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Forty-fifth Annual Report

OF

The Connecticut Agricultural Experiment Station

Being the annual report for the year ending October 31

1921

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THE BOARD OF CONTROL.

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NEW HAVEN, CONN.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

OFFICERS AND STAFF

February, 1922.

BOARD OF CONTROL.

His Excellency, Everett J. Lake, *ex-officio, President.*

James H. Webb, *Vice President*.....Hamden
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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.*
MISS J. V. BERGER, *Stenographer.*
WILLIAM VEITCH, *In charge of Buildings and Grounds.*

Chemistry, Analytical Laboratory.

E. M. BAILEY, PH.D., *Chemist in Charge.*
R. E. ANDREW, M.A., C. E. SHEPARD, H. D. EDMOND, B.S., OWEN L. NOLAN, R. T. MERWIN, H. J. FISHER, B.A. — *Assistant Chemists.*
FRANK SHELDON, *Laboratory Assistant.*
V. L. CHURCHILL, *Sampling Agent.*
MISS ALTA H. MOSS, *Clerk.*

Biochemical Laboratory.

T. B. OSBORNE, PH.D., SC.D., *Chemist in Charge.*

Botany.

G. P. CLINTON, SC.D., *Botanist in Charge.*
E. M. STODDARD, B.S. *Pomologist.*
MISS FLORENCE A. MCCORMICK, PH.D., *Pathologist.*
G. E. GRAHAM, *General Assistant.*
MRS. W. W. KELSEY, *Stenographer.*

Entomology.

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

Forestry.

WALTER O. FILLEY, *Forester in charge.*
A. E. Moss, M.F., H. W. HICOCK, M.F., — *Assistant Foresters.*
MISS PAULINE A. MERCHANT, *Stenographer.*

Plant Breeding.

DONALD F. JONES, *Plant Breeder in charge.*
P. C. MANGELSDORF, B.S., *Assistant.*

Tobacco Station.

G. H. CHAPMAN, PH.D., Windsor, Conn.

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ERRATA

Report for 1921:

In the Report for 1920, page 346, eighth line from bottom, for not renewed, read June 16, 1921.

On same page, fifth line from bottom, for not renewed, read April 4, 1921.

Report for 1922:

Page 78. First line of table, for potash read potato.

Page 100. Strike out the first and second lines in the table and insert in their place the last three lines of the same table.

Page 106. 20th line, near middle of page, for 16008, read 16608.

Bulletin 233, page 37. 23d line from top, after 1614 insert arcadian sulphate of ammonia, made by Barrett Co., N. Y. City; and in same line for New York read Bridgeport.

Report of the Board of Control

OF

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION

To His Excellency, Everett J. Lake, Governor of Connecticut:

As required by Statute, the Board of Control of the Connecticut Agricultural Experiment Station herewith submits its annual report for the year ending Oct. 31, 1921.

The General Assembly (Chapter 193, Public Acts, January Session, 1921), provided for the appointment of a State Forester by the State Park and Forest Commission, repealing the Statute which made him an appointee of this Station. This relieves the Station Forester of much administrative work and gives greater opportunity for experimental work in forestry.

The General Assembly made the following biennial appropriations for the maintenance of this Station and for the work required of the Station staff by Statute.

Current expenses	$82,000	
Food and drug inspection	15,000	
Suppression of gipsy and browntail moths and inspection of imported nursery stock	60,000	
Bee diseases	4,000	
Control of white-pine blister-rust	10,000	
Mosquito elimination	12,000	
State Entomologist	25,000	
Total		$208,000

The Assembly also appropriated to this board, for the biennial period, $10,000 for research and experiment on the causes and prevention of diseases and injuries to the Connecticut tobacco crop and for the improvement of the crop by selection and breeding and by coöperative experiments with growers.

The Station has secured a tract of land of thirteen and one-half acres, well suited for the work, without any expenditure of State funds, and has begun experimental work on it.

The Connecticut Valley Tobacco Improvement Association has been organized by growers and packers of tobacco in Connecticut and Massachusetts, and funds have been raised for the same object as that for which the State appropriation was made. Dr. G. H. Chapman, formerly of the Massachusetts Agricultural Station, has been appointed as research director, an arrangement has been made by which Dr. Chapman is added to the Staff of this Station, and the two agencies propose to work in the closest coöperation.

The changes in the Station staff have been few. Mr. C. D. Hubbell, assistant to the plant breeder, resigned on April first, and Mr. P. C. Mangelsdorf was appointed in his place July first. Mr. H. D. Edmond, chemist, was given leave of absence in November, 1920, on account of serious illness, and Mr. R. N. Copeland served temporarily as chemist from March first to September first. Mr. H. J. Fisher was appointed as chemist in October, 1921.

In view of the fact that the salaries paid here have been considerably lower than for service of the same character in many other institutions, the fact that so few changes have occurred here within recent years is a tribute to the loyalty of the members of the Staff of this institution for which we wish to record our grateful appreciation.

The report of the Director now in the printer's hands gives in brief outline the character and results of this Station's work during the year just closed, and will be submitted to you as soon as it appears.

Respectfully submitted,

GEORGE A. HOPSON,
Secretary.

REPORT OF THE TREASURER

July 1, 1920 - June 30, 1921

E. H. JENKINS, in account with THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION for the fiscal year ending June 30, 1921.

RECEIPTS.

Balance on hand, July 1, 1920 (Analysis Fees) ...		$13.45
State Appropriation (General)	$22,500.00	
State Appropriation (Transfer from Blister-Rust Appropriation)	500.00	
State Appropriation (Food)	2,500.00	
State Appropriation (Food Deficiency)	5,200.00	
State Appropriation (Insect Pest)	7,500.00	
United States Appropriation (Hatch)	7,500.00	
United States Appropriation (Adams)	7,500.00	
Fertilizer Analysis Fees	17,000.00	
Lockwood Trust Income (including sale of tree seedlings and Mt. Carmel Farm Produce)	10,500.00	
Interest on Bank Deposits	85.03	
Connecticut State Department of Health (rent) ..	200.00	
Connecticut Agricultural College (for A. E. Moss)	1,500.00	
Sales of Gasoline and Oil	378.92	
Sale of Station Produce	1.00	
Miscellaneous	56.69	
Court Fees (E. H. Jenkins)	1.00	
Court Fees (E. M. Bailey)	70.23	
		82,992.87
		$83,006.32

DISBURSEMENTS.

E. H. Jenkins, director (salary)	$2,800.00
E. H. Jenkins, treasurer "	400.00
V. E. Cole (salary)	1,375.00
L. M. Brautlecht "	975.00
T. B. Osborne "	3,150.00
E. M. Bailey "	3,100.00
C. E. Shepard "	2,100.00
W. E. Britton "	3,100.00
G. P. Clinton "	3,100.00
E. M. Stoddard "	2,225.00
W. O. Filley "	3,100.00
A. E. Moss "	2,500.00
F. A. McCormick "	1,058.33
D. F. Jones "	3,075.00
R. E. Andrew "	2,625.00
R. N. Copeland "	566.66

H. D. Edmond	(salary)	$1,100.00
V. L. Churchill	"	1,275.00
Wm. Veitch	"	987.50
P. A. Merchant	"	480.00
G. E. Graham	"	1,375.00
C. D. Hubbell	"	695.00
H. W. Hicock	"	300.00
Alta H. Moss	"	897.00
Mrs. L. D. Kelsey	"	663.33
Owen Nolan	"	1,635.00
D. Paguirigan	"	116.67
Frank Sheldon	"	975.00
G. A. Hopson	"	353.15
Marion Pickett		24.20
Clara L. Weed		253.86
Jane V. Berger		553.33
Henry Kiley		1,394.00
Herbert W. Edwards		1,394.00
Oliver J. Welch		1,295.00
Thomas F. Barrows		756.00
Thomas O'Donnell		80.67
Richard Merwin		934.00
Ervin Applegate		72.00
Labor		4,781.41
Publications		527.15
Postage		231.54
Stationery		532.12
Telephone and Telegraph		240.01
Freight and Express		181.31
Gas, Electricity and Kerosene		1,327.97
Coal		3,759.62
Water		123.30
Chemicals		1,000.76
Laboratory Supplies		687.07
Seeds, Plants, etc.		176.63
Agricultural and Horticultural Supplies		113.60
Food Samples		20.57
Ice		118.75
Photographic Supplies		113.26
Automobile Oil		69.68
Miscellaneous Supplies		515.99
Fertilizers		392.70
Feeding Stuffs		433.35
Library (Books and Periodicals)		495.03
Library (Binding)		135.65
Tools, Machinery and Appliances		552.66
Tools, Machinery and Appliances (Repairs)		1,006.19
Furniture and Fixtures		437.79
Furniture and Fixtures (Repairs)		114.74
Scientific Apparatus		154.15
Scientific Apparatus (Repairs)		6.65
Live Stock		57.50
Traveling by the Board		142.09
Traveling by the Staff		1,220.38
Gasoline for Automobiles		804.17
Traveling in connection with Adams Fund Investigations		69.54
Insurance		882.27
Insect Pest Appropriation to State Entomologist		7,500.00

Contingent	$426.64	
Buildings (New)	30.00	
Buildings and Land (Betterments)	107.03	
Buildings and Land (Repairs)	617.13	
Total Disbursements		$82,966.10
Balance on hand, June 30, 1921 (Analysis Fees)		40.22
		$83,006.32

NEW HAVEN, CONN., Aug. 5, 1921.

THIS IS TO CERTIFY that we have examined the accounts of E. H. Jenkins, Treasurer of the Agricultural Experiment Station, for the fiscal year ending June 30, 1921, and have found them correct.

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

REPORT OF
E. H. JENKINS, DIRECTOR,
in Account with
MOSQUITO ELIMINATION APPROPRIATION
for the two years ended June 30, 1921.

Receipts

		July 1, 1919, to June 30, 1921
Petty Cash Fund from B. H. Walden, May 1, 1920		$500.00
From State Comptroller for vouchers sent by		
B. H. Walden	$2,006.49	
E. H. Jenkins	11,549.38	
		$13,555.87
Total		$14,055.87

Expenditures

	July 1, 1919, to June 30, 1920	July 1, 1920, to June 30, 1921	
B. H. Walden (salary)	$499.98	.....	$499.98
S. T. Sealy (salary)	424.04	$2,100.00	2,524.04
Nicholas Matiuck (labor)	440.00	700.00	1,140.00
Prokofee Mickevich (labor)	237.00	.....	237.00
J. W. Draper (labor)	269.50	.....	269.50
A. Davidiuk (labor)	182.97	.....	182.97
Russell Bartlett (labor)	217.88	281.25	499.13
L. E. Rice and others (labor)	85.50	729.50	815.00
Town of Guilford for Frank Blatchley (labor)	90.00	687.65	777.65
John Lubeck (labor)	102.50	.....	102.50
Yakop Faidash (labor)	61.00	17.50	78.50
Henry Pawlikowski (labor)	72.90	42.30	115.20
Jake Hauser (labor)	23.75	.....	23.75
Jos. Hauser (labor)	11.03	.....	11.03
John Faidash (labor)	4.50	.....	4.50
Stephen Osmolek (labor)	4.50	38.50	43.00
Jos. Krivenski (labor)	.....	235.00	235.00
J. D. O'Shea (labor)	.....	314.84	314.84
F. D. Luddington (labor)	.....	274.00	274.00
R. E. Fitch (labor)	.....	248.66	248.66
E. Barton (labor)	.....	98.38	98.38
F. Williams (labor)	.....	32.00	32.00
John Kosch (labor)	.....	82.00	82.00
A. Antczak (labor)	.....	198.03	198.03
Frank Kudlicki (labor)	.....	196.08	196.08
George Davis (labor)	.....	187.93	187.93
Roy Clinton (labor)	.....	238.68	238.68
Elon Bragg (labor)	.....	171.50	171.50
John Gilbert (labor)	.....	234.13	234.13

Frank Toth (labor)	.....	$ 45.50	$ 45.50
Eaton, Brown & Simpson (ditching)	.....	250.00	250.00
Labor (extra)	$ 1.35	.....	1.35
Stationery	.....	92.03	92.03
Postage	.....	4.65	4.65
Telephone and Telegraph	3.08	3.85	6.93
Team and Horse Hire and Carting	48.25	101.15	149.40
Freight and Express	.59	1.51	2.10
Oil for Mosquitoes	81.94	8.82	90.76
Miscellaneous Supplies	26.15	57.95	84.10
Automobile Supplies	.....	2.50	2.50
Automobile Oil	4.25	4.35	8.60
Automobile (new purchase)	650.00	.....	650.00
Automobile (repairs)	76.82	826.84	903.66
Tools, Machinery and Appliances	24.45	36.90	61.35
Tile, Lumber, Cement, etc.	174.42	.....	174.42
Tide-Water Gates	.....	520.00	520.00
Furniture and Fixtures	.....	27.38	27.38
Scientific Apparatus	.....	38.48	38.48
Automobile Insurance	73.60	56.90	130.50
Contingent	4.00	.....	4.00
Travel	110.24	144.90	255.14
Travel (gasoline for automobile)	17.90	200.14	218.04
Total	$4,024.09	$9,531.78	$13,555.87

Balance on hand, June 30, 1921 (Petty Cash Fund)	$500.00

Of the total amount expended in two years as above ($13,555.87), there was spent for

Supervision: Maintenance of old work	$5,351.77	
Supervision: New work	43.12	
		$5,394.89
New Work (Groton)		250.00
*Maintenance:		
Madison	$531.13	
Guilford	798.64	
Branford	1,561.40	
East Haven	75.42	
New Haven	1,314.20	
Orange	643.16	
Fairfield	2,830.88	
Groton	72.00	
Stamford	84.15	
		$7,910.98
		$13,555.87

*Of the expense of maintenance in the towns, three-quarters is to be paid by the towns, as follows: Madison, $398.34; Guilford, $598.98; Branford, $1,171.06; East Haven, $56.57; New Haven, $985.65; Orange, $482.36; Fairfield, $2,123.16; Groton, $54.00; Stamford, $63.11.—Total, $5,933.23.

CONNECTICUT

AGRICULTURAL EXPERIMENT STATION

NEW HAVEN, CONN.

BULLETIN 232 **OCTOBER, 1921**

Report of the Director

For the Year ending October 31, 1921

By E. H. Jenkins

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The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

OFFICERS AND STAFF

OCTOBER, 1921

BOARD OF CONTROL.

His Excellency, Everett J. Lake, *ex-officio, President.*

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George A. Hopson, *Secretary* ..... Mt. Carmel
E. H. Jenkins, *Director and Treasurer* ..... New Haven
Joseph W. Alsop ..... Avon
Charles R. Treat ..... Orange
Elijah Rogers ..... Southington
William H. Hall ..... South Willington

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MISS J. V. BERGER, *Stenographer.*
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Plant Breeding.
DONALD F. JONES, S.D., *Plant Breeder in Charge.*
P. C. MANGELSDORF, B.S., *Assistant.*

In charge of the Tobacco Station.
G. H. CHAPMAN, PH.D., Windsor, Conn.

Report of the Director

FOR THE YEAR ENDING OCTOBER 31ST, 1921.

To the Board of Control of the Connecticut Agricultural Experiment Station:

A formal report of your Board to the Governor of the State is made annually. This, however, is not distributed with the bulletins and is therefore not generally seen by the public.

It seems wise, therefore, to give some brief summary of this Station's work in a form which can be read by all who are interested.

While much of the Station's work is fundamental and essential to the teaching of the Agricultural College and of the Extension Service, it is done without advertising and does not attract public notice, so that the needs of the Station and the importance of its work are quite generally overlooked. In addition to doing this agricultural research work this Station has become during the forty-six years of its life an agency of public service, primarily agricultural, but serving in large measure all the citizens of the State.

BIOCHEMICAL DEPARTMENT.

Dr. T. B. Osborne in charge.

Two projects are being studied in this department.

One of them, in charge of Dr. Osborne, is a study of the chemistry of the different proteins.

Another problem, closely related, in which Dr. Osborne and Dr. L. B. Mendel of Yale University are collaborating, is a study of the relative values of these proteins in nutrition. This has necessarily involved a study of all other factors of nutrition. Thus it has led to the discovery of the fat-soluble vitamine (coincidentally with its discovery by another investigator) and to further knowledge of the rôle of the other ingredients of the diet as well as to the perfection of artificial rations which have opened a wider field for study of fundamental problems. The first project was undertaken about thirty years ago by Dr. Osborne, long before the Adams fund was provided by Congress. The published results of these two researches have contributed largely to a new conception of the nature and composition of the proteins and their different values in nutrition, and have finally demonstrated the falsity of the assumption that the proteins of food are about alike in nutritive value, having shown that some are incapable of supporting the growth and even the life of animals, and that the others differ very considerably in their effectiveness.

The work of the present year may be briefly noticed as follows:

A method has been devised by which a ration for experimental animals can be prepared in which fat is at most a minimal contamination. On such rations young rats quadrupled their weight in the usual time and appeared as well nourished as rats which had liberal amounts of fat in their diets. Unless, therefore, a minute amount of fat plays as important a part in assimilation as do the vitamines, it is reasonable to assume that pure fats are not an essential part of the mammalian diet.

The same kind of experiment was then carried on with carbohydrates. A ration was prepared in which the amount of carbohydrates was at most exceedingly small. In some of these trials the rats grew from early age to adult size at a rate rarely exceeded on normal rations. A chemical analysis of the entire bodies of some of them showed that they contained practically as much glycogen as is found in rats fed on diets in which carbohydrates are abundant, indicating that the rat can manufacture the necessary supply of tissue carbohydrates from non-carbohydrate material, and can also supply its energy from other sources than carbohydrates.

Next an experiment was tried of excluding *both* carbohydrates and fat from the diet, which then contained more than 90 percent of protein, 5 percent of inorganic salts along with small daily doses of vitamines in dried alfalfa and brewery yeast, thus forcing the animal to meet its energy requirement from protein alone. In these trials, which are still in progress, the rats have grown at more than normal rate to about 225 grams, but subsequent growth has been much slower so that the final outcome is uncertain.

Trials with variable quantities of vitamine B, in rations which were otherwise identical, show a quantitative relation between the amount of vitamines fed and the gain in weight.

The record of 1,000 rats which have been under experiment here show that ophthalmia has appeared only in rats deprived of the fat-soluble vitamine, but never in those weakened by any other disease or defect of diet, and never has it "spread," though the ophthalmic rats have been close to those which did not have the disease. This strongly indicates that xerophthalmia is purely a food-deficiency disease and is not infectious.

In view of the question frequently asked whether dried milk is deficient in vitamines, it is worth while noting that in this laboratory rats have grown from early age to full adult size, for more than a year, on dried milk powder, corn starch and lard.

Dr. Osborne has undertaken the study of the proteins of green or growing plants; a study of extreme difficulty, but in which the experience of many years in the study of reserve proteins of seeds is of great value. This is a very important field of study which

apparently has received no attention because of its great difficulties.

The work above described is of fundamental importance. Its results may not be immediately applied to feeding practice, but it provides the basis on which most rational experimental work on feeding problems can be securely placed.

The co-operative exhibits for the meeting of the American Medical Association and of the National Child Welfare Association have been noticed in the report of the Chemical Department.

The results of the work of the biochemical laboratory are published in scientific journals. Following is a list of those which have appeared during the present year:

Skimmed Milk as a Supplement to Corn in Feeding. Thomas B. Osborne and Lafayette B. Mendel. Jour. Biol. Chem. (1920) XLIV, 1-4.

Growth on Diets Poor in True Fats. Thomas B. Osborne and Lafayette B. Mendel. Jour. Biol. Chem. (1920) XLV, 145-152.

A Critique of Experiments with Diets Free from Fat-Soluble Vitamine. Thomas B. Osborne and Lafayette B. Mendel. Jour. Biol. Chem. (1921) XLV, 277-288.

The Effect of Alkali on the Efficiency of the Water-Soluble Vitamine B. Thomas B. Osborne and Charles S. Leavenworth. Jour. Biol. Chem. (1921) XLV, 423-426.

Does Growth Require Preformed Carbohydrate in the Diet? Thomas B. Osborne and Lafayette B. Mendel. Proc. Soc. Exper. Biol. and Med. (1921) XVIII, 136-137.

Growth on Diets Containing More than Ninety Per Cent of Protein. Thomas B. Osborne and Lafayette B. Mendel. Proc. Soc. Exper. Biol. and Med. (1921) XVIII, 167-168.

Ophthalmia and Diet. Thomas B. Osborne and Lafayette B. Mendel. Jour. Am. Med. Assn. (1921) LXXVI, 905-908.

La oftalmia y el regimen. Thomas B. Osborne and Lafayette B. Mendel. Jour. Am. Med. Assn. Edicion Espanol. (1921) V, 503-506.

Anaphylaxis Reactions with Purified Proteins from Milk. H. Gideon Wells and Thomas B. Osborne. Jour. Infect. Dis. (1921), XXIX, 200-216.

The Botanical Department.

Dr. G. P. Clinton in charge.

This department, in co-operation with the Entomological Department and with Mr. B. A. Porter of the U. S. Bureau of Entomology, has conducted rather elaborate experiments on the comparative efficiency of dusting *versus* spraying apples and peaches to combat insect and fungous pests. Mr. Stoddard was the co-operating member from this department. This is a continuance of similar tests made last year on apples.

For this work the apple orchards of Messrs. W. F. Platt and F. N. Platt at Milford were used and the Station's orchard at Mt. Carmel. The experiments with peaches were carried on at Mr. M. L. Coleman's orchard at Cheshire and the Station's orchard at Mt. Carmel. The number of trees involved was 1,017, and the fruit individually examined and scored amounted to about 334 barrels of apples and 1,715 baskets of peaches.

The work on the improvement of sweet-corn seed, now in its second year, has been done by Mr. Stoddard at the farms of Mr. C. R. Treat of Orange, and the E. B. Clark Seed Co. of Milford, with gratifying results and will be continued for another year at least.

Data have been gathered on the condition and yield of the individual trees in the fertilizer tests at the Barnes experimental peach orchard, now in the tenth bearing year.

Studies of the white-pine blister-rust have been continued and the results partially prepared for publication by Dr. Clinton and Dr. McCormick. These include work on some other rusts.

A tobacco disease survey has been carried on, chiefly by Dr. Clinton, the results to be published as soon as other work will permit.

A study of the wild-fire of tobacco has taken most of the time of Dr. Clinton, Dr. McCormick and Mr. Graham during the past summer. It is hoped to prepare the results shortly for publication.

Dr. McCormick has made life-history studies of the *Thielavia basicola* (root rot of tobacco) and has brought to light the ascospores of this fungus in artificial cultures.

Cultures of miscellaneous fungi, especially of *Pythium*, have been obtained and are being studied by Dr. Clinton and Dr. McCormick.

Eight hundred and sixty-two samples of agricultural seeds have been tested for various growers, besides about 2,000 ears of sweet corn for the seed-corn selection work of the Station, and also the ears of twenty-five barrels of sweet corn for the E. B. Clark Seed Co., for selection of their seed stock planting.

Three hundred and eighty-two specimens have been added to the herbarium, which now numbers nearly 48,500 specimens.

The Chemical Department.

Dr. E. M. Bailey in charge.

The time of this department is largely occupied with the chemical examination of fertilizers, feeding stuffs, human foods and drugs, as required by statute and with analyses required by experimental field work at this Station and at Storrs. Six hundred and three samples of commercial and other fodder materials, more than one thousand samples of commercial and other fertilizers, and about twenty-two hundred samples of foods, drugs and miscellaneous materials have been examined and the results have been published or are being prepared for publication. Ten hundred and sixty-nine pieces of Babcock glassware have been tested and certified for creameries and individuals in this state. Of the number tested, about one percent were found inaccurate and so marked.

In collaboration with the Biochemical Department an educational exhibit was prepared and exhibited at the annual meeting of the American Medical Association held in Boston. It consisted of stuffed experimental animals, photographs and charts showing the results of various lines of investigations. A descriptive leaflet was also distributed. A similar exhibit was prepared for the meeting of the American Child Hygiene Association in New Haven.

The chemist in charge has continued to collaborate with the Council of the American Medical Association in matters pertaining to diabetic and other special foods; and, as Associate Referee on the cryoscopy of milk for the Association of Agricultural Chemists, has prepared a report of data obtained in this and other laboratories upon the freezing point range of authentic milk from normal and abnormal cows for the purpose of establishing a basis for the judgment of market milk with reference to the detection of added water.

Mr. Andrew, as Referee on Tea for the same Association, has prepared a report of studies on the determination of caffeine, which includes a new method for this determination devised in this laboratory; and he has further collaborated in the study of methods for the analysis of drugs.

Mr. Shepard has continued to participate in the co-operative analytical program of the American Oil Chemists' Society, which involves analyses of check cottonseed meals and fertilizers every month, with the aim of securing greater uniformity of procedure in the examination of these products.

Expert testimony in court has been furnished to the Dairy and Food Commissioner when required.

The department has issued Bulletin 223 on Fertilizers, Bulletin 227 on Food Products and Drugs, and Bulletin 229 on Feeding Stuffs.

Mr. R. N. Copeland, Ph.B., filled a temporary appointment as chemist from March 1st to September 1st, 1921. Mr. Harry J. Fisher, A.B., was appointed as a chemist on October 17th, 1921.

Entomological Department.

Dr. W. E. Britton in charge.

The control operations against the gypsy moth in the eastern portion of the state have been continued vigorously under the supervision of Mr. John T. Ashworth, in co-operation with the Federal Bureau of Entomology. The federal men have scouted the margin of the infested area, while the state men have worked in the more thickly infested territory. The federal scouts found three new towns infested (Stafford, Somers and Suffield), all bordering upon Massachusetts. While this pest has done great

damage in the neighboring states of Massachusetts and Rhode Island, any serious damage in this state has been prevented. The imported nursery stock inspected consisted of twenty-one shipments, containing 126 cases. Ten shipments, or 47.6 per cent, were found to contain insects or other animals or plant diseases, some of which are known to be pests, and the infested material was destroyed.

The ninety-four nurseries in the State have all been inspected, one of them twice, but a few of them have not yet cleaned up their nurseries so as to receive certificates. In addition, sixty-five orchards and gardens have been examined with reference to insect pests.

The elaborate experiments on the comparative efficiency of dusting *versus* spraying on apples and peaches, in which this department co-operated with the Botanical Department and Mr. B. A. Porter of the Bureau of Entomology, has already been noted above.

Mr. Walden has studied the life history of the raspberry fruit worm, *Byturus unicolor,* and will continue his observations next year and also test measures of control.

Mr. Walden has made further collections of leafhoppers which, together with the material collected in 1920, form an exceedingly valuable series from Connecticut.

Mr. Zappe has carried out a number of minor projects, mostly along control lines. Some of these are as follows:—spraying to control the arbor-vitae leaf miner; wire-worm experiments on tobacco; controlling the rhododendron lace bug; relation between flea-beetles and tobacco wild-fire; paradichlorobenzene as a remedy for the peach borer. Mr. Zappe has made important collections of beetles and has spent much time rearranging the Coleoptera in the Station collection to conform with the new Check List.

Dr. Garman has given considerable attention to a study of the European red mite, *Paratetranychus pilosus,* and is experimenting with various materials to destroy the eggs. He has studied the violet midge, *Contarinia violicola,* which caused much damage in the large greenhouses of the W. W. Thomson Company of West Hartford. Dr. Garman has made studies of the grass-feeding spittle-bug, and his paper has been published as Bulletin 230 of this Station. He will continue to study the other species of this group of insects (family *Cercopidae*), as their life histories are not at all well known.

Dr. Garman has nearly finished a paper on the Odonata or dragon-flies of Connecticut, to be published by the State Geological and Natural History Survey, and will prepare a paper on the mites of Connecticut, to be published also by the Survey.

Dr. Garman has made important collections of Odonata from the different sections of the state, and has made many drawings to be used to illustrate the Hemiptera of Connecticut.

