Wallace, Arthur T.	Wallingford	2	Oct. 16	1138
Wild, Henry	Riverside	1	Sept. 27	1118
Wilson & Co., C. E.	Manchester	10	Sept. 17	1101
Yale University Forest School	New Haven	1	Sept. 13	1090
Young, Mrs. Nellie A.	Pine Orchard	1	Sept. 18	1104
Total acreage		1,553		

INSPECTION OF IMPORTED NURSERY STOCK.

The establishment of Federal Quarantine, No. 37, which became effective June 30, 1919, has greatly reduced the quantity of nursery stock entering Connecticut from foreign countries. In fact it has prohibited general importation and the only kind now entering the state directly and needing inspection by state inspectors is stock for propagating purposes. This is nearly all Manetti rose stock, which is consigned to the larger florists' establishments, and fruit seedlings purchased by the larger nurseries that grow fruit trees. As these plants are small, a large number of them can be packed in a case of ordinary size. As only a few firms import such stock, the number of shipments received was much smaller than in preceding years, but the number of plants was in much greater proportion, as the following figures for 1919 and 1920 will show:

Year.	No. of Shipments.	No. of Cases.	No. of Plants.
1919	131	1,075	1,164,701
1920	17	87	814,491

Most of this stock was inspected by Messrs. Zappe, Chamberlain and Walden, and the time required amounts to 133 hours, or 17.7 days of seven and one-half hours each, or .68 months of 26 working days each. The cost according to the office accounts amounted to $825.83, including time of men and traveling expenses, and was paid out of the state appropriation for suppressing gipsy and brown-tail moths and inspecting nursery stock.

The sources of this imported nursery stock were as follows:—

SOURCES OF IMPORTED NURSERY STOCK, 1919–1920.

Country.	No. of Shipments.	No. of Cases.	No. of Plants.
France	8	31	359,300
Holland	4	20	152,691
England	4	28	290,000
Scotland	1	8	12,500
Total	17	87	814,491

The following table shows quantity of stock as inspected by months:—

Month.	No. of Shipments.	No. of Cases.	No. of Plants.
January	1	2	15,500
February	4	15	111,700
March	4	16	208,100
April	7	52	467,500
May	1	2	11,691
Total	17	87	814,491

Of the 17 shipments, 11 shipments or 64.8 per cent. were found to be infested with insects or plant diseases, some of which are pests.

Last year many imported bulbs were inspected, but this is now all done by Federal inspectors at the ports of entry.

Details regarding the infestations on imported nursery stock are as follows:—

PESTS FOUND ON IMPORTED NURSERY STOCK.

11 Shipments Infested.

Insects, etc.

Bulb Mite on Manetti rose. (1 shipment) Thos. Smith & Son, Stranraer, Scotland.

Emphytus cinctus Linn. on Rose. (7 shipments) R. H. Both, Wisbech, England. Franco-American Seedling Co., Angers, France. Thos. Smith & Son, Stranraer, Scotland. Levasseur & Fils, Ussy, France. S. Bide & Sons, Ltd., Farnham, Surrey, England. W. Fromow & Sons, Windlesham Surrey, England. As. Ouwerkerk, Boskoop, Holland.

Lepidopterous cocoons. (2 shipments) Kings Acre Nurseries, Henford, England. S. Bide & Sons, Ltd., Farnham, Surrey, England. Larva. (1 shipment) Felix & Dykhuis, Boskoop, Holland.

Sow bugs. (1 shipment) Levasseur & Fils, Ussy, France.

Spider. (2 shipments) Levasseur & Fils, Ussy, France. S. Bide & Sons, Ltd., Farnham, Surrey, England.

Staphalinid beetle on rose. (2 shipments) Thos. Smith & Son, Stranraer, Scotland. Felix & Dykhuis, Boskoop, Holland.

Vespula germanica Fabr. (1 shipment) Franco-American Seedling Co., Angers, France.

Woolly aphis on apple. (1 shipment) Franco-American Seedling Co., Angers, France.

Plant Diseases.

Crown Gall on rose. (5 shipments) Vincent Lebreton's Nurseries, La Pyramide, France. Franco-American Seedling Co., Angers, France. Felix & Dykhuis, Boskoop, Holland. W. Fromow & Sons, Windlesham Surrey, England.

INSPECTION OF APIARIES.

There has been no change in the system of apiary inspection or in the personnel of the inspectors since last year. The new law passed by the last General Assembly requiring beekeepers to register with their town clerks was generally though not fully observed, and proved quite a help to the inspectors in locating apiaries.

Mr. H. W. Coley of Westport has continued to inspect in Fairfield, New Haven, Middlesex and New London counties, and Mr. A. W. Yates of Hartford likewise has continued to inspect in Litchfield, Hartford, Tolland and Windham counties, each working on a basis of six dollars per day and expenses.

Many colonies of bees did not survive the winter, and though more apiaries were inspected than in 1919, the number of colonies was considerably smaller.

During the summer of 1920, 762 apiaries, containing 4,797 colonies of bees, were inspected as against 723 apiaries and 6,070 colonies in 1919. In making these inspections, 119 towns were visited in 1920 and 102 towns in 1919.

Inspections have never been made in the towns of Union (Tolland County) and Eastford (Windham County).

The following ten towns were visited in inspection work in 1920 for the first time:

Fairfield County—Sherman and New Fairfield.
New Haven County—East Haven.
Middlesex County—Essex, Chester and Middlefield.
New London County—Lebanon, Preston and Voluntown.

Inspections were made in the following 38 towns not visited in 1919:

Fairfield County—Brookfield, New Fairfield, Sherman and Trumbull.
New Haven County—Bethany, East Haven North Haven and Woodbridge.
Middlesex County—Chester, Clinton, Cromwell, Essex, Haddam and Middlefield.
New London County—Bozrah, Colchester, Franklin, Griswold, Preston and Voluntown.
Litchfield County—Barkhamsted, Canaan, Colebrook, Cornwall, Goshen, Morris, New Hartford, Norfolk, North Canaan, Roxbury, Salisbury, Sharon and Winchester.
Hartford County—Hartland and Simsbury.
Tolland County—Columbia, Ellington and Hebron.

On the other hand, inspections were made in 1919 in the following 29 towns, not visited in 1920:

Fairfield County—Bethel and Redding.
New Haven County—Oxford and Wolcott.
Middlesex County—East Hampton and Killingworth.
New London County—Groton, Old Lyme and Stonington.
Litchfield County—Bethlehem, Plymouth and Warren.

Hartford County—Avon, Canton, Manchester, Windsor and Windsor Locks.
Tolland County—Stafford, Tolland and Willington.
Windham County—Brooklyn, Killingly, Plainfield, Pomfret, Putnam, Scotland, Sterling, Thompson and Woodstock.

The percentage of apiaries infested with European foul brood has decreased each year since the inspection service was established. In 1920 it was only 4.3 per cent. as against 6.6 in 1919. The percentage of colonies, however, was 1.5 per cent. in 1920, slightly larger than the 1.2 per cent. found infested in 1919. This is due, not to any increase in the disease as the percentages of infested apiaries show, but to the smaller number of colonies in the average apiary, which is only 6.5 in 1920, as against 11.2 in 1919, on account of so many bees dying in the winter. During 1920, the European foul brood was found in the following 22 towns:

Fairfield County—Darien, Fairfield and Sherman.
New Haven County—North Haven, Prospect and Wallingford.
Middlesex County—Essex, Durham and Haddam.
New London County—Waterford.
Litchfield County—Barkhamsted, Bridgewater, Thomaston, Washington, Watertown and Winchester.
Hartford County—Glastonbury, Hartland, Marlborough and Southington.
Tolland County—Ellington and Mansfield.

American foul brood was found in nine apiaries and in five towns and was much less prevalent than in 1919, when it occurred in 22 apiaries in eight towns. In 1920, this disease was found in Wallingford (New Haven County), Durham (Middlesex County), East Lyme (New London County), Winchester (Litchfield County), and Wethersfield (Hartford County). Wallingford and East Lyme were infested in 1919.

The percentage of apiaries infested with American foul brood in 1920 is 1.18 and of colonies .25, as against 3.00 per cent. and 1.1 per cent. respectively in 1919.

The statistics of the apiaries inspected in 1920 in each of the 119 towns visited, are arranged by counties in the following pages and summarized on page 149:

APIARIES INSPECTED IN 1920.

	No. Apiaries Inspected.	No. Apiaries Diseased.	No. Colonies Inspected.	No. Colonies Diseased.
Fairfield County:				
Bridgeport	2	1	55	2‡
Brookfield	6	1	54	1‡
Danbury	18	0	163	0
Darien	3	1	28	1†

* American Foul Brood.
† European Foul Brood.
‡ Sacbrood.

	No. Apiaries Inspected.	No. Apiaries Diseased.	No. Colonies Inspected.	No. Colonies Diseased.
Easton	1	0	56	0
Fairfield	8	2	93	2‖†
Greenwich	7	0	102	0
Monroe	4	0	44	0
New Canaan	2	0	22	0
New Fairfield	4	0	34	0
Norwalk	7	0	66	0
Ridgefield	3	0	11	0
Shelton	2	0	24	0
Sherman	10	2	80	2†
Stamford	7	0	40	0
Stratford	3	0	33	0
Trumbull	2	0	14	0
Weston	2	0	2	0
Westport	8	0	76	0
Wilton	16	0	159	0
	115	7	1156	8
New Haven County:				
Beacon Falls	1	0	0	0
Bethany	3	0	7	0
Branford	4	1	45	1‡
Cheshire	2	0	26	0
Derby	4	0	31	0
East Haven	4	0	17	0
Guilford	3	0	18	0
Hamden	12	0	46	0
Madison	2	0	3	0
Meriden	26	0	155	0
Middlebury	2	0	14	0
Milford	3	0	32	0
Naugatuck	6	0	32	0
New Haven	3	0	10	0
North Haven	2	1	31	1†
Prospect	4	1	29	3†
Seymour	1	0	11	0
Wallingford°	17	7	106	9°
Waterbury	8	0	34	0
Woodbridge	4	0	16	0
	111	10	663	14
Middlesex County:				
Chester	4	0	15	0
Clinton§	1	0	0	0
Cromwell	7	1	26	1‡
Durham	6	3	65	4**
East Haddam	2	0	5	0

* American Foul Brood.
† European Foul Brood.
‡ Sacbrood.
‖ Paralysis.
° 3 apiaries with 1 A. F. B. each, 3 with 1 E. F. B. each, 1 with 2 A. F. B. and 1 E. F. B.
** 1 A. F. B., 1 E. F. B. and 2 Sacbrood.

	No. Apiaries Inspected.	Diseased.	No. Colonies Inspected.	Diseased.
Essex	4	2	16	2†
Haddam	3	1	16	2†
Middlefield	5	0	30	0
Middletown	19	0	85	0
Old Saybrook	2	0	7	0
Saybrook	6	0	24	0
Westbrook	2	0	8	0
	61	7	297	9
New London County:				
Bozrah	4	1	40	1‡
Colchester	14	1	30	1‡
East Lyme	4	1	15	1*
Franklin	1	0	6	0
Griswold§	4	0	1	0
Lebanon	4	1	10	1‡
Lisbon	3	0	7	0
Montville	7	0	18	0
New London	1	0	10	0
Norwich	6	0	369	0
Preston	5	1	19	1‡
Voluntown‖	4	0	2	0
Waterford	3	1	18	4†
	60	6	545	9
Litchfield County:				
Barkhamsted	4	2	74	5†
Bridgewater	7	2	37	3†
Canaan	6	0	29	0
Colebrook	1	0	10	0
Cornwall	2	0	2	0
Goshen	4	0	20	0
Harwinton	1	0	3	0
Litchfield	7	0	27	0
Morris	6	0	27	0
New Hartford	5	0	24	0
New Milford	14	0	101	0
Norfolk	5	0	10	0
North Canaan	10	0	88	0
Roxbury	5	0	22	0
Salisbury	6	0	42	0
Sharon	8	0	66	0
Thomaston	6	1	38	3†
Torrington	6	1	84	1‖
Washington	10	1	86	2†
Watertown	13	2	70	3†
Winchester	19	5	54	8§
	145	14	914	25

* American Foul Brood.
† European Foul Brood.
‡ Sacbrood.
‖ All bees killed in 3 aparies.
§ 4 A. F. B. and 4 E. F. B.