Mr. Sealy has supervised the maintenance of the mosquito ditching work during the season. There has been very little new work. The appropriation was increased $2,000 by the General Assembly.

The insect collection now contains more than 5,500 named species. The number of specimens is as follows:—

Systematic collection	20,800 specimens
Duplicates	30,000 specimens
Undetermined	5,000 specimens
Total	55,800 specimens

The department library now contains about 1,000 bound volumes and 3,000 separate pamphlets. There are 2,300 photographic negatives, 720 lantern slides, and 1,400 microscopic mounts of insects.

The entomologist has aided in a number of the projects, has investigated an injury to tobacco plants by the seed corn maggot, has attended to the correspondence and issued the necessary certificates, and has spent much time editing and revising the manuscript of the Hemiptera of Connecticut soon to be published by the Geological and Natural History Survey. His Check-List of the Insects of Connecticut was published early in the year.

Some time has also been devoted to the work of the Tree-Protection Examining Board.

Publications of Entomological Department 1921.

By W. E. Britton:

Twentieth Report State Entomologist of Connecticut (Bulletin 226); 84 pages, 13 figures, 12 plates; 10,500 copies distributed in April 1921.

Spray Now to Kill the European Red Mite; Bulletin of Immediate Information No. 13 (mimeographed), 3 pages; 600 copies distributed March 10, 1921.

Check List of the Insects of Connecticut; Bulletin 31, State Geological and Natural History Survey; 397 pages; distributed in spring by State Librarian at Hartford.

The European Corn Borer; Report Connecticut Board of Agriculture for 1919-1920, page 92; 4 pages; 1921.

Report of Committee on Injurious Insects; Proceedings 30th Annual Meeting Connecticut Pomological Society; page 36.

Report of Committee on Insects and Diseases, Insects; Report Connecticut Vegetable Growers' Association, page 21; 1921.

First Report of the Tree-Protection Examining Board; Bulletin 231; 12 pages; 11,500 copies distributed in November 1921; 1000 copies in the form of a separate to be used by the Board.

The House Fly as a Carrier of Disease Germs and How Controlled; 12 pages, 2 figures; published as an unnumbered bulletin of the State Department of Health (Revised Edition).

By W. E. Britton and G. P. Clinton:

Spray Calendar (Bulletin 224), 44 pages, 95 figures: 11,500 copies distributed in March 1921.

By W. E. Britton and L. O. Howard:

William Hampton Patton, Entomological News, Vol. XXXII, page 33 February 1921, 8 pages, 1 plate.

By B. H. Walden:

Progress of Anti-Mosquito Work in Connecticut, Proceedings 7th Annual Meeting New Jersey Mosquito Extermination Association, page 92, 1920.

By M. P. Zappe:

Aphis Control, Report Connecticut Board of Agriculture for 1919-20, page 96, 1921.

By Philip Garman:

A Study of the Bulb Mite (Bulletin 225) 20 pages, 3 figures, 3 plates; 10,500 copies distributed in March 1921.

The Grass-Feeding Frog-Hopper or Spittle-Bug (Bulletin 230) 12 pages, 3 figures, 2 plates: 10,500 copies distributed in November 1921.

The Relation of Certain Greenhouse Pests to a Geranium Leaf Spot (Bulletin 239, Maryland Agr. Exp. Station), 30 pages, 7 figures, October 1920.

The European Red Mite, *Paratetranychus pilosus,* Can. & Fanz., in Journal of Economic Entomology, Vol. 14, page 355, 1921.

By Philip Garman and F. L. Stevens:

The Genus Septoria Presented in Tabulation with Discussion, Trans. Ill. State Acad. Science, Vol. XIII, page 176, 44 pages, 1920.

Forestry Department.

W. O. Filley in charge.

Since 1901 the Station Forester has, as State Forester, purchased and administered land for state forests and since 1905 has, as State Forest Fire Warden, organized and supervised the local fire warden service. Hereafter the State Forester will be appointed by the State Park and Forest Commission with an office in Hartford. The first incumbent of the new position is Austin F. Hawes, who served as forester of this Experiment Station from 1904 until 1909.

The new arrangement relieves the Experiment Station of responsibility for the state forests and the fire warden service, both of which require an increasing amount of administrative routine. This change will give the Station Forester more time for experimental work. He is by statute made an ex-officio member of the State Park and Forest Commission, and will continue to co-operate with the State Forester in his work.

Forest Planting.—The nursery work at Mt. Carmel was confined to lifting and shipping over 50,000 transplants set out as

two-year seedlings in 1919, and transplanting a few thousand two-year seedlings from seed beds on the Station grounds. The fifty thousand transplants were shipped to the Portland, Simsbury and Eastford State Forests.

An arrangement was made with a commercial nursery to fill small orders for forest planting stock at prices based on the total amount of orders placed by the Experiment Station. In this way wholesale rates were secured for thirty land owners whose orders totalled 122,500 red and white pine transplants. Ten thousand trees for use on state forests and parks were purchased in the same way. The total shipments for forest planting by the Experiment Station and by the commercial nursery on Experiment Station orders, amounted to 175,000 trees.

The plantations at Rainbow have required but little attention. Mr. F. M. Snow continues to act as caretaker. He has harrowed the fire lines and attended to sales of wood as well as guarded against fires and trespassers.

White Pine Survey.—The white pine survey undertaken in 1919 was completed in the winter of 1921 in co-operation with the Bureau of Plant Industry.

The fifty-four towns covered by the survey give the following results:

County	Forest Area Acres	Hardwood and Pine Areas Acres	Pure Pine Stands Acres	Pine Reproduction Acres	Standing Pine Timber Acres
Litchfield, (15 towns)	220,050	56,450	6,700	6,725	52,970,000
Hartford, (16 towns)	117,150	3,625	5,600	5,850	33,940,000
Tolland, (8 towns)	109,100	15,700	2,600	1,550	21,325,000
Windham, (11 towns)	147,950	56,550	3,725	1,725	22,770,000
New London, (2 towns)	31,950	9,550	450	275	4,950,000
	626,200	141,875	19,075	16,125	135,955,000

Throughout the rest of the State there are a few scattering stands of pine which would doubtless bring the total to 140,000,000 Ft. B.M. There is also a sufficient acreage planted to pine in the other towns to make the total area of young growth at least 20,000 acres. The value of standing pine is approximately $1,120,000 and the present value of young pine growth is not less than $500,000.

White Pine Blister Rust.—Control work has been carried on under the supervision of Mr. Hicock.

(1). The Branford area was carefully scouted for pine infections but, as in previous years, none were found.

(2). Inspection of plantations. Twelve plantations and one nursery in which pine infections had previously been found and eradication work done were again inspected. Infected pines were found in seven of these but the infections were so localized as to indicate that the disease is being effectually controlled there.

(3). The eradication of wild Ribes (currants and gooseberries) from infected areas in Norfolk, Canaan and Colebrook between May 1st and September 15th, covered about 8,000 acres, one half of which had been previously worked in 1916-1917, and 1919. In the area worked for the first time considerable pine infection was found, but mostly concentrated near small infection centers. In the areas reworked few Ribes were found, and almost no pine infections of a date subsequent to the eradication. About 39,000 Ribes bushes were pulled and destroyed during the summer.

(4). The Pomfret area, of which a survey was made in 1919, was carefully scouted again and five infected pines found. Only one of these was outside the original infected area. The disease seems to be under control here, although the area must be watched for several seasons.

(5). Cornwall. As new pine infections had been located in Cornwall last winter, that town was thoroughly scouted during the summer and infected pines were found very widely distributed. They were mostly 1918 and 1919 infections which had not yet fruited. The situation is so serious that it seems necessary to begin eradication work in this town next season, and it will be necessary to ask land owners to bear a share of the cost, as the state appropriation alone will not be sufficient for all the work to be done next year.

(6). Further scouting. After September 15th, scouting was done in Canaan, North Canaan, Salisbury, and the towns along the Rhode Island line. In these latter no suspicious infections were discovered, but the towns northwest of Cornwall show almost as bad conditions as were found in that town.

It seems evident that the blister rust had become established in Cornwall, Canaan, North Canaan and Salisbury before control work was effective in Norfolk. Until this year, however, most of these infections could not be detected and only a small percentage has as yet fruited. The northern half of Litchfield County will require radical measures in the near future if the spread of the disease is to be checked. It may be necessary to establish a quarantine and prohibit the growing of currant and gooseberry bushes in that region. Financial co-operation with the towns, or with the land owners, must also supplement the state appropriation, which is entirely inadequate to relieve the situation promptly and effectively.

State Forests.—The State Forests were under the charge of the Station Forester for eight months of the year. Only two purchases of land were made during that time. The addition of

154 acres at Eastford and twenty acres at Portland made the total area of State Forests 4,441 acres as turned over to the new State Forester. Additional purchases have been completed since July 1st from the appropriation of $10,000 granted by the Legislature of 1921. Sales of wood, ties, poles, etc., amounted to $2,375.

In the spring, plantings were made as follows:

Portland	12,000 red pine	500 arborvitae	
Simsbury.....	17,000 red pine	4,000 arborvitae	
Eastford	15,000 red pine	4,000 Douglas fir	4,000 white spruce

The total number of trees planted on state forests was 56,500.

In the fall of 1920 Mr. Moss and Mr. Hicock started the field work for a topographic and type map of the Eastford State Forest, but were unable to complete it that season. Mr. Moss therefore continued the work during the summer and fall of 1921, as a co-operative project with the State Forester. Since this survey was initiated and carried out by the Experiment Station, it will probably be published as a Station bulletin, as was the working plan for the Portland State Forest made in 1913.

State Forest Fire Warden.—The calendar year 1920 showed the smallest total number of forest fires in any year since records have been kept. Only 408 fires were reported, of which 208 were in the month of April, and 112 in May, leaving only eighty-eight for the balance of the year. The area burned over was 11,348 acres, and the estimated damage was $40,000, both these totals also establishing new low records. Although due credit should be given to the fire wardens for increased vigilance and efficiency, it is probably true that the decrease in the number of fires is largely due to weather conditions. During the first six months of 1921, 530 fires were reported with an area burned of 17,465 acres, and an estimated damage of $70,000. This increase over the previous year is readily accounted for by a comparatively light snow fall during the winter, especially in March, so that the ground was bare over most of the state by the first of April. The precipitation was below normal in most parts of the State for every month except April.

Tree Protection Examining Board.—The work of this Board, of which Mr. Filley is Secretary, has already been reported in Bulletin 231.

Plant Breeding Department.

Dr. Jones in charge.

Ten years' work in careful selection from a cross between Sumatra and Broadleaf tobacco has resulted in fixing a type called Connecticut Round Tip, which combines the higher number and better shape of leaves of the Sumatra with the larger size of the Broadleaf.

This is briefly described in Bulletin 228.

While its actual value and the best method of growing and fermenting this type is not yet fully established, it is meeting with favor among growers. About 200 acres have been grown this year, and a larger acreage next year seems assured.

The method of corn-breeding based on selection in self-fertilized lines is now in its third year. Following our initiative, sixteen Stations in this country, two in Canada, and one each in Spain and Italy are taking up this method and applying it to the improvement of corn.

The number of generations of self-fertilization necessary to attain complete uniformity and stability in a naturally cross-pollinated plant, such as corn, is being studied, using material which has been inbred for sixteen years.

The breeding work on tobacco will be greatly facilitated by the establishment of the tobacco station which is noticed elsewhere. It includes:

(1). The study of inheritance of yield, quality, shape and number of leaves after crossing established varieties. Particular attention is now being given to several selections of a cross of Broadleaf and Cuban varieties.

(2). A strain test to determine whether inherited differences have arisen in established varieties of tobacco which are normally self-fertilized, and if so the most desirable will be propagated and tested.

(3). Selection of plants on the basis of resistance to root-rot disease to determine whether such differences permanently exist, and if so, whether sufficient resistance exists as to be commercially practicable and what is its relation to yield and quality.

In co-operation with the Storrs Station this department has made a careful corn survey of the State and after collecting the varieties which appeared most productive and otherwise desirable, comparative field tests have been made with them during six years at Storrs and Mt. Carmel. The results have been tabulated and sent to those specially interested with a map of the state showing the sections in which different varieties may be expected to give the most satisfactory yields and also giving the names of growers from whom the seed may be obtained.

In addition to the bulletin cited above there has been published:

Genetic Studies on the Protein Content of Maize. E. M. East and D. F. Jones. Genetics, 5: 543-610, Nov. 1920.

The Tobacco Experiment Station.

The last General Assembly appropriated to the Board of Control of the Connecticut Agricultural Station $10,000 for the biennial period for research and experiment on the causes and

prevention of diseases and injuries to the Connecticut tobacco crop which occur in the field or in the preparation for market and for improving the crop by selection and breeding and by co-operative experiments with growers.

The Board is authorized to accept gifts or loans of land or equipment, or gifts of money to be used exclusively for the purposes named above, such gifts of land to be accepted in the name of the state.

The Station is required to make an annual report to the Governor to be printed with the Station report and is authorized to issue bulletins of information of value to tobacco growers.

The Act was approved May 5, 1921.

Anticipating this action, Messrs. F. W. Morgan, J. E. Ransom and J. B. Stewart of Windsor, because of their interest in the project, generously bought a tract of 13½ acres of excellent tobacco land with three tobacco barns in Windsor and offered it to the Station at its cost to them, refusing a better offer from another source. The Station obtained funds from private sources to buy this land as no state appropriation could be used for the purpose.

This secures for the work what is absolutely necessary for its success, perpetual control of the land and the crops.

It was imperative to start work at once, or to lose a year's use of the land; but on May 5th, the earliest date on which we could undertake it, there were no seed beds, no tools, no fertilizers ready, and no one engaged to manage the field work.

In spite of these embarrassments it was determined to make a beginning, however unfavorable the outlook. Mr. Louis Evans, who had much experience in growing tobacco, was engaged to handle the field work. About seven acres of turf land were broken up, fertilized and fitted for the crop. Dr. Jones had a small supply of six tobacco selections from crosses of two types which were to be tested in the field for further selection and fermented for judgment of their quality. By gift and purchase plants were secured for setting about three and one-half acres of Round Tip tobacco, and a portion of the field was set off for study of tobacco diseases under Dr. Clinton's supervision, infected plants being supplied from beds made by him at the Station in New Haven and by donation from growers.

The plants were set during the first week in June.

About $800 had to be spent in repairing and fitting the barns, and over $500 for tools and miscellaneous supplies. In common with the experience of many other growers, the crop suffered from wild-fire, which gave opportunity for valuable study of this bacterial disease.

The crop cured successfully. The Round Tip is to be sold in the bundle and the selections are now being fermented under Dr. Chapman's supervision.

Immediately after the passage of this Act, leading growers and

packers in Connecticut and Massachusetts, appreciating the suggestion of the Legislative Committee on Appropriations that, if the state made an appropriation, the growers and packers should also co-operate with the state in financing, and realizing that the funds appropriated by the state were insufficient to adequately equip and maintain the tobacco experiment station to the extent deemed necessary, organized and incorporated the Connecticut Valley Tobacco Improvement Association, the objects of which are to "carry on any kind of work calculated to improve the quality of, or to protect from disease, New England tobacco, and to co-operate in this work with any individuals or organizations interested in such tobacco work."

This Association secured the services of Dr. George H. Chapman, of the Massachusetts Agricultural Experiment Station, to act in the capacity of Research Director, and also equipped an office and laboratory with sufficient endowment for maintenance and experiment at Windsor, in which pathological and chemical work necessary to the solution of the various problems can be carried on.

It was evident to both the Station and to the managers of this Association that the common aim of both could best be secured by the closest co-operation between them. The Station had suitable land for experimental work which, so far as can be seen, is secure for the long-continued work which is absolutely necessary, but the funds appropriated by the State are not sufficient to support the work which should be done. After full discussion, therefore, the following arrangement was concluded between the two organizations:

"It is the intention of the Board of Control of the Connecticut Agricultural Experiment Station to devote exclusively the land and buildings in Windsor held by it under the Lockwood Trust, to experiments on the growing of tobacco and on processes for its preparation for manufacture, so long as there are sufficient funds provided by the state or by a co-operating company for the suitable conduct of such work.

To this work the Station will devote the use of its land and the buildings already there and whatever money the state has appropriated or may appropriate for study of the tobacco crop.

The Station wishes the fullest co-operation possible with all agencies in the same kind of work.

In particular it desires close relations with the Connecticut Valley Tobacco Improvement Association as at present organized and administered; it being understood that while this Association is supported entirely by the contributions of its members, yet its work and findings are in the interest of all growers and handlers of tobacco in the New England district, and will be freely communicated to them in suitable ways.

To that end the following agreement has been made:

(1). Plans for the different kinds of experimental work to be carried out at the Tobacco Station may be proposed both by the Director of the Station and the Research Director of the said Association, and shall be adopted by mutual agreement and consent.

(2). The Research Director of the Association shall have general direction of the work in the field and of the curing, fermenting and further handling of the leaf and of its sale and it is understood that all income from sales shall be devoted to the furtherance of the experimental work.

(3). The Plant Breeder of the Station shall have the management of work in breeding and selection.

(4). Both the Research Director of the Association and the staff of the station shall be fully informed of the progress and results of the work done under the supervision of either.

(5). There shall be opportunity for work by the Station botanist on tobacco diseases on land especially set apart by mutual agreement for that purpose.

(6). If desired, a building or buildings for the purpose of experiment may be built on the land at the expense of either party. If it should be necessary for the Station at any time to dispose of the property, the Connecticut Valley Tobacco Improvement Association shall have opportunity to buy the property at its fair valuation as determined by competent judges selected by buyer and seller; but from the purchase price shall be deducted the value of any buildings erected by the said Association at their value as determined at the time of sale and by the said method of valuation.

(7). It is the present understanding of the Station that the fund appropriated by the state may be spent in any way for the furtherance of the work, either in salaries, labor, or supplies, and probably in building, though the opinion of the Attorney General on the last item is desirable.

(8). It seems desirable, if not necessary, that all publications should appear as co-operative between the Tobacco Improvement Association and the Station. For example—

Cause and Prevention of Canker in Tobacco, by G. H. Chapman, Research Expert. The Connecticut Valley Tobacco Improvement Association and the Connecticut Agricultural Experiment Station Co-operating.

Round Tip Tobacco, by D. F. Jones, Plant Breeder of the Conn. Agric. Expt. Sta. The Conn. Agric. Sta. and the Conn. Valley Tobacco Improvement Assn. Co-operating.

(9). For the publication of bulletins on the progress of results of the work the Station will provide, subject to limitations of space imposed by State authority.

(10). The Station laboratories and apparatus will be used in the work to the extent consistent with the other demands on it.

(11). Any further arrangements regarding the detail of the work shall be exclusively settled by the Research Director of the Connecticut Valley Tobacco Improvement Association, the Director of the Station, and Mr. J. W. Alsop, representing both agencies.

(12). In order that the Research Director may receive publications of other Stations and to facilitate the use of the franking privilege, he is made a member of the Station staff as "In charge of the Tobacco Station."

Farmers' Week.

Beginning on January 24th, 1921, conferences of the various agricultural societies were held in Hartford, and an Exhibit was staged in the State Armory.

The Station occupied a floor space of about 64 by 18 ft., and made an educational exhibit of the work done in the six separate departments of its work. The success of the Exhibit was due to the very cordial co-operation of every one in the Station employ, for all of whom unusual work became necessary.

The Field Day.

On August 31st the annual Station Field Day was held at Mt. Carmel. As this year marks the three hundredth anniversary of the first planting of corn in New England by white men it was fitting that the breeding, selection and growing of corn should have been the subject of the talks after lunch. Between 250 and 300 were present.

Physical Equipment.

The equipment of the Station includes a working library of about 6,500 volumes and about 500 volumes not owned by the Station but deposited here as a loan, an herbarium of 48,500 specimens, an insect collection of 55,800 specimens, 1,500 lantern slides, 3,700 negatives, and 3,745 microscope slides.

The valuation of the Station land and buildings is.....	$295,275
The valuation of the contents of the buildings.....	97,360
	$392,635

Respectfully submitted,

E. H. Jenkins,
Director.

Connecticut
Agricultural Experiment Station
NEW HAVEN, CONN.

BULLETIN 233 NOVEMBER, 1921

Fertilizer Report for 1921

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

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

OFFICERS AND STAFF

October, 1921.

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Donald F. Jones, S.D., *Plant Breeder.*
P. C. Mangelsdorf, B.S., *Assistant.*

In charge of the Tobacco Station.
G. H. Chapman, Ph.D., Windsor, Conn.

Report on Commercial Fertilizers, 1921

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

We desire here to emphasize certain points regarding the law and the gratuitous analysis of fertilizers, which do not seem to be fully understood by those concerned. Complete understanding of these points will greatly increase the effectiveness of our work and its value, both to sellers and users of fertilizers.

What is required of all who sell commercial fertilizers in this state?

The seller is responsible for the proper labeling of each package, as provided in Section 1 of the law, for the registration at the Station of every brand sold by him and for the payment of the analysis fee, before offering for sale, and annually thereafter on January 1st.

The seller must also, on the 1st of January and July, report the tonnage of fertilizer sold within the preceding six months and pay to the director of the Station a tonnage fee of 6 cents per ton.

On request, copies of the law and blanks for registration and for tonnage reports will be supplied by the Station.

If, however, proper labeling, registration and payments have been provided for by the manufacturer of the brands or by another responsible person, all sellers of such brands are released from the above mentioned requirements. *The retailer, therefore, should assure himself that the requirements of the law have been met by the manufacturers of the brands which he handles, or himself be prepared to meet all these requirements.*

What is required of persons drawing samples for analysis?

The Station every year analyzes a large number of samples sent by individuals, representing fertilizers bought by them for their own use. The object of the sender is to learn whether the fertilizer contains all that is guaranteed, and, if it does not, to provide evidence for a claim against the seller. *It is absolutely necessary that the sample should be taken essentially in the way prescribed by the law and in the presence of a witness.* If this is not done, it will be difficult to prove the fairness of the sample, the Station will have been put to useless expense and the analysis of the sample will not be of any value to the sender. Therefore, the Station will supply to any applicant a form which describes the method of sampling and on which the sample should be fully described. This description should be sent to the Station with

(not in) the sample. It thus makes the analysis of public interest and value, which is the only justification for doing the work at state expense, and it is the only way by which it is possible for the sender to learn the true composition of the stock sampled and to prove its composition if a claim for rebate is made.

The Station desires to know the retail cash ton price of each fertilizer but, if so requested, will not publish the information.

In 1921, 76 individuals and firms registered for sale in this state 544 brands of commercial fertilizers, classified as follows:

Nitrogenous superphosphates	330
Cotton seed meal and castor pomace	61
Other chemicals and unmixed materials	153
Total	544

To meet the legal requirements, the following list of registered brands has been prepared:

American Agricultural Chemical Co., 2 Rector St., New York, N. Y.
Basic Lime Phosphate
Bone-Phosphate and Potash
Castor Pomace
Complete Potato Mixture
Cotton Seed Meal
Double A Tobacco Fertilizer
Dry Ground Fish
Fine Ground Bone
Fish and Potash
Grass and Lawn Top Dressing
Grass and Oats Fertilizer
Ground Tankage
High Grade Acid Phosphate
High Grade Ground Bone
High Grade Sulphate of Potash
Kainit
Monarch Potato Manure
Muriate of Potash
Nitrate of Soda
Pulverized Sheep Manure
16% Acid Phosphate
Special Ground Bone
Sulphate of Ammonia
Tobacco Mixer
Tobacco Special
Universal Phosphate
Bradley's Complete Manure for Top Dressing Grass and Grain
Bradley's Corn Phosphate
Bradley's New Method Fertilizer
Bradley's Northland Potato Grower
Bradley's Potato Fertilizer
Bradley's Potato Manure
Bradley's Reliable 6% Potash Fertilizer

Bradley's Valley Tobacco Fertilizer
Bradley's XL Superphosphate of Lime
Great Eastern General 1921
Great Eastern Northern Corn Special 1920
Great Eastern Potato Manure 1920
Packers' Union Animal Corn Fertilizer
Packers' Union Potato Manure 1921
Packers' Universal Fertilizer 1920
Quinnipiac Climax Phosphate
Quinnipiac Corn Manure
Quinnipiac Phosphate
Quinnipiac Potato Phosphate
Quinnipiac Potato Manure
Quinnipiac 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 Corn Phosphate
Williams & Clark's Americus Potato Manure
Williams & Clark's Potato Phosphate
Williams & Clark's Prolific Fertilizer
Williams & Clark's Seed Leaf Tobacco Manure

American Agricultural Chemical Co. of New Jersey, Newark, N. J.
Listers Balancer for Cotton Seed Meal
Listers Bone Meal 1916
Listers Celebrated Ground Bone and Tankage Acidulated
Listers Celebrated Tobacco Fertilizer
Listers Complete Tobacco Fertilizer without Potash
Listers Complete Tobacco Manure
Listers Corn and Potato Fertilizer
Listers Eastern Pride Fertilizer
Listers Fish and Potash Fertilizer
Listers 4-8-4 Fertilizer
Listers High Grade Acid Phosphate
Listers Standard Pure Superphosphate of Lime
Listers Success Fertilizer
Listers Tobacco Fertilizer
Nitrate of Soda

American Cotton Oil Co., 65 Broadway, New York, N. Y.
"Acco" Brand Cotton Seed Meal
"Surety" Brand Cotton Seed Meal

American Milling Co., Peoria, Ill.
43% Amco Cottonseed Meal

Apothecaries Hall Co., Waterbury, Conn.
Acid Phosphate
Bone and Meat Tankage
Bone Meal
Castor Pomace
Fish
Ground Animal Tankage
Liberty Corn, Fruit and All Crops
Liberty Market Gardeners' Special
Liberty Market Gardeners' Special (potash)
Liberty Potato and Vegetable Special
Liberty 3-8-4
Liberty Tobacco Special
Liberty Tobacco Special (potash)

Muriate of Potash
Nitrate of Soda
Sheep Manure
Sulphate of Ammonia
Sulphate of Potash

Armour Fertilizer Works, 305 Broadway, New York, N. Y.
Armour's Big Crop Acid Phosphate
Armour's Big Crop Fertilizer 0-10-5
Armour's Big Crop Fertilizer 3-8-4
Armour's Big Crop Fertilizer 4-10-0
Armour's Big Crop Fertilizer 5-8-5
Armour's Big Crop Potato & Onion 4-8-4
Armour's Big Crop Tobacco Special 5-4-5
Armour's Corn Grower 2-8-2
Armour's Fertilizer 5-4-3
Armour's General Crop 1-7-1
Armour's Nitrate of Soda
Armour's Sheep Manure

Ashcraft-Wilkinson Co., 1309 Candler Building, Atlanta, Ga.
Helmet Brand Prime Cotton Seed Meal
Monarch Brand
Paramount Brand Good Cotton Seed Meal

Atlantic Packing Co., New Haven, Conn.
Atlantic Acid Phosphate
Atlantic Cotton Seed Meal
Atlantic Dry Ground Fish
Atlantic 5-8
Atlantic 4-8-6
Atlantic Grain Fertilizer
Atlantic Potato Phosphate
Atlantic Special Vegetable
Atlantic Superphosphate
Atlantic Tankage
Atlantic Tobacco
Atlantic Tobacco Grower
Atlantic Tobacco Manure
Atlantic Tobacco Special

Baker Castor Oil Co., 120 Broadway, New York, N. Y.
Pure Castor Pomace

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

Berkshire Fertilizer Co., Bridgeport, Conn.
Acid Phosphate
Berkshire Ammoniated Bone Phosphate
Berkshire Complete Fertilizer
Berkshire Complete Tobacco
Berkshire Grass Special
Berkshire Long Island Special
Berkshire Market Garden Fertilizer
Berkshire Potato and Vegetable Phosphate
Berkshire Tobacco Grower
Berkshire Tobacco Starter
Castor Pomace
Dry Ground Fish
Fine Ground Bone
43% Protein Cotton Seed Meal
Ground Sheep Manure

Muriate of Potash
Nitrate of Soda
Precipitated Bone Phosphate
Sulphate of Potash
Tankage 7.5-10
Tankage 5-18
Vegetable Potash

Boardman, F. E., Middletown, Conn.
Boardman's Complete Fertilizer for Potatoes and General Crops
Boardman's Complete Fertilizer for Tobacco

Bowker Fertilizer Co., 60 Trinity Place, New York, N. Y.
Bowker's 16% Acid Phosphate
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 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 Square Brand Farm and Garden Phosphate
Bowker's Superphosphate with Ammonia 4%
Bowker's Sure Crop Phosphate Revised
Bowker's Tobacco Elements
Bowker's Tobacco Grower
Maryland Corn Phosphate
Maryland Standard Fertilizer
Maryland Truck Garden Fertilizer
Stockbridge "B" General Crop Manure
Stockbridge Early Crop Manure
Stockbridge Market Garden Manure
Stockbridge Tobacco Manure
Stockbridge Top Dressing and Forcing Manure

Bridge's Sons, Amos D., Inc., Hazardville, Conn.
Corn, Potato and General Purpose Fertilizer
Special Tobacco Fertilizer

Brodé, F. W., Corporation, 119 Madison Ave., Memphis, Tenn.
Owl Brand 43 Cotton Seed Meal
Owl Brand 41 Cotton Seed Meal

Buckeye Cotton Oil Co., Gwynn Building, 6th and Main Sts., Cincinnati, Ohio.
"Buckeye" Good Cotton Seed Meal
"Buco" Cotton Seed Feed

Chittenden, E. D., Co., Bridgeport, Conn.
Chittenden's Complete Tobacco and Onion Grower with 4% Potash
Chittenden's Complete Tobacco and Onion Grower with 6% Potash
Chittenden's Complete Tobacco and Onion Grower without Potash
Chittenden's Dry Ground Fish
Chittenden's High Grade Potato with 4% Potash
Chittenden's Tobacco Special with 5% Potash
Chittenden's Tobacco Special without Potash
Chittenden's Vegetable and Onion Grower with 3% Potash
Chittenden's Vegetable and Onion Grower without Potash
Ground Castor Pomace

Clark, Everett B., Seed Co., Milford, Conn.
Clark's Special Mixture for General Use

Clark's Special Mixture with Potash (4-10-4)
Clark's Special Mixture with Potash (4-8-6)
16% Acid Phosphate

Coe-Mortimer Co., Inc., 51 Chambers St., New York, N. Y.
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 Cotton Seed Supplement
E. Frank Coe's Gold Brand Excelsior Guano Revised
E. Frank Coe's New Englander Special
E. Frank Coe's 16% Superphosphate
E. Frank Coe's Special Grass Top Dressing
E. Frank Coe's Tobacco Leaf Fertilizer
Fine Ground Bone
Nitrate of Soda

Connecticut Fat Rendering & Fertilizing Corporation, New Haven, Conn.
Tankage

Cornwall, H. B., Meriden, Conn.
Cornwall's Potato and General Use
Cornwall's Tobacco Grower

Davis, S. P., Little Rock, Ark.
Beauty Brand Cotton Seed Meal
Good Luck 41% Protein Cotton Seed Meal and Cracked Screened Cake
Steerboy 43% Protein Cotton Seed Meal and Cracked Screened Cake

Dold, Jacob, Packing Co., Buffalo, N. Y.
Dold Quality Bone Meal

Eastern States Farmers' Exchange, 292 Worthington St., Springfield, Mass.
Bone Meal
Castor Pomace
Dried Ground Fish
Eastern States 16% Acid Phosphate
Eastern States 2-8-2
Eastern States 3-8-4
Eastern States 4-8-4
Eastern States 4-10
Eastern States 4-8-7
Eastern States 5-4-3
Eastern States 5-4-5
Eastern States 5-8-5
Ground Bone
Ground Tankage
Muriate of Potash
Nitrate of Soda
Precipitated Bone
Sulphate of Ammonia
Sulphate of Potash

Essex Fertilizer Co., 39 North Market St., Boston, Mass.
Essex 1-10-1 for Grain and Grass
Essex 2-8-2 for Farm and Garden
Essex 2-8-3 for All Crops
Essex 4-8-4 for Potatoes, Roots and Vegetables
Essex Fish Fertilizer 3-8-3 for All Crops
Essex 5-8-6

Essex Ground Bone
Essex Market Garden 3-8-4 for Vegetables and Grass
Essex Special Tobacco 5-5-4
Essex Tobacco Manure 5-7-2

Frisbie, L. T., Co., New Haven, Conn.
Castor Pomace
Cotton Seed Meal
Frisbie's Acid Phosphate
Frisbie's Bone Meal
Frisbie's Corn and Grain Fertilizer
Frisbie's Dry Ground Fish
Frisbie's 2-10
Frisbie's 4-10
Frisbie's 5-8
Frisbie's 5-8-7
Frisbie's High Grade Sulphate of Potash
Frisbie's Market Garden
Frisbie's Special 4-10-6
Frisbie's Special (3-8-4)
Frisbie's Special (5-8.5-5)
Frisbie's Special Vegetable and Potato Grower
Frisbie's Sulphate of Ammonia
Frisbie's Superphosphate
Frisbie's Tankage (5-14)
Frisbie's Tankage (9-6.40)
Frisbie's 3-8-6
Frisbie's Tobacco
Frisbie's Tobacco Grower
Frisbie's Tobacco Special
Muriate of Potash
Nitrate of Soda
Tobacco Manure 5-8-6

Hailey, John H., Co., Houston, Texas.
Texas Brand (Cotton Seed Cake or Meal)

Hall, W. D., Co., Atlanta, Ga.
Hall Brand Good Cotton Seed Meal

Hayes Grain & Commission Co., Little Rock, Ark.
Hayes Brand Cotton Seed Meal and Cake
Nutrine Brand Cotton Seed Meal and Cake

Head & Co., Dallas, Texas.
Rabbitfoot Brand Cotton Seed (Cake and) Meal

Humphreys-Godwin Co., (Not Inc.), Memphis, Tenn.
Bull Brand Cotton Seed Meal
Danish Brand Cotton Seed Meal
Dixie Brand Cotton Seed Meal
Unit—1
Unit—2
Unit—3

Industrial Cotton Oil Properties, 65 Broadway, New York, N. Y.
Longhorn Brand Prime Cotton Seed Meal

International Agricultural Corporation, Buffalo Fertilizer Works, 126 State St., Boston, Mass.
Bone Meal
Buffalo Economy
Buffalo Farmers' Choice
Buffalo General Favorite
Buffalo High Grade Manure

Buffalo New England Special
Buffalo Onion Special
Buffalo Phosphate and Potash
Buffalo 16%
Buffalo 10-8
Buffalo Tobacco Grower
Buffalo Tobacco Producer
Buffalo Tobacco Special
Buffalo Top Dresser and Starter
Buffalo Vegetable and Potato
Dry Ground Fish
I. A. C. Complete
I. A. C. Complete Tobacco
I. A. C. Early Harvest
Nitrate of Soda

Jennings-Brown Co., Inc., Shreveport, La.
Robin Brand Good Cotton Seed Meal

Joynt, John, Lucknow, Ontario, Canada.
The Joynt Brand Unleached Hardwood Ashes

Lovitt, L. B., & Co., Memphis, Tenn.
"Lovit"
"Memphis"
"Neal's Choice"
"Thirty Six"

Lowell Fertilizer Co., 40 North Market St., Boston, Mass.
Dry Ground Fish
Lowell Acid Phosphate 16%
Lowell Animal Brand 3-8-4 for All Crops
Lowell Bone Fertilizer 2-8-2 for Corn, Grain, Grass and Vegetables
Lowell Empress 1-10-1 for Grain and Vegetables
Lowell 2-8-3 for Vegetables and Grain
Lowell 3-8-3 for Corn, Grain and Vegetables
Lowell 4-8-4 for Potatoes, Corn and Vegetables
Lowell 5-8-0 for Grass, Grain and Vegetables
Lowell 5-8-4 for Vegetables and Grass
Lowell Ground Bone
Lowell 4-10
Lowell Lawn and Garden Dressing 4-7-2
Lowell 5-8-6
Lowell Tobacco 5-5-4 for Tobacco, Fruits and Vines
Lowell Tobacco 5-6-0 for Tobacco, Fruit and Vines
Lowell Tobacco 5-7-2
Nitrate of Soda

Lyle & Lyle, Huntsville, Ala.
Economy Cotton Seed Feed
Lyle's Best Cotton Seed Meal

Mapes Formula & Peruvian Guano Co., 143 Liberty St., New York, N. Y.
Mapes Connecticut Valley Special
Mapes Corn Manure
Mapes Cotton Seed Tobacco Manure
Mapes General Tobacco Manure
Mapes General Truck Manure
Mapes General Use Manure
Mapes Grain Brand
Mapes Potato Manure
Mapes Pure Ground Bone

Mapes Tobacco Ash Constituents
Mapes Tobacco Starter Improved
Mapes Top Dresser

Meech & Stoddard, Inc., Middletown, Conn.
Connecticut Cotton Seed Meal
Pure Raw Bone Meal

Middlesex Fertilizer Co., Middletown, Conn.
White Star Fertilizer

Miller Fertilizer Co., Maryland Life Bldg., 10 South St., Baltimore, Md.
Acid Phosphate
Miller's Clermont
Miller's 5-8-7
No. 1 Potato and Vegetable Grower
Standard Phosphate

Mitchell, W. L., 699 Forest St., New Haven, Conn.
Mitchell's Raw Phosphate Float

National Fertilizer Ct., 60 Trinity Place, New York, N. Y.
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. 2
National Nitrogen Phosphate Mixture No. 4
National Potato Phosphate
National 16% Plain Superphosphate
National Special Tobacco Revised
National Tobacco Foundation
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. Corn Phosphate 2-8-2 for Grain and Vegetables
N. E. 2-8-3 for Vegetables and Grain
N. E. 3-8-3 for Corn, Grain and Vegetables
N. E. Superphosphate 3-8-4 for All Crops
N. E. 4-8-6 for Potatoes and Vegetables
N. E. 5-8-7 for Potatoes and Market Gardens
N. E. Tobacco 5-6-0
N. E. Tobacco Manure 5-5-4
N. E. 5-8-6

Nitrate Agencies Co., 85 Water St., New York, N. Y.
Naco Brand Acid Phosphate
Naco Brand Fish
Naco Brand Muriate of Potash
Naco Brand NitraPo
Naco Brand Nitrate Soda
Naco Brand Sulphate of Ammonia
Naco Brand Sulphate of Potash
Naco Brand Tankage
Naco Brand 2-8-2 Formula
Naco Brand 3-8-4 Formula
Naco Brand 4-8-4 Formula
Naco Brand 4-8-7 Formula
Naco Brand 5-8-5 Formula

Nothern, W. C., Box 414, Memphis, Tenn.
Bee Brand Cotton Seed Meal
Queen Bee Brand Cotton Seed Meal
Standard Cotton Seed Meal

Olds & Whipple, Hartford, Conn.
Acid Phosphate
Cotton Hull Ashes
High Grade Sulphate of Potash
Nitrate of Soda
O & W Bone Phosphate and Potash Compound
O & W Castor Pomace
O & W Complete Corn, Onion and Potato Fertilizer
O & W Complete Tobacco Fertilizer
O & W Dry Ground Fish
O & W H. G. Starter and Potash Compound
O & W H. G. Tobacco Starter
O & W Special Complete Corn, Onion and Potato Fertilizer
O & W Special Grass Fertilizer
O & W Tobacco Special Fertilizer
Precipitated Bone Phosphate

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

Park & Pollard Co., 131 State St., Boston, Mass.
Cloverland Cotton Seed Meal
Highland Cotton Seed Meal
Upland Cotton Seed Meal

Parmenter & Polsey Fertilizer Co., 41 North Market St., Boston, Mass.
P & P 1-10-1 for Grain and Grass
P & P Plymouth Rock Brand 3-8-4 for All Crops
P & P 4-8-4 for Potatoes, Corn and Vegetables
P & P 2-8-2 for Farm and Garden
P & P 2-8-3 for Corn, Fruits and Vegetables

Pentecost & Martin, Inc., 15 East 40th St., New York, N. Y.
Potash Marl

Piedmont-Mt. Airy Guano Co., 707 Keyser Bldg., Baltimore, Md.
Brown's Corn and Grain Fertilizer
Brown's Fish, Bone and Potash
Brown's 5-8-7 Fertilizer
Brown's Market Garden Fertilizer
Brown's Potato Phosphate
Brown's Special for Tobacco
Brown's Top Dresser
Home Mixture
Muriate of Potash
Nitrate of Soda
8% Tankage
Sulphate of Ammonia
Piedmont 16% Acid Phosphate
10% Fish (Dry Ground)
3 50 Bone Meal

Proto-Feed & Guano Co., 4121 South La Salle St., Chicago, Ill.
Master Brand Pulverized Sheep Manure

Providence Farmers' Exchange, Inc., 16 South Water St., Providence, R. I.
Exchange Brand 2-8-2 Fertilizer
Exchange 3-8-4 Fertilizer

Exchange 4-8-4 Fertilizer
Exchange 4-10-0 Fertilizer
Exchange 5-8-5 Fertilizer
16% Acid Phosphate
Muriate of Potash
Nitrate of Soda
9-15 Tankage

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

Quality Seed & Fertilizer Co., Stamford, Conn.
All Crop Fertilizer
Bartlett Brand Special Tree Fertilizer
Grain Fertilizer
Potato Fertilizer
Sheep Manure Tankage

Robinson, Geo. B., Jr., 18 Broadway, New York, N. Y.
"Robin" Cotton Seed Meal

Rogers & Hubbard Co., Middletown, Conn.
Ground Fish (Dried)
Hubbard's "Bone Base" Fertilizer for Seeding Down
Hubbard's "Bone Base" Oats and Top Dressing Borax .40
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
Nebraska Potash
Nitrate of Soda
Rogers & Hubbard's All Soils-All Crops Phosphate
Rogers & Hubbard's Climax Tobacco Brand
Rogers & Hubbard's Complete Phosphate
Rogers & Hubbard's Soluble Tobacco Manure
Rogers & Hubbard's Tobacco Grower, Vegetable Formula
The R & H Brand Cotton Seed Meal

Royster, F. S., Guano Co., 1603 Munsey Bldg., Baltimore, Md.
Castor Pomace
Dry Ground Fish
Nitrate of Soda
Royster's Arrowhead Tobacco Formula
Royster's Bully Guano
Royster's Fine Ground Bone Meal
Royster's Fish and Potash
Royster's Fish, Flesh and Fowl
Royster's Landmark Brand
Royster's Perfecto Tobacco Formula
Royster's Prime Fish Brand
Royster's Quality Trucker
Royster's 16% Acid Phosphate
Royster's Trucker's Delight
Royster's Valley Tobacco 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 High Grade 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 South American Sheep and Goat Manure
Sanderson's Tobacco Grower
Sanderson's Top Dressing for Grass and Grain

Shoemaker, M. L., & Co., Venango St. and Delaware Ave., Philadelphia, Pa.
Swift-Sure Bone Meal
Swift-Sure Superphosphate Tobacco and General Use
Swift-Sure Superphosphate Tobacco Starter

Soper, J. E., Co., 206 Chamber of Commerce, Boston, Mass.
Pioneer Cotton Seed Meal
Priscilla Cotton Seed Meal
Puritan Cotton Seed Meal

Southland Cotton Oil Co., Paris, Texas.
Climax Brand Cotton Seed Meal

Springfield Rendering Co., Springfield, Mass.
Springfield Animal Brand
Springfield Ground Bone
Springfield Special Potato, Onion and Vegetable
Springfield 2-8-2 Fertilizer

Talfa Company, 43 Commercial St., Boston, Mass.
Nature's Plant Food

Texas Cake & Linter Co., Dallas, Texas.
"Texoma Brand" Prime Cotton Seed Meal

Van Iderstine Co., Long Island City, N. Y.
Van Iderstine's Pure Ground Bone

Virginia-Carolina Chemical Co. (of Delaware), Equitable Bldg., 120 Broadway, New York, N. Y.
Bone Meal
V-C Beaver Brand
V-C Callenge Brand
V-C Champion Brand
V-C Cherokee Brand
V-C Comet Brand
V-C Fish Phosphate and Potash Brand
V-C Indian Chief Brand
V-C Marvel Brand
V-C Nitrate of Soda
V-C Owl Brand
V-C Pawnee Brand
V-C Perfection Brand
V-C Plant Bed Brand
V-C Plow Brand
V-C Star Brand
V-C Universal Brand

Westervelt, A. C., & Co., Memphis, Tenn.
Planet Brand Cotton Seed Meal
Star Brand Cotton Seed Meal
Sun Brand Cotton Seed Meal

What Cheer Chemical Co., Inc., 188 Grotto Ave., Pawtucket, R. I.
Shay's Corn
Shay's Potato

Shay's Special
Superior Brand
What Cheer Brand
What Cheer Special

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

Witherbee, Sherman & Co., 2 Rector St., New York, N. Y.
Barium-Phosphate Grade A
Ground Phosphate Rock
Nitrate of Potash

Woodruff, S. D., & Sons, Orange, Conn.
Woodruff's Home Mixed

Worcester Rendering Co., Auburn, Mass.
Royal Worcester Corn and Grain 2-8-2
Royal Worcester Ground Steam Bone
Royal Worcester Potato and Vegetable 4-8-4

During the year, V. L. Churchill, the station sampling agent, has visited 95 towns and villages and drawn 636 samples for analysis. These include all of the registered brands which could be found on sale.

Classification of Fertilizers Analyzed.

1. *Containing nitrogen as the chief active ingredient:*

Nitrate of soda	30
Sulphate of ammonia	9
Cotton seed meal	318
Castor pomace	19

2. *Containing phosphoric acid as the chief active ingredient:*

Barium-Phosphate	1
Ground rock phosphate	3
Precipitated bone phosphate	20
Dissolved rock phosphate or acid phosphate	28

3. *Containing potash as the chief active ingredient:*

Muriate of potash	9
Sulphate of potash	28
Nebraska potash	2
Cotton hull ashes	1
Vegetable potash	1
Kainit	1

4. *Raw materials containing nitrogen and potash:*	
NitraPo	2
Nitrate of potash	2
5. *Raw materials containing nitrogen and phosphoric acid:*	
Fish manures	48
Slaughterhouse tankage	20
Garbage tankage	1
Bone manures	33
Bone and tankage	3
6. *Mixed fertilizers:*	
Phosphate and potash compounds	9
Nitrogenous superphosphates without potash	38
Nitrogenous superphosphates with potash:	
Sampled by station	286
Sampled by purchasers	22
Home mixtures:	
Sampled by station	16
Sampled by purchasers	15
7. *Miscellaneous fertilizers, amendments and waste products:*	
Tobacco stems	2
Tobacco ashes	1
Sheep manure	13
Wood ashes	15
Lime	4
Peat or muck	6
Dried sludge	4
Miscellaneous wastes	16
	1,026
Fungicides and insecticides	13
Total	1,039

A review of the analyses which follow shows these facts regarding the cost to consumers of the plant food bought in fertilizer chemicals and raw materials.

Ammonium sulphate has been the cheapest source of fertilizer nitrogen this year; the cost of nitrogen per pound ranging from 22.3 to 17.2 cents per pound, the average cost being 19 cents.

Nitrate of soda has come next, its nitrogen in the samples examined ranging in price from 28.1 to 19.1 cents per pound, the average being 23.4 cents.

In cotton seed meal nitrogen has cost about 36 cents per pound but the cost has varied very greatly.

In castor pomace nitrogen has cost 45.1 cents per pound.

In fish scrap, if 10 cents per unit is allowed for bone phosphate, nitrogen has cost 38.6 cents per pound as the average, the cost ranging from 46.3 to 24 cents.

Phosphoric acid in ground raw rock has cost 3 cents per pound.

In precipitated bone, available phosphoric acid has cost 8.5 cents per pound as an average, prices ranging from 9.5 to 7.5 cents.

In acid phosphate available phosphoric acid has cost 9.5 cents per pound as an average, prices ranging from 11.7 cents to 6.9 cents.

Water-soluble potash in both muriate and sulphate has cost about 11 cents per pound.

I. RAW MATERIALS CHIEFLY VALUABLE FOR NITROGEN.

NITRATE OF SODA.

Thirty samples were analyzed as follows:

16508. Sold by Apothecaries Hall Co., Waterbury. Stock of Connecticut Sumatra Tobacco Co., Hartford.

16658. Sold by Sanderson Fertilizer and Chemical Co., New Haven. Sampled at the factory.

17876. Sold by L. T. Frisbie Co., New Haven. Sent by H. F. Johnson, County Agent, Norwich.

17338. Sold by Coe-Mortimer Co., New York. Stock of W. R. Holcomb, Somerville.

17409. Sold by Eastern States Farmers' Exchange, Springfield, Mass. Stock of A. R. Carpenter, Bloomfield.

17245. Sold by The Rogers & Hubbard Co., Middletown.

Sampled at the factory:

16901. Sold by Olds & Whipple, Hartford. Stock of The Haviland Tobacco Co., East Windsor Hill.

17308. Sold by Armour Fertilizer Works, New York. Stock of Rockville Grain & Coal Co., Rockville.

16769. Sold by American Agricultural Chemical Co., New York. Stock of J. A. Glasnapp, West Cheshire.

16655. Sold by Olds & Whipple, Hartford. Sampled at the factory.

16937. Sold by Piedmont-Mt. Airy Guano Co., Baltimore, Md. Stock of Windsor Clark, Putnam.

17230. Sold by Providence Farmers' Exchange, Inc., Providence, R. I. Stock of Walter Scott, Niantic.

16881. Sold by Eastern States Farmers' Exchange, Springfield, Mass. Stock of John M. Herr, Burnside.

17374. Sold by International Agricultural Corp., Boston, Mass. Stock of P. Schwartz Co., New London.

16764. Sold by Lowell Fertilizer Co., Boston, Mass. Stock of Geo. S. Jennings, Southport.

16772. Sold by Piedmont-Mt. Airy Guano Co., Baltimore, Md. Stock of Joseph Adams, Green's Farms.

16849. Sold by Apothecaries Hall Co., Waterbury. Stock of Connecticut State School for Boys, Meriden.

16776. Sold by Wilcox Fertilizer Co., Mystic. Stock of Geo. R. Stannard, Branford.

16413. Sold by Berkshire Fertilizer Co., Bridgeport. Stock of J. E. Shepard, South Windsor.

16768. Sold by Bowker Fertilizer Co., New York. Stock of Goodsell Bros., Bristol.

17387. Sold by Virginia-Carolina Chemical Co., New York. Stock of J. R. Reinhard, West Cheshire.

17244. Sold by Nitrate Agencies Co., New York. Stock of E. N. Austin, Suffield.

17390. Sold by F. S. Royster Guano Co., Baltimore, Md. Stock of Silliman Hardware Co., New Canaan.

15796, 15797 and **15798.** Sold by Wesel-Duval Co., New York. Stock of Griffin-Neuberger Tobacco Co., North Bloomfield.

16647. Sold by L. T. Frisbie Co., New Haven. Sampled at the factory.

16732. Sold by L. T. Frisbie Co., New Haven. Stock of H. Dudek, Talcottville.

17368. Manufacturer unknown. Sent by County Agent, F. L. Davis, Putnam.

17115. Manufacturer unknown. Sent by Hackett Bros., Buckland.

TABLE I. ANALYSES OF NITRATE OF SODA.

Station No.	Per cent. of Nitrogen Guaranteed.	Per cent. of Nitrogen Found.	Cost per ton.	Nitrogen costs cents per pound.
16508	15.00	15.72	$60.00	19.1
16658	15.00	15.79	63.00	19.9
17873	.....	15.54	66.00	21.2
17338	15.00	15.12	65.00	21.5
17409	14.80	15.54	68.00	21.9
17245	15.80	14.84	65.00	21.9
16901	15.00	15.86	70.00	22.1
17308	14.81	15.28	68.00	22.3
16769	15.00	15.60	70.00	22.4
16655	15.00	15.56	70.00	22.5
16937	15.23	15.42	70.00	22.7
17230	14.81	15.20	70.00	23.0
16881	14.80	14.76	68.75	23.3
17374	15.00	15.04	70.00	23.3
16764	15.00	14.83	70.00	23.6
16772	15.23	13.88	66.00	23.8
16849	15.00	15.04	72.00	23.9
16776	15.00	15.77	80.00	25.4
16413	13.98	15.08	77.00	25.5
16768	15.00	15.20	78.00	25.7
17387	14.80	15.12	80.00	26.5
17244	15.00	15.00	80.00	26.7
17390	15.00	15.12	85.00	28.1
15796	.....	15.10	.....	....
15797	.....	15.16	.....	....
17598	.....	15.52	.....	....
16647	14.80	15.56	.....	....
16732	14.80	15.84	.....	....
17368	.....	15.40	.....	....
17115	.....	15.70	.....	....

The costs of nitrate of soda here reported have ranged from $85.00 to $60.00 per ton, but it has been bought in the late spring at considerably lower prices. Since the beginning of the year the wholesale New York price fell from $65.00 to $40.00 per ton. With the exception of sulphate of ammonia, nitrate of soda has been the cheapest and most profitable form of nitrogen in our market.

The average cost of nitrogen in the samples here reported has been 23.4 cents per pound, ranging from 19.1 to 28.1 cents.

One sample, **16772,** sold by the Piedmont-Mt. Airy Guano Co., failed to meet the guaranty of 15.23 per cent. of nitrogen. It contained only 13.88 per cent.

SULPHATE OF AMMONIA.

Nine samples were analyzed as follows:

17872. Sold by L. T. Frisbie Co., New Haven. Sampled by H. F. Johnson, County Agent, Norwich.

17419. Sold by Eastern States Farmers' Exchange, Springfield, Mass. Stock of H. H. McKnight, Ellington.

16773. Sold by Piedmont-Mt. Airy Guano Co., Baltimore, Md. Stock of Joseph Adams, Green's Farms.

16770. Sold by American Agricultural Chemical Co., New York. Stock of J. A. Glasnapp, West Cheshire.

16842. Sold by Apothecaries Hall Co., Waterbury. Sampled at factory.

16414. Sold by Berkshire Fertilizer Co., New York. Stock of J. E. Shepard, South Windsor.

16736. Sold by L. T. Frisbie Co., New Haven. Stock of H. Dudek, Talcottville.

17264. Sold by Nitrate Agencies Co., New York. Stock of J. McAllister, Farmers' Exchange, Cromwell.

17463. Sold by L. T. Frisbie Co., New Haven. Sampled at the factory.

TABLE II. ANALYSES OF SULPHATE OF AMMONIA.

Station No.	Per cent. of Nitrogen Guaranteed.	Per cent. of Nitrogen Found.	Cost per ton.	Nitrogen costs cents per pound.
17872	.....	20.66	$62.00	15.0
17419	20.56	20.66	71.00	17.2
16773	20.51	20.20	70.75	17.5
16770	20.16	20.20	75.00	18.6
16842	20.56	20.76	80.00	19.3
16414	20.75	20.94	93.30	22.3
16736	20.56	20.98	.....	....
17264	20.56	20.56	.....	....
17463	20.56	20.42	.....	....

This has been the cheapest form of nitrogen in our market this year, the average cost of nitrogen being about 19 cents per pound.

From January to August the wholesale price fell about 33 per cent.

Here again the only sample below guaranty, **16773,** was sold by the Piedmont-Mt. Airy Guano Co. and had 0.3 per cent. less nitrogen than was guaranteed.

COTTON SEED MEAL.

In a following table are analyses of 318 samples, the larger part of which represented car lots. The amount of cotton seed meal bought and used as a fertilizer in this state during the year cannot be far from fifteen thousand tons.