	No. Apiaries Inspected.	Diseased.	No. Colonies Inspected.	Diseased.
Hartford County:				
Berlin	18	0	136	0
Bloomfield	11	0	85	0
Bristol§	1	0	0	0
Burlington	1	0	5	0
East Granby	6	0	28	0
East Hartford	15	0	58	0
East Windsor	9	0	97	0
Enfield	3	0	22	0
Farmington	22	0	49	0
Glastonbury	17	1	55	2†
Granby	4	0	47	0
Hartford	26	0	92	0
Hartland	2	1	4	2†
Marlborough	2	1	22	3†
New Britain	17	0	69	0
Newington	10	0	51	0
Plainville	5	0	35	0
Rocky Hill	8	0	10	0
Simsbury	3	0	6	0
Southington	12	2	65	7†
South Windsor	8	0	22	0
Suffield	1	0	7	0
West Hartford	24	0	57	0
Wethersfield	13	1	44	1*
	238	6	1066	15
Tolland County:				
Andover	1	0	1	0
Bolton	1	0	4	0
Columbia	3	0	10	0
Coventry	2	0	10	0
Ellington	13	1	49	1†
Hebron	3	0	6	0
Mansfield	3	2	36	16†
Vernon	5	0	36	0
	31	3	152	17
Windham County:				
Windham	1	0	4	0

Summary.

County.	No. of Towns.	No. Apiaries Inspected.	Diseased.	No. Colonies Inspected.	Diseased.
Fairfield	20	115	7	1156	8
New Haven	20	111	10	663	14
Middlesex	12	61	7	297	9
New London	13	60	6	545	9
Litchfield	21	145	14	914	25
Hartford	24	238	6	1066	15
Tolland	8	31	3	152	17
Windham	1	1	0	4	0
	119	762	53	4797	97

* American Foul Brood.
† European Foul Brood.
§ 6 colonies winter killed.

	No. Apiaries	No. Colonies
Inspected	762	4,797
Infested with European foul brood	33	72
Per cent. infested	4.3	1.5
Infested with American foul brood	9	12
Per cent. infested	1.18	.25
Sacbrood	9	11
Bee Paralysis	2	2
Average number of colonies per apiary		6.5
Cost of inspection		$1,954.55
Average cost per apiary		$2.565
Average cost per colony		.41

REPORT OF WORK IN SUPPRESSING THE GIPSY AND BROWN-TAIL MOTHS.

Season of 1919-1920.

By W. E. Britton, Irving W. Davis and John T. Ashworth.*

The plan and methods developed in preceding years has been followed with satisfactory results. Full and hearty co-operation between the Federal Bureau of Entomology and the state forces has resulted beneficially to both parties. Most effort has been directed against the gipsy moth as the brown-tail moth has not been abundant for several years. The gipsy moth has been held well in check and except in the towns of Thompson, Woodstock, Killingly, Brooklyn and Griswold, the number of infestations has been smaller than last year.

The gipsy moth work was considerably handicapped on account of labor and weather conditions. The former was mainly a lack of experienced men. New men were taken on the work, but before they had become at all proficient would leave for more remunerative positions. August was the beginning of a rainy spell which virtually lasted until the heavy snows came in February. The depth of the snow caused so much delay, that twelve pairs of snow-shoes were purchased and did excellent service while the snow lasted.

No new towns were found infested and no trace of the gipsy moth was found in seven of the towns that were infested a few years ago. These towns are as follows: Ashford, Mansfield, Windham, Scotland, Franklin, Sprague and Stonington.

As in the last two years, in the older infested towns, single egg-clusters were not counted as infestations. In the border towns and in the towns not previously known to be infested, single egg-clusters have been reckoned as infestations.

No special work was done against the brown-tail moth this winter, but during scouting for the gipsy moth the men kept a sharp lookout for brown-tail webs, but none were found.

New Equipment.

In 1918 a truck body was mounted on a Ford chassis, as was noted in the report for that year and this proved so satisfactory that during the summer of 1919 two new Fords with delivery bodies were purchased. These have given excellent service during

*Note.—Mr. Davis who has been in charge of this field work for nearly seven years, resigned June 10, 1920, to accept a position with the Danielson Trust Company of Danielson. Mr. Ashworth who has been employed under Mr. Davis for nearly three years is now in charge of the field work. The details of the work in each town, table of statistics and new equipment have been prepared by Messrs. Davis and Ashworth, and I have written the introduction, the chapter on parasites and prepared the financial statements and recommendations, etc.—W. E. Britton.

the year past. The second-hand Buick car which was purchased in 1918 gave us considerable trouble, and in January, 1920, it was sold and a new Ford touring car purchased to replace it. This has been very satisfactory.

Each year we have had to borrow one or more spraying machines from the Federal Government. This year it seemed advisable for the State to purchase apparatus, and a new automobile truck power sprayer was obtained similar to the one purchased in 1918 (for description see Report for 1918, page 273). As the price of spraying hose had advanced so much it was not thought wise to purchase more than twelve hundred feet of 1-in. hose and 50 feet of 2½-in. suction hose. (This hose has not proved satisfactory and much of it will have to be replaced.)

By the middle of February the snow was so deep that it was useless to continue scouting. An effort was made to borrow some snow-shoes for experiment, but as these could not be obtained, twelve pairs were purchased and during the rest of the winter were used with a great saving of time and effort.

Labor and Board.

At the close of the war practically all of the men who left this work to enter the service returned to it as soon as discharged. These men were all experienced and made a valuable addition to the force. With the trades advancing wages in all lines many of the men left to obtain higher wages elsewhere. This was particularly true of the new men who received the minimum wage, in the graduated wage-scale now in force. This shortage of men was felt keenly, especially as the winter came on for it proved to be the most severe of any winter we have had since this work started. With the aid of the Government forces, however, the scouting was completed, although it had to be continued so late that there was little time for the work of banding the trees.

Obtaining board continued to be one of the handicaps to the work. Such high wages were paid, that people who had formerly taken boarders found more money and shorter hours in the mills. It was therefore almost impossible to obtain board and when obtained, the price was so high as to be prohibitive to the men at the wages they were receiving. The men were therefore transported from the towns where they lived (in most cases Killingly) and brought back at night. For this purpose the Ford delivery trucks were a necessity, and have been used continuously since they were purchased.

Financial Statement.

Appropriation for biennial period ending June 30, 1921	$70,000.00
Expended year ending June 30, 1920	33,081.11
Balance for current year	$36,918.89

LASSIFIED EXPENDITURES FOR THE YEAR ENDING JUNE 30, 1920.

Salaries and Wages:		
I. W. Davis	$1,766.62	
J. T. Ashworth	1,435.00	
J. A. McEvoy	1,241.92	
K. E. Buffington	1,198.80	
C. A. Burdick	1,218.32	
F. C. Rich	1,222.84	
J. Knight	400.88	
W. P. Colvin	1,073.25	
C. W. Roth	472.23	
A. J. Gilbert	1,019.33	
R. F. Franklin	856.60	
C. Ladd	454.44	
D. La Belle	858.82	
J. W. Longo	979.91	
R. G. Newton	798.70	
P. H. Shea	1,000.36	
T. Perreault	651.66	
G. D. Stone	620.32	
A. J. Duprey	541.51	
Other labor	2,534.46	
		$20,345.97
Printing and Illustrations		29.91
Postage		18.24
Stationery		12.28
Telegraph and Telephone		54.66
Office Supplies		71.05
Express, Freight and Cartage		10.92
Machinery, Tools and Supplies		8,433.69
Insurance		608.49
Rental and Storage		220.77
Traveling Expenses, Gasoline, etc.		1,262.19
Automobile Tires and Repairs		1,120.54
Inspection of Imported Nursery Stock		825.83
Heat and Light		58.57
Miscellaneous		8.00
Total		$33,081.11

Details of Gipsy Moth Work by Towns

The following pages give a detailed account of the gipsy moth work in each of the towns infested:

Thompson—134 Infestations—4,342 Egg-clusters.

As was true of the scouting in many of the towns this past winter, the work in Thompson was greatly handicapped by the heavy snows and stormy weather. The work was finished about the last of March, and resulted in finding one hundred and thirty-four infestations containing four thousand three hundred and forty-two egg-clusters.

These colonies were spread over the entire town, but were a little more scattered in the western part than in the central and eastern portions. Where so many colonies are present it is diffi-

cult to indicate which are the most serious, but some of the larger may be mentioned.

One on land of Warren Logee about a mile from Brandy Hill, contained three hundred and twenty egg-clusters. These were found on three trees and a nearby stone wall.

A colony in woodland owned by Mrs. J. M. Robinson was found to contain one hundred and eighty-nine egg-clusters, and the examination of an infested stone wall about two miles further north resulted in the finding of two hundred and eighteen more.

In the western part of the town the largest colony was in pasture land owned by Mr. Fred Parker and situated near Fabyan. At this colony the one hundred and ninety egg-clusters were found in a stone wall and four oak trees.

Some tanglefoot was applied in this town, but as it was one of the last to be banded, larvae were observed before the work was quite completed.

During June, eighty-nine of the largest colonies and those most exposed to wind-spread, were sprayed with one of the truck sprayers, and after the spraying season was over, scouts were sent out to visit and inspect all colonies in the town and note the results from spraying; one thousand eighty-two larvae were found and destroyed.

Woodstock—41 Infestations—882 Egg-clusters.

Woodstock, besides being one of the largest towns in Connecticut, has a large road mileage. Many of these roads are old and have been discontinued for several years so that they are no longer passable, but in the gipsy moth work we have always considered them as thoroughfares and scouted them accordingly. From this fact it will be seen that the area of Woodstock is well covered in each years' scouting. This year proved no exception as this was the first town scouted and the work was largely done by the older men. As soon as it was deemed practicable all of the older men who could be spared were sent to work in the western part of Woodstock, and new men were added as fast as they were trained. One crew was withdrawn in the middle of October for work in Canterbury, and another the first of November to scout Eastford.

The rainy weather during the autumn months caused many delays in the work both from the actual time lost and from the poor roads. The scouting was completed on the twenty-eighth day of November, and resulted in finding forty-one colonies of the gipsy moth. These colonies were mostly found in the northeast and southwest portions of the town, with scattering ones in the southeast corner, while the northwest portion was very free from this pest. The majority of these colonies contained less than twenty egg-clusters, while the largest colony contained two hundred and twenty-eight. The latter was a woodland colony and found on land of Mr. Shead near the Thompson line. While this colony

was scattered over several acres, the timber was cut late in the fall and no further work was deemed necessary this winter.

Other large colonies were on land of Samuel Ide in the northerly part of the town, on land owned by Sidney P. Butler and Irving Perry in West Woodstock, and that on land of Charles Clark near Eastford.

At sixteen of the forty-one colonies, tanglefoot bands were placed around the trees as they were on land that was open and high, and therefore gave a good chance for wind-spread.

Thirty-one of the larger colonies were sprayed during the season using about 425 pounds of arsenate of lead. In all three hundred and twenty-five larvae were found and destroyed; only six, however, were found alive after spraying, four of which were found at infestation No. 35, where one hundred and twenty-five dead larvae were found at the same time.

Union—1 Infestation—1 Egg-cluster.

Union was scouted by the state men this year, and as there was but little time remaining before the eggs would hatch, only the eastern portion of the town was covered. One egg-cluster was found, and that on a small oak near the Massachusetts line. The nearby growth was carefully scouted, but no other evidences of the pest were found. No spraying was done, but the territory around the infestation was watched during the larval season and nothing found.

Putnam—15 Infestations—482 Egg-clusters.

There was a notable decrease in the gipsy moth colonies in this town this past year. Only fifteen colonies containing four hundred and eighty-two egg-clusters were located, and the most of these lay to the west of the city of Putnam.