Guaranties.

Of 267 samples in which the guaranty is known, 32 failed to meet their guaranties, but 14 of these were deficient by less than 0.2 per cent. Those samples which had a larger deficiency are the following:

No.	Seller.	Nitrogen deficiency.
17277	Ashcraft-Wilkinson Co.	0.71
16091	F. W. Brodé & Co.	0.35
16564	J. H. Hailey Co.	0.30
16565	J. H. Hailey Co.	0.39
16028	Humphreys-Godwin Co.	0.38
16459	Humphreys-Godwin Co.	0.23
16784	Humphreys-Godwin Co.	0.20
16287	Humphreys-Godwin Co.	0.25
16561	Humphreys-Godwin Co.	0.43
16280	Humphreys-Godwin Co.	0.27
17127	Humphreys-Godwin Co.	0.28
17248	Humphreys-Godwin Co.	0.32
16707	Humphreys-Godwin Co.	0.25
16462	L. B. Lovitt & Co.	0.37
16559	L. B. Lovitt & Co.	0.67
15896	McGregor Cotton Oil Co.	0.21
17455	W. C. Nothern	0.24
16490	G. B. Robinson, Jr.	0.34

In considering the larger number of deficiencies in meal sold by Humphreys-Godwin Co., it must be noted that the number of samples of their goods is very much larger than that of others and that the *percentage* of deficiencies is a little less than the average.

Composition.

The percentage of nitrogen has ranged from 5.5 to 8.11 and the average of 193 samples, in which the nitrogen found, nitrogen guaranteed and cost are all given, is 6.3, which is slightly lower than the average last year.

Cost.

The price of cotton seed meal, in common with that of all fertilizers, has fluctuated wildly since the summer of 1920. It was quoted in car lots f.o.b. *factory* at $30.00 in January, 1921, at $26.00 in May and $35.00 in September. The wholesale prices prior to January were much higher. In the late spring, cut-prices prevailed. The car-lot prices to Connecticut buyers have ranged from $70.00 to $36.00.

The average cost per ton of 193 lots in this state was $44.32 and the average cost per pound of nitrogen was 36 cents.

TABLE III. ANALYSES OF COTTON SEED MEAL.

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.	Cost per ton.
	American Cotton Oil Co., New York City.				
16040	Longhorn, 84265	Griffin-Neuberger Tobacco Co., North Bloomfield	7.14	6.88	.....
17164	Surety, 160194 Southern	The Coles Co., Middletown	5.90	5.76	$46.00
	American Milling Co., Peoria, Ill.				
16398	Amco Brand	B. M. Rosenberg, Ellington	7.38	6.88	50.00
16486	Amco, 42562 Pa	The Coles Co., Middletown	6.91	6.88	41.50
17498	Amco	Station Agent, from J. W. McAllister, Farmers' Exchange, Cromwell	6.80	6.88	.....
16375	C. S. M. 14681 Pa	Broad Brook Lumber and Coal Co., Broad Brook	7.13	6.88	55.00
16377	C. S. M., T. P. W., 2353	Broad Brook Lumber and Coal Co., Broad Brook	6.83	6.88	45.00
16399	C. S. M., 20456	Broad Brook Lumber and Coal Co., Broad Brook	7.00	6.88	45.00
	Apothecaries Hall Co., Waterbury, Conn.				
16471	C. S. M.	Huntington Bros., Windsor	7.16	....	.....
	Ashcraft-Wilkinson Co., Atlanta, Ga.				
17277	Helmet	Jeremiah McGrath, Broad Brook	5.85	6.56	41.00
16588	Monarch	Station Agent, from A. D. Bridge Sons Co., Hazardville	7.07	6.88	44.00
16721	Monarch, 192371	The Coles Co., Middletown	6.80	6.88	47.00
16853	Monarch	Station Agent, from Arthur Manning, South Manchester	7.04	6.88	38.00
16882	Monarch	Manning & Kahn, Manchester	7.08	6.88	38.00
16774	Paramount	Station Agent, from F. C. Morse, Guilford	5.98	5.76	39.00
	F. W. Brodé Co., Memphis, Tenn.				
15975	Jay, J. E., 47778	Geo. E. Phelps & Co., Thomsonville	5.85	5.75	38.00
16528	Owl, J. L.	Garber-Northam Grain Co., Hartford	6.99	6.88	44.00
16631	Owl, M. & St. P	E. H. Rollins, Granby	7.00	6.56	66.50
16634	Owl, C. B. & Q., 99150	E. H. Rollins, Granby	7.00	6.56	66.50
16957	Owl	Station Agent, from A. W. Shepard & Son, Hartford	6.96	6.88	42.75
16091	C. S. M., N. Y. C., 240346	Broad Brook Lumber & Coal Co., Broad Brook	6.53	6.88	45.50
16283	C. S. M., C. B. & Q., 107108	Broad Brook Lumber & Coal Co., Broad Brook	7.12	6.88	55.50
16295	C. S. M., 1312103	Broad Brook Lumber & Coal Co., Broad Brook	6.90	6.88	.....

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

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent. Nitrogen Found.	Per cent. Nitrogen Guaranteed.	Cost per ton.
	Buckeye Cotton Oil Co., Cincinnati, Ohio.				
16236	Buckeye	J. B. Cannon, Granby	5.84	5.76	$40.00
	Cotton Seed Products Co., Louisville, Ky.				
16156	Prime, M. K. & T. 81653	Broad Brook Lumber & Coal Co., Broad Brook	7.16	6.88	.....
	E. Crosby & Co., Brattleboro, Vt.				
16220	C. S. M., N. Y. C., 258423	Spencer Bros., Inc., Suffield	5.83	5.75	50.00
	Dallas Peanut Feed Mfrs., Dallas, Texas.				
15914	Besfeed, 47735	Griffin-Neuberger Tobacco Co., North Bloomfield	7.41	6.88	.....
16021	Besfeed, 89549	Griffin-Neuberger Tobacco Co., North Bloomfield	7.03	6.88	.....
	S. P. Davis, Little Rock, Ark.				
16406	Beauty	Station Agent, from A. D. Bridge Sons Co., Hazardville	5.69	5.75	52.00
16628	Good Luck, 45225	E. H. Rollins, Granby	6.98	6.56	65.00
16632	Good Luck, M. P., 8492	E. H. Rollins, Granby	6.98	6.56	64.50
17499	Good Luck	Station Agent, from Geo. Ackley, New Milford	6.48	6.50	42.50
16635	Good Luck, Wab., 78139	E. H. Rollins, Granby	7.24	6.56	65.00
16418	Steerboy	Herbert Cotton, East Granby	6.81	6.88	47.50
16630	Steerboy, N. Y. C., 218987	E. H. Rollins, Granby	6.71	6.88	45.00
16780	Steerboy	Station Agent, from C. F. Allen, Warehouse Pt	7.08	6.88	43.50
16786	Steerboy, S. S. W., 14062	Geo. T. Soule, New Milford	7.04	6.88	43.00
	Dixie Cotton Oil Co., Little Rock, Ark.				
16453	C. S. M., 170589	Griffin-Neuberger Tobacco Co., North Bloomfield	7.01	....	.....
	Eastern States Farmers' Exch. Springfield, Mass.				
16898	C. S. M.	Station Agent, from C. B. Sikes, Ellington	7.10	6.87	43.00
	Ennis Cotton Oil & Mfg. Co., Ennis, Texas.				
15884	C. S. M., N. H., 71436	Geo. T. Soule, New Milford	7.43	6.88	.....

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

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.	Cost per ton.
	Fidelity Products Co., Houston, Texas.				
16331	C. S. M., L. E. & W., 11906.	Broad Brook Lumber & Coal Co., Broad Brook	6.86	6.56	$48.00
16378	C. S. M., Southern, 26935.	Broad Brook Lumber & Coal Co., Broad Brook	6.57	6.56	50.00
16494	C. S. M.	Fred Lyman, Manchester	6.72	6.88	48.00
16629	C. S. M., S. S. W., 29178.	E. H. Rollins, Granby	7.16	6.88	41.25
	L. T. Frisbie Co., New Haven, Conn.				
16648	C. S. M.	Station Agent, from factory	7.28	6.58	.....
16734	C. S. M.	H. Dudek, Talcottville	6.89	6.88	.....
	John H. Hailey Co., Houston, Texas.				
16566	Texas	F. R. & R. M. Goodrich, Portland.	7.06	6.88	....[1]
16609	Texas	The Allied Tobacco Co., Hartford.	7.28	6.88	42.50
17500	Texas	Station Agent, from W. J. Norton, Broad Brook	7.04	6.87	46.00
16564	C. S. M., P. R. R., 44433.	F. R. & R. M. Goodrich, Portland	6.76	7.06	....[1]
16565	C. S. M., N. P., 39582	F. R. & R. M. Goodrich, Portland	7.04	7.43	....[1]
	W. D. Hall Co., Atlanta, Ga.				
15977	Good, 21727	Olin H. Osborn, Warehouse Point	5.94	5.76	51.50
17574	Good	Station Agent, from Leonard Grain Co., Winsted	6.21	5.76	45.00
	Hayes Grain & Comm. Co., Little Rock, Ark.				
16897	Hayes	Station Agent, from Patrick Colbert, South Windsor	6.92	6.87	45.00
	Hill County Cotton Oil Co., Hillsboro, Texas.				
15903	C. S. M., 51344	Griffin-Neubergar Tobacco Co., North Bloomfield	7.43	6.88	.....
	Honey Grove Cotton Oil Co., Honey Grove, Texas.				
16407	C. S. M.	Station Agent, from John Klaus, Scitico	7.00	6.88	59.00

[1] $4.90 per unit ammonia.

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

Station No.	Manufacturer or Jobber, Car No. or Mark	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.	Cost per ton.
	Humphreys-Godwin Co., Memphis, Tenn.				
15902	Bull, 8188	Griffin-Neuberger Tobacco Co., North Bloomfield	7.00	6.88	.....
15912	Bull, 29846	Griffin-Neuberger Tobacco Co., North Bloomfield	7.43	6.88	.....
15919	Bull, 79034	Griffin-Neuberger Tobacco Co., North Bloomfield	6.99	6.88	.....
15925	Bull, 44808	Griffin-Neuberger Tobacco Co., North Bloomfield	6.92	6.88	.....
16007	Bull, 124146	Griffin-Neuberger Tobacco Co., North Bloomfield	7.40	6.88	.....
16008	Bull, 22196	Griffin-Neuberger Tobacco Co., North Bloomfield	6.79	6.88	.....
16009	Bull, 48876	Griffin-Neuberger Tobacco Co., North Bloomfield	7.00	6.88	.....
16011	Bull, 120688	Griffin-Neuberger Tobacco Co., North Bloomfield	6.71	6.88	.....
16012	Bull, 121600	Griffin-Neuberger Tobacco Co., North Bloomfield	6.90	6.88	.....
16013	Bull, 18122	Griffin-Neuberger Tobacco Co., North Bloomfield	7.17	6.88	.....
16018	Bull, 36929	Griffin-Neuberger Tobacco Co., North Bloomfield	6.88	6.88	.....
16019	Bull, 104154	Griffin-Neuberger Tobacco Co., North Bloomfield	6.90	6.88	.....
16022	Bull, 49245	Griffin-Neuberger Tobacco Co., North Bloomfield	6.83	6.88	.....
16028	Bull, 41425	Griffin-Neuberger Tobacco Co., North Bloomfield	6.50	6.88	.....
16036	Bull, 16803	Griffin-Neuberger Tobacco Co., North Bloomfield	6.82	6.88	.....
16038	Bull, 122422	Griffin-Neuberger Tobacco Co., North Bloomfield	7.46	6.88	.....
16042	Bull, 34384	Griffin-Neuberger Tobacco Co., North Bloomfield	6.94	6.88	.....
16043	Bull, 76636	Griffin-Neuberger Tobacco Co., North Bloomfield	7.10	6.88	.....
16047	Bull, 29907	Griffin-Neuberger Tobacco Co., North Bloomfield	6.84	6.88	.....
16048	Bull, 28372	Griffin-Neuberger Tobacco Co., North Bloomfield	7.30	6.88	.....
16292	Bull, 24207 G. N.	G. S. Phelps & Co., Thompsonville	7.24	6.88	$48.50
16332	Bull, N. C., 62601	G. S. Phelps & Co., Thompsonville	7.29	6.88	48.50
16365	Bull, W. A. B., 67886	G. S. Phelps & Co., Thompsonville	6.94	6.88	42.75
16366	Bull, Southern, 131666	G. S. Phelps & Co., Thompsonville	6.70	6.88	44.00
16383	Bull, 10127, C. B.	E. F. Miller, Ellington	7.30	6.88	42.50
16405	Bull, M. K. & T., 81176	G. S. Phelps & Co., Thompsonville	6.82	6.88	44.00
16446	Bull, 5156	American Sumatra Tobacco Co., East Hartford	6.89	6.88	.....

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

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.	Cost per ton.
	Humphreys-Godwin Co., Memphis, Tenn. (*Continued*).				
16448	Bull, 34316	American Sumatra Tobacco Co., East Hartford	7.11	6.88	.....
16449	Bull, 130389	American Sumatra Tobacco Co., East Hartford	6.99	6.88	.....
16450	Bull, 36563	American Sumatra Tobacco Co., East Hartford	7.04	6.88	.....
16452	Bull, 37771	American Sumatra Tobacco Co., East Hartford	7.23	6.88	.....
16459	Bull, 14442	American Sumatra Tobacco Co., East Hartford	6.65	6.88	.....
16460	Bull, 29328	American Sumatra Tobacco Co., East Hartford	6.88	6.88	.....
16461	Bull, 26576	American Sumatra Tobacco Co., East Hartford	6.84	6.88	.....
16586	Bull	Station Agent, from J. E. Shepard, South Windsor	7.14	6.88	$41.65
16595	Bull, I. C., 49448	G. S. Phelps & Co., Thompsonville	6.98	6.88	43.00
16596	Bull, C. & E., 60806	G. S. Phelps & Co., Thompsonville	7.49	6.88	43.00
16598	Bull, M. O. P., 32542	E. F. Miller, Ellington	7.14	6.88	42.50
16662	Bull	Station Agent from Fassler & Silberman, Hartford	6.84	6.88	49.50
16669	Bull, N.Y.,N.H.& H.,74070	G. S. Phelps & Co., Thompsonville	7.20	6.88	44.75
16737	Bull, C. of G., 51046	G. S. Phelps & Co., Thompsonville	7.06	6.88	42.50
16738	Bull, A. C. L., 31464	G. S. Phelps & Co., Thompsonville	6.92	6.88	42.00
16760	Bull, M. P., 6298	G. S. Phelps & Co., Thompsonville	6.92	6.88	42.50
16761	Bull, 35548	G. S. Phelps & Co., Thompsonville	6.78	6.88	41.00
16762	Bull, 130617, Southern	G. S. Phelps & Co., Thompsonville	6.76	6.88	40.00
16763	Bull, S. A. L., 27205	G. S. Phelps & Co., Thompsonville	7.00	6.88	41.00
16784	Bull	C. R. Dubia, Brookfield	6.68	6.88	.....
16880	Bull	John M. Herr, Burnside	7.30	6.88	49.50
16906	Bull	Station Agent, from Haviland Tobacco Co., East Windsor Hill	7.30	6.88	42.25
16912	Bull, 37492	G. S. Phelps & Co., Thompsonville	6.94	6.88	40.00
16913	Bull, 7304	G. S. Phelps & Co., Thompsonville	7.22	6.88	40.00
16914	Bull, 8514	G. S. Phelps & Co., Thompsonville	6.86	6.88	40.00
16944	Bull, 7129	G. S. Phelps & Co., Thompsonville	6.98	6.88	40.00
17007	Bull, 30683	Steane, Hartman & Co., Hartford	7.13	6.88	.....
17008	Bull, 140962	Steane, Hartman & Co., Hartford	7.18	6.88	.....
17009	Bull, 107113	Steane, Hartman & Co., Hartford	7.08	6.88	.....
17010	Bull, 22127	Steane, Hartman & Co., Hartford	7.16	6.88	.....
17011	Bull, 33001	Steane, Hartman & Co., Hartford	7.28	6.88	.....
17122	Bull, B. & O., 195707	Spencer Bros., Inc., Suffield	7.18	6.88	43.00
16284	Danish, D. & R. S., 67092	Spencer Bros., Inc., Suffield	5.83	5.75	50.00
16285	Danish, C. N. W., 27414	Spencer Bros., Inc., Suffield	5.75	5.75	50.00
16286	Danish, A. C. L., 41711	Spencer Bros., Inc., Suffield	5.85	5.75	.....
16287	Danish, Southern, 121499	Spencer Bros., Inc., Suffield	5.50	5.75	50.00
16288	Danish, N. Y. C., 225933	Spencer Bros., Inc., Suffield	6.07	5.75	50.00

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

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.	Cost per ton.
	Humphreys-Godwin Co., Memphis, Tenn. (*Continued*)				
16289	Danish, N. S., 21467	Spencer Bros., Inc., Suffield	6.27	5.75	$50.00
16290	Danish, T. O. C., 14176	Spencer Bros., Inc., Suffield	5.76	5.75	50.00
16297	Danish, Penn., 517571	Spencer Bros., Inc., Suffield	5.85	5.75	50.00
16298	Danish, Penn., 501717	Spencer Bros., Inc., Suffield	6.14	5.75	50.00
16463	Danish, N. & W., 62319	G. S. Phelps & Co., Thompsonville	5.90	5.75	41.00
16464	Danish, R. I., 45718	Spencer Bros., Inc., Suffield	5.80	5.75	42.00
16465	Danish, N. Y. C., 260294	Spencer Bros., Inc., Suffield	5.67	5.75	46.00
16487	Danish	S. J. Orr, West Suffield	5.81	5.75	61.50
16488	Danish	S. J. Orr, West Suffield	5.82	5.75	61.60
16560	Danish, R. I., 54548	Spencer Bros., Inc., Suffield	5.74	5.75	40.00
16561	Danish, G. N., 24206	Spencer Bros., Inc., Suffield	5.32	5.75	50.00
16562	Danish, S.S.W., 19460	G. S. Phelps & Co., Thompsonville	5.58	5.75	41.00
16654	Danish, C. B. & Q., 107422	G. S. Phelps & Co., Thompsonville	5.98	5.75	41.00
17004	Danish	E. S. Lovell, Newtown	6.18	5.75	44.00
17057	Danish, C. V., 62735	Spencer Bros., Inc., Suffield	6.30	5.75	38.50
17058	Danish, Southern, 335756	Spencer Bros., Inc., Suffield	6.00	5.75	38.50
17059	Danish, Southern, 151673	Spencer Bros., Inc., Suffield	6.08	5.75	38.50
17060	Danish, N. Y. C., 161229	Spencer Bros., Inc., Suffield	5.94	5.75	38.50
17061	Danish, B. & O., 171756	Spencer Bros., Inc., Suffield	5.98	5.75	38.50
17062	Danish, 302510	Spencer Bros., Inc., Suffield	5.76	5.75	36.00
17063	Danish, L. & N., 103046	Spencer Bros., Inc., Suffield	6.90	5.75	38.50
17064	Danish, Southern, 134287	Spencer Bros., Inc., Suffield	6.24	5.75	38.50
17120	Danish, S. S. W., 13750	Spencer Bros., Inc., Suffield	6.02	5.75	48.50
17121	Danish, C. B. & Q., 133067	Spencer Bros., Inc., Suffield	6.18	5.75	38.50
17525	Danish, St.L.& S.F., 124872	The Coles Co., Middletown	5.78	5.75	50.00
17573	Danish, 8152	The Coles Co., Middletown	5.66	5.75	52.00
17599	Danish	Station Agent, from Geo. S. Phelps & Co., Thompsonville	5.68	5.75	38.00
16030	Dixie, 107142	Griffin-Neuberger Tobacco Co., North Bloomfield	6.90	6.56	.....
16045	Dixie, 12158	Griffin-Neuberger Tobacco Co., North Bloomfield	7.11	6.56	.....
16280	Dixie	L. B. Haas & Co., Hartford	6.29	6.56	56.00
16281	Dixie	L. B. Haas & Co., Hartford	6.41	6.56	56.00
16282	Dixie	L. B. Haas & Co., Hartford	6.37	6.56	56.00
16367	Dixie, G. N., 24780	H. C. Nelson, West Suffield	6.46	6.56	47.00
16382	Dixie, P. & R., 4578	G. S. Phelps & Co., Thompsonville	6.56	6.56	42.75
16504	Dixie, D., 130621–71673	Garber-Northam Co., Hartford	6.58	6.56	50.50
16512	Dixie, 45619	Olds & Whipple, Hartford	6.64	6.56	40.00
16531	Dixie	G. S. Phelps & Co., Thompsonville	6.68	6.56	54.00
16580	Dixie	Station Agent, from Chas. Ott, Burnside	7.08	6.56	43.50
16590	Dixie	John Ewald, Cromwell	6.74	6.56	42.50
16620	Dixie, C. M. & St.P., 503721	G. S. Phelps & Co., Thompsonville	6.63	6.56	43.00
16829	Dixie, 66622	E. S. Seymour, Suffield	6.72	6.56	39.75
16828	Dixie, 22148	E. S. Seymour, Suffield	6.76	6.56	39.75

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

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.	Cost per ton.
	Humphreys-Godwin Co., Memphis, Tenn. (*Continued*)				
17127	Dixie	Station Agent, from A. Manning, Manchester	6.28	6.56	$42.00
17248	Dixie	G. A. Peckham, Suffield	6.24	6.56	....
15777	C. S. M., 102781	The Coles Co., Middletown	6.02	5.76	69.08
15894	C. S. M., 99958	Griffin-Neuberger Tobacco Co., North Bloomfield	6.80	....	.....
15895	C. S. M., 13932	Griffin-Neuberger Tobacco Co., North Bloomfield	6.94	....	.....
15897	C. S. M., 30695	Griffin-Neuberger Tobacco Co., North Bloomfield	7.31	....	.....
15898	C. S. M., 17005	Griffin-Neuberger Tobacco Co., North Bloomfield	6.82	....	.....
15899	C. S. M., 35613	Griffin-Neuberger Tobacco Co., North Bloomfield	7.05	....	.....
15900	C. S. M., 241740	Griffin-Neuberger Tobacco Co., North Bloomfield	7.30	....	.....
15901	C. S. M., 132692	Griffin-Neuberger Tobacco Co., North Bloomfield	6.96	....	.....
15906	C. S. M., 11741	Griffin-Neuberger Tobacco Co., North Bloomfield	6.74	....	.....
15907	C. S. M., 44729	Griffin-Neuberger Tobacco Co., North Bloomfield	6.63	....	.....
15908	C. S. M., 55878	Griffin-Neuberger Tobacco Co., North Bloomfield	6.64	....	.....
15909	C. S. M., 57284	Griffin-Neuberger Tobacco Co., North Bloomfield	7.27	....	.....
15910	C. S. M., 87500	Griffin-Neuberger Tobacco Co., North Bloomfield	6.71	....	.....
15913	C. S. M., 90104	Griffin-Neuberger Tobacco Co., North Bloomfield	7.25	....	.....
15915	C. S. M., 101182	Griffin-Neuberger Tobacco Co., North Bloomfield	6.68	....	.....
15916	C. S. M., 208711	Griffin-Neuberger Tobacco Co., North Bloomfield	6.39	....	.....
15917	C. S. M., 4378	Griffin-Neuberger Tobacco Co., North Bloomfield	6.69	....	.....
15918	C. S. M., 20196	Griffin-Neuberger Tobacco Co., North Bloomfield	6.33	....	.....
15920	C. S. M., 13752	Griffin-Neuberger Tobacco Co., North Bloomfield	6.68	....	.....
15921	C. S. M., 45886	Griffin-Neuberger Tobacco Co., North Bloomfield	6.86	....	.....
15922	C. S. M., 2530	Griffin-Neuberger Tobacco Co., North Bloomfield	6.89	....	.....
15923	C. S. M., 17239	Griffin-Neuberger Tobacco Co., North Bloomfield	7.01	....	.....

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

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent. Nitrogen Found.	Per cent. Nitrogen Guaranteed.	Cost per ton.
	Humphreys-Godwin Co., Memphis, Tenn. (*Continued.*)				
15924	C. S. M., 15598	Griffin-Neuberger Tobacco Co., North Bloomfield	6.55	....	.....
15926	C. S. M., 46131	Griffin-Neuberger Tobacco Co., North Bloomfield	7.04	....	.....
16006	C S. M., 30406	Griffin-Neuberger Tobacco Co., North Bloomfield	7.22	....	.....
16010	C. S. M., 90489	Griffin-Neuberger Tobacco Co., North Bloomfield	7.16	....	.....
16020	C. S. M., 234420	Griffin-Neuberger Tobacco Co., North Bloomfield	7.13	....	.....
16023	C. S. M., 25507	Griffin-Neuberger Tobacco Co., North Bloomfield	6.96	....	.....
16024	C. S. M., 54644	Griffin-Neuberger Tobacco Co., North Bloomfield	6.92	....	.....
16025	C. S. M., 126125	Griffin-Neuberger Tobacco Co., North Bloomfield	7.05	....	.....
16029	C. S. M., 63348	Griffin-Neuberger Tobacco Co., North Bloomfield	7.10	....	.....
16031	C. S. M., 241750	Griffin-Neuberger Tobacco Co., North Bloomfield	7.13	....	.....
16033	C. S. M., 93742	Griffin-Neuberger Tobacco Co., North Bloomfield	6.88	....	.....
16034	C. S. M., 61573	Griffin-Neuberger Tobacco Co., North Bloomfield	6.90	....	.....
16035	C. S. M., 102829	Griffin-Neuberger Tobacco Co., North Bloomfield	7.00	....	.....
16039	C. S. M., 21763	Griffin-Neuberger Tobacco Co., North Bloomfield	6.98	....	.....
16046	C. S. M., 14891	Griffin-Neuberger Tobacco Co., North Bloomfield	6.97	....	.....
16215	C. S. M., S. F., 27712	Spencer Bros., Inc., Suffield	5.88	5.75	$50.00
16216	C. S. M., N. Y. C., 115279	Spencer Bros., Inc., Suffield	5.60	5.75	50.00
16217	C. S. M., C. G. R., 84555.	Spencer Bros., Inc., Suffield	6.02	5.75	50.00
16218	C. S. M., Southern, 152676	Spencer Bros., Inc., Suffield	5.62	5.75	50.00
16219	C. S. M., C. H. D., 40299.	Spencer Bros., Inc., Suffield	6.04	5.75	50.00
16409	C. S. M	Station Agent, from J. E. Shepard, South Windsor	6.92	6.91	.....
16411	C. S. M	Station Agent, from J. E. Shepard, South Windsor	7.19	7.29	43.41
16416	C. S. M., 11359	Station Agent, from J. E. Shepard, South Windsor	7.88	7.96	46.95
16417	C. S. M., 84487	Station Agent, from J. E. Shepard, South Windsor	8.11	8.15	48.06
16455	C. S. M., 88678	American Sumatra Tobacco Co., East Hartford	7.14	....	.....