The largest colonies were found in woodland during the early fall and contained nearly half of the egg-clusters found in the town. These, two in number, were both in the eastern part of the town and covered a large area; in one case, forty trees being infested and in the other ninety-four. The danger of spread from these infestations is very small, as they are located so that they are not exposed to the wind.

A group of four colonies found on the hill to the east of the Grove Street cemetery are in an exposed location. While these colonies contained only forty-eight egg-clusters in all, they will need careful attention because the growth on this hill is rather light and therefore is badly wind-swept.

Several of these colonies were banded with tanglefoot during May, and in June ten of the fifteen colonies were sprayed. In looking over the colonies during the latter part of July and the first of August, one thousand six hundred sixteen larvae were found and destroyed, over half of them being just outside in-

festation No. 14, along a stone-wall containing a number of egg-clusters which were covered with snow when the country was scouted last winter.

Pomfret—22 Infestations—274 Egg-clusters.

The western half of this town was scouted just before the heavy snows of last winter. These storms caused the work in this town to be stopped about the first of February. It was later resumed, however, and the town finished the last part of April.

Only twenty-two infestations were found and these may be roughly divided into three groups, one in each of the three corners of the town, while the fourth, the northeast, contained but one colony.

The colonies were all small, considering that Pomfret has been infested for seven years, the largest having only thirty-six egg-clusters. In several of the colonies the trees were banded with tanglefoot and following that were examined for larvae prior to spraying.

In June, eleven of the largest colonies were sprayed with arsenate of lead, and after the spraying season was over all colonies were inspected to determine the results obtained, and in all colonies sprayed and not sprayed a total of only six hundred sixty larvae were found and destroyed.

Eastford—10 Infestations—178 Egg-clusters.

A glance at the map of Connecticut will show the peculiar shape of the town of Eastford. A long narrow portion, bounded by Ashford, Union and Woodstock, extends northward, while the southern part is broader and more rectangular in shape. In this northern portion was located only one of the one hundred and seventy-eight egg-clusters found in this town. The majority of both colonies and egg-clusters were found in a group to the north and northeast of Phoenixville.

All of the gipsy moth colonies found in Eastford were in either pasture or woodland. None were considered serious, and the largest colony contained only forty egg-clusters. This was in some woodland owned by Mr. Charles Wheaton and situated to the east of the road which leads past Crystal Lake.

Several of the colonies were banded early in May, and nine of the ten were sprayed during the month of June, three thousand gallons of spray mixture being used. In checking up the results after spraying, the men were unable to find a single larva at any of the colonies, although six hundred fifteen were destroyed before spraying.

Killingly—46 Infestations—1,579 Egg-clusters.

Late in the summer of 1919, considerable woodland scouting was done in Killingly, and three infestations were located on the

ridge about a mile east of the Borough of Danielson. This woodland was cut over during the winter and it is doubtful if it would pay to spray it.

In the winter scouting, the entire town proved to be infested, the only locality which was free of colonies being in the southwest corner of the town. This is explained by the fact that this section is rather open, the growth being mostly scrub-oak and pine.

Two of the colonies are worth noting, both of which were found in the northeastern corner of the town. One of these contained three hundred and thirty and the other three hundred and twenty-nine egg-clusters. The former was on land owned by William Roberts and situated a little south of the Putnam line. The infested growth was three apple trees in a pasture, but was so located that the spraying could be done with a hand-sprayer.

The latter was at the northern end of Chestnut Hill on land belonging to Mrs. Roxy Bartlett. This is about a mile south of the former infestation "as the crow flies." The egg-clusters here were found mostly in a stone wall by the roadside, although an oak and apple tree were also infested.

During the latter part of May, six hundred and fourteen tanglefoot bands were applied to trees at twenty-nine of the infestations, following which thirty-eight of the forty-six infestations were sprayed, one truck sprayer and a small hand sprayer being used. Two thousand forty-five larvae were found and destroyed; of this number, only thirty-four were located after the colonies had been sprayed.

Brooklyn—20 Infestations—499 Egg-clusters.

When the snow became so deep in February, one of the scouting crews were sent into Brooklyn. As the scouts were all living in Danielson, the eastern part of the town was scouted first, most of the work being done on snow-shoes. After the snow had disappeared, many of the colonies were examined again for egg-clusters which might be found beneath the snow line.

The eastern section of the town contained most of the colonies, only one being found in the extreme western part. This one, however, was the largest found in Brooklyn, and contained one hundred and thirteen egg-clusters. This colony was on a high elevation in a wooded pasture owned by Joseph Stetson. As this was a wind-swept area, careful work was done to prevent spread from it.

Most of the other colonies were small, and not of great importance. Two colonies which contained seventy-six and one hundred and thirteen egg-clusters, respectively, were so situated that control measures were easily accomplished. The former was in an old apple tree which was cut down, and the latter was in a swamp to the west of Tatnic Hill, where spread by means of wind would be largely eliminated.

At twelve of the colonies, three hundred ninety-four bands of tanglefoot were put around the trees the early part of May, and in June fifteen were sprayed, two thousand three hundred gallons of spray mixture being used. A total of five living larvae were found at four of the colonies when the men looked them over during the latter part of July.

Hampton—5 Infestations—6 Egg-clusters.

Though the number of gipsy moth egg-clusters found in the various towns of this state has remained about the same as last year, in Hampton there has been a marked decrease. This year fewer infestations and fewer egg-clusters were found than in 1914, when the town was first found infested.

In three of the five colonies, the trees were banded with tanglefoot, and as there were so few egg-clusters, spraying was not considered necessary.

Chaplin—1 Infestation—3 Egg-clusters.

Only one infestation of gipsy moths was found in Chaplin during the past season's scouting. This was a small colony and was found in an orchard on land owned by Mr. Murphy near the northeastern part of the town. The trees were banded with tanglefoot during the latter part of May. It was not thought necessary to spray this colony. A close watch was kept but no larvae were found.

Sterling—9 Infestations—177 Egg-clusters.

The Moosup River flowing to the west from Rhode Island divides Sterling into a north and south portion of very nearly equal areas. All of the colonies of the gipsy moth found in Sterling this year were to the north of this river. None of these colonies contained a very large number of egg-clusters, the largest colony being that found on land of Mr. G. R. Brown, which totaled fifty-eight. This was located in an apple tree by the roadside and adjacent stone wall. Another colony about a mile northwest of this one, was that on land of John Dixon. This was on a hill which has an elevation of six hundred forty feet, and as that is rather high for that locality, the danger from wind-spread is great.

The trees in most of the colonies in Sterling were banded with tanglefoot early in May. All but one of the colonies in Sterling were sprayed, that being one on land of the Hillside Farm near North Sterling, twenty-two of the twenty-four egg-clusters being old ones, it was not thought advisable to spend the time that could be used to advantage elsewhere.

Plainfield—10 Infestations—398 Egg-clusters.

This was one of the last towns scouted this year, and as the season was so far advanced only the southern portion of the town

was well covered. In the northern section, the scouting was done only around the infestations of the previous year.

The largest colony located was on the western slope of Black Hill in the western part of the town. This colony contained two hundred and eleven egg-clusters and was in some pasture apple trees. While this infestation is in a wind-swept locality it is rather easy to control, as there is but little growth near it. The few trees which are there were banded with tanglefoot early in May.

Another colony of importance was found on what is known as the Green Hollow road near the Killingly Line. This was found in a group of pasture oaks on land owned by Mr. Charles A. Tillinghast, and contained sixty-one egg-clusters. In several of the most open and wind-swept colonies, the trees were tanglefooted and later all of them were sprayed, the hand sprayer being used at two of the colonies; very few larvae were found after spraying and a large portion of them were dead.

Canterbury—9 Infestations—126 Egg-clusters.

One of the crews started scouting in Canterbury about the middle of October and finished the first of December. This was more time than it was planned to spend in this town, but the delay was largely due to the excessive rains.

Nine infestations were the result of this scouting, and these were scattered throughout the town. They contained a total of one hundred and twenty-six egg-clusters, about half of which were a year old. The colonies were all rather small, the largest containing thirty egg-clusters. This colony was found in an old orchard in the northern part of the town near the village of Wauregan.

The most serious infestation was probably one located near the Brooklyn line on land owned by Mr. Kerr. This consisted of twenty-three egg-clusters and was found in some oaks on a rather high elevation about half a mile from the nearest traveled road. During the month of May the trees in six of the infestations in this town were banded with tanglefoot.

Eight of the nine infestations were sprayed in June, one thousand eight hundred gallons of solution being used. It was not thought advisable to spray infestation No. 6, as there was only one new egg-cluster found. Three hundred and twenty-four larvae were found and destroyed during the season.

Voluntown—2 Infestations—2 Egg-clusters.

During the past winter, only two egg-clusters of the gipsy moth were found in this town, and both of these were in the northern part, but about three miles apart. These were not considered serious enough to warrant further work.

GRISWOLD—11 Infestations—33 Egg-clusters.

The colonies of the gipsy moth found in Griswold were all small, the largest containing only ten egg-clusters. All but two of these were found to the north of the Griswold Post Office. In the most serious of these colonies the trees were banded early in May.

Three colonies in Griswold were sprayed, four hundred and seventy-five gallons of solution being used. No larvae were found at the colonies during the season.

LISBON—1 Infestation—1 Egg-cluster.

The Federal men scouted Lisbon during the past winter and found but a single egg-cluster. This occurred in the western part of the town near the Sprague line. It was not thought serious enough to warrant the banding of the trees with tanglefoot and no spraying was done.

PRESTON—6 Infestations—127 Egg-clusters.

Though one hundred and twenty-seven gipsy moth egg-clusters were found in Preston during the past winter, one hundred and twenty-two of them were in two colonies. These two colonies were close together and a little to the north of the state road leading from Norwich to Preston City.

One of these infestations was located on land of Frank Ayer and contained one hundred and ten egg-clusters. This was in open woodland on some large oaks, but on rather low ground and from which there is little danger of wind-spread.

The other large colony was in an orchard belonging to Steve Stanewiez. There were but few trees found infested, but all of the trees in the orchard have cavities in them which make control measures difficult.

At four of the colonies the trees were banded with tanglefoot in May, and in the early part of June the two above-mentioned infestations were sprayed.

NORWICH—5 Infestations—74 Egg-clusters.

The result of the winters' scouting in the town of Norwich was the discovery of five colonies. Three of these contained but a single egg-cluster each and all of this group were located in the northeastern part of the town. The largest colony of forty-two egg-clusters was just inside the city limits, in the south part of the city. These were in an oak tree and stone wall, but there was very little growth near it. The most serious colony was in the western part of the town near the Bozrah line on the top of Wawecus Hill, which has an elevation of over four hundred feet. The colony is in roadside maples and apple trees and therefore is badly wind-swept

which may cause spread. The trees in this vicinity were banded early in May with tree tanglefoot, and were watched during the summer but no larvae found.

In the early part of June two of the colonies were sprayed.

BOZRAH—1 Infestation—4 Egg-clusters.

Only one infestation was found in Bozrah and that on land owned by Mr. R. A. Bethan and located near the Norwich line. The trees in this colony were banded during the month of May, and sprayed in June.

NORTH STONINGTON—1 Infestation—29 Egg-clusters.

Although only one infestation is listed as being found within the limits of this town, there were several single egg-clusters which were not counted as infestations. These were found well scattered throughout the town. The infestation noted was found close to the Hopkinton, R. I., line on land owned by Mr. Thomas Wheeler and the trees in this vicinity were banded early in the month of May. This infestation was sprayed on June 9th and during July most of singles were inspected at the same time as the above-described infestation and thirty-six larvae were found and destroyed; twenty-six of these larvae were at a single egg-cluster infestation situated near the Stonington line.

LEDYARD—3 Infestations—4 Egg-clusters.

All of the gipsy moth colonies found in Ledyard were in apple orchards, and all were small, there being only four egg-clusters found in the entire town. The trees near two of these infestations were banded with tanglefoot, and one was sprayed in June.

GROTON—1 Infestation—1 Egg-cluster.

Only one egg-cluster was found in Groton, and this was in the extreme northern part of the town. Aside from the creosoting of the egg-cluster no other work was considered necessary.