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

Station No.	Manufacturer or Jobber, Car No. or Mark	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.	Cost per ton.
	Humphreys-Godwin Co., Memphis, Tenn. (*Continued*).				
16470	C. S. M., N. Y. C., 238827	Huntington Bros., Windsor	7.24	....	.....
16524	C. S. M.	Huntington Bros., Windsor	7.06	....	....[1]
16582	C. S. M., 34105	Station Agent, from J. E. Shepard, South Windsor	7.19	7.20	$42.49
16583	C. S. M., 36005	Station Agent, from J. E. Shepard, South Windsor	7.08	7.07	42.14
16589	C. S. M.	Station Agent, from J. E. Shepard, South Windsor	7.19	....	42.43
16702	C. S. M., G. A., 8658	Spencer Bros., Inc., Suffield	6.10	5.75	40.00
16703	C. S. M., S. A. L., 24838	Spencer Bros., Inc., Suffield	7.30	7.00	43.00
16704	C. S. M., A.T.& S.F.,27477	Spencer Bros., Inc., Suffield	5.70	5.75	39.00
16705	C. S. M., Southern, 133553	Spencer Bros., Inc., Suffield	7.08	7.00	45.00
16706	C. S. M., G. A., 5106	Spencer Bros., Inc., Suffield	6.09	5.75	38.00
16707	C. S. M., A. C. L., 39760	Spencer Bros., Inc., Suffield	5.50	5.75	40.00
16708	C. S. M., Penn., 22004	Spencer Bros., Inc., Suffield	6.20	5.75	41.00
16709	C. S. M., P. R. R., 14879	Spencer Bros., Inc., Suffield	5.95	5.75	41.00
16710	C. S. M., Penn., 52944	Spencer Bros., Inc., Suffield	5.58	5.75	40.00
16711	C. S. M., M. K. T., 88132	Spencer Bros., Inc., Suffield	6.15	5.75	40.00
16712	C. S. M., Frisco, 32235	Spencer Bros., Inc., Suffield	6.12	5.75	40.00
16713	C. S. M., G. A., 1005	Spencer Bros., Inc., Suffield	6.03	5.75	40.00
16886	C. S. M., G. T., 12821	Spencer Bros., Inc., Suffield	6.02	5.75	40.00
16887	C. S. M., U. P., 10455	Spencer Bros., Inc., Suffield	5.82	5.75	39.00
16888	C. S. M., A. C. L., 35742	Spencer Bros., Inc., Suffield	6.06	5.75	38.60
16889	C. S. M., St.L.&B.&M.,1646	Spencer Bros., Inc., Suffield	5.73	5.76	40.00
16890	C. S. M., St.L.&S.F.,125280	Spencer Bros., Inc., Suffield	5.74	5.75	38.50
16891	C. S. M., A. C. L., 32300	Spencer Bros., Inc., Suffield	5.56	5.75	40.00
16892	C. S. M., N. S., 4023	Spencer Bros., Inc., Suffield	6.08	5.75	38.50
16893	C. S. M., A. C. L., 39956	Spencer Bros., Inc., Suffield	5.90	5.75	50.00
16894	C. S. M., N.C.&St.L.24516	Spencer Bros., Inc., Suffield	5.88	5.75	40.00
16972	C. S. M., N. Y. C., 255668	Spencer Bros., Inc., Suffield	5.97	....	36.00
16973	C. S. M., 4067	Spencer Bros., Inc., Suffield	5.74	....	36.00
16974	C. S. M., 14707	Spencer Bros., Inc., Suffield	5.78	....	36.00
16975	C. S. M., R. I., 155248	Spencer Bros., Inc., Suffield	6.01	....	36.00
	Industrial Cotton Oil Prop't's, Houston, Texas.				
16665	Longhorn	Fassler & Silberman, Hartford	7.12	6.88	46.75
	Jayton Cotton Oil Co., Jayton, Texas.				
15892	Ordinary, 16803	Griffin-Neuberger Tobacco Co., North Bloomfield	6.99	6.88	.....
15905	Ordinary, 180965	Griffin-Neuberger Tobacco Co., North Bloomfield	6.97	6.88	.....
16004	Ordinary, 52844	Griffin-Neuberger Tobacco Co., North Bloomfield	6.90	6.88	.....
16016	Ordinary, 2400	Griffin-Neuberger Tobacco Co., North Bloomfield	7.07	6.88	.....

[1] $4.90 per unit ammonia.

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

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.	Cost per ton.
	Jefferson Oil Co., Jefferson, Texas				
16037	Ordinary, 248755	Griffin-Neuberger Tobacco Co., North Bloomfield	6.70	6.88	.....
16451	Jefferson, 130396	American Sumatra Tobacco Co., East Hartford	6.79	6.88	.....
	Kasco Mills, Waverly, N. Y.				
16621	C. S. M., 30916, D. W. P.	The Coles Co., Middletown	7.26	6.88	$50.00
16623	C. S. M., Erie 72823	The Coles Co., Middletown	6.91	6.16	47.50
	L. B. Lovitt & Co., Memphis, Tenn.				
17540	Lovit	Station Agent, from T. J. Colemen, Warehouse Point	6.82	6.56	50.00
16783	Memphis	Station Agent, from W. C. Everett, Bloomfield	6.16	6.16	44.00
16960	Neal's Choice	Station Agent, from A. N. Shepard & Son, Hartford	7.12	6.88	47.50
16782	36 Brand	Station Agent, from A. R. Carpenter, Bloomfield	5.68	5.75	46.00
16237	C. S. M.	Thomas Connor, Poquonock	6.30	....	....[1]
16291	C. S. M.	John B. Parker, Poquonock	6.79	....	....[2]
16376	C. S. M.	John B. Parker, Poquonock	6.55	7.38	....[2]
16462	C. S. M., G. T., 23273	A. R. Fairbanks, Windsor	6.32	6.69	69.19
16558	C. S. M.	I. Meyer & Co., Windsor Locks	6.00	5.76	41.00
16559	C. S. M.	I. Meyer & Co., Windsor Locks	5.09	5.76	41.00
	Lyle & Lyle Huntsville, Ala.				
16778	Economy	Station Agent, from Meech & Stoddard, Middletown	6.04	5.76	39.00
16779	Lyle's Best	Station Agent, from H. C. Vibert, South Windsor	6.94	6.88	40.50
16899	Lyle's Best	Station Agent, from R. E. Hyde, Ellington	6.96	6.88	43.00
17874	Lyle's Best	H. F. Johnson, Co. Agent, Norwich	6.88	6.88	45.00
15785	C. S. M., 15698	The Coles Co., Middletown	5.87	5.76	70.00
16622	C. S. M., 36464	The Coles Co., Middletown	5.90	5.76	45.00
16962	C. S. M., 133187, Southern	Station Agent, from A. N. Shepard & Son, Hartford	7.04	6.88	42.75
	Mart Cotton Oil Co., Mart, Texas.				
16032	C. S. M., 8207	Griffin-Neuberger Tobacco Co., North Bloomfield	7.32	6.88	.....

[1] $8.50 per unit ammonia.
[2] $8.85 per unit ammonia.

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

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent. Nitrogen		Cost per ton.
			Found.	Guaranteed.	
	McGregor Cotton Oil Co., McGregor, Texas.				
15896	C. S. M., 24044	Griffin-Neuberger Tobacco Co., North Bloomfield	6.67	6.88	.....
	Meech & Stoddard, Inc., Middletown.				
16777	Connecticut	Station Agent, from manufacturer	6.20	5.76	$39.00
	Morrilton Cotton Oil Co., Morrilton, Ark.				
16447	Big Four, 31055	American Sumatra Tobacco Co., East Hartford	7.29	6.88	.....
	Munger Oil & Cotton Co., Teague, Texas.				
15904	C. S. M., 24480	Griffin-Neuberger Tobacco Co., North Bloomfield	7.23	6.88	.....
16005	C. S. M., 59617	Griffin-Neuberger Tobacco Co., North Bloomfield	7.50	6.88	.....
16015	C. S. M., 84008	Griffin-Neuberger Tobacco Co., North Bloomfield	7.40	6.88	.....
	W. C. Nothern, Memphis, Tenn.				
17496	Bee	Station Agent, from Wm. Reeves, Windsorville	6.68	6.56	45.00
16852	Queen Bee, P. R. R., 32149	Station Agent, from D. E. and R. C. Neelans, Hazardville	6.98	6.88	48.00
17455	Queen Bee	Station Agent, from E. N. Austin, Suffield	6.64	6.88	43.00
16408	Standard	Station Agent, from Jos. Klaus, Scitico	6.10	5.75	57.00
	Osage Cotton Oil Co., Kansas City, Mo.				
16456	Special Quality, 3427	American Sumatra Tobacco Co., East Hartford	6.92	6.88	.....
16458	Special Quality, 17678	American Sumatra Tobacco Co., East Hartford	7.07	6.88	.....
16041	C. S. M., 78632	Griffin-Neuberger Tobacco Co., North Bloomfield	7.27	6.88	.....
16044	C. S. M., 102643	Griffin-Neuberger Tobacco Co., North Bloomfield	7.28	6.88	.....
16454	C. S. M., 18926	American Sumatra Tobacco Co., East Hartford	7.28	6.88	.....

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

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent. Nitrogen.		Cost per ton.
			Found.	Guaranteed.	
	Park & Pollard Co., Boston, Mass.				
16767	Upland	Station Agent, from F. B. Newton Estate, Plainville	5.66	5.75	$56.00
17005	Upland, 49459	Broad Brook Lumber and Coal Co., Broad Brook	6.88	5.75	40.00
16474	C. S. M., Southern, 40217.	Broad Brook Lumber and Coal Co., Broad Brook	6.73	6.56	52.00
16633	C. S. M., R. I., 36847	E. H. Rollins, Granby	7.05	6.88	59.00
	Planters Cotton Oil Co., Bonham, Texas.				
16027	C. S. M., 38766	Griffin-Neuberger Tobacco Co., North Bloomfield	6.83	6.88	.....
	Riverside Cotton Oil Co., Fort Worth, Texas.				
15893	C. S. M., 552825	Griffin-Neuberger Tobacco Co., North Bloomfield	7.12	6.88	.....
15911	C. S. M., 98181	Griffin-Neuberger Tobacco Co., North Bloomfield	6.89	6.88	.....
16017	C. S. M., 33252	Griffin-Neuberger Tobacco Co., North Bloomfield	6.74	6.88	.....
16026	C. S. M., 42455	Griffin-Neuberger Tobacco Co., North Bloomfield	6.90	6.88	.....
	G. B. Robinson, Jr., New York City.				
16489	Robin, P. R. R., 49566	A. E. Potwine, East Windsor	6.60	6.50	39.80
16490	Robin, P. R. R., 40419	A. E. Potwine, East Windsor	6.16	6.50	39.80
16827	C. S. M., 125145	Griffin-Neuberger Tobacco Co., North Bloomfield	7.13	6.88	40.75
	The Rogers & Hubbard Co., Middletown, Conn.				
16602	C. S. M., N. Y., N. H. & H., 89549	Fred. E. Lord, Warehouse Point	6.61	6.58	43.50
16907	C. S. M	Station Agent, from Arthur Manning, South Manchester	6.44	6.17	42.00
17092	C. S. M	W. E. Harvey, Windsor	6.44	6.08	.....
17126	C. S. M	Station Agent, from Arthur Manning, South Manchester	6.58	6.58	42.00
17128	C. S. M	Station Agent, from Arthur Manning, South Manchester	6.64	6.58	42.00
17211	C. S. M	F. A. Hamilton, Warehouse Point	6.96	6.58	42.50

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

Station No.	Manufacturer or Jobber, Car No. or Mark	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.	Cost per ton.
	J. E. Soper Co., Boston, Mass.				
16182	Priscilla	E. N. Austin, Suffield	7.23	6.75	$49.00
16484	Priscilla	Arthur E. Pascoe, Warehouse Point	7.08	6.75	52.50
16781	Puritan	Station Agent, from R. F. Harvey, Burnside	6.12	5.75	48.50
	Southland Cotton Oil Co., Paris, Texas.				
16457	Climax, 172063	American Sumatra Tobacco Co., East Hartford	6.82	6.88	.....
16584	Climax, 84562	Station Agent, from J. E. Shepard, South Windsor	7.18	6.88	42.53
16585	Climax, 19481	Station Agent, from J. E. Shepard, South Windsor	7.20	6.88	42.53
	A. C. Westervelt & Co. Memphis, Tenn.				
16689	Planet, Southern, 150019	Martin E. Noone, Suffield	7.10	6.88	41.00
16963	Planet	Station Agent, from A. N. Shepard & Son, Hartford	7.14	6.88	55.50
16965	Planet	Station Agent, from A. N. Shepard & Son, Hartford	7.08	6.88	55.50
16860	Sun	Fred D. Weed, Danbury	5.93	5.75	47.00
	West Cotton Oil Mill, West, Texas.				
16610	C. S. M	Richard & Cooley, East Hartford.	7.08	6.88	46.00
	E. H. Young Co., Inc., Fort Worth, Texas.				
16014	Young's 43, 50109	Griffin-Neuberger Tobacco Co., North Bloomfield	7.15	6.88	.....
	Unknown.				
16299	C. S. M	A. N. Farnham, Westville	5.60	....	.....
16510	C. S. M., 36285	Conn. Sumatra Tobacco Co., Buckland	6.66	6.58	40.00
16805	C. S. M	Geo. C. Eno, Simsbury	6.90	....	42.50
17111	C. S. M	Hackett Brothers, Buckland	7.08	....	.....
17114	C. S. M	Hackett Brothers, Buckland	6.88	....	.....

CASTOR POMACE.

Nineteen samples were analyzed as follows:

17288. Sold by Eastern States Farmers' Exchange, Springfield, Mass. Stock of Robert Gregg, West Suffield.

16516. Sold by Apothecaries Hall Co., Waterbury. Stock of Conn. Sumatra Tobacco Co., Buckland.

16604. Sold by Independent Trading Co., Inc., New York. Stock of J. H. Lynch, Ellington.

16976. Sold by Eastern States Farmers' Exchange, Springfield, Mass. Stock of Spencer Bros., Inc., Suffield.

16443. Sold by Baker Castor Oil Co., New York. Stock of American Sumatra Tobacco Co., East Hartford.

17329. Sold by E. D. Chittenden Co., Bridgeport. Stock of W. J. Norton, Broad Brook.

16445. Sold by Baker Castor Oil Co., New York. Stock of American Sumatra Tobacco Co., East Hartford.

16660. Sold by Olds & Whipple, Hartford. Sampled at factory.

16843. Sold by Apothecaries Hall Co., Waterbury. Sampled at factory.

16444. Sold by Baker Castor Oil Co., New York. Stock of American Sumatra Tobacco Co., East Hartford.

16744. Sold by Baker Castor Oil Co., New York. Stock of Olds & Whipple, Hartford.

16904. Sold by Baker Castor Oil Co., New York. Stock of Haviland Tobacco Co., East Windsor.

16680. Sold by Berkshire Fertilizer Co., Bridgeport. Sampled at factory.

16806. Sold by Olds & Whipple, Hartford. Stock of Geo. Eno, Simsbury.

17497. Sold by Apothecaries Hall Co., Waterbury. Stock of O. S. Olmsted, Hazardville.

15928. Sold by Baker Castor Oil Co., New York. Stock of Griffin-Neuberger Tobacco Co., North Bloomfield.

15929. Sold by Baker Castor Oil Co., New York. Stock of Griffin-Neuberger Tobacco Co., North Bloomfield.

16472. Sold by Olds & Whipple, Hartford. Stock of Huntington Bros., Windsor.

16651. Sold by L. T. Frisbie Co., New Haven. Sampled at factory.

TABLE IV. ANALYSES OF CASTOR POMACE.

Station No.	Per cent. of Nitrogen Found	Per cent. of Nitrogen Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
17288	6.18	5.76	$51.50	41.7
16516	6.00	4.52	50.00	41.7
16604	5.96	....	50.00	41.9
16976	6.02	5.76	51.50	42.8
16443[1]	5.19	4.50	45.00	43.4
17329	5.70	4.52	50.00	43.9
16445[1]	5.10	4.50	45.00	44.1
16660	6.60	5.00	58.90	44.6
16843	5.58	4.52	50.00	44.8
16444[1]	4.99	4.50	45.00	45.1
16744[1]	5.58	4.50	52.00	46.6
16904[1]	5.36	4.50	51.00	47.6
16680	5.18	4.52	50.00	48.3
16806	6.30	....	62.00	49.2
17497	5.40	4.53	55.00	50.9
15928	5.36	....	.....	....
15929	6.39	....	.....	....
16472	5.53	....	.....	....
16651	5.87	5.35	.....	....

[1] Guaranty of 1 to 3 per cent. potash and 1-3 per cent. phosphoric acid.

In ten of the samples about 5 per cent. nitrogen is guaranteed. 5.76 is the highest guaranty.

The average cost of nitrogen in castor pomace has been 45.1 cents per pound.

The usual amounts of phosphoric acid and potash found in castor pomace are shown in the following five analyses:

TABLE V. NITROGEN, PHOSPHORIC ACID AND POTASH IN CASTOR POMACE.

Station No.	16443	16445	16444	16744	16904	Average
Percentage of						
Nitrogen	5.19	5.10	4.99	5.58	5.36	5.24
Water-and citrate-soluble phosphoric acid	1.78	1.78	1.76	1.79	1.72	1.77
Total phosphoric acid	1.79	1.82	1.79	1.87	1.80	1.81
Total potash	1.12	1.17	1.09	1.00	1.06	1.09

II. RAW MATERIALS CHIEFLY VALUABLE FOR PHOSPHORIC ACID.

BARIUM-PHOSPHATE.

17391. Grade A. Sold by Witherbee, Sherman & Co., New York, N. Y. Stock of Chas. Q. Eldredge, Mystic. Guaranteed 28 per cent. phosphoric acid.

ANALYSIS OF BARIUM-PHOSPHATE.

Station No.	17391
Percentage of	
Water-soluble phosphoric acid	0.04
Citrate-soluble phosphoric acid	5.17
Insoluble phosphoric acid	25.34
Total phosphoric acid	30.55

RAW ROCK PHOSPHATE.

Three samples were analyzed as follows:

16883. Mitchell's Raw Phosphate Float. Sold by Walter Mitchell, New Haven. Sent by F. E. Prentice, North Haven.

17414. Mitchell's Raw Phosphate Float. Sold by Walter Mitchell, New Haven. Stock of Louis Schwartz, Mt. Carmel.

16577. Tetraphosphate, submitted by Herbert Myrick, Springfield, Mass.

TABLE VI. ANALYSES OF RAW ROCK PHOSPHATE.

Station No.	16883	17414	16577
Percentage of			
Water-soluble phosphoric acid	.....	.....	.....
Citrate-soluble phosphoric acid	4.33	.....	1.75
Citrate-insoluble	26.35	.....	22.90
Total phosphoric acid	30.68	30.47	24.65
"Available" phosphoric acid	4.33	.....	1.75
Cost per ton	$19.00	$20.00	.....

PRECIPITATED BONE PHOSPHATE.

This is a manufacturing by-product, in fine mechanical condition, containing from 30 to 40 per cent. of phosphoric acid, most of it in "available" form.

The analyses of twenty samples are given in the table. There appear to be three distinct grades; four samples contained 38 per cent. or more of available phosphoric acid, ten contained from 33 to 38 per cent., four from 30 to 32, and two under 30 per cent.

Most of this phosphate was sold at a stated price "per unit" of available phosphoric acid, as shown by analysis, a "unit" being 20 pounds or one per cent.

In these samples the price has ranged from 7½ to 9½ cents per pound for available phosphoric acid.

15784 is of inferior quality selling at a high price, unless the quotation is at retail for small amounts.

17446 was found by a trade chemist to contain 39.92 per cent. of available phosphoric acid and a somewhat larger percentage of total phosphoric acid than this Station found. The difference probably is explained by a difference in the method of extraction, the method used here being prescribed by the fertilizer law.

TABLE VII. ANALYSES OF PRECIPITATED BONE PHOSPHATE.

Station No.	Manufacturer or Wholesale Dealer	Dealer or Purchaser.	Phosphoric Acid.					Cost per ton.
			Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.	"Available."	
	Sampled by Station:		%	%	%	%	%	
17584	Berkshire Fertilizer Co., B'dgeport	Sampled at factory	0.90	38.21	0.73	39.84	39.11[1]	.....
16659	Olds & Whipple, Hartford	Sampled at factory	0.85	38.06	0.63	39.54	38.91[2]	.....
16905	Olds & Whipple, Hartford	Haviland Tob. Co., East Windsor Hill	0.73	38.50	0.23	39.46	39.23[3]	$66.66
17446	Wilcox Fertilizer Co., Mystic	M. E. Thompson, Ellington	0.77	37.09	0.36	38.22	37.86[3]	70.00
	Sampled by Purchaser:							
15930	American Glue Co., Boston, Mass.	Griffin-Neuberger Tobacco Co., North Bloomfield	2.12	30.96	1.56	34.64	33.08	.....
15931	American Glue Co., Boston, Mass.	Griffin-Neuberger Tobacco Co., North Bloomfield	1.80	33.32	2.32	37.44	35.12	.....
16434	American Glue Co., Boston, Mass.	American Sumatra Tobacco Co., East Hartford	0.98	33.83	0.73	35.54	34.81	.....
16435	American Glue Co., Boston, Mass.	American Sumatra Tobacco Co., East Hartford	0.76	35.57	0.79	37.12	36.33	.....
16436	American Glue Co., Boston, Mass.	American Sumatra Tobacco Co., East Hartford	0.68	35.59	0.99	37.26	36.27	.....
16437	American Glue Co., Boston, Mass.	American Sumatra Tobacco Co., East Hartford	0.73	35.34	0.95	37.02	36.07	.....
16438	American Glue Co., Boston, Mass.	American Sumatra Tobacco Co., East Hartford	0.71	37.00	0.93	38.64	37.71	.....
16439	American Glue Co., Boston, Mass.	American Sumatra Tobacco Co., East Hartford	0.84	36.23	0.93	38.00	37.07	.....
16878	East. St. Farm. Exch., Springfield.	John Herr, Burnside	0.61	36.54	0.87	38.02	37.15	57.00
15789	A. W. Higgins, Westfield, Mass.	Griffin-Neuberger Tobacco Co., North Bloomfield	1.80	30.41	1.33	33.54	32.21	.....
15790	A. W. Higgins, Westfield, Mass.	Griffin-Neuberger Tobacco Co., North Bloomfield	1.75	28.89	1.87	32.51	30.64	.....
15791	A. W. Higgins, Westfield, Mass.	Griffin-Neuberger Tobacco Co., North Bloomfield	1.58	29.46	3.45	34.49	31.04	.....
15792	A. W. Higgins, Westfield, Mass.	Griffin-Neuberger Tobacco Co., North Bloomfield	1.03	29.72	1.70	32.45	30.75	.....
16518	Olds & Whipple, Hartford	Conn. Sumatra Tobacco Co., Buckland	1.63	26.52	5.39	33.54	28.15	.....
16523	Olds & Whipple, Hartford	Huntington Bros., Windsor	0.68	37.57	0.13	38.38	38.25[4]	52.32
15784	Unknown	Quality Shop, Stamford	2.02	25.28	1.97	29.27	27.30	60.00

[1] Guaranty 38% "available." [2] Guaranty 30% "available." [3] Guaranty 39.50% "available." [4] Guaranty 36.08% phosphoric acid.

DISSOLVED ROCK PHOSPHATE OR ACID PHOSPHATE.

The analyses of 28 samples are given in table VIII.

The guaranty is the same in all cases, except **17186,** sold by the Virginia-Carolina Chemical Co., in which 20 per cent. "available" was guaranteed and 18.87 per cent. was found.

Two other samples, **17051,** from the American Agricultural Chemical Co., and **17019,** from the Coe-Mortimer Co., did not meet their guaranties.

The cost of available phosphoric acid to the farmer in 21 samples ranged from 6.9 to 11.7 cents per pound and averaged 9.4 cents.

During the last year the price of acid phosphate has been very high and almost prohibitive until the market broke and forced sales reduced the price from $30.00 or more to less than $20.00.

The wholesale price of acid phosphate in bulk, f.o.b. N. Y., was $16.00 in January and $12.50 in the following September.

Sampled by Station:

17240. Sold by Nitrate Agencies Co., New York. Stock of J. McAllister, Farmers' Exchange, Cromwell.

17101. Sold by Eastern States Farmers' Exchange, Springfield, Mass. Stock of A. R. Carpenter, Bloomfield.

16765. Sold by Everett B. Clark Seed Co., Milford. Sampled at factory.

16771. Sold by Piedmont-Mt. Airy Guano Co., Baltimore, Md. Stock of Joseph Adams, Green's Farms.

16656. Sold by Olds & Whipple, Hartford. Sampled at factory.

16775. Sold by Wilcox Fertilizer Co., Mystic. Stock of G. R. Stannard, Branford.

17134. Sold by Providence Farmers' Exchange, Providence, R. I. Stock of Walter Scott, Niantic.

17451. Sold by Nitrate Agencies Co., New York. Stock of E. N. Austin, Suffield.

17146. Sold by Virginia-Carolina Chemical Co., New York. Stock of J. R. Reinhard, West Cheshire.

16678. Sold by Berkshire Fertilizer Co., Bridgeport. Stock of D. L. Clark & Sons, Milford.

17186. Sold by Virginia-Carolina Chemical Co., New York. Stock of J. D. Kelsey, Madison.

17373. Sold by International Agricultural Corp., Woburn, Mass. Stock of P. Schwartz Co., New London.

16845. Sold by Armour Fertilizer Works, New York. Stock of Rockville Grain & Coal Co., Rockville.

16766. Sold by Bowker Fertilizer Co., New York. Stock of W. T. McKenzie, Yalesville.

17198. Sold by F. S. Royster Guano Co., Baltimore, Md. Stock of Silliman Hardware Co., New Canaan.

TABLE VIII. ANALYSES OF ACID PHOSPHATE.

Station No.	Phosphoric Acid. Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.	"Available" found.	Cost per ton.	"Available" phosphoric acid costs cents per pound.
	%	%	%	%	%		
17240	14.59	2.78	0.04	17.41	17.37	$24.00	6.9
17101	12.31	3.74	0.63	16.68	16.05	33.00	7.5
16765	14.12	1.79	0.29	16.20	15.91	24.50	7.7
16771	13.30	2.59	0.61	16.50	15.89	25.75	8.1
16656	14.50	2.64	0.22	17.36	17.14	29.45	8.6
16775	15.21	3.04	0.15	18.40	18.25	31.50	8.6
17134	13.57	2.70	0.90	17.17	16.27	28.00	8.6
17451	14.69	2.10	0.05	16.84	16.79	30.00	8.9
17146	14.09	2.21	1.11	17.41	16.30	30.00	9.2
16678	14.99	1.64	1.61	18.24	16.63	31.00	9.3
17186	15.81	3.06	1.19	20.06	18.87	33.00	9.3
17373	11.11	4.94	1.23	17.28	16.05	30.00	9.3
16845	14.11	2.70	0.93	17.74	16.81	33.00	9.8
16657	13.57	3.23	1.01	17.81	16.80	34.75	10.3
17198	13.26	4.01	0.36	17.63	17.27	36.00	10.4
16683	11.97	4.84	0.75	17.56	16.81	36.00	10.7
17576	10.18	4.71	0.67	15.56	14.89	32.00	10.7
17023	12.24	4.40	0.63	17.27	16.64	36.00	10.8
17051	10.00	4.83	0.84	15.67	14.83	33.00	11.1
17019	10.73	4.46	0.87	16.06	15.19	35.50	11.7
16766	11.15	5.04	1.14	17.33	16.19	38.00	11.7
16649	13.18	3.76	0.28	17.22	16.94	.....	....
16650	13.54	3.88	0.31	17.73	17.42	.....	....
16851	14.28	2.39	0.70	17.37	16.67	.....	....
16900	10.14	5.96	1.00	17.10	16.10	.....	....
17332[1]	15.44	0.96	0.12	16.52	16.40	.....	....
17117	.....	....	....	17.33	.....	.....	....
17875	14.27	3.27	0.52	18.06	17.54	24.00	6.9

[1] Old Stock.