The statistics of this work as applies to each town and given in the preceding pages are summarized in the following table:

STATISTICS OF INFESTATION.

Town.	Infestations.	Egg-clusters.	Tanglefoot Bands.	Sprayed.	Larvae.
Thompson	134	4,342	216	89	1,082
Woodstock	41	882	83	31	328
Putnam	15	482	264	10	1,616
Pomfret	22	274	53	11	660
Eastford	10	178	20	9	615
Ashford	0	0	0	0	0
Killingly	46	1,579	614	38	2,045
Brooklyn	20	499	394	15	251

STATISTICS OF INFESTATION—*Cont'd.*

Town.	Infestations.	Egg-clusters.	Tanglefoot Bands.	Sprayed.	Larvae.
Hampton	5	6	35	0	0
Chaplin	1	3	10	0	0
Sterling	6	177	133	5	17
Plainfield	10	398	78	10	614
Canterbury	9	126	129	8	324
Scotland	0	0	0	0	0
Mansfield	0	0	0	0	0
Voluntown	0	0	0	0	0
Griswold	11	33	81	3	0
Lisbon	1	1	0	0	0
Sprague	0	0	0	0	0
North Stonington	2	29	24	1	36
Stonington	0	0	0	0	0
Groton	1	1	0	0	0
Union	1	1	0	0	0
Windham	0	0	0	0	0
Preston	6	127	51	2	24
Norwich	5	74	111	2	0
Ledyard	3	8	13	1	0
Bozrah	1	4	5	1	0
Franklin	0	0	0	0	0
21 Towns Infested	350	9,224	2,314	236	7,612

PARASITES.

In preceding years, an attempt has been made each year to liberate one or more species of the different parasites in some of the infested towns of the state, but owing to the weather and the labor conditions, we were unable to do it in 1920. However, collections of gipsy moth larvae were made in Thompson, Woodstock, Putnam, Pomfret, Killingly, Plainfield, Canterbury and Brooklyn, and sent to the Government laboratory at Melrose Highlands, Mass., in order to determine if any species of parasites could be recovered as a result of planting colonies. We are indebted to Mr. A. F. Burgess for much of the information regarding the planting and recovery of parasites, a full report up to that time being included in the Report of this Station for 1917, page 250. The following resumé brings the subject up to date, so far as Connecticut is concerned.

Calosoma sycophanta Linn.

Though not a parasite, both adults and larvae of this large ground beetle devour the caterpillars of the gipsy moth and it is therefore quite an important agency for holding that species in check. It was liberated in Stonington in 1914, in Thompson in 1915, and in Killingly in 1917. This species now seems to be fairly well distributed over the state, as it has been collected or observed in Thompson, Putnam, Killingly, Scotland, Plainfield, Groton, Lyme, Clinton, New Haven, Meriden and Darien. Our employees have reported observing these beetles feeding upon gipsy moth larvae in Thompson and Killingly in 1920.

Anastatus bifasciatus Fonsc.

This very minute Hymenopterous egg parasite was first liberated in Connecticut in 1917, when colonies were placed in Thompson, Woodstock, Putnam, Killingly, Pomfret, Eastford, Brooklyn, Hampton, Chaplin, Mansfield and Canterbury. More colonies were planted in Brooklyn in 1918, Canterbury 1919, Eastford 1918 and 1919, Griswold in 1918, Hampton in 1918 and 1919, Killingly in 1918 and 1919, Ledyard in 1919, Mansfield in 1918, Norwich in 1919, Plainfield in 1918 and 1919, Pomfret in 1919, Putnam in 1918 and 1919, Scotland in 1918, Sterling in 1918 and 1919, Thompson in 1919, Voluntown in 1918 and 1919, and Woodstock in 1918.

This insect was recovered from Eastford in 1917, and from Voluntown in 1918.

Apanteles lacteicolor Vier.

This is a small Hymenopterous parasite of the brown-tail moth larvae. It has been colonized in Connecticut as follows: Putnam in 1912, Suffield, Hartford, Mansfield, Norwich, Stonington, Griswold, Plainfield, Killingly and Hampton in 1913, Manchester Chester, Colchester and Lebanon in 1915, East Lyme and Canterbury in 1916, Montville and Groton in 1917.

This species has been recovered as follows: Brooklyn 1916, Canterbury 1917, East Hartford 1916, Groton 1918, Hartford 1913 and 1914, Killingly 1916, Lebanon 1915, Pomfret 1913, Putnam 1917, Stafford 1917, Stonington 1915, Suffield 1915, Thompson 1913 and 1916, Waterford 1914, 1916 and 1917, Wethersfield 1916, Woodstock 1913, 1915 and 1916.

Pteromalus egregius Forst.

A minute Hymenopterous parasite of the brown-tail caterpillars not colonized in Connecticut, but recovered from Hartford in 1913 and 1914, and Putnam in 1915.

Monodontomerus aereus Walker.

A minute Hymenopterous parasite of the pupae of both gipsy and brown-tail moths. Not colonized in Connecticut but recovered from Putnam in 1911 and 1915, Hartford and Suffield in 1912.

Meteorus versicolor Wesm.

This is a minute Hymenopterous parasite of the brown-tail caterpillars, and though no attempt was ever made to colonize the species in Connecticut, probably some cocoons were mixed with those of *Apanteles lacteicolor* and thus it became distributed. It was recovered from Hartford in 1914, and from Brooklyn, Killingly, Thompson, and Woodstock in 1916, and from Groton in 1918.

Compsilura concinnata Meigen.

This is a medium-sized Dipterous parasite or two-winged fly of the family Tachinidae attacking both the gipsy and brown-tail moths. It was colonized at Putnam in 1912, Hartford in 1913, Mansfield, Plainfield and Stonington in 1914, Stafford, Suffield, Colchester, Norwich and Old Lyme in 1915, and Hampton and Scotland in 1917. It has been recovered from Woodstock in 1915, Stonington in 1916, Putnam, Stafford, Plainfield and North Stonington in 1917, Pomfret, Putnam and Stonington in 1918, Killingly,

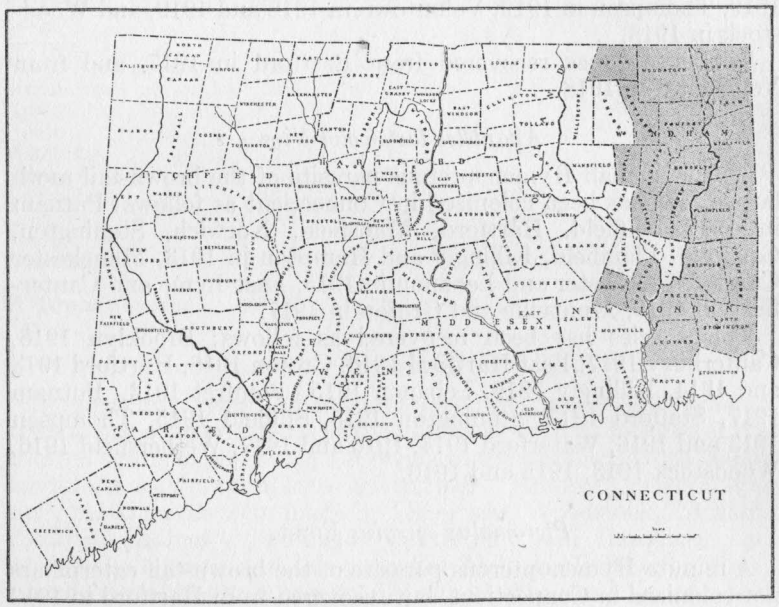

Figure 4. Map of Connecticut showing area quarantined on account of gipsy moth.

Plainfield, Pomfret, Putnam, Scotland and Thompson in 1919, and from Plainfield, North Stonington and Putnam in 1920.

Sturmia (*Zygobothria*) *nidicola* Townsend.

This is another Tachinid fly of medium size parasitizing the larvae of both gipsy and brown-tail moths, and though never colonized in Connecticut, it was recovered from Canterbury and Waterford in 1917, and from Groton and Stonington in 1918.

The foregoing records of parasites lead us to believe that most of these species have become fairly well distributed around the infested portion of the state even though not actually planted

there. Some help may therefore be expected from them in the years to come. The effectiveness of parasites depends much upon conditions, and is usually more pronounced in localities where the host is extremely abundant, and on account of the suppression work done, this has never been the case in Connecticut. Though parasites play an important part as a natural agency in controlling or holding in check a given species, they never exterminate their hosts. Of course, where conditions are like those in Connecticut, where their hosts are not very abundant and suppressive measures are being carried on, the parasites do not have the best kind of a chance. However, we are glad to know that they are still present.

Quarantine.

During 1919 eight Connecticut towns were removed from the Federal quarantined area as no traces of the gipsy moth had been found in them. This past winter three of these towns, Preston, Norwich and Bozrah, were again found to be infested and were added to the quarantined area.

The spread in the states of northern New England was very heavy and this gave rise to erroneous newspaper reports that there had been a great increase of the gipsy moth in Connecticut.

Only two towns, Groton and Stonington, were quarantined against the brown-tail moth, and as there were no webs of this insect found in this state last winter, it is doubtful if they are quarantined this year.

Under the Federal regulations, shipments going from the infested area to another state were inspected by the Federal agents, but shipments to another point within the state were not subject to inspection. This left the greater part of the state subject to infestation from the colonies in the eastern portion. Accordingly, after due notice, a hearing was held in Hartford on March 3, 1920, after which the following quarantine regulations were established:

State of Connecticut
Office of State Entomologist
Agricultural Experiment Station
New Haven, Conn.

Quarantine Order No. 2.

Concerning Gipsy and Brown-Tail Moths.

In order to protect uninfested parts of Connecticut from danger of infestation by the gipsy moth and the brown-tail moth, under authority given in Section 2106 of the General Statutes, the following regulations are hereby established.

1. The towns of Union, Woodstock, Thompson, Eastford, Pomfret, Putnam, Chaplin, Hampton, Brooklyn, Killingly, Scotland, Canterbury, Plainfield, Sterling, Lisbon, Griswold, Voluntown, Ledyard and North Stonington because of the gipsy moth, and all the above-named towns and Groton and Stonington because of the brown-tail moth are now under

quarantine by the Federal Horticultural Board of the United States Department of Agriculture, and it shall be unlawful to remove from this quarantined area any woody nursery stock, lumber, cordwood, telegraph or telephone poles, railroad ties, or other forest plant products, unless the products shall have been inspected and certified by an authorized state or Federal inspector.

2. In view of possible future changes in the lines between the infested and non-infested areas of the State, the areas quarantined by the State shall conform to those quarantined by the United States Department of Agriculture; furthermore the regulations established by the Federal Horticultural Board of the United States Department of Agriculture for interstate shipments, are hereby adopted for the inspection and certification of similar shipments from the quarantined area to points outside of this area within the State of Connecticut.

3. This order shall take effect from its date.

Dated March 23, 1920.

E. H. JENKINS,
Director, Connecticut Agricultural Experiment Station.

Approved
M. H. HOLCOMB,
Governor.

Instructions to Nurserymen, Lumbermen, Wood Dealers, Shippers and Transportation Companies.

Any shipments of nursery stock, or forest products originating within the quarantined area must not be shipped out of that area into the territory not infested, unless inspected and accompanied by the inspector's certificate. All shipments going into other States must be examined by a Federal Inspector, and the Federal Inspectors have also been authorized to inspect shipments consigned to points within the State: the State inspector can also examine such shipments in case of convenience or if the Federal Inspectors are busy elsewhere.

Transportation companies must not accept nursery stock or forest products consigned to points outside of the infested area unless accompanied by certificate of inspection.

INSPECTORS.

Federal Inspectors.

Herbert J. Miles, P. O. Box 62, Putnam, Conn. Telephone 321-14, Putnam. Inspector for Windham and Tolland Counties.

William J. Ahearn, Box 63, Westerly, R. I. Telephone 2277, Westerly. Inspector for New London County.

State Inspector.

John T. Ashworth, 26 Reynolds St., Danielson, Conn. Telephone 28-3, Danielson. Inspector for any shipments not going outside of the State.

So far the inspections have all been made by the Federal inspectors, and reports of all shipments to uninfested parts of Connecticut are sent to the office of the State Entomologist, where they are placed on file. The Federal quarantine also covers field stone and quarry products, but apparantly our state law (Section 2106) provides only for the control of shipments of plants or plant products.

INFESTATIONS DISCOVERED IN NEW JERSEY AND NEW YORK.

In midsummer an infestation of about one hundred square miles in extent was discovered on the Duke estate at Somerville, N. J. From a nursery on this estate many shipments had been sent during the past few years and in following up the destinations of these shipments several smaller infestations were found in New Jersey and one in Brooklyn, N. Y. Through the kindness of Mr. A. F. Burgess of the Bureau of Entomology, reports were received of eleven shipments of nursery stock from the Duke estate consigned to six parties in Connecticut. Most of these shipments were made between 1913 and 1916 and were sent to Greenwich, Stamford, Fairfield, Bridgeport, Ridgefield and Sharon.

Messrs. B. H. Walden and M. P. Zappe, Assistant Entomologists of the Station visited all of these places and inspected the plantations in and around the places where these plants were set. No indications were found of the presence of the gipsy moth in any of these places.

RECOMMENDATIONS.

On account of the existing conditions, we have reason to believe that the gipsy moth is now well in hand in Connecticut. If the work should be stopped, the pest would soon become sufficiently abundant to cause noticeable damage to trees by stripping them in June. State action would then be demanded. Such a possibility should not for a moment be considered, because the experience of Massachusetts shows its folly. Though confined to a rather small area in Massachusetts when the work stopped in 1900, the pest became so troublesome that the work was again taken up in 1905, but it was found to have spread over an area more than six times its former size and the difficulty and cost of control correspondingly increased. In Connecticut, the gipsy moth should be held just where it now is or the infested area reduced if possible.

Federal co-operation has been most cordial and satisfactory, but the Federal appropriation was reduced, and on account of the rather rapid spread northward, extra work was needed in Maine, New Hampshire and Vermont. Then, too, during the past summer new infestations were discovered in the states of New Jersey and New York, thus requiring that a portion of the Federal appropriation be used in those States.

The Connecticut forces are now fairly well equipped with spraying machinery and supplies, and with motor vehicles. The initial outlay for new apparatus should, therefore, not be very heavy for the next two years. Federal quarantine No. 37 has resulted in keeping out much of the imported nursery stock which formerly had to be inspected out of this appropriation. There will still be considerable fruit stock and Manetti rose stock for propagating, that must be inspected, but the quantity will be relatively

small, and the cost of inspection considerably less than in former years. As will be seen from the financial statement on page five, the cost of this work for the past year was $825.83, and it will probably be about the same for each season.

The appropriation for gipsy moth work should be sufficiently large, together with the possible Federal aid, to cope with any emergency such as a serious wind-spread. All things considered, we therefore respectfully request that sixty thousand dollars ($60,000.00) be appropriated for the biennial period ending June 30, 1923, for the purpose of suppressing the gipsy moth, the brown-tail moth, and for inspecting imported nursery stock.

EXPERIMENTS IN DUSTING IN COMPARISON WITH SPRAYING TO CONTROL APPLE INSECTS.

On March 30, 1920, entomologists from New York, New Jersey, Pennsylvania, Connecticut, and the U. S. Department of Agriculture held a conference at the Grand Central Station in New York City to consider a common plan for the testing of dust mixtures. It was agreed that it seemed desirable to conduct experiments in each of the states represented, to ascertain whether the common pests of the apple orchard could be satisfactorily controlled by dusting operations, and especially to learn if the addition of nicotine sulphate to the dust would control apple aphids and red bug.

The secretary afterwards prepared copies of the general plan of experiment and sent them with the minutes of the conference, to each entomologist who had been in attendance. In general the plans called for a dust containing 90 per cent. sulphur, and 10 per cent. arsenate of lead, to which nicotine sulphate was to be added in three different proportions, *viz.*, one-half of one per cent., one per cent., and three per cent. It was also recommended that one plot should be sprayed and one left untreated for purposes of comparison; that not less than 100 trees be included in the experiment; that standard varieties and rather large trees be used if feasible; and that at least four treatments be given (delayed dormant; pre-pink, calyx, and young fruit). In other respects the operations were to be conducted in conformity with the demands of the orchard and practices of the region where the work was conducted.

After examining several orchards, one owned by Mr. William F. Platt of Milford seemed to meet most fully the requirements. This orchard contained 30 acres, most of the trees having been planted 26 years, was in sod and was situated just over the line in the town of Orange. Consequently arrangements were made with the owner, to allow us to experiment on his trees and to furnish team and help where needed. The Station was to furnish materials and the owner was to have the fruit crop. The owner had given the entire orchard a dormant treatment with "Scalecide," one part in fifteen parts of water.

The detailed plan of the experiment was developed through the co-operation of the Entomological and Botanical Departments of this Station and the Division of Deciduous Fruit Insect Investigations of the Federal Bureau of Entomology, which has for several years maintained at Wallingford, Conn., a field station for the study of orchard insects.

To the owner, Mr. William F. Platt, to the Bureau of Entomology, to The Niagara Sprayer Company, and to the Botanical Department of this Station, our thanks are due for help and co-operation to make this work possible.

Most of the actual work was done by Messrs. B. A. Porter and C. H. Alden, of the Wallingford field station of the Bureau of Entomology, E. M. Stoddard and G. E. Graham of the Botanical Department, and M. P. Zappe, B. H. Walden, P. Garman and W. E. Britton of the Entomological Department of this Station.

The dust was applied with a Niagara power duster, owned by the Federal Bureau of Entomology and used in the experiments last year at Wallingford. Dr. Quaintance and Mr. Porter kindly granted us permission to use this machine. It was hauled about the orchard with a pair of horses owned by Mr. Platt as is shown on Plates IV and V, a. The liquid spray was applied with the owner's regular sprayer (a Friend power outfit) which is shown on Plate V, b.

The dust mixtures were prepared by the Niagara Sprayer Co., Middleport, N. Y., and 300 lbs. each of Formulas 1, 2, and 3, were furnished gratis for the experiments. These amounts were not sufficient, and later 100 lbs. Formula 1, 100 lbs. Formula 2, and 200 lbs. Formula 3, were purchased from this firm.

MIXTURES USED.

Formula 1 Dust	Powdered sulphur, 90 per cent. Powdered lead arsenate, 10 per cent. Nicotine sulphate, one-half per cent.
Formula 2 Dust	Powdered sulphur, 90 per cent. Powdered lead arsenate, 10 per cent. Nicotine sulphate, 1 per cent.
Formula 3 Dust	Powdered sulphur, 90 per cent. Powdered lead arsenate, 10 per cent. Nicotine sulphate, 3 per cent.
Formula 4 Liquid Spray	Liquid lime-sulphur, 1 part. Water, 9 parts. Nicotine sulphate, ¾ pint per 100 gallons.

Formula 4 was modified by diluting the liquid lime-sulphur at the rate of 1 part to 33 parts of water for the 2nd, 3rd and 4th treatments which were applied to the foliage, and 3 lbs. of powdered lead arsenate, per 100 gallons, was added.

The plan of that portion of the orchard where the experiments were conducted, showing the location of the plots and trees, is reproduced in figure 5.

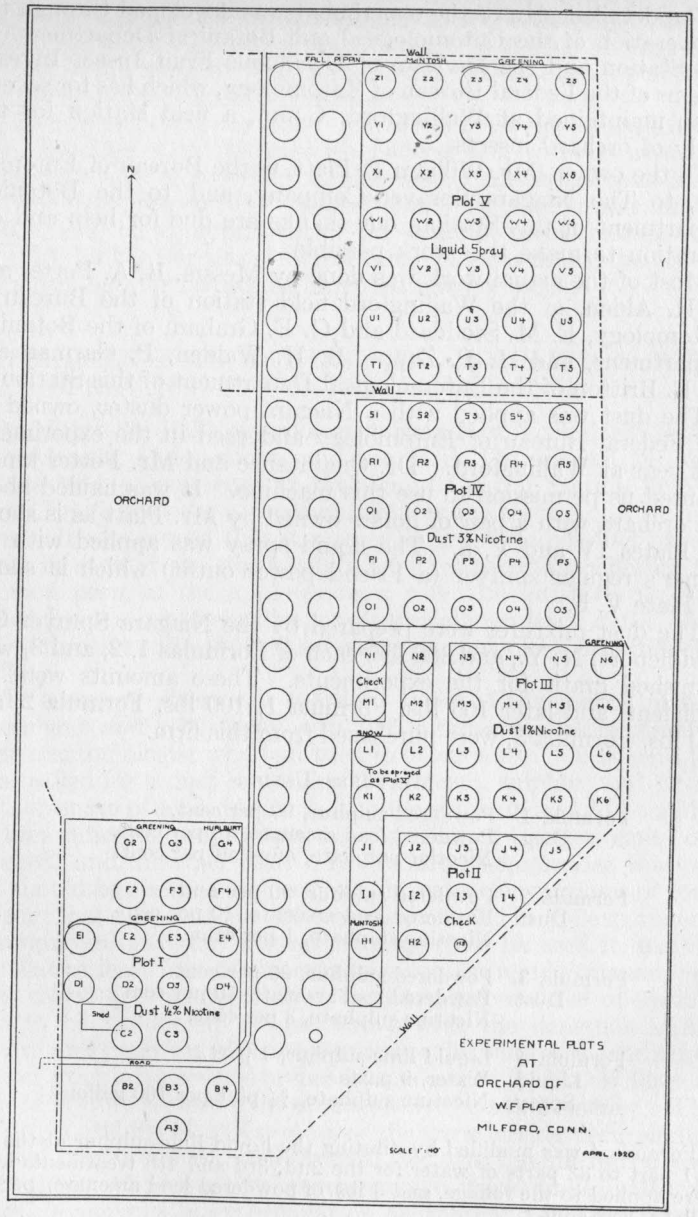

Figure 5. Plan showing arrangement of experiment plots, in orchard of W. F. Platt, Milford, where experiments in dusting and spraying were conducted.

As to varieties, most of the trees were Greening; plot I had 18 Greening and 2 Hurlburt trees; plots II and III were all Greening; plot IV contained 15 Greening, 5 McIntosh and 5 Fall Pippin; plot V contained 21 Greening, 7 McIntosh and 7 Fall Pippin. In all, 104 trees were included in the experiment, and the remaining portion of the thirty acre orchard was sprayed by the owner with a weaker lime-sulphur (1 part to 66 parts of water), but at about the same time and in the same manner as plot V, and was available for collecting data and making observations.

This paper concerns only the treatments and their effects on the insect pests of the orchard. The effect on apple scab and other fungous diseases will be treated separately elsewhere by the Botanical Department.

The treatments given the trees on the different plots were as follows:—

TREATMENTS APPLIED.

Plot I.	Dust, Formula 1.....	20 trees.
Plot II.	Check. No treatment	8 "
Plot III.	Dust, Formula 2	16 "
Plot IV.	Dust, Formula 3	25 "
Plot V.	Liquid Spray, Formula 4.....	35 "
		104 trees.

Additional trees in rows adjoining plots II and III on the west were sprayed like plot V, with two trees saved as checks, to obtain data regarding effect on apple scab, by the Botanical Department.

The applications were made on the following dates:

1st Application	Delayed Dormant	April 22.
2nd "	Pre-pink	May 11
3rd "	Calyx	June 2
4th "	Young fruit	June 25

FIRST, OR DELAYED DORMANT TREATMENT.

Arrangements were completed to make the first application on the morning of April 22. It had rained all of the day preceding, and the trees were moist but not dripping. It was cloudy on the 22nd, with a gentle breeze from the northwest. The treatment began about 8 o'clock A. M., and was finished about 12.30. Messrs. Zappe, Stoddard and Porter made the application. The leaf buds showed a little green at the tips and green apple aphids had hatched and were present on the buds. The trees appeared to be well covered with dust. Living green apple aphids were observed partly covered with dust, about three hours after applying. Rain fell the following day.