16683. Sold by Miller Fertilizer Co., Baltimore, Md. Stock of Ansonia Flour & Grain Co., Ansonia.

17576. Sold by Miller Fertilizer Co., Baltimore, Md. Stock of Laden Bros., Inc., Wallingford.

17023. Sold by American Agricultural Chemical Co., New York. Stock of Frank Upham, Stafford.

17051. Sold by American Agricultural Chemical Co., New York. Stock of Fred Appel, Riverton.

17019. Sold by Coe-Mortimer Co., New York. Stock of Gunther Bros., Rockville.

16657. Sold by Sanderson Fertilizer & Chemical Co., New Haven. Sampled at factory.

16649. Sold by L. T. Frisbie Co., New Haven. Sampled at factory.

16650. Sold by Atlantic Packing Co., New Haven. Sampled at factory.

16851. Sold by Apothecaries Hall Co., Waterbury. Stock of Connecticut School for Boys, Meriden.

16900. Sold by National Fertilizer Co., New York. Stock of F. O. Williams, Silver Lane.

17332.[1] Stock of J. F. Brown, North Stonington.

Sampled by Purchaser:

17117. Stock of Hackett Bros., Buckland.

17875. Sold by L. T. Frisbie Co., New Haven. Stock of Norwich Coöp. Exchange, Norwich.

III. RAW MATERIALS CONTAINING POTASH.

In table IX are given analyses of 9 samples of muriate, 28 of high grade sulphate, 2 of Nebraska potash, and one each of kainit, "vegetable potash" and cotton hull ashes. Six of these failed to meet their guaranties. These were—

		Deficiency per cent.
17410	Eastern States Farmers' Exchange.....	4.75
17231	Providence Farmers' Exchange.....	3.30
16733	L. T. Frisbie Co.	0.40
17210	The Rogers & Hubbard Co.	0.25
16473	Olds & Whipple.....	0.80
16509	.....	3.00

Every sample of potash salts analyzed was tested for borax with negative result.

The average cost per pound of potash as muriate in 5 samples drawn by the Station was 11.3 cents.

The average cost per pound of potash as sulphate in 7 samples drawn in the same way was 11.1 cents.

Muriate of Potash. Sampled by Station Agent.

16848. Sold by Apothecaries Hall Co., Waterbury. Stock of Connecticut School for Boys, Meriden.

16934. Sold by Piedmont-Mt. Airy Guano Co., Baltimore, Md. Stock of Farmers' Exchange, Putnam.

16681. Sold by Berkshire Fertilizer Co., Bridgeport. Sampled at factory.

17410. Sold by Eastern States Farmers' Exchange, Springfield, Mass. Stock of A. R. Carpenter, Bloomfield.

[1] Old stock.

17231. Sold by Providence Farmers' Exchange, Providence, R. I. Stock of Walter Scott, Niantic.

16401. Sold by Apothecaries Hall Co., Waterbury. Stock of Highwood Fruit Growers' Association, Highwood.

16646. Sold by L. T. Frisbie Co., New Haven. Sampled at factory.

17479. Sold by American Agricultural Chemical Co., New York. Stock of J. E. Stoddard, Abington.

Muriate of Potash. Sampled by Purchaser.

15960. Dealer unknown. Sent by S. G. McLean, South Glastonbury.

Sulphate of Potash. Sampled by Station Agent.

17871. Sold by L. T. Frisbie Co., New Haven. Stock of Norwich Cooperative Association.

16061. Sold by L. T. Frisbie Co., New Haven. Stock of A. N. Shepard & Son, Hartford.

16679. Sold by Berkshire Fertilizer Co., Bridgeport. Sampled at factory.

16661. Sold by Olds & Whipple, Hartford. Sampled at factory.

17412. Sold by Eastern States Farmers' Exchange, Springfield, Mass. Stock of C. B. Sikes, Ellington.

17449. Sold by Nitrate Agencies Co., New York. Stock of E. N. Austin, Suffield.

16902. Sold by Olds & Whipple, Hartford. Stock of Haviland Tobacco Co., East Windsor Hill.

16932. Sold by Nitrate Agencies Co., New York. Stock of W. R. Holcomb, Somerville.

16850. Sold by Apothecaries Hall Co., Waterbury. Stock of Connecticut School for Boys, Meriden.

Sulphate of Potash. Sampled by Purchaser.

16555. Sold by Grace & Co., Montreal, Canada. Stock of I. Meyer & Co., Windsor Locks.

16879. Sold by Eastern States Farmers' Exchange, Springfield, Mass. Stock of John M. Herr, Burnside.

16509. Seller unknown. Stock of Conn. Sumatra Tobacco Co., Broad Brook.

15799 to **15811** were sold by G. F. Taylor, New York, and sampled by the Griffin-Neuberger Tobacco Co., North Bloomfield.

16473. Sold by Olds & Whipple, Hartford. Stock of Huntington Bros., Windsor.

16733. Sold by L. T. Frisbie Co., New Haven. Stock of H. Dudek, Talcottville.

16858. Seller unknown. Sent by Department of Agronomy, Connecticut Agricultural College.

TABLE IX. ANALYSES OF POTASH SALTS.

Station No.	Potash. Found.	Potash. Guaranteed.	Cost per ton.	Potash costs cents per pound.
	%	%		
16848	57.04	48.00	$110.00	9.6
16934	49.96	50.00	97.00	9.7
16681	49.96	50.00	100.00	10.0
17410	43.28	48.00	96.00	11.1
17231	44.36	48.00	100.00	11.3
16401	56.60	.....	.....	....
16646	50.24	48.00	.....	....
17479	50.32	48.00	.....	....
15960	56.76	.....	92.00	9.2
17871	50.24	.....	.....	...
16061	49.32	48.00	85.00	8.6
16679	52.36	48.00	110.00	10.5
17449	51.16	47.00	120.00	11.7
16661	53.08	48.00	120.00	11.3
17412	48.16	48.00	110.00	11.4
17449	51.16	47.00	120.00	11.7
16902	49.40	48.65	118.00	11.9
16932	48.80	47.00	125.00	12.8
16850	50.60	48.00	.....	....
16555	50.64	50.32	110.00	10.9
16879	48.68	48.00	110.00	11.3
16509	46.32	49.37	115.00	12.4
15799	49.40	.....	.....	....
15800	49.92	.....	.....	....
15801	49.32	.....	.....	....
15802	49.04	.....	.....	....
15803	50.00	.....	.....	....
15804	50.36	.....	.....	....
15805	50.44	.....	.....	....
15806	49.16	.....	.....	....
15807	49.16	.....	.....	....
15808	50.12	.....	.....	....
15809	49.20	.....	.....	....
15810	50.68	.....	.....	....
15811	50.12	.....	.....	....
16473	49.92	50.73	.....	....
16733	49.56	50.00	.....	....
16858	50.00	.....	.....	....
17332	27.74	27.50	49.00	8.8
16682	37.00	37.00	90.00	12.2
17210	27.24	27.50	42.50	7.8
15479	20.42	.....	.....	...
17572	14.82	15.00	16.30	5.5

Miscellaneous Potash Materials. Sampled by Station Agent.

17332. Nebraska Potash. Sold by Rogers & Hubbard Co., Middletown. Sampled at factory.

16682. Vegetable Potash. Sold by Berkshire Fertilizer Co., Bridgeport. Sampled at factory.

Miscellaneous Potash Materials. Sampled by Purchaser.

17210. Nebraska Potash. Sold by Rogers & Hubbard Co. Stock of F. A. Hamilton, Warehouse Point.

15479. Cotton Hull Ashes. Sold by Olds & Whipple, Hartford. Stock of Windsor Tobacco Growers' Corporation.

17572. Kainit. Sold by Rogers & Hubbard Co., Middletown. Stock of the Lyman Farm, Middlefield.

IV. MATERIALS CONTAINING NITROGEN AND POTASH.

NITRAPO.

16475. Sold by Nitrate Agencies Co., New York. Sent by S. R. MacDonald, Atlantic City, N. J. Found to contain 14.88 per cent. nitrogen and 16.01 per cent. potash.

17270. Sold by Nitrate Agencies Co., New York. Stock of E. N. Austin, Suffield. Found to contain 9.96 per cent. nitrogen and 18.24 per cent. potash; guaranteed 14.80 nitrogen, 15 potash. Sold for $107.00 per ton.

One sample of NitraPo meets its guaranty, the other is far below it in nitrogen.

One sample contained 0.18 per cent. of borax, the other 0.39 per cent.

NitraPo is said to be a by-product in the refining of nitrate of soda and should be an excellent source of both nitrogen and potash, if the amount of borax present is inconsiderable.

NITRATE OF POTASH.

16884. Sent by J. L. Watrous, Middlefield. Found to contain 12.56 per cent. of nitrogen and 42.92 per cent. of potash.

17386. Sold by Witherbee, Sherman & Co., New York. Sampled from stock of M. L. Coleman, Cheshire. Found to contain 12.47 per cent. of nitrogen and 43.40 per cent. of potash.

V. MATERIALS CONTAINING NITROGEN AND PHOSPHORIC ACID.

FISH MANURES.

In table X are analyses of 48 samples, 18 of them taken by the Station agent and 30 by other individuals.

GUARANTIES.

Six samples contained considerably less nitrogen than was guaranteed. They are—

		Per cent. deficiency.
17411	Eastern States Farmers' Exchange	0.58
17581	John Meehan & Son	0.49
16729	John Meehan & Son	0.96
16335	Apothecaries Hall Co.	0.34
17265	Nitrate Agencies Co.	0.42
17448	Nitrate Agencies Co.	0.34

COST.

As with other fertilizer chemicals, the price of fish to the farmer has varied widely. In the samples received here the highest price was $91.00 and the lowest $48.33. The usual fluctuations in the regular market have been increased by "resales," "forced sales," etc.

Allowing 10 cents per unit of bone phosphate, the cost of nitrogen has ranged from 46.3 cents to 24 cents per pound. The average is 38.6 cents.

The fish scrap has been of higher grade than it was last year, the average percentages of nitrogen and phosphoric acid being 9.11 and 7.78 respectively, as against 8.33 and 6.01 last year.

TABLE X. ANALYSES OF

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.
	Sampled by Station Agent:	
16864	American Agricultural Chemical Co....	F. S. Bidwell & Co., Windsor Locks....
17015	Apothecaries Hall Co.....	Sampled at factory.....
16587	Atlantic Packing Co.....	Ellsworth Sperry, East Windsor Hill...
16415	Berkshire Fertilizer Co.....	J. E. Shepard, South Windsor.....
17330	E. D. Chittenden Co.....	Frank Dowd, Ellington.....
17411	Eastern States Farmers' Exchange.....	C. B. Sikes, Ellington.....
16410	L. T. Frisbie Co.....	J. E. Shepard, South Windsor.....
16959	L. T. Frisbie Co.....	A. N. Shepard & Son, Hartford.....
17359	International Agric. Corp.....	Fred Bogli, Glastonbury.....
16844	Lowell Fertilizer Co.....	T. J. Coleman, Warehouse Point.....
17581	John Meehan & Son.....	W. J. Norton, Broad Brook.....
17265	Nitrate Agencies Co.....	J. McAllister, Farmers' Exchange, Cromwell.....
17448	Nitrate Agencies Co.....	E. N. Austin, Suffield.....
16903	Olds & Whipple.....	Haviland Tobacco Co., East Windsor Hill.....
16804	Piedmont-Mt. Airy Guano Co.....	Joseph Adams, Green's Farms.....
17246	Rogers & Hubbard Co.....	Sampled at factory.....
16838	Wilcox Fertilizer Co.....	Spencer Bros., Suffield.....
16809	F. S. Royster Guano Co.....	Geo. S. Phelps & Co., Thompsonville...
	Sampled by Purchaser:	
16049	American Glue Co.....	Griffin-Neuberger Tobacco Co., North Bloomfield.....
16050	American Glue Co.....	Griffin-Neuberger Tobacco Co., North Bloomfield.....
16051	American Glue Co.....	Griffin-Neuberger Tobacco Co., North Bloomfield.....
16052	American Glue Co.....	Griffin-Neuberger Tobacco Co., North Bloomfield.....
16053	American Glue Co.....	Griffin-Neuberger Tobacco Co., North Bloomfield.....
16335	Apothecaries Hall Co.....	C. A. Huntington, Windsor.....
16511	Apothecaries Hall Co.....	Conn. Sumatra Tobacco Co., Buckland
17175	Atlantic Packing Co.....	F. Howard Ensign, East Hartford.....
16227	Atlantic Packing Co.....	Ellsworth Sperry, East Windsor Hill..
16527	Atlantic Packing Co.....	John Leonard, Burnside.....
16877	Eastern States Farmers' Exchange.....	John M. Herr, Burnside.....
16735	L. T. Frisbie Co.....	H. Dudek, Talcottville.....
16729	John Meehan & Son.....	Aaron Dobkin, Ellington.....
16603	John Meehan & Son	J. H. Lynch, Ellington.....
17125	New England Fertilizer Co.....	J. McGrath, East Windsor Hill.....

FISH MANURES.

Nitrogen.				Phosphoric Acid.						
As ammonia.	As organic.	Total found.	Total guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total found.	Total guaranteed.	Cost per ton.	Nitrogen costs cents per pound.[1]
%	%	%	%	%	%	%	%	%		
0.18	8.74	8.92	8.23	0.69	6.03	1.34	8.06	6.00	$81.00	44.4
0.40	8.40	8.80	8.20	1.03	6.04	1.65	8.72	5.50	.....	....
0.24	9.42	9.66	8.22	....	....	....	7.96	6.40	78.00	39.5
0.10	8.04	8.14	8.23	0.54	5.31	1.19	7.04	6.00	77.00	46.3
0.20	9.18	9.38	8.22	....	....	....	7.52	6.00	80.00	41.8
0.13	....	7.64	8.22	....	....	....	5.25	4.58	52.00	33.3
0.17	9.00	9.17	8.24	0.58	6.11	1.61	8.30	6.40	77.00	40.9
0.24	9.28	9.52	8.22	0.57	5.65	1.24	7.46	6.40	87.90	45.3
0.16	7.96	8.12	8.00	....	....	....	3.57	3.70	75.00	45.7
0.20	9.40	9.60	8.22	0.59	5.62	1.24	7.45	6.40	75.00	38.2
....	....	8.61	9.10	....	....	....	7.54	....	63.50	35.9
0.12	7.18	7.80	8.22	0.50	4.10	0.84	5.44	4.57	.....	....
0.12	7.76	7.88	8.22	0.61	4.77	0.68	6.06	4.58	62.00	38.5
0.30	8.66	8.96	8.23	0.79	5.98	0.87	7.64	5.50	70.00	38.1
0.08	8.54	8.62	8.23	0.81	5.39	1.85	8.05	....	51.40	28.8
0.18	8.60	8.78	8.25	0.38	12.09	1.06	13.53	12.50	65.00	35.3
0.16	9.36	9.52	8.24	0.53	6.37	1.27	8.17	5.00	80.00	41.0
0.20	9.04	9.24	8.24	0.62	6.08	1.91	8.61	5.00	87.00	46.0
0.15	8.88	9.03	....	0.57	7.62	1.28	9.47	....	.....	....
0.09	9.86	9.95	....	0.50	6.64	1.05	8.19	....	.....	....
0.89	8.55	9.44	....	1.12	5.92	0.88	7.92	....	.....	....
0.11	10.01	10.12	....	0.51	6.21	1.01	7.73	....	.....	....
0.16	9.42	9.58	....	0.37	6.60	1.22	8.19	....	.....	....
0.10	9.43	9.53	9.87	0.62	4.80	1.54	6.96	5.50	56.55[2]	28.8
....	....	....	9.16	0.70	4.90	2.81	8.41	7.51	52.00	27.7
....	....	9.82	8.22	....	....	....	7.64	6.86	90.99	45.5
0.17	9.18	9.35	9.50	0.50	7.03	0.90	8.43	7.87	78.00	40.7
....	....	9.66	8.22	0.56	5.49	1.38	7.43	6.40	70.00	35.4
....	....	8.40	8.22	....	....	....	5.62	4.58	52.00	....
0.18	9.46	9.64	8.22	0.54	5.18	1.89	7.61	6.40	.....	....
0.48	8.84	9.32	10.28	0.88	5.24	1.39	7.51	....	83.00	43.6
0.42	8.28	8.70	....	0.83	4.54	1.87	7.24	....	82.00	46.2
0.14	8.62	8.76	....	0.54	7.40	0.64	8.58	....	70.00	38.8

[1] Allowing 10c. per unit of bone phosphate.
[2] Cost $4.75 per unit ammonia + $.10 per unit bone phosphate.

TABLE X. ANALYSES OF

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.
	Sampled by Purchaser—(Continued):	
16431	Piedmont-Mt. Airy Guano Co.	American Sumatra Tobacco Co., East Hartford
16557	Piedmont-Mt. Airy Guano Co.	I. Meyer & Co., Windsor Locks
17209	Rogers & Hubbard Co.	F. A. Hamilton, Warehouse Point
15793	Wilcox Fertilizer Co.	Griffin-Neuberger Tobacco Co., North Bloomfield
15794	Wilcox Fertilizer Co.	Griffin-Neuberger Tobacco Co., North Bloomfield
15795	Wilcox Fertilizer Co.	Griffin-Neuberger Tobacco Co., North Bloomfield
15927	Wilcox Fertilizer Co.	Griffin-Neuberger Tobacco Co., North Bloomfield
16432	Wilcox Fertilizer Co.	American Sumatra Tobacco Co., East Hartford
16433	Wilcox Fertilizer Co.	American Sumatra Tobacco Co., East Hartford
16400	Unknown	L. Wetstone, Hartford
16501	Unknown	Farnham Tobacco Corp., Hartford
16502	Unknown	Farnham Tobacco Corp., Hartford
16513	Unknown	Conn. Sumatra Tobacco Co., Buckland
16520	Unknown	Conn. Sumatra Tobacco Co., Buckland
17116	Unknown	Hackett Bros., Buckland

SLAUGHTER HOUSE TANKAGE.

Analyses of 20 samples appear in table XI.

The mechanical analyses show that some of these tankages are very coarse and, therefore, not so readily available to crops as they would be if more finely ground.

FISH MANURES—(*Concluded*).

Nitrogen.				Phosphoric Acid.						
As ammonia.	As organic.	Total found.	Total guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total found.	Total guaranteed.	Cost per ton.	Nitrogen costs cents per pound.[1]
%	%	%	%	%	%	%	%	%		
0.12	9.32	9.44	....	0.31	6.86	1.41	8.58	....	.....	....
0.14	9.34	9.48	9.60	0.58	6.52	1.61	8.71	7.56	$48.33	24.0
....	....	8.66	8.00	....	....	....	12.49	11.00	60.00	33.0
0.82	8.06	8.88	....	1.34	4.71	0.79	6.84	....	.....	....
0.72	7.66	8.38	....	0.82	5.32	0.86	7.00	....	.....	....
1.23	7.85	9.08	....	1.54	4.83	0.51	6.88	....	.....	....
0.11	9.52	9.63	....	0.55	6.41	0.74	7.70	....	.....	....
0.82	8.52	9.34	....	1.10	4.87	0.67	6.64	....	.....	....
0.94	8.34	9.28	....	1.04	4.85	0.92	6.81	....	.....	....
0.20	9.66	9.86	....	0.58	6.05	1.78	8.41	....	.....	....
0.16	9.40	9.56	8.22	0.32	6.72	1.60	8.64	6.86	.....	....
0.18	9.40	9.58	8.22	0.44	6.46	1.56	8.46	6.86	.....	....
0.36	8.80	9.16	9.16	0.58	6.38	1.68	8.64	7.54	.....	....
0.12	9.30	9.42	9.16	0.51	4.81	1.36	6.68	7.54	.....	....
0.10	9.28	9.38	....	0.59	7.15	0.97	8.71	....	.....	....

[1] Allowing 10c. per unit of bone phosphate.

Tankage is a general name used for any dried animal refuse and it varies greatly in composition and fertilizing value, which depend on the kind of refuse used and the process of rendering it. Thus, in these samples nitrogen ranges from 3½ to 8 per cent. and phosphoric acid from 5 to 23¼ per cent. It is, therefore, not possible, as in the case of most other raw materials, to make a statement of average composition.

Garbage Tankage **17719**, sent by J. A. Martin, Wallingford, contained 2.31 per cent. of nitrogen and 3.26 per cent. of phosphoric acid. Its commerical value was requested by the sender. The nitrogen of such material is not very available, though its solubility varies a good deal with the variations in the quality of the garbage. Neither the nitrogen nor the phosphoric acid of garbage can be worth more than half as much as they are in nitrate

TABLE XI. ANALYSES OF

Station No.	Manufacturer.	Dealer or Purchaser.
	Sampled by Station Agent:	
17458	American Agricultural Chemical Co.	L. F. Burr, Branford
16847	Apothecaries Hall Co	Conn. School for Boys, Meriden
17468	Atlantic Packing Co	Sampled at factory
17585	Berkshire Fertilizer Co	Sampled at factory
16643	Conn. Fat Rendering & Fertilizer Co.	Sampled at factory
17413	Eastern States Farmers' Exchange	West Woods Farmers' Cooperative Assn., Mt. Carmel
16644	L. T. Frisbie Co	Sampled at factory
16645	L. T. Frisbie Co	Sampled at factory
16966	L. T. Frisbie Co	C. E. Lyman, Middlefield
17478	Lowell Fertilizer Co	M. E. Cook, Wallingford
17226	Piedmont-Mt. Airy Guano Co	Minor Ives, South Meriden
17579	P. J. O'Donnell & Son	Burr Nurseries, Manchester
	Sampled by Purchaser:	
16742	Apothecaries Hall Co	H. S. Coe, Waterbury
17305	Conn. Fat Rendering Co	C. Lewis Alling, West Haven
16908	L. T. Frisbie Co	A. E. Plant's Sons Co., Branford
16909	L. T. Frisbie Co	A. E. Plant's Sons Co., Branford
16403	Middlesex Fertilizer Co	A. N. Pierson, Inc., Cromwell
16717	Middlesex Fertilizer Co	A. N. Pierson, Inc., Cromwell
16718	Middlesex Fertilizer Co	A. N. Pierson, Inc., Cromwell
16296	Wilson Co	S. D. Woodruff & Sons, Orange

of soda and acid phosphate. We consider that twelve cents for nitrogen and five for phosphoric acid per pound would be the upper limit for their valuation in this material.

BONE MANURES.

Thirty-three samples of these manures have been analyzed this year.

Six samples failed to meet their nitrogen guaranty and two failed in phosphoric acid, but in every case the deficiency in one ingredient was more than met in money value by the overrun in the other.

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.
%	%	%	%	%	%	%	%	
0.41	5.35	5.76	4.94	17.33	13.73	58.00	42.00	$45.00
0.50	5.50	6.00	5.82	13.13	15.00	40.00	60.00	.....
0.18	5.06	5.24	4.10	15.98	14.00	18.00	82.00	.....
0.09	6.37	6.46	6.17	11.45	10.00	55.00	45.00	.....
0.10	3.34	3.44	3.20	23.24	22.00	64.00	36.00	50.00
0.23	6.15	6.38	5.75	5.18	6.86	34.00	66.00	.....
0.20	7.28	7.48	7.40	12.19	6.40	26.00	74.00	.....
0.10	5.04	5.14	4.10	16.23	14.00	16.00	84.00	.....
0.18	4.94	5.12	4.10	16.30	14.00	20.00	80.00	30.00
0.28	....	5.14	4.82	14.10	14.00	35.00	65.00	53.00
0.44	6.17	6.61	6.58	5.86	.....	30.00	70.00	45.00
....	....	5.04	4.94	18.15	18.00	62.00	38.00	40.00
0.16	7.90	8.06	5.76	8.42	15.00	60.00	40.00	50.00
0.02	3.76	3.78	....	21.93	.....	60.00	40.00	.....
0.18	4.06	4.24	4.10	16.41	14.00	20.00	80.00	45.00
0.24	7.32	7.56	7.41	11.88	6.40	30.00	70.00	55.00
0.03	6.03	6.06	....	13.16	.....	.....	.....	40.00
....	....	8.10	6.06	9.33	13.16	.....	.....	40.00
....	....	5.96	6.06	15.61	13.16	.....	.....	40.00
0.26	....	7.95	7.58	7.29	8.81	56.00	44.00	.....

As a rule the bone manures are in finer mechanical state than are tankages, only 9 of the 32 having less than half their weight coarser than 1/50 inch. Specially fine is Rogers & Hubbard's Pure Raw Knuckle Bone Flour, in which 97 per cent. is finer than 1/50 inch.

In the samples examined the average percentages of nitrogen and phosphoric acid are 2.95 and 24.35 respectively and the average cost of 26 samples is $56.44.

TABLE XII. ANALYSES OF

BONE MANURES.

Station No.	Manufacturer and Brand.	Dealer or Purchaser	Nitrogen. Found.	Nitrogen. Guaranteed.	Phosphoric Acid. Found.	Phosphoric Acid. Guaranteed.	Mechanical analysis. Finer than 1-50 inch.	Mechanical analysis. Coarser than 1-50 inch.	Cost per ton.
	Sampled by Station Agent:		%	%	%	%	%	%	
17000	Am. Agr. Chem. Co., Special Ground Bone	J. E. Stoddard, Abington	2.17	2.06	29.55	28.00	62.00	38.00	$57.00
17430	Am. Agr. Chem. Co., Fine Ground Bone	F. S. Bidwell & Co., Windsor Locks	2.60	2.47	26.38	22.88	53.00	47.00	56.00
17439	Am. Agr. Chem. Co. of N. J., Listers Bone Meal	S. J. Orr, West Suffield	3.22	2.47	23.28	22.88	66.00	34.00	50.00
17440	Apothecaries Hall Co., Pure Bone Meal	Sampled at factory	3.84	3.29	24.56	20.00	40.00	60.00	50.00
16412	Berkshire Fertz. Co., Fine Ground Bone	J. E. Shepard, South Windsor	2.70	2.50	27.07	20.00	54.00	46.00	46.00
17433	Bowker Fertz. Co., Fresh Ground Bone	Goodsell Bros., Bristol	2.72	2.47	23.62	22.88	64.00	36.00	60.00
17437	Coe-Mortimer Co., Inc., Fine Ground Bone	Morrison & Dunham, Bethel	2.54	2.47	24.36	22.88	57.00	43.00	58.00
17445	East' States Farmers' Exch., Ground Bone	C. B. Sikes, Ellington	3.46	2.47	21.57	22.88	56.00	44.00	51.00
17434	Essex Fertz. Co., Ground Bone	A. R. Brewer & Co., Hartford	2.34	2.05	28.32	26.00	64.00	36.00	50.75
17431	L. T. Frisbie Co., Bone Meal	Stamford Mason Supply Co., Stamford	3.28	2.46	25.46	20.00	52.00	48.00	56.00
17436	International Agr. Corp., Bone Meal	Newcomb & Barber, Litchfield	2.62	2.50	22.44	22.00	53.00	47.00	58.00
17147	Lowell Fertz. Co., Ground Bone	John O. Fox & Co., Putnam	2.08	2.05	28.18	20.00	62.00	38.00	60.00
17438	Mapes Formula & Peruvian Guano Co., Pure Ground Bone	R. E. Morgan & Co., Windsor	3.90	2.47	25.00	20.00	33.00	67.00	45.00
16958	Meech & Stoddard, Inc., Fine Ground Bone	A. N. Shepard & Son. Hartford	4.12	3.70	22.64	12.00	42.00	58.00	50.00
16940	Piedmont-Mt. Airy Guano Co., Bone Meal	F. L. Davis, Farmers' Exch., Putnam	3.56	2.47	21.31	22.90	42.00	58.00	48.00
17429	Rogers & Hubbard Co., Pure Raw Knuckle Bone Flour	Cadwell & Jones, Hartford	3.88	3.82	26.28	24.70	97.00	3.00	88.00
17435	Rogers & Hubbard Co., "Bone Base" Strictly Pure Fine Bone	Tuttle Brick Co., Newfield	3.10	3.29	24.74	20.59	55.00	45.00	60.00
17432	F. S. Royster Guano Co., Fine Ground Bone Meal	Plumb Bros. Co., Waterbury	3.12	2.47	26.56	22.88	45.00	55.00	.....
17444	Sanderson Fertz. & Chem. Co., Fine Ground Bone	G. R. Stannard, Branford	3.24	2.47	24.69	22.88	48.00	52.00	59.00
17442	M. L. Shoemaker & Co., Swift-Sure Bone Meal	Olds & Whipple, Hartford	4.62	4.53	24.69	20.00	73.00	27.00	71.25
17450	Springfield Rendering Co., Ground Bone	E. N. Austin, Suffield	1.80	2.47	29.81	23.00	75.00	25.00	55.00
17583	Springfield Rendering Co., Ground Bone.	Henry Adams, Suffield	1.56	2.47	30.44	23.00	69.00	31.00	50.00
17453	Van Iderstine Co., Pure Ground Bone	McArdle Seed Store, Greenwich	1.62	2.00	30.32	27.00	65.00	35.00	60.00
17443	Virginia-Carolina Chem. Co., Bone Meal.	F. T. Blish Hardware Co., South Manchester	2.64	2.47	25.87	22.00	53.00	47.00	53.50
	Sampled by Purchaser:								
16731	L. T. Frisbie Co., Steam Ground Bone	H. Dudek, Talcottville	2.30	2.47	28.55	22.88	40.00	60.00	.....
15886	Godfrey Fertilizer & Chemical Co., Pure Bone Meal	A. N. Pierson, Inc., Cromwell	2.68	.....	24.33	.....	63.00	37.00	65.60
16556	Products Mfg. Co., Ground Bone	I. Meyer & Co., Windsor Locks	3.29	3.73	22.20	19.12	70.00	30.00	35.00
15818	Unknown	Frank J. Beach, Woodmont	3.67	.....	25.94	.....	.....	.....	.....
16503	Unknown	Farnham Tobacco Corp., Hartford	2.63	2.47	27.38	22.88	45.00	55.00	77.00
16521	Unknown	Conn. Sumatra Tob. Co., Buckland	3.52	3.29	20.88	18.30	32.00	68.00	.....
17091	Unknown	S. B. Hoyt, Inc., New Canaan	2.24	.....	12.59	.....	50.00	50.00	.....
15412	M. L. Shoemaker & Co., Unground Bone	Sent by Manufacturer	3.28	.....	.....	.....	.....	.....	.....
17112	Unknown	Hackett Bros., Buckland	3.86	.....	23.21	.....	.....	.....	.....