For this treatment about 55 lbs. of formula 1; 60 lbs. of formula 2; 75 lbs. of formula 3; and about 150 gallons of formula 4 were used.

This first treatment was followed by cold weather and cold rains which retarded the normal progress of growth for this season of the year.

Second, or Pre-pink Treatment.

The second treatment was made on May 11. At this time the very foremost blossom buds began to show pink, but the others did not. The leaves were only partly developed, but enough so to catch and hold the dust and spray. The weather was ideal for making the application; it had rained a little the day before and it was still and partly cloudy. The work commenced about 8 A. M., and by 9.30 the dusting was finished. The spraying was finished about 11.20. About 4 P. M., a light rain set in which continued during a part of the night.

We ran out of materials of formula 3, before finishing plot IV, and used a little of formula 2, in order to finish. For the spray mixture liquid lime-sulphur was diluted at the rate of 3 gallons, with 3 lbs. of powerded lead arsenate for each 100 gallons. About 225 gallons of the liquid spray mixture were used in this treatment.

The applications were made by Messrs. Zappe, Porter and Stoddard. Very few aphids were present even on the untreated trees. No red bugs had yet appeared and the apple leafhopper, *Empoa rosae* Linn. was just beginning to hatch.

On May 12, a visit to the orchard revealed the fact that the dust was not appreciably washed off by the rains, and though it had collected in low places, or along the mid-rib, or at the tip, was still abundant on the leaves. No injury could be detected on any of the sprayed or dusted trees.

On May 17, another visit was made to the orchard. Bud worms were at work and there were only a few aphids present. Lady beetles were present in moderate numbers.

On May 25, visited orchard again. Greening trees were in full bloom and a few petals beginning to fall. There seemed to be more green apple aphids present than at any preceding visit and a few winged ones were seen. Only one nymph of the false red bug *Lygidea mendax* Reut. was seen, though in the orchard of F. N. Platt, perhaps a mile distant, they were rather common, and most of them were in the second instar.

Third, or Calyx Treatment.

This was made on June 2. The petals had all fallen except here and there a late flower remained. Began dusting about 7:30 A. M. It was quite still with a slight southwest breeze. Material was applied by Messrs. Zappe, Porter and Stoddard.

On June 4, visited the orchard. A light shower came on the afternoon of June 3, but it did not seem to wash off the dust. Found five red bugs in 3rd instar, one of which had left the terminal leaves and was on a cluster of four young apples, each of which had been punctured several times. One colony of rosy aphid was noticed on one of the sprayed trees; green aphid had nearly all disappeared.

Visited orchard on June 8. Could not find any red bugs. A few leaf-eating larvae were found, dead. Also visited the orchard of F. N. Platt, and found plenty of red bugs on one tree in northwest corner of the orchard next to a piece of woodland. There was a bug on nearly every terminal shoot, and some of the bugs were already on the fruit clusters and beginning to puncture the young apples which were then about the size of small marbles. These bugs were in the 4th instar.

Fourth, or Young Fruit Treatment.

This was the final application and was made on June 25. There was a light breeze from the northwest. Apparently it required about four pounds of dust per tree, and about 300 gallons of the spray mixture was used. For this application the dusting machine was towed about the orchard with a Ford truck. Messrs. Zappe, Porter and Stoddard did the work. The McIntosh apples were about an inch in diameter at this time. A little of the rosy apple aphid was noticed, but red bugs were scarce. Leafhoppers (*Empoa rosae* Linn.) were present. In afternoon, visited F. N. Platt's orchard and found red bugs just transforming to the adult stage.

Messrs. Britton and Zappe visited orchard on July 2. There were many nymphs and adults of apple leafhopper present causing whitish spots on the leaves. Also visited F. N. Platt's orchard. Most of the red bugs had gone and only a few adults were seen.

General Seasonal Appearance of Trees.

There was little if any difference in appearance between the sprayed and dusted trees during the early part of the season. Both treatments controlled the leaf feeders in a fairly satisfactory manner. Now and then we found the bud worm at work on the tender terminal leaves. The check or untreated trees were not in such good condition though they were not eaten badly.

A slight difference became noticeable late in the season, for at harvest time the dusted trees seemed to have matured or ripened up earlier and had shed more leaves than the sprayed trees. Thus the sprayed trees were slightly greener. This applied to the foliage rather than to the fruit. No injury from any of the applications was noticed during the season. Nearly all of the trees produced fruit.

Scoring and Counting the Fruit

In order to obtain definite and accurate results on the effect of the treatment it was necessary to count and examine the fruit for

insect injuries from a certain number of trees in each plot. We attempted to select count trees from the center of each plot. Such trees would be less likely to be affected by the treatments given adjoining plots, because the dust and spray will sometimes be blown upon nearby trees. The following number of count trees were selected in each plot: plot I, 4 trees; plot II, 8 trees; plot III, 4 trees; plot IV, 8 trees, and plot V, 8 trees.

As most of the fruit falls which is badly injured by insects it was thought desirable to gather and score the dropped fruit as well as that remaining at harvest time. The drops from the count trees were therefore gathered about once each fortnight, counted, examined for insect and fungus injuries and a record kept. As the Fall Pippin and McIntosh apples matured earlier than the Greening, they were gathered and examined before the Greenings were harvested. On September 30, a few days before harvest time a severe storm took off a large proportion of the apples and these were also picked up, counted and scored separately.

It is interesting to note that the percentage of apples which were brought to the ground from the count trees by this storm varied considerably in the different plots as the following table shows:

FRUIT REMOVED BY STORM SEPTEMBER 30.

Plot.	No. Count Trees.	Percentage fruit dropped.	Treatment.
			Dusted
I	4	8.3	½% nicotine.
			Check
II	8	25	No treatment
			Dusted
III	4	30	1% nicotine
			Dusted
IV	8	23	3% nicotine
V	8	17	Sprayed

On account of plot I being in the corner of the orchard, it was unquestionably somewhat protected by the nearby woodland trees and by the packing shed which stands amongst the trees of this plot. It is also on slightly lower ground than any of the others with the possible exception of plot II. With the exception of plot I, the sprayed trees (plot V) lost a slightly smaller proportion of fruit from the storm than the other plots.

The picking was done mostly by Mr. Platt's men, and the counting and scoring was done by Messrs. Porter, Alden, Stoddard, Graham, Zappe, Walden, Garman and Britton.

The dropped fruit was gathered four times for scoring and counting, on July 7, July 23, August 9, and August 30. The Fall Pippins were harvested September 10-15, and the McIntosh and Greening apples were harvested soon after October 1, the work being finished on October 13. This work involved the counting, separate handling, examination, and making record of each, of 159,668 individual apples.

RESULTS OF TREATMENTS.

The results of the experiments might be given in detail as concerns each of the principal insect pests occurring in the orchard and attacking the fruit, but they are summarized in the accompanying table. It should be noted that the sum of the percentages for each treatment does not equal 100, because the records of percentages for fungous diseases are not included in this table, and even if they were included, in most cases the percentages would total more than 100 because some fruits showed marks indicating that more than one pest had attacked them.

STATISTICS OF RESULTS.

Treatment.	Total No. of Apples.	Good per cent.	Red Bug per cent.	Aphis per cent.	Codling Moth per cent.	Curculio per cent.	Other Insects per cent.
Check.....	34,273	38.6	7.5	.85	4.77	21.00	5.3
Dusted:							
½% Nicotine.	20,290	60.8	7.1	2.31	.306	19.8	7.4
1% Nicotine.	23,972	86.5	2.05	2.82	.505	6.7	6.8
3% Nicotine.	44,486	82.6	1.66	.795	.398	5.25	4.5
Sprayed.....	36,647	88.0	1.66	1.665	.326	7.45	4.54

DISCUSSION OF RESULTS.

It should be borne in mind that these tests represent only one season's work in one locality, and that quite different results might be obtained if the experiments were continued over a period of several years, or if duplicated in a number of orchards in different sections of the state. However, they are given here for what they are worth, and with certain reservations which are noted, may serve as a guide for future work. The percentage of good fruit was somewhat greater on the sprayed trees (plot V) than on any of the dusted trees though those containing one per cent., and three per cent. of nicotine (plots III and IV) were not very far below. The check or untreated trees gave only 38.6 per cent. of good fruit. The results as applied to the chief insect pests of the orchard are as follows:

Red Bug.—This insect was rather scarce in this orchard in 1920, but its injury was detected here and there throughout the orchard and the bugs were seen on a number of occasions. In all cases it was the false red bug *Lygidea mendax* Reut. The figures show that there was little difference between the sprayed trees (plot V) and those treated with one per cent. or more of nicotine in the dust (plots III and IV) but both those having less than one per cent. nicotine in the dust (plot I) and the check or untreated trees (plot II) gave more than three times as much red bug injury on the fruit as each of the other three plots.

Aphids.—Both the green apple aphid, *Aphis pomi* DeGeer, and the rosy aphid, *Anuraphis malifoliae* Fitch (*Aphis sorbi* Kalt.) were present in the orchard but not in sufficient numbers to make them very destructive. No doubt they were somewhat held in

check by the cold and rainy weather during the first half of the summer, and also by the lady beetles which were present. The percentage figures in the table as applied to aphids, appear to have no value, as the untreated trees (plot II) had less aphid injury than any of the other plots except that having three per cent.of nicotine in the dust (plot IV).

Codling Moth.—The codling moth *Carpocapsa pomonella* Linn. was held in check satisfactorily by both liquid spray and dust. Even the untreated trees (plot II) showed less than five per cent. of injured apples.

Curculio.—There was a large amount of injury (21 per cent.) attributed to the plum curculio, *Conotrachelus nenuphar* Herbst., on the untreated trees (plot II), and on the dusted trees containing only one-half of one per cent. of nicotine (plot I) it was only slightly less or 19.8 per cent. As it is a question if nicotine is of any value in controlling this pest and as the trees in plot I were treated with lead arsenate like those in plots III and IV, where the injury was less than one-third as great, some factor other than the treatment must be considered if an explanation is found. The trees of plot I surrounded the packing shed, and were separated only by a stone wall from a pasture partly covered with a growth of brush and some wood had recently been cut there. Possibly these conditions may have furnished better hibernating quarters for the beetles than obtained in the close vicinity of the other plots. The untreated trees (plot II) were only slightly nearer plot I, than was plot III, but it was on the southeast corner of the orchard. A stone wall extended along one side, not only of this plot, but also plots III, IV, and V, in which there was little difference in the amount of curculio injury.

Other Insects.—This category contains minor injuries by chewing insects which could not with reasonable certainty be attributed to codling moth or curculio, though it is possible that both these pests contributed. By far the major portion was due to gnawing of the fruit rather late in the season by Lepidopterous larvae, of which the bud moth *Tmetocera ocellana* Schiff., the lesser apple worm *Enarmonia prunivora* Walsh, and the red banded leaf-roller *Eulia velutinana* Walker, were recognized. The first was reared. There is practically no difference between the plots in regard to this kind of injury, but we believe that it might have been reduced considerably by one or two late applications. (See Plate VI, a).

Recommendations.

It would be unfair to draw final conclusions from these tests of a single season in one locality, and it is hoped that more work may be carried on the coming summer. We cannot advise orchardists to discard their spray outfits to take up dusting, though it is apparently possible to hold the chewing insects in fairly satisfactory control by the use of the dust treatment.

With the addition of nicotine solution some of the sucking insects, particularly false red bug, seem to have been checked, but the data are too meager upon which to base conclusions. The nicotine makes the dusting mixture very much more expensive.

The chief advantage of dusting over spraying is in the saving of time and labor. The disadvantage is in the cost of the materials and apparently this more than offsets the saving in time and labor, as the approximate cost of one treatment per tree was fully three times as great for dusting as for spraying.

If varieties are grown which are not susceptible to scab, and if sucking insects are not troublesome, dusting may give good results, but if these pests are serious in the orchard, better control will probably be obtained by spraying,—a method which has been in common practice long enough so that we know its possibilities. So many experiments have been conducted, that there is an abundance of data to show the value of spraying.

Probably new and more efficient, and possibly cheaper dust mixtures will be devised, but until that time the Connecticut orchardist may as well continue to spray.