MIXED BONE AND TANKAGE.

17466. Listers Celebrated Ground Bone and Tankage Acidulated, made by American Agricultural Chemical Co. of New Jersey. Stock of J. F. Brown, North Stonington; cost $64.00 per ton.

17014. Bone and Meat Tankage sold by Apothecaries Hall Co., Waterbury. Sampled at factory.

17441. Made by the Connecticut Fat Rendering Co., New Haven. Sold by Apothecaries Hall Co., Waterbury. Sent by Louis Warncke & Son, Cannondale; cost $58.00.

ANALYSES OF MIXED BONE AND TANKAGE.

Station No.	17466	17014	17441
Percentage of			
Nitrogen in ammonia	0.38	0.22	....
Total nitrogen found	3.04	2.92	3.00
Total nitrogen guaranteed	2.67	3.29	3.29
Total phosphoric acid found	12.92	23.26	26.43
Total phosphoric acid guaranteed	12.00	20.00	20.00

VI. MIXED FERTILIZERS.

MIXED FERTILIZERS CONTAINING PHOSPHATES AND POTASH.

17002. American Agl. Chem. Co.'s Bone Phosphate and Potash. Stock of Frank Upham, Stafford.

17049. American Agl. Chem. Co.'s Grass and Oats Fertilizer. Stock of N. A. Johnson, Forestville.

16794. Armour's Big Crop Fertilizer. Stock of Lightbourn & Pond, New Haven.

17192. Armour's Big Crop Fertilizer. Stock of Lightbourn & Pond, New Haven.

17355. International Agricultural Corporation's Buffalo Phosphate and Potash. Stock of J. S. Dewey, Tariffville.

17378. International Agricultural Corporation's Buffalo Ten-Eight. Stock of Edward Bidwell, Glastonbury.

17237. Olds & Whipple's Bone Phosphate and Potash Compound. Stock of Fred Gerber, Ellington.

17145. Va.-Carolina Chemical Co.'s V. C. Comet Brand. Stock of E. O. Chapman, North Haven.

ANALYSES

Station No.	17002	17049	16794	17192	17355	17378	17237	17145
	%	%	%	%	%	%	%	%
Water-soluble phosphoric acid	6.64	7.76	7.95	7.82	4.32	4.66	1.13	8.83
Citrate-soluble phosphoric acid	5.54	4.46	1.69	1.89	7.11	5.82	3.61	1.80
Citrate-insoluble phosphoric acid	0.40	0.65	0.27	0.27	0.86	0.83	0.19	0.58

Total phosphoric acid found	12.58	12.87	9.91	9.98	12.29	11.31	4.93	11.21
Total phosphoric acid guaranteed	13.00	13.00	10.50	10.50	11.00	11.00	4.00	11.00
"Available" phosphoric acid found	12.18	12.22	9.64	9.71	11.43	10.48	4.74	10.63
"Available" phosphoric acid guaranteed	12.00	12.00	10.00	10.00	10.00	10.00	4.00	10.00
Potash as muriate	2.92	2.08	5.47	5.18	1.52	7.62	....	7.38
Total potash found	2.92	2.08	5.47	5.18	5.07	8.60	16.16	7.38
Total potash guaranteed	2.00	2.00	5.00	5.00	4.00	8.00	15.00	8.00
Price per ton	$46.00	$45.00	$55.00	$55.00	$48.00	$59.75	$73.00	$54.50

A sample labeled "Potash," **16968**, sent by E. S. Seymour, Suffield, and stated to have been bought of Olds & Whipple, Hartford, for $66.30 per ton, contained 5.94 per cent. of phosphoric acid and 14.60 per cent. of potash. This has the composition of O. & W's Phosphate and Potash Compound.

NITROGENOUS SUPERPHOSPHATES WITHOUT POTASH.

Thirty-eight samples of this class have been analyzed with the results given in Table XIII.

Of these **17251** was sent by G. A. Peckham, Suffield, stated to be Rogers & Hubbard's Soluble Corn & General Crop. This is not representative of any brand as we have been advised that it was bought several years ago and probably its composition has changed during storage.

DIFFERENCES IN GRADE AND COST OF NITROGEN.

Of the samples examined, 6 we class as low grade containing less than 2.5 per cent. of nitrogen, 13 we class as of medium grade having from 2.5 to 4.11 per cent., and 10 we class as high grade containing more than 4.11 per cent. of nitrogen.

From the quoted cash prices it appears that allowing ten cents per pound for available phosphoric acid the average cost of nitrogen in the low grade goods here reported was sixty-eight cents per pound, in the medium grade fifty cents and in the high grade fifty-six and six tenths cents per pound. It will be noted that all of these high grade goods were tobacco manures, probably most of them compounded with cotton seed meal.

This emphasizes the fact which we always urge that the buyer cannot afford to use low grade goods. Manufacturers are reducing the number of low grade fertilizers which they offer, and buyers should always give the preference to medium or high grade goods.

GUARANTIES.

Six of the brands failed to meet their nitrogen guaranties by more than one-tenth per cent., but in all but one case the money value of the nitrogen deficiency was more than made good by an overrun in the amount of phosphoric acid.

TABLE XIII. NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.	Nitrogen.	
				In nitrates.	In ammonia.
	Sampled by Station Agent:				
	American Agricultural Chem. Co., New York City.			%	%
17452	Tobacco Special	Portland	$63.00	0.92	0.12
	Apothecaries Hall Co., Waterbury.				
17301	Liberty Market Gardeners' Special.	Wapping	35.00	0.16	2.08
17315	Liberty Tobacco Special	Wapping	67.00	0.46	0.68
	Atlantic Packing Co., New Haven.				
17295	Atlantic 5–8	Prospect	54.00	1.52	1.06
	Berkshire Fertilizer Co., Bridgeport.				
16695	Long Island Special	Milford	48.35	1.80	0.28
17307	Tobacco Grower	Suffield	.....	1.42	0.14
16869	Tobacco Starter	Suffield	70.00	2.02	0.82
	Bowker Fertilizer Co., New York.				
17328	Superphosphate with Ammonia 4%	Avon	58.00	0.58	1.37
17312	Tobacco Grower	Avon	68.00	0.92	0.14
	E. D. Chittenden Co., Bridgeport.				
17020	Complete Tobacco & Onion Grower without Potash	Ellington	53.50	1.82	0.92
17331	Tobacco Special without Potash	Suffield	62.00	0.78	0.48
16802	Vegetable & Onion Grower without Potash	Green's Farms	48.00	0.54	1.38
	Everett B. Clark Seed Co., Milford.				
16810	Special Mixture for General Use	Milford	45.00	0.20	2.00
	L. T. Frisbie Co., New Haven.				
17348	2–10	New Britain	49.00	0.70	0.04
17352	4–10	Clintonville	48.00	1.74	0.06
17351	5–8	Buckland	48.00	1.39	1.16
	International Agricultural Corp., Boston, Mass.				
17356	Buffalo Onion Special	Tariffville	55.00	1.10	0.25
16928	Buffalo Tobacco Grower	Glastonbury	66.75	0.75	1.21
17357	Buffalo Tobacco Special	West Suffield	60.00	0.78	0.63
17286	Buffalo Top Dresser and Starter	Tariffville	74.00	2.93	0.24
	Lowell Fertilizer Co., Boston, Mass.				
17485	4–10	New Haven	.....	0.18	1.64
16922	5–8 for Grass, Grain and Vegetables	Warehouse Point.	60.00	0.96	1.00

WITHOUT POTASH.

Nitrogen.				Phosphoric Acid.							Station No.
Organic, water-soluble.	Organic, water-insoluble.	Total.		Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.		So-called "Available."		
		Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	
%	%	%	%	%	%	%	%	%	%	%	
0.13	3.35	4.52	4.11	2.02	3.95	0.20	6.17	5.00	5.97	4.00	17452
0.06	0.94	3.24	3.29	8.08	2.26	0.78	11.12	11.00	10.34	10.00	17301
none	3.30	4.44	4.11	0.88	3.17	0.26	4.31	5.00	4.05	4.00	17315
0.41	1.25	4.24	4.10	3.78	5.46	1.07	10.31	9.00	9.24	8.00	17295
0.32	1.26	3.66	3.30	3.29	4.83	0.90	9.02	9.00	8.12	8.00	16695
0.18	2.58	4.32	4.11	0.81	4.97	0.22	6.00	4.00	5.78	4.00	17307
0.11	1.95	4.90	5.00	2.06	2.87	0.28	5.21	5.00	4.93	4.00	16869
0.47	0.75	3.17	3.29	7.44	3.40	0.79	11.63	11.00	10.84	10.00	17328
0.31	3.57	4.94	4.11	2.22	3.36	0.20	5.78	5.00	5.58	4.00	17312
none	0.62	3.36	3.29	7.40	2.81	1.10	11.31	11.00	10.21	10.00	17020
0.06	2.82	4.14	4.12	2.00	2.76	0.75	5.51	5.00	4.76	4.00	17331
0.08	0.47	2.47	2.47	8.41	2.10	0.47	10.98	11.00	10.51	10.00	16802
0.02	1.34	3.56	3.29	8.70	2.62	1.92	13.24	10.50	11.32	10.00	16810
0.30	0.86	1.90	1.64	7.03	4.18	0.51	11.72	11.00	11.21	10.00	17348
0.32	1.18	3.30	3.28	7.02	4.57	0.46	12.05	11.00	11.59	10.00	17352
0.39	1.30	4.24	4.10	2.92	5.95	0.90	9.77	9.00	8.87	8.00	17351
0.55	0.54	2.44	2.50	5.32	5.57	2.03	12.92	11.00	10.89	10.00	17356
0.08	2.10	4.14	4.10	2.04	2.54	0.35	4.93	5.00	4.58	4.00	16928
0.06	1.87	3.34	3.30	1.69	2.35	0.26	4.30	4.00	4.04	3.00	17357
0.16	2.65	5.98	5.80	3.42	3.44	0.87	7.73	7.00	6.86	6.00	17286
0.48	1.44	3.74	3.28	7.97	3.92	0.52	12.41	11.00	11.89	10.00	17485
0.70	1.00	3.66	4.10	3.91	4.05	0.51	8.47	9.00	7.96	8.00	16922

TABLE XIII. NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.	Nitrogen. In nitrates.	Nitrogen. In ammonia.
	National Fertilizer Co., New York.			%	%
17268	5-4 Tobacco Manure	Windsorville	.....	0.22	0.84
17267	Nitrogen Phosphate Mixture No. 2	Melrose	44.00	0.60	0.48
16923	Nitrogen Phosphate Mixture No. 4	Silver Lane	.....	0.56	1.12
	New England Fertilizer Co., Boston, Mass.				
17271	5-6	East Granby	.....	1.06	0.12
	Olds & Whipple, Hartford.				
17242	High Grade Tobacco Starter	Pine Meadow	.....	3.40	0.22
17238	Special Grass Fertilizer	Ellington	.....	2.88	0.08
17233	Tobacco Special Fertilizer	Glastonbury	$66.00	1.00	0.10
	Providence Farmers' Exchange, Inc., Providence, R. I.				
17132	Exchange Brand 4-10	Waterbury	.....	0.36	2.00
	F. S. Royster Guano Co., Baltimore, Md.				
17194	Landmark	Waterbury	57.00	0.10	1.74
17110	Prime Fish Brand	Shelton	44.00	0.10	0.92
	Sanderson Fertilizer & Chem. Co., New Haven.				
16836	High Grade Ammoniated Phosphate	Wethersfield	54.25	0.94	1.18
17227	Phosphate without Potash	New Canaan	50.00	0.36	0.62
17395	Tobacco Grower	Warehouse Point.	63.00	0.80	0.09
	M. L. Shoemaker & Co., Philadelphia, Pa.				
16743	Swift-Sure Superphosphate Tobacco Starter	Hartford	58.90	0.90	0.10
17190	Swift-Sure Superphosphate Tobacco Starter	Suffield	62.00	1.08	0.10
	Sampled by Purchaser:				
17251*	Rogers & Hubbard's Soluble Corn & General Crop	Suffield: G. A. Peckham	.....	....	....
17161	Shoemaker's Swift-Sure Phosphate	Hartford	58.90	....	....
17177	Shoemaker's Swift-Sure	Granby	57.00	....	....

See note on page 73.

In **16922** Lowell Fertilizer Company's 5-8 for Grass, Grain and Vegetables, there was a nitrogen deficiency of 0.44%, which valued at thirty cents a pound would make a deficiency of $2.64 per ton.

WITHOUT POTASH—(*Concluded*).

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.
%	%	%	%	%	%	%	%	%	%	%	
0.05	3.21	4.32	4.11	1.50	4.11	0.17	5.78	5.00	5.61	4.00	17268
0.01	0.61	1.70	1.65	6.17	4.88	1.15	12.20	11.00	11.05	10.00	17267
0.10	1.66	3.44	3.29	7.54	2.79	1.29	11.62	11.00	10.33	10.00	16923
0.31	2.29	3.78	4.10	4.29	2.76	0.28	7.33	7.00	7.05	6.00	17271
0.30	4.70	8.62	8.23	2.63	1.80	0.29	4.72	3.00	4.43	3.00	17242
0.16	1.72	4.84	4.95	6.36	3.14	0.20	9.70	8.00	9.50	8.00	17238
none	3.19	4.29	4.11	2.16	3.17	0.17	5.50	4.00	5.33	4.00	17233
0.20	0.78	3.34	3.29	8.22	2.24	0.68	11.14	10.50	10.46	10.00	17132
0.06	1.28	3.18	3.29	7.82	2.43	0.56	10.81	10.50	10.25	10.00	17194
none	0.68	1.70	1.65	5.86	2.20	0.17	8.23	8.50	8.06	8.00	17110
0.13	0.85	3.10	3.29	7.68	3.77	1.24	12.69	11.00	11.45	10.00	16836
0.14	0.68	1.80	1.65	6.17	4.81	1.37	12.35	11.00	10.98	10.00	17227
0.04	3.13	4.06	4.11	1.80	3.93	0.33	6.06	5.00	5.73	4.00	17395
0.81	2.01	3.82	3.30	5.54	4.39	2.16	12.09	12.00	9.93	10.00	16743
0.83	1.83	3.84	3.30	8.04	3.65	1.92	13.61	12.00	11.69	10.00	17190
....	....	1.16	2.50	....	....	....	5.16	12.00	.....	.....	17251
....	....	3.76	3.30	....	....	0.90	11.91	12.00	11.01	10.00	17161
....	....	3.22	3.30	....	....	....	13.29	12.00	.....	.....	17177

QUALITY OF THE NITROGEN.

In none of the samples was the availability of the organic nitrogen found to be decidedly poor.

NITROGENOUS SUPERPHOSPHATES CONTAINING POTASH.

In Table XIV are given analyses of 286 samples of this class of fertilizers with the cash ton prices quoted by the firms from whose stock the samples were drawn. There are also given 22 analyses of samples sent by purchasers.

Guaranties.

One hundred and thirty-one of the brands (45 per cent. of the whole number) did not fully meet their guaranty in all respects. Ninety-eight were deficient in one ingredient, thirty-one in two, and two in three ingredients.

In all but twenty-eight cases however the deficiency in one was more than made up in money value by an overrun in the other ingredients.

The following did not make up the money deficiency, if, as seems fair, nitrogen is reckoned at forty cents, available phosphoric acid at ten cents and potash at eleven cents per pound respectively.

Number.	Name.	Deficiency.
17084	Bradley's Northland Potash Grower	$ 1.07
16992	A. A. C. Co.'s Quinnipiac Potato	1.64
17326	Bowker's Maryland Truck Garden Fertilizer	1.48
17417	Eastern States 4-8-7	3.37
17335	Essex Fertilizer Co.'s Fish Fertilizer 3-8-3	1.98
17082	Frisbie's Market Garden Fertilizer	1.60
17260	Frisbie's Market Garden Fertilizer	1.14
17371	Lowell's 5-8-0 Vegetable	4.40
16920	Lowell's Animal Brand	2.41
17537	Lowell's Animal Brand	3.36
17369	Lowell's Bone Fertilizer 2-8-2	2.87
16813	Lowell's Empress Brand	2.51
17149	Miller Fertilizer Co. 5-8-7	2.48
16752	Miller Fertilizer Co. No. 1 Potato and Vegetable	2.62
16685	Miller Fertilizer Co. Standard Phosphate	1.93
17266	New England Fertilizer Co.'s 3-8-3	3.22
17071	New England Fertilizer Co.'s 4-8-6	2.25
16939	Piedmont-Mt. Airy Co.'s Brown's 5-8-7	13.50
16967	Piedmont-Mt. Airy Co.'s Brown's Fish, Bone and Potash	3.74
16933	Piedmont-Mt. Airy Co.'s Brown's Market Garden	3.92
19635	Piedmont-Mt. Airy Co.'s Brown's Top Dresser	10.43
16803	Piedmont-Mt. Airy Co.'s Brown's Potato Phosphate	3.15
17185	Piedmont-Mt. Airy Co.'s Brown's Potato Phosphate	5.10
16936	Piedmont-Mt. Airy Co.'s Brown's Home Mixture	4.80
17197	F. S. Royster Co.'s Trucker's Delight	1.43
17087	F. S. Royster Co.'s Quality Trucker	2.75
17106	Shay's Special Fertilizer 3-8-3	2.54
17148	Worcester Rendering Co.'s Corn and Grain Fertilizer	2.04

Of thirteen brands of the Lowell Fertilizer Co. five were deficient in money value. All of the three Miller Fertilizer Co.'s brands were thus deficient, and seven out of the "Brown" brands made by the Piedmont-Mt. Airy Co. were likewise deficient.

Composition and Nitrogen Cost.

Of two hundred and eighty brands

28 have a guarantee of 0.82 per cent. nitrogen
57 " " " " 1.65 " " "
65 " " " " 2.47 " " "
57 " " " " 3.29 " " "
60 " " " " 4.11 " " "
13 have a still higher nitrogen guaranty.

It is gratifying to note the relatively small number of brands in the State which have a low nitrogen content.

As nitrogen in organic forms costs at present about four times as much as available phosphoric acid or potash its cost is of special importance to purchasers.

The relative cost in brands of different grades is shown in the following statement.

Phosphoric acid is reckoned at ten cents and potash at eleven cents per pound respectively (which has been about their average price in raw materials) and the sum of these values is subtracted from the average cost of the fertilizer. This remainder divided by the number of pounds of nitrogen gives the cost per pound of nitrogen—plus the costs of manufacture and sale. As these are not very different for the different grades of goods, the nitrogen cost per pound shows fairly its relative difference in these different grades.

Such a comparison is as follows:

Formulas.	Number of brands.	Average Cost per ton.	Nitrogen costs per lb.	Average.
.82-8-2	11	$46.11	$0.96	$1.18
.82-10-2	5	47.80	1.41	
1.65-8-2	30	50.08	0.90	.79
1.65-8-3	17	52.18	0.68	
2.47-8-3	13	53.70	0.63	.71
2.47-8-4	20	58.83	0.69	
2.47-8-6	5	69.95	0.82	
3.29-8-4	24	61.55	0.56	.55
3.29-8-6	10	64.03	0.54	
4.11-4-3	10	73.23	0.71	.70
4.11-4-4	4	74.38	0.70	
4.11-4-5	10	74.25	0.68	

It appears that the average cost of nitrogen has been lowest in the 3.29 grade and about half of what it has been in the low (0.82 per cent.) grade. The 4.11 grade consists chiefly of special tobacco fertilizers with cotton seed meal as the chief nitrogen base.

Superphosphates costing about $65 were more economical than the low grade costing about $47.

The National Fertilizer Association, composed of manufacturers of fertilizers, has urged its members to make and offer for sale fertilizers with high analysis. The Association points out that this is in the interest of both buyer and seller, since the costs of manufacture and sale are the same in both high-analysis and low-analysis goods and therefore the overhead expense per unit of plant food is less in the former than in the latter.

Quality of the Water-Insoluble Nitrogen.

The distribution of water-insoluble organic nitrogen into so-called active and inactive fractions is effected by means of two methods, both of which are based upon the action of permanganate of potash on the insoluble organic nitrogen, the one in alkaline solution, the other in neutral solution. The results obtained are taken as an index of the quality of the insoluble organic nitrogenous material. Thus if less than 50 per cent. is found to be "active" when the alkaline method is applied, or less than 80 per cent. when the neutral method is used, the substance and quality of the organic nitrogen present is regarded as inferior. That the so-called "active" insoluble nitrogen is available as plant food is substantiated by vegetation tests. The operation of these methods in inspection and commercial laboratories is reasonably uniform but the construction placed upon the results obtained varies considerably in practice. Thus, in some cases, quality is judged in connection with the proportion which the insoluble organic nitrogen bears to the total nitrogen present, and again, it has been suggested that the water-soluble organic nitrogen and the active insoluble portion should be reckoned together after the manner of expressing so-called available phosphoric acid. It has been our practice to judge the insoluble organic nitrogen on the basis of quality as contemplated by the authors of the methods, recognizing, however, that the distribution of small amounts (.3 per cent. or less) of insoluble nitrogen may lead to conclusions that are without practical significance, and further, that no criticism should attach to goods in which the total nitrogen found exceeds that guaranteed by an amount which equals or closely approximates the inactive insoluble organic nitrogen. It is clearly desirable, however, that some uniform method of expressing conclusions be arrived at to the advantage alike of the purchaser, the analyst and the manufacturer.

The following brands contained insoluble organic nitrogen, less than 50 per cent. of which was found to be "active" by the alkaline method and substantially less than 80 per cent. by the neutral method.

Solubility of Nitrogen.

		Total Nitrogen		Water-insol. organic nitrogen.	"Active" by alkaline method.	"Active" by neutral method.
		Guaranteed.	Found.			
16701	Quinnipiac Potato Phosphate	1.65	1.54	0.48	49	69
16752	Miller No. 1 Potato and Vegetable Grower	3.30	2.96	0.70	38	67
17578	Miller Standard Phosphate	2.47	2.24	0.42	44	63
17149	Miller 5-8-7	4.12	3.82	0.64	37	66
17323	Chittenden Vegetable and Onion Grower, 3% Potash	2.47	2.34	0.75	43	46
16802	Chittenden Vegetable and Onion Grower without Potash	2.47	2.47	0.47	47	48
17281	Listers Tobacco Fertilizer	1.65	1.59	0.40	39	57
17416	Eastern States 3-8-4	2.46	2.48	0.62	45	63

HOME MIXTURES.

These include mixtures made by individuals from raw materials delivered to them or mixtures made for them by manufacturers from materials and formulas prescribed by the purchaser.

In Table XV are given analyses of 15 samples with the statements of the amounts of the several raw materials used in the mixture.

Table XVI includes 16 samples of which the formulas were not reported to the Station.

In general these home mixtures contain a higher average percentage of nitrogen than the average of factory-mixed goods. They are distinctly higher grade and indicate possibly a conviction that on our light soils, low in humus, and with the scarcity of stable manure, lack of available nitrogen is the fertilizer factor most likely to limit crop production.

16441. Formula B.1; **16440,** Formula B.2; **16442,** Formula S.L., were sent by the American Sumatra Tobacco Co., Hartford.

16402. Mixed by Olds & Whipple, Hartford. Sampled and sent by Brewer Bros., Hockanum.

16840. Stated to be a mixture of acid phosphate, cotton seed meal and wood ashes. Sampled and sent by W. H. Carrier, Glastonbury.

16863. Mixed by L. T. Frisbie Co. Sampled and sent by Frank J. Beach, Woodmont.

16984. Mixed by L. T. Frisbie Co. Sampled and sent by E. E. Tucker, Rockville.

16861. Sampled and sent by D. E. Golden, Hazardville.

16601. Mixed by Rogers & Hubbard Co., Middletown. Sampled and sent by F. E. Lord, Warehouse Point.

16563. Sampled and sent by Meyer & Mendelsohn, Inc., Hartford.

16607. Special mixture made by Olds & Whipple. Sampled and sent by the Allied Tobacco Co., Hartford.

TABLE XIV. NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station:		
	American Agricultural Chemical Co.		
17447	Complete Potato Mixture	Riverton	$58.00
17480	Double A Tobacco Fertilizer	Windsor	80.00
16796	Fish & Potash	Southport	63.00
16793	Grass and Lawn Top-Dressing	Hazardville	73.00
16994	Monarch Potato Manure	New Haven	.....
17139	Special Mixture	South Manchester	7.00
16870	Tobacco Mixer	Suffield	76.00
16999	Universal Phosphate	Putnam	48.00
17293	Bradley's Complete Manure for Top Dressing Grass and Grain	Stafford Springs	70.00
17001	Bradley's Corn Phosphate	Stafford Springs	46.00
16797	Bradley's New Method Fertilizer	Norwalk	50.00
17084	Bradley's Northland Potato Grower	Putnam	65.00
16750	Bradley's Potato Manure	Hazardville	59.75
16991	Bradley's Potato Fertilizer	Thompsonville	54.00
17465	Bradley's 6% Potash Fertilizer	North Franklin	64.00
17297	Bradley's Valley Tobacco Fertilizer	New Milford	84.00
16690	Bradley's XL Superphosphate of Lime	Windsor Locks	55.00
17086	Great Eastern Northern Corn Special, 1920	Forestville	49.00
17054	Great Eastern General, 1921	Riverton	44.00
17294	Great Eastern Potato Manure, 1920	Forestville	51.00
17052	Packers' Union Animal Corn Fertilizer	Riverton	54.00
17298	Packers' Union Potato Manure, 1921	Waterford	54.00
17303	Packers' Union Universal Fertilizer, 1920	Westville	42.00
16694	Quinnipiac Climax	Milford	47.50
17193	Quinnipiac Climax Phosphate	North Haven	48.00
16795	Quinnipiac Corn Manure	Milford	53.50
17304	Quinnipiac Phosphate	North Haven	55.00
16992	Quinnipiac Potato Manure	Milford	56.00
16701	Quinnipiac Potato Phosphate	Southport	55.00
17135	Quinnipiac Potato Phosphate	Plainfield	50.00
17300	Quinnipiac Wrapper Leaf Tobacco Manure	Windsor	80.00
17296	Wheeler's Corn Fertilizer	Riverton	48.00
17482	Wheeler's Cuban Tobacco Grower	Granby	77.00
17053	Wheeler's Potato Manure, 1920	Riverton	51.00
16997	Williams & Clark's Americus Ammoniated Bone Superphosphate	Hazardville	53.00
16993	Williams & Clark's Americus Potato Manure	New Britain	55.00
17154	Williams & Clark's Americus Corn Phosphate	New London	55.00
16867	Williams & Clark's Prolific Fertilizer	New Britain	54.00
16998	Williams & Clark's Potato Phosphate	Clark's Corner	.....
17302	Williams & Clark's Seed Leaf Tobacco Manure	Granby	75.50

WITH POTASH.