Our experience in 1920, not only in Mr. Platt's orchard, but from observations in other orchards, leads us to advise strongly one or two additional and later treatments, in order to forestall the injury from codling moth larvae and other chewing insects late in the season.

NOTES ON THE LIFE HISTORY OF THE FALSE APPLE RED BUG IN CONNECTICUT.

Lygidea mendax Reuter.

By M. P. Zappe.

During recent years this insect has become quite a serious pest in some of the Connecticut apple orchards. It is rather local in its appearance and consequently the injury which it causes is also local. During the summer of 1920, it caused considerable damage to both foliage and fruit in certain orchards. See Plate VII.

The eggs of this species are laid in the lenticels of the apple twigs and hatch at the time when the earliest blossom buds begin to show pink at the tips; most of the buds do not show any color at this time.

When first hatched the young nymphs crawl to the tip of the twig and begin to puncture the young tender leaves which at this time are about one inch long and there are an average of four uncurled ones on each cluster. In a short time the punctured leaves show reddish spots and the sides curl upward. See Plate VII, a.

When the nymphs are in the third instar a few of them begin to leave the terminal twigs and go to the fruit to feed, but the

majority of the young bugs do not leave the terminal shoots until they reach the fourth instar. At this time the apples are about the size of marbles. The nymphs when disturbed have the curious habit of dodging around to the back or opposite side of the leaf or twig. After they become winged they drop readily, spreading their wings as they drop. As a rule they do not fly far, usually alighting on a nearby branch. They do not live long as adults. Out of doors they were transforming to the adult stage on June 25, and on the 2nd of July very few adults could be found. Mating and oviposition were not observed.

Moults.

This insect passes through five moults before it reaches the adult stage. The length of time varies with the weather. The spring of 1920 was rather cold and backward and it took an average of 37 days from the time the eggs hatched until the adult stage was reached. The first newly hatched nymphs were seen on May 22 and the first adults on June 28.

First Instar. One day after hatching.

Color, carmine*, eyes darker red, with white margins. Antennae darker than body except last segment which is lighter. Legs colorless, rather transparent, and covered with small black spines. Beak colorless except tip, which is black. Black spot on middle of dorsal part of abdomen between third and fourth segments. Head with median groove. Dark oval pattern on dorsal part of thorax with median line running through the center. Abdomen one-third wider than thorax. Length 1.8 mm; width across thorax .33 mm; width across widest part of abdomen .66 mm.

Second Instar.

Abdomen not so wide in comparison to length but still a little wider than thorax and a little darker. Eyes much darker than rest of insect with paler margins. Legs darker than first instar. Black oval pattern of thorax seen in first instar is gone. Thoracic segments darker at edges Length 2 mm; width across thorax .5 mm.

Third Instar. Resembles second instar.

Body covered with fine white pubescence which becomes darker a few hours after moulting. Tylus black, antennae and legs darker than rest of body. Length 2.5 mm; width .87 mm.

Fourth Instar.

Wing pads appear in this stage and extend to cover the sides of the first abdominal segment. A deep fovea on each side of middle of second thoracic segment. Length 3.5 mm; width 1.33 mm.

Fifth Instar.

Wings in this stage extend to the sixth abdominal segment. Posterior third of wings and tip of abdomen dusky, also a dark line on the sides of the scutellum. Length 4 mm; width 2 mm.

Sixth Instar.

Adult stage. Bright orange red, antennae and narrow bar across the base of pronotum, black. Clavus, inner angles of corium, and membrane, fuscous; in dark specimens the scutellum and all but the narrow margin of the hemelytra fuscous; legs greenish yellow with fuscous on the tibiae. Length 6 mm; width 2.33 mm. The adult is shown on Plate VII, a.

*Windsor and Newton's water colors in Smith's Explanation of Terms Used in Entomology.

Control.

This insect may be controlled by spraying the trees just before the blossom buds open. Nicotine solution, 1 pint to 100 gallons of water, will hold the insect in check, especially if the tree can be sprayed from both sides at once. If only one side is sprayed at a time the young bugs have a chance to go to the opposite side of a leaf or twig and dodge the spray. This spraying may be combined with what is commonly known as the "pink spray,," which consists of arsenate of lead and commercial lime and sulphur.

As all of the red bugs probably will not be killed at this time, nicotine should be added to later sprays, especially the first calyx spray, soon after the petals fall.

Literature.

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NOTES ON THE LIFE HISTORY OF A SAWFLY FEEDING ON AUSTRIAN PINE.

Itycorsia zappei Rohwer.

By M. P. Zappe.

On June 23, 1915, while collecting insects in New Haven, near some Austrian pines, a large sawfly was taken that looked different from anything in the Station collection. A special effort was made to collect a few more specimens which were flying around Austrian pines.

Several of these specimens were sent for determination to Mr. S. A. Rohwer of the Bureau of Entomology, who is a specialist in this family. He pronounced them an undescribed species of the genus *Itycorsia*, which he afterward named *zappei*. In the Proceedings of the U. S. National Museum, No. 2312, Vol. 57, page

209, Mr. Rohwer published the descriptions of both sexes of the adults.

The next summer larvae were found feeding in small silken webs on the new growth of the Austrian pines. The writer suspected that these larvae might have some connection with the adults that had been present on the trees, so a number were collected and reared. The following summer adults emerged and proved to be the same as those captured from the trees.

The Egg.

The eggs are laid singly on the needles of the new growth late in June and early in July. They are about 4 mm. long and are of a pale clay yellow color. They are crescent-shaped and are laid lengthwise on the needle, being fastened at the back. Both ends are up-turned and pointed, one tapering a little more than the other. When the young larva hatches it emerges from the end which tapers the least. See Plate VIII, a.

The Larva.

First Instar.

Length about 3 mm., body greenish yellow, first thoracic segment with a black marking extending from middle of one side to middle of opposite side with a black spot at each end. A black crescent-shaped mark at base of each leg. Two elongated black spots between each pair of legs on ventral surface of thorax. Legs black. Cerci at end of body with three segments, two distal segments black. Head rufous with appendages lighter. Antennae black with white rings at joints, last segment pointed at tip. Eyes black. Body covered with minute hairs. The eleventh segment bears a pair of atrophied prolegs.

Second Instar.

Length 6 mm. Head light brown with appendages black. Body greenish yellow, legs black. A narrow black stripe extends from base of first pair of legs to under side of head. Other markings same as in first instar.

Third Instar.

No change in markings or other characters from preceding moult.

Fourth Instar.

Head orange brown. Crescent-shaped marks at base of legs not so distinct except on first segment which still shows plainly though not so distinct as in preceding instar. Body becoming more or less glabrous except anal segment which has a number of rather long hairs.

Fifth Instar.

Markings above base of legs gone. Color of body darker green than in preceding instars except head and the first three segments and last two segments which are brownish. First segment has a dark brown bar on the dorsal surface.

Sixth Instar. (See Plate VIII, b.)

Larva entirely green except head which is still brown. There is a dorsal stripe of green darker than rest of body. In this instar the larvae stop feeding and go into the ground where they hollow out a small cell and pass the winter. In the late spring they transform to pupae and emerge as adults about the latter part of June.

The feeding period of the larva is just about one month.

Habits of the Larva.

When the young larvae hatch from the eggs they begin to spin a loose web around themselves, fastening the outer threads to the needles. As the larvae reach full size these webs are often four to five inches long and the larvae move up and down inside them by wriggling the body. The larvae have no prolegs and when removed from their webs and placed on a smooth surface, are unable to crawl until they have spun a sort of a web over themselves.

Their method of feeding is rather interesting. They usually begin at the top of their web and with their strong jaws bite off a needle at its base, just above the bundle sheath, very much as a cut-worm cuts off a plant. Then they proceed to eat it, beginning at the cut off end until they have devoured the entire severed needle. Then they take the next one. They have never been observed to leave their web and go to another twig. The larva in its case is shown on Plate VIII, c, and an empty case at d, of the same Plate.

The Adult.

In order to bring together in one publication the descriptions of all stages of this insect, the original descriptions of the adults as published by Rohwer, in the Proceedings of the U. S. National Museum, Vol. 57, page 209, 1920, are given below.

Itycorsia zappei Rohwer.

"Of the North American species, this new species is probably most closely allied to *maculiventris* (Norton), but the male differs in a number of ways from the description given for that species, and the description of the female given by MacGillivray does not agree in all details with the female of the species described here. In MacGillivray's key to the species of *Itycorsia* of Connecticut (Bull. 22, Conn. Geol. and Nat. Hist. Survey, p. 33) this species runs to couplet 6, but differs from both *luteomaculata* (Cresson) and *albomaculata* (Cresson) in the black cypeus and other minor characters. Of the European species it seems to be more closely allied to *stellata*, but differs from the descriptions of that species in the color of both adult and larva."

"Female.—Length 13 mm. Anterior margin of the clypeus truncate; medianly the clypeus is strongly raised by the extension of the antennal carina; its surface is shining, impuncate; median fovea deep, elongate; area above the frontal crest with rather close, small punctures; median ocellus in a diamond-shaped depression; posterior ocellus bordered laterad and caudad by a deep furrow; posterior orbits and vertex shining, with large widely separated punctures, frontal crest obsolete; antennae 31-jointed, the third joint slightly longer than the fourth and fifth combined; prescutum shining, practically impunctate; scutum shining, with a median area of close, large punctures; scutellum shining, practically impunctate; mesepisternum subopaque, with sparse, rather large, setigerous punctures. Black; spot on the mandibles at base, spot on the superior orbits, two spots on the vortex, spot on the occiput behind the eye, and with a line-like projection toward the supraorbital spot, the posterior margin of the pronotum, tegulae, two spots near the posterior margin of the prescutum, two spots along the notauli on the scutum, two large spots on the scutum posteriorly, a small spot on the lower posterior orbits, an elongate spot on the mesepisternum dorsally, circular spot on the sides of the pronotum,

most of the metepisternum, dorsal and ventral margins of tergites, the apical margin of the sternites 3, 4, 5, and 6, yellowish-white; legs black; the tibiae and basal joints of the anterior tarsi rufous; wings hyaline basally, fuliginous beyond the basal margin of the stigma; venation dark brown."

"Paratype females show that this species may vary as follows: the spot on the metepisternum may be greatly reduced; the line projecting toward the supraorbital spot may be complete or entirely absent; the yellow spot on the lower margin of the posterior orbits is usually wanting."

"Male.—Length 8.5 mm. In puncturation and characters of the head, the male agrees with the above description of the female, except the declivous face is a little more sharply defined on the frontal crest, however, the frontal crest is rounded and not margined; antennae 31-jointed; the third joint slightly longer than the fourth and fifth; hypopygidium broadly rounded apically. Black and yellow; antennae yellowish-ferruginous, apical half brownish; scape above black; head black; mandibles except apices, clypeus except two points medianly, lateral supraclypeal area, area between the antennae and extending caudad in two lines to the level of the anterior ocellus, the lateral orbits near the top of the eye where they narrow and extend almost to the middle of the occiput, supraorbital spot, connected with the line extending posteriorly to meet the line of the occiput, two spots on the vertex, yellow; thorax black, the posterior dorsal margins of the pronotum, tegulae, most of the prescutum, two spots on the scutum anteriorly, spots on the scutum posteriorly, the scutellum, most of the metepisternum, sternum, metepimerun, and episternum, yellow; sternites, and tergites ventrally, and the lateral margin of the tergites dorsally yellow; the rest of the tergites black; legs yellow with the base of the coxae posteriorly, line of the femora and trochanters posteriorly black; wings hyaline; venation dark brown; costa and also margin of the stigma yellowish."

"Type Locality.—New Haven, Connecticut. Described from eight females and two males collected by M. P. Zappe for whom the species is named. The type female was collected as a larva August 2, 1916, on Austrian pine and emerged June 7, 1917. It is recorded under No. 670 Connecticut Agricultural Experiment Station. The type male and the paratype male were collected as larvae on August 2, 1916, on white pine, and emerged June 26, 1917, and are recorded under No. 669 Connecticut Agricultural Experiment Station. The other females were collected in June and July, 1915."

"Type, Allotype, and four female Paratypes.—Cat. No. 21605, U. S. N. M."

"Three female paratypes and the male paratype returned to the Connecticut Agricultural Experiment Station."

TESTS OF SOAP SPRAYS TO KILL THE PINK AND GREEN POTATO APHID.

Macrosiphum solanifolii Ashmead.

By M. P. Zappe.

During the summer of 1920 there was a local outbreak around New Haven of the pink and green potato aphid which has done considerable damage during the last three or four years. At Woodmont there was a rather heavy infestation in two large fields of about sixty acres of potatoes. The owner came to the Station for advice. He did not wish to spray unless it was absolutely necessary. In one of the fields there were large numbers of parasites and parasitized aphids present, also many lady-beetles and their larvae. A fungous disease was also present and had killed quite a large number of the aphids, consequently it did not seem worth while to spray the potatoes in this field. In the other field, however, the infestation on the Green Mountain variety was rather heavy, and though parasites were also present, they were not nearly as abundant as in the first field.

It was decided to spray the second field and keep a close watch on the other. The usual spray of nicotine solution and soap was recommended, but on account of the scarcity of labor the owner wished to avoid the task of dissolving the soap. But if he did have to dissolve soap, he felt that he might better use a little more soap in the spray and omit the nicotine solution (which had advanced in price from $10.75 to $13.75 per ten pound package).

Soft soaps were suggested and a cheap kind of soft soap was procured at one and one-half cents a pound and tried on a small scale. A chemical analysis showed the soap to be 93 per cent. water with a very large excess of free alkali. There was so much free alkali that it would burn one's hands. This soap proved to be of little value for killing aphids even when used as strong as one part soap to two parts water.

Another soft soap which was intended for washing automobiles was tried with much better results. This soap was a better grade of soap than that just mentioned. It was made with a linseed oil base and contained only 56.2 per cent. of water. This soap cost twenty-five cents a pound wholesale in twenty-five pound pails. When used at the rate of one-half ounce to one gallon of water, this soap was 100 per cent. effective in killing the aphids on dipped potato plants. Part of the second field of potatoes was sprayed with this soap with very good results. The sprayer was of the four-row type with three nozzles to each row. The lower nozzles could be turned up at any angle desired so that the underside of the leaves could be easily sprayed. See Plate VI, b.

Still another brand of automobile soft soap was tried. This was claimed by the dealer to be just the same as the soap described above, but the price was much higher (thirty-eight cents a pound in five pound pails) and it was not nearly so effective in killing aphids. To get the same result, over twice as much soap had to be used.

THE EUROPEAN RED MITE, A NEW ORCHARD PEST IN CONNECTICUT.

Paratetranychus pilosus Can. and Fanz.

Order Acarina Family Tetranychidae

By Philip Garman.

A number of Connecticut orchardists observed with no little concern during the past season, the damage caused by the European red mite. Most of them had little success with the ordinary insect control measures which consisted for the most part of lime-sulphur, nicotine and lead arsenate preparations applied in accordance with the usual spray calendar recommendations. In consequence, it is important to state what is known of the habits and control of the mite under local conditions as well as to indicate what measures have been successful for similar troubles in other localities. Considering the fact that the pest is often mistaken for others less injurious, it is also important to describe its structure and indicate characters for its recognition. These facts together with a history of the pest in Connecticut will form the present statement regarding the European red mite.

Discovery in Connecticut.

About July 2, 1920, Doctor Britton, State Entomologist, visited the orchard of Mr. Frank N. Platt, of Milford. He noted there a tree which had brown leaves, and thought from appearances, that the red spider (*Tetranychus bimaculatus* Harvey) was responsible. Examination of leaves brought by him to the laboratory showed them to be infested with the European red mite, a species not hitherto reported from Connecticut. Examination of material brought from Milford earlier in the season by Mr. Zappe led to the suspicion that there was something different in hand, but the pest was identified from material obtained later. Referring then to the Experiment Station collection of unidentified mites, a single slide was found which contained the same species. This was collected by Mr. Zappe at Clintonville, in the town of North Haven, April 17, 1917. Eggs were also received in the fall of 1919 on a small peach twig. These were allowed to hatch and a comparison of the larvae with those obtained later showed that they are the same.

Distribution.

The above observations indicate that the European red mite has been in Connecticut at least three years. During the last year it has been found in Greenwich, Danbury, Milford, Branford, Wallingford, Middletown and Meriden. It is reported from Canada (Ontario), Pennsylvania, and is thought to occur in New

Jersey. Probably it has a much wider distribution and has in many cases been mistaken for the red spider (*Tetranychus bimaculatus* Harvey) or the clover mite (*Bryobia pratensis* Garman).

Description.

Adult mites are dark velvety red in color, the young somewhat brighter. The eggs are dull red.

The egg is slightly flattened above, is radially grooved and has a short stalk arising from the center, the stalk being slightly longer than the vertical diameter of the egg. It measures .15 mm. in diameter when fresh. See figure 6, 2, and for appearance of eggs on twig, Plate IX, b.

The larval and nymphal stages are similar to the adult female in general appearance; but are smaller in size and the larva has only three pairs of legs instead of four.

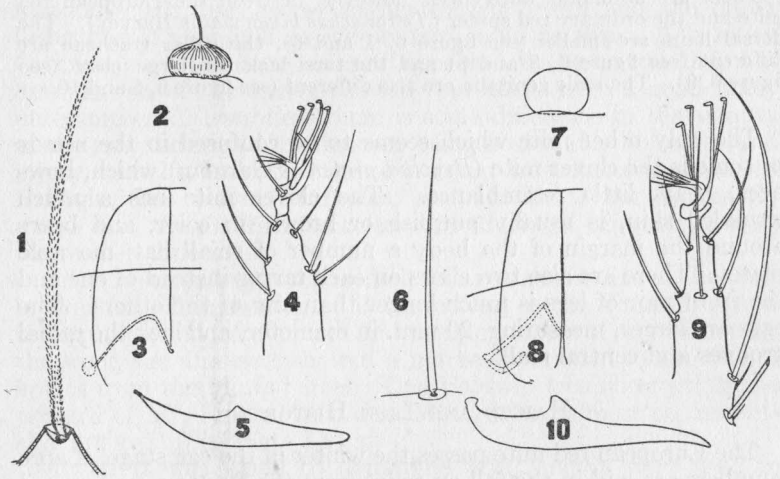

Figure 6. Structures of European red mite *Paratetranychus pilosus* Can. and Fanz. and common red spider *Tetranychus bimaculatus* Harvey.

1, *Paratetranychus pilosus*, seta of dorsum 846 times enlarged; 2, egg, 14 times enlarged; 3, collar trachea and mandibular plate, 714 times enlarged; 4, tarsus of first pair of legs of female, 921 times enlarged; 5, penis, 1400 times enlarged.

6, *Tetranychus bimaculatus*, seta of dorsum, 846 times enlarged; 7, egg, 14 times enlarged; 8, collar trachea and mandibular plate, 714 times enlarged; 9, tarsus of first pair of legs of female, 921 times enlarged; 10, penis, 1400 times enlarged.

The adult female is about .31 mm. in length. There are 26 setose dorsal bristles arising from small tubercles (see figure 6, 1) which when viewed with a lens of small magnifying power appear as white dots. The tarsi, or last segment of the legs, is provided with a single claw, widest at the mid point and with apparently five (there are probably six) appendiculate spurs projecting at right angles (see figure 6, 4). There are also four tenent hairs with hooked tips arising from the base of the claw and exceeding it considerably in length. The mandibular plate (see figure 6, 3) is similar to that of most other red spiders, but the collar

trachea consists of a simple tube suddenly dilated at the tip to form a nearly spherical chamber. The maxillae consist of about four segments, each of which is tipped with a short spatulate body probably representing an additional one. The next to the last segment has a strong hook, and the last has five setae (two apical, two basal on the dorsum, and one lateral) and a clavate hair between the two dorsal pairs.

The male is much smaller in size and the tip of the abdomen is more pointed than in the female. The male genitalia of the different species of red spiders are characteristic of each.

Probably the most closely related representative of the red spider family is the west coast mite, known as the citrus red spider (*Paratetranychus citri* McGregor[1]). This mite does similar damage to fruit trees in Oregon and differs from the European red mite only in minute characters of the male genitalia, and the mandibular plate. The egg, however, seems to have a longer central stalk and the guy fibrils reported on the citrus mite egg have not been seen in the egg of the European red mite.

There are abundant differences, however, between the European red mite and the ordinary red spider (*Tetranychus bimaculatus* Harvey). The dorsal hairs are smaller (see figure 6, 1 and 6), the collar tracheae are different (see figure 6, 3 and 8) and the tarsi lack the large claw (see figure 6, 9). The male genitalia are also different (see figure 6, 5 and 10.)

The only other mite which seems to be confused in the minds of some is the clover mite (*Bryobia pratensis* Garman) which, however, bears little resemblance. The clover mite has a much wrinkled skin, is usually purplish or brown in color, and bears around the margin of the body a number of small flat movable plates. There are also two claws on each tarsus instead of one and the front pair of legs is much longer than any of the others. The eggs are larger, measuring .20 mm. in diameter, and lack the radial grooves and central stalk.

Habits and Life History.

The European red mite passes the winter in the egg stage. Large numbers are laid in the fall on twigs from the size of a lead pencil to three-fourths of an inch in diameter. They are frequently found several layers deep about bud scars or in crevices in the bark. Apples are also selected for egg laying, the eggs being frequently placed in the calyx cavity as shown on Plate IX, b. Here they are protected from being rubbed off in handling and are doubtless carried from place to place in the shipment of fruit. Under favorable conditions they may hatch, and regain a host, thus starting a new colony.

Emergence takes place early in the spring though the exact time cannot be stated for this locality. In Sweden the eggs of the same mite hatch about the first of May and young mites were observed in 1920 about this time in Connecticut. From then on they develop rapidly if conditions are suitable, and several generations probably develop before the winter eggs are laid. In 1920, they became much reduced in numbers on the leaves about the

[1] = *mytilaspidis* Riley.

first of August, and very few could be found, although numerous cast skins were present on the leaves. The greatest development therefore took place between May and August (in 1920) and it is probable that most damage was done in June. The different stages consist of a larva, three nymphal, and the adult stage. Eggs, larvae, nymphs and adults may be found on the leaves at the same time so that there appears to be no definite brood limits.

The European red mite spins little or no web. Larvae spin more than adults, but they never produce as much web as the common red spider.

Observations in Various Orchards.

The first extensive leaf injury was seen in Plant Brothers' Orchard, Branford, Connecticut. Here a large block of Baldwin was affected, the leaves having turned brown and the injury being visible as far off as the orchard could be seen. A block of Greening in the same orchard appeared to be untouched, but examination of the leaves showed that there were a good many mites present. Doubtless there is some difference in the vitality of the two varieties, the Greening being better able to withstand injury. In this and other orchards injury from mites was seen on Baldwin, Ben Davis, McIntosh, and Hurlburt, but in nearly every case the Baldwin showed the effects of infestation more than other varieties.

Infested trees lose some of their foliage and the size of the fruit is affected. Examination of Baldwin fruit in the Plant Brothers' orchard, selected from injured and uninjured trees of approximately the same age and size, showed a marked reduction in the size of apples from the injured trees. One Baldwin tree observed in the orchard of Mr. Frank Platt, near Milford, had almost no marketable apples. (See Plate IX, a.)

An effort was made to determine what sprays were used in orchards showing the worst injury. The Plants' orchard proved to be the most instructive, and showed that attention must be given to early sprays, especially the delayed dormant application. This spray apparently should not be diluted more than 1 to 9 in the case of lime-sulphur, and should be applied with great care to cover as much of the tree as possible.

Recommendations of Other Investigators.

Sulphur in some form is usually recommended for control of red spiders. Sulphur dust is said to require an average temperature of 75° F., (7, page 523*,) in the shade, to be effective, but just how it kills is not well understood. It is thought that it vaporizes at this temperature and that the fumes do the work; and it apparently acts only at short range.

*See literature at the end of the article.