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.
%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	
0.27	1.00	0.47	0.76	2.50	2.47	4.19	3.91	1.24	9.34	9.00	8.10	8.00	4.00	4.00	4.00	17447
1.04	0.08	0.38	2.74	4.24	4.11	0.89	5.30	0.31	6.50	5.00	6.19	4.00	0.92	4.52	5.00	17480
0.10	0.74	0.39	1.05	2.28	2.47	8.17	2.86	1.01	12.04	11.00	11.03	10.00	2.94	2.94	3.00	16796
1.96	2.02	0.26	1.06	5.30	4.94	4.91	1.25	0.22	6.38	7.00	6.16	6.00	4.64	4.64	4.00	16793
0.60	1.32	0.18	1.26	3.36	3.29	5.15	3.25	1.43	9.83	9.00	8.40	8.00	1.41	3.74	4.00	16994
.....	.....	.....	.....	6.09	.....	.....	.....	0.40	5.50	.....	5.10	.....	8.05	9.50	.....	17139
1.76	0.01	none	0.63	2.40	2.47	1.04	8.04	0.55	9.63	9.00	9.08	8.00	0.88	5.80	6.00	16870
0.34	0.02	0.25	0.19	0.80	0.82	2.41	5.29	0.19	7.89	9.00	7.70	8.00	2.09	2.09	2.00	16999
2.82	1.48	0.27	0.43	5.00	4.94	3.29	3.37	0.40	7.06	7.00	6.66	6.00	4.14	4.14	4.00	17293
0.52	0.76	0.42	0.04	1.74	1.65	4.66	3.70	0.54	8.90	9.00	8.36	8.00	2.09	2.09	2.00	17001
0.10	0.12	0.23	0.55	1.00	0.82	3.27	4.96	1.56	9.79	9.00	8.23	8.00	0.35	1.90	2.00	16797
1.04	1.02	none	1.00	3.06	3.29	5.37	3.17	0.77	9.31	9.00	8.54	8.00	3.86	3.86	4.00	17084
0.74	0.98	0.07	0.67	2.46	2.47	5.85	2.48	0.92	9.25	9.00	8.33	8.00	4.06	4.06	4.00	16750
0.70	0.16	0.09	0.73	1.68	1.65	5.19	3.07	0.95	9.21	9.00	8.26	8.00	0.36	2.81	3.00	16991
1.08	1.54	0.23	0.55	3.40	3.29	4.65	3.36	0.77	8.78	9.00	8.01	8.00	5.49	5.49	6.00	17465
0.40	0.10	0.73	2.65	3.88	4.11	1.17	5.35	0.29	6.81	5.00	6.52	4.00	0.57	2.78	3.00	17297
0.26	0.80	0.10	1.36	2.52	2.47	5.95	3.08	1.05	10.08	10.00	9.03	9.00	2.49	2.49	2.00	16690
0.52	0.62	none	0.48	1.62	1.65	4.63	3.79	1.02	9.44	9.00	8.42	8.00	2.02	2.02	2.00	17086
none	0.14	0.41	0.39	0.94	0.82	2.52	5.33	1.27	9.12	9.00	7.85	8.00	1.95	1.95	2.00	17054
0.44	0.22	0.47	0.67	1.80	1.65	5.09	3.05	0.97	9.11	9.00	8.14	8.00	2.47	2.79	3.00	17294
0.58	0.96	0.50	0.58	2.62	2.47	5.40	3.75	1.30	10.45	10.00	9.15	9.00	1.75	2.00	2.00	17052
0.10	0.68	0.61	0.27	1.66	1.65	4.15	3.99	0.27	8.41	9.00	8.14	8.00	2.72	2.72	3.00	17298
none	0.24	0.28	0.36	0.88	0.82	3.72	4.22	1.05	8.99	9.00	7.94	8.00	1.87	1.87	2.00	17303
0.08	0.16	0.21	0.45	0.90	0.82	2.31	5.58	1.59	9.48	9.00	7.89	8.00	1.13	1.84	2.00	16694
0.10	0.18	0.39	0.35	1.02	0.82	1.88	6.14	1.28	9.30	9.00	8.02	8.00	0.84	1.83	2.00	17193
0.42	0.74	0.24	0.34	1.74	1.65	4.20	3.84	1.00	9.04	9.00	8.04	8.00	1.24	1.97	2.00	16795
0.24	0.94	0.48	0.82	2.48	2.47	5.47	3.09	1.39	9.95	10.00	8.56	9.00	2.30	2.30	2.00	17304
0.74	0.82	none	0.76	2.32	2.47	3.85	4.17	1.33	9.35	9.00	8.02	8.00	3.78	3.78	4.00	16992
0.28	0.48	0.30	0.48	1.54	1.65	5.06	3.33	0.83	9.22	9.00	8.39	8.00	2.76	2.76	3.00	16701
.....	.....	.....	.....	1.52	1.65	.....	.....	0.27	8.33	9.00	8.06	8.00	2.81	2.81	3.00	17135
0.97	0.08	0.35	2.61	4.01	4.11	1.18	4.54	0.28	6.00	5.00	5.72	4.00	0.70	3.16	3.00	17300
0.47	0.70	0.19	0.34	1.70	1.65	3.76	4.51	0.79	9.06	9.00	8.27	8.00	0.68	2.02	2.00	17296
1.00	0.08	0.76	2.72	4.56	4.11	0.76	4.71	0.31	5.78	5.00	5.47	4.00	0.94	4.73	5.00	17482
0.52	0.64	0.15	0.41	1.72	1.65	2.86	5.18	1.25	9.29	9.00	8.04	8.00	1.00	2.91	3.00	17053
0.54	0.78	0.31	0.77	2.40	2.47	5.86	3.98	1.37	11.21	10.00	9.84	9.00	2.09	2.09	2.00	16997
0.40	0.68	0.07	0.49	1.64	1.65	2.99	5.16	1.27	9.42	9.00	8.15	8.00	1.00	2.93	3.00	16993
0.58	0.76	0.12	0.36	1.82	1.65	3.60	4.76	0.54	8.81	9.00	8.27	8.00	2.13	2.13	2.00	17154
0.10	0.18	0.06	0.48	0.82	0.82	5.25	2.89	1.05	9.19	9.00	8.14	8.00	1.97	1.97	2.00	16867
1.66	0.14	0.19	0.53	2.52	2.47	5.04	3.66	0.64	9.34	9.00	8.70	8.00	3.65	3.65	4.00	16998
0.50	0.14	0.69	2.81	4.14	4.11	1.05	4.75	0.32	6.12	5.00	5.80	4.00	0.62	2.86	3.00	17302

TABLE XIV. NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station:		
	American Agricultural Chemical Co., of New Jersey, Newark, N. J.		
17317	Listers 4–8–4 Fertilizer	Rockville	.....
17376	Listers Balancer for C.S.M.	Glastonbury	$73.00
17283	Listers Celebrated Tobacco Fertilizer	Warehouse Point	.....
17278	Listers Corn & Potato Fertilizer	Norfolk	53.00
17379	Listers Fish & Potash Fertilizer	Warehouse Point	58.00
17467	Listers Standard Pure Superphosphate of Lime	North Stonington	53.00
17088	Listers Success Fertilizer	Norfolk	50.00
17281	Listers Tobacco Fertilizer	Brookfield	51.00
	Apothecaries Hall Co., Waterbury, Conn.		
16754	Liberty 3–8–4	Meriden	46.25
17311	Liberty Corn, Fruit and All Crops	Windsorville	45.75
16753	Liberty Market Gardeners' Special	Meriden	50.25
17313	Liberty Potato and Vegetable Special	Windsorville	56.00
17021	Liberty Tobacco Special	Windsorville	71.00
	Armour Fertilizer Works, New York, N. Y.		
16798	Big Crop Fertilizer, 3–8–4	Norwalk	68.00
17131	Big Crop Fertilizer 3–8–4	New Canaan	60.00
16874	Big Crop Fertilizer 5–8–5	Rockville	70.00
16875	Big Crop Potato and Onion 4–8–4	Rockville	63.00
17017	Big Crop Tobacco Special 5–4–5	Rockville	83.00
17314	Big Crop Tobacco Special 5–4–5	Poquonock	78.50
16865	Corn Grower	New Haven	56.00
17137	Corn Grower	Poquonock	44.00
17044	Fertilizer 5–4–3	Rockville	75.00
16692	General Crop 1–7–1	New Haven	45.00
	Atlantic Packing Co., New Haven, Conn.		
17108	4–8–6	New Haven	68.25
17487	4–8–6	New Haven	68.25
16996	Grain Fertilizer	New Britain	51.75
17484	Grain Fertilizer	New Haven	.....
17047	Potato Phosphate	New Haven	57.75
16995	Superphosphate	New Britain	60.35
17459	Special Vegetable	New Britain	68.85
17299	Tobacco Grower	South Windsor	.....
17469	Tobacco Manure	Silver Lane	70.00

WITH POTASH—(*Continued*).

	Nitrogen.						Phosphoric Acid.							Potash.			
					Total.					Total.		So-called "Available."					
Station No.	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.
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	
17317	1.64	0.28	0.61	0.77	3.30	3.29	4.36	4.28	1.25	9.89	9.00	8.64	8.00	3.28	3.28	4.00	17317
17376	1.72	0.07	0.03	0.66	2.48	2.47	4.02	4.61	0.67	9.30	9.00	8.63	8.00	0.70	6.50	6.00	17376
17283	1.01	0.10	none	3.39	4.50	4.11	3.50	2.14	0.42	6.06	5.00	5.64	4.00	0.28	3.43	3.00	17283
17278	0.10	0.30	0.52	0.80	1.72	1.65	4.20	4.01	1.92	10.13	9.00	8.21	8.00	3.28	3.28	3.00	17278
17379	0.73	0.25	0.55	0.84	2.37	2.47	6.75	3.78	1.16	11.69	11.00	10.53	10.00	2.85	2.85	3.00	17379
17467	1.12	0.32	0.54	0.60	2.58	2.47	3.90	4.74	1.80	10.44	10.00	8.64	9.00	1.97	1.97	2.00	17467
17088	0.20	0.18	0.48	0.69	1.55	1.65	4.57	3.76	1.70	10.03	9.00	8.33	8.00	1.97	1.97	2.00	17088
17281	0.54	0.20	0.45	0.40	1.59	1.65	4.81	3.08	1.05	8.94	9.00	7.89	8.00	3.04	3.04	3.00	17281
16754	0.12	1.90	0.02	0.38	2.42	2.47	6.77	1.52	0.35	8.64	8.00	8.29	8.00	4.01	4.01	4.00	16754
17311	0.18	0.82	0.11	0.81	1.92	1.65	5.05	2.88	0.68	8.61	9.00	7.93	8.00	2.34	2.34	2.00	17311
16753	0.10	2.46	0.08	0.50	3.14	3.29	7.36	0.93	0.26	8.55	9.00	8.29	8.00	3.86	3.86	4.00	16753
17313	0.14	1.82	0.12	0.52	2.60	2.47	6.21	2.31	0.52	9.04	10.00	8.52	9.00	5.26	5.26	5.00	17313
17021	0.66	0.66	none	3.10	4.42	4.11	1.53	2.73	0.40	4.66	5.00	4.26	4.00	0.57	5.29	5.00	17021
16798	0.74	0.78	0.12	0.64	2.28	2.47	6.37	1.95	0.56	8.88	8.50	8.32	8.00	4.00	4.00	4.00	16798
17131	....	....	....	....	2.34	2.47	....	....	0.45	8.67	8.50	8.22	8.00	....	4.04	4.00	17131
16874	1.00	1.84	none	1.13	3.97	4.11	4.74	3.32	0.92	8.98	8.50	8.06	8.00	5.40	5.40	5.00	16874
16875	1.12	1.16	0.04	0.82	3.14	3.29	6.26	2.18	0.77	9.21	8.50	8.44	8.00	3.80	3.80	4.00	16875
17017	0.88	0.12	none	2.94	3.94	4.11	3.72	2.54	0.37	6.63	4.50	6.26	4.00	0.21	5.35	5.00	17017
17314	0.80	0.24	0.07	2.93	4.04	4.11	2.50	2.16	0.27	4.93	4.50	4.66	4.00	0.39	4.88	5.00	17314
16865	0.54	0.36	none	0.70	1.60	1.65	5.06	3.19	0.55	8.80	8.50	8.25	8.00	1.77	1.77	2.00	16865
17137	....	....	....	....	1.76	1.65	....	....	0.42	8.51	8.50	8.09	8.00	....	2.00	2.00	17137
17044	0.96	0.08	0.21	3.25	4.50	4.11	2.38	2.73	0.42	5.53	4.50	5.11	4.00	0.21	3.88	3.00	17044
16692	0.12	0.44	none	0.38	0.94	0.82	1.76	5.39	0.91	8.06	7.50	7.15	7.00	1.10	1.10	1.00	16692
17108	1.42	0.06	0.46	0.84	2.78	3.28	5.02	4.14	0.45	9.61	9.00	9.16	8.00	6.33	6.33	6.00	17108
17487	1.62	0.09	0.95	0.86	3.52	3.28	4.93	4.10	0.64	9.67	9.00	9.03	8.00	5.48	5.48	6.00	17487
16996	0.58	0.06	0.25	0.63	1.52	1.64	4.94	3.44	1.36	9.74	9.00	8.38	8.00	2.06	2.06	2.00	16996
17484	0.05	0.67	0.43	0.57	1.72	1.64	4.97	4.35	0.97	10.29	9.00	9.32	8.00	2.33	2.33	2.00	17484
17047	1.12	0.32	0.41	0.61	2.46	2.46	5.19	3.95	0.35	9.49	9.00	9.14	8.00	3.97	3.97	4.00	17047
16995	0.76	0.44	0.35	0.81	2.36	2.46	4.34	4.13	1.06	9.53	9.00	8.47	8.00	3.17	3.17	3.00	16995
17459	0.05	0.81	1.46	0.82	3.14	3.28	4.60	3.60	0.88	9.08	9.00	8.20	8.00	3.95	3.95	4.00	17459
17299	1.51	0.12	0.33	2.22	4.18	4.10	1.78	4.94	0.38	7.10	6.00	6.72	5.00	0.68	4.02	4.00	17299
17469	1.86	0.11	1.00	1.21	4.18	4.10	5.42	4.11	0.50	10.03	9.00	9.53	8.00	0.69	6.16	6.00	17469

TABLE XIV. NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station:		
	Berkshire Fertilizer Co., Bridgeport, Conn.		
16700	Ammoniated Bone Phosphate	Southport	$45.00
17050	Ammoniated Bone Phosphate	Waterbury	52.00
17310	Grass Special	Ellington	.....
17013	Complete Fertilizer	Waterbury	63.00
17309	Complete Tobacco	Ellington	.....
16696	Market Garden Fertilizer	Milford	61.50
17012	Potato and Vegetable Phosphate	Milford	46.00
16943	Special Mixture	Brooklyn	48.00
	F. E. Boardman, Middletown, Conn.		
17460	Complete Fertilizer for Potatoes & General Crops	Middletown	54.00
17461	Complete Fertilizer for Tobacco	Middletown	55.00
	Bowker Fertilizer Co., New York City.		.....
17043	All Round Fertilizer	Yalesville	67.00
17321	Connecticut Valley Tobacco Fertilizer	Thompsonville	76.00
16873	Corn, Grain and Grass Phosphate	Rockville	47.00
17306	Fisherman's Brand Fish and Potash	Yalesville	66.00
17046	Hill and Drill Phosphate	Mansfield Depot	60.00
16800	Potato and Vegetable Phosphate	Plainville	56.00
16799	Square Brand Farm and Garden Phosphate	Yalesville	54.00
17022	Sure Crop Phosphate revised	Willimantic	40.00
16747	Tobacco Elements	Thompsonville	74.00
17085	Maryland Corn Phosphate	Willimantic	36.00
17326	Maryland Truck Garden Fertilizer	Willimantic	.....
17327	Stockbridge Early Crop Manure	Mansfield Depot	80.00
16814	Stockbridge Market Garden Manure	Plainville	68.00
16871	Stockbridge Tobacco Manure	Suffield	.....
	A. D. Bridge's Sons, Inc., Hazardville, Conn.		
16667	Corn, Potato and General Purpose Fertilizer	Hazardville	60.00
16666	Special Tobacco Fertilizer	Hazardville	69.00
	E. D. Chittenden Co., Bridgeport, Conn.		
17016	Complete Tobacco and Onion Grower with 4% Potash	Suffield	.....
17324	Complete Tobacco and Onion Grower with 6% Potash	Enfield	68.50
16941	High Grade Potato with 4% Potash	Brooklyn	52.50
16872	Tobacco Special 5% Potash	Suffield	.....
17323	Vegetable and Onion Grower, 3% Potash	Green's Farms	56.50

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.
%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	
0.64	0.14	none	0.24	1.02	0.80	9.51	1.81	0.24	11.56	11.00	11.32	10.00	1.84	1.84	2.00	16700
0.84	0.08	0.03	0.25	1.20	0.80	8.41	2.06	0.15	10.62	11.00	10.47	10.00	1.92	1.92	2.00	17050
4.04	0.28	0.10	1.38	5.80	5.75	0.72	4.23	0.18	5.13	5.00	4.95	4.00	3.95	3.95	4.00	17310
1.74	0.22	none	0.62	2.58	2.50	6.77	1.73	0.58	9.08	9.00	8.50	8.00	2.66	2.66	3.00	17013
1.46	0.14	0.19	2.51	4.30	4.11	1.19	4.85	0.37	6.41	4.00	6.04	4.00	0.56	4.70	4.00	17309
1.78	0.28	0.29	1.17	3.52	3.30	2.39	5.84	0.84	9.07	9.00	8.23	8.00	3.95	3.95	4.00	16696
1.18	0.16	none	0.48	1.82	1.70	6.77	1.77	0.35	8.89	9.00	8.54	8.00	2.64	2.64	2.00	17012
2.00	0.12	0.28	1.70	4.10	4.11	0.36	8.34	1.43	10.13	9.00	8.70	.....	4.84	4.84	5.00	16943
0.74	0.74	0.12	1.84	3.44	3.30	4.37	2.97	0.18	7.52	7.50	7.34	7.00	4.80	4.80	4.00	17460
0.91	0.84	0.18	1.71	3.64	3.30	4.81	3.56	0.23	8.60	7.50	8.37	7.00	0.23	4.06	4.00	17461
0.72	0.86	0.33	0.57	2.48	2.47	5.90	2.83	0.83	9.56	9.00	8.73	8.00	4.11	4.11	4.00	17043
1.02	0.13	0.03	2.94	4.12	4.11	1.19	4.49	0.41	6.09	5.00	5.68	4.00	0.78	3.36	3.00	17321
0.62	0.22	0.18	0.74	1.76	1.65	5.09	3.62	1.05	9.76	9.00	8.71	8.00	2.29	2.29	2.00	16873
0.16	0.76	0.38	1.07	2.37	2.47	7.92	3.14	0.88	11.94	11.00	11.06	10.00	2.71	2.71	3.00	17306
0.94	1.08	0.08	0.48	2.58	2.47	5.79	3.60	0.28	9.67	10.00	9.39	9.00	2.19	2.19	2.00	17046
0.32	0.62	0.33	0.47	1.74	1.65	3.12	4.92	1.41	9.45	9.00	8.04	8.00	1.16	3.08	3.00	16800
0.24	0.58	0.35	0.41	1.58	1.65	4.93	3.64	1.05	9.62	9.00	8.57	8.00	2.07	2.07	2.00	16799
0.38	0.10	0.15	0.19	0.82	0.82	2.59	5.45	0.75	8.79	9.00	8.04	8.00	2.11	2.11	2.00	17022
1.74	0.08	none	0.94	2.76	2.47	1.56	6.53	0.72	8.81	9.00	8.09	8.00	0.88	5.63	6.00	16747
0.64	0.74	none	0.28	1.66	1.65	4.41	3.83	0.42	8.66	9.00	8.24	8.00	2.06	2.06	2.00	17085
1.40	1.02	0.52	0.20	3.14	3.29	4.92	3.37	0.31	8.60	9.00	8.29	8.00	3.61	3.61	4.00	17326
1.24	1.82	0.34	0.66	4.06	4.11	5.11	2.96	0.41	8.48	9.00	8.07	8.00	7.43	7.43	7.00	17327
0.52	1.30	0.28	1.38	3.48	3.29	5.74	2.41	1.01	9.16	9.00	8.15	8.00	3.95	3.95	4.00	16814
1.28	0.06	0.30	2.58	4.22	4.11	1.26	4.09	0.29	5.64	5.00	5.35	4.00	0.64	4.77	5.00	16871
0.66	1.06	.....	.....	3.76	3.30	2.81	6.14	1.04	9.99	8.00	8.95	8.00	0.19	4.55	4.00	16667
0.54	0.06	.....	.....	4.26	4.11	1.14	4.36	0.49	5.99	4.00	5.50	4.00	0.28	4.89	4.00	16666
1.46	1.02	0.08	0.76	3.32	3.29	5.86	3.09	0.54	9.49	9.00	8.95	8.00	0.76	4.31	4.00	17016
1.62	0.90	none	0.68	3.20	3.29	5.21	3.54	0.54	9.29	9.00	8.75	8.00	5.86	5.86	6.00	17324
0.12	2.72	0.03	1.43	4.30	4.12	6.82	2.49	0.86	10.17	9.00	9.31	8.00	4.46	4.46	4.00	16941
1.65	0.02	none	2.79	4.46	4.12	2.46	2.31	0.26	5.03	5.00	4.77	4.00	0.35	6.24	5.00	16872
0.96	0.58	0.05	0.75	2.34	2.47	5.55	3.00	0.51	9.06	9.00	8.55	8.00	2.94	2.94	3.00	17323

TABLE XIV. NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station:		
	Everett B. Clark Seed Co., Milford, Conn.		
16868	Special Mixture with Potash (4–8–6)	Milford	$53.00
17322	Special Mixture with Potash (4–10–4)	Southport	50.00
17481	Special Mixture with Potash (4–8–6)	Woodmont	53.00
	The Coe-Mortimer Co., New York City		
17339	Celebrated Special Potato Fertilizer Revised	Plantsville	.....
16697	Columbian Corn and Potato Fertilizer	Milford	50.00
17341	Connecticut Wrapper Grower	Poquonock	82.00
17099	Cotton Seed Supplement	Glastonbury	73.00
16698	Gold Brand Excelsior Guano Revised	Milford	60.00
17325	New Englander Special	Abington	45.00
17342	Special Grass Top Dressing	Glastonbury	73.00
17343	Tobacco Leaf Fertilizer	Glastonbury	70.00
	H. B. Cornwall, Meriden, Conn.		
17615	Potato and General Use	Southington	64.00
17616	Tobacco Grower	Glastonbury	70.00
	Eastern States Farmers' Exchange, Springfield, Mass.		
17109	2–8–2	Bristol	52.00
17416	3–8–4	Madison	44.25
17415	4–8–4	Bristol	68.50
17417	4–8–7	Madison	65.00
17420	5–4–5	South Manchester	57.60
	Essex Fertilizer Co., Boston, Mass.		
17081	1–10–1 for Grain and Grass	Hartford	49.25
17103	2–8–2 for Farm and Garden	South Manchester	56.00
17336	4–8–4 for Potatoes, Roots and Vegetables	Hartford	70.00
17340	Special Tobacco 5–5–4	Wapping	77.50
17464	5–8–6	Wapping	70.00
17335	Fish Fertilizer, 3–8–3 for All Crops	Hartford	62.25
17337	Market Garden 3–8–4 for Vegetables and Grass	South Manchester	66.00
17083	Tobacco Manure 5–7–2	Rockville	70.00
	L. T. Frisbie Co., New Haven, Conn.		
17462	3–8–6	New Hartford	57.00
17350	5–8–7	Putnam	.....
17078	Corn and Grain Fertilizer	Stamford	60.00
17488	Corn and Grain Fertilizer	New Haven	56.00
17082	Market Garden	Hartford	.....

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	1.82	0.11	1.45	3.58	3.29	6.91	2.33	1.01	10.25	8.50	9.24	8.00	6.48	6.48	6.00	16868
0.08	2.10	0.14	1.00	3.32	3.29	8.13	2.09	0.77	10.99	10.50	10.22	10.00	4.04	4.04	4.00	17322
0.09	2.13	0.15	1.19	3.56	3.29	5.78	2.96	0.73	9.47	8.50	8.74	8.00	6.01	6.01	6.00	17481
0.38	1.04	0.24	1.52	3.18	3.29	6.18	2.19	0.84	9.21	9.00	8.37	8.00	3.75	3.75	4.00	17339
0.58	0.70	none	0.40	1.68	1.65	2.94	5.39	1.06	9.39	9.00	8.33	8.00	1.20	3.13	3.00	16697
0.83	0.10	0.54	2.70	4.17	4.11	0.81	4.89	0.31	6.01	5.00	5.70	4.00	0.85	4.60	5.00	17341
1.72	0.02	0.07	0.71	2.52	2.47	1.28	7.65	0.45	9.38	9.00	8.93	8.00	0.93	6.28	6.00	17099
0.42	1.04	0.14	0.90	2.50	2.47	4.89	2.99	1.45	9.33	9.00	7.88	8.00	3.95	3.95	4.00	16698
0.29	0.07	0.32	0.14	0.82	0.82	2.98	5.00	0.68	8.66	9.00	7.98	8.00	1.93	1.93	2.00	17325
1.43	2.13	0.64	0.84	5.04	4.94	4.78	2.89	0.45	8.12	7.00	7.67	6.00	3.45	3.45	4.00	17342
1.15	0.11	0.29	2.79	4.34	4.11	1.16	4.44	0.26	5.86	5.00	5.60	4.00	0.66	2.99	3.00	17343
0.91	0.15	0.22	2.14	3.42	3.70	6.37	3.44	1.04	10.85	.....	9.81	9.00	8.26	8.26	7.50	17615
2.75	0.17	0.41	1.91	5.24	5.76	2.59	4.92	1.11	8.62	.....	7.51	5.00	0.89	5.91	5.00	17616
0.20	0.58	0.07	0.85	1.70	1.65	6.64	2.22	0.41	9.27	9.00	8.86	8.00	1.52	2.00	2.00	17109
1.16	0.07	0.61	0.64	2.48	2.46	3.86	4.35	0.63	8.84	9.00	8.21	8.00	4.52	4.52	4.00	17416
1.52	0.23	0.72	0.93	3.40	3.29	6.53	2.33	0.82	9.68	9.00	8.86	8.00	0.51	4.39	4.00	17415
0.27	1.03	1.24	0.50	3.04	3.29	5.54	2.63	0.90	9.07	9.00	8.17	8.00	6.22	6.22	7.00	17417
0.15	1.04	0.16	2.87	4.22	4.11	3.84	1.62	0.26	5.72	5.00	5.46	4.00	0.53	6.70	5.00	17420
none	0.34	0.17	0.41	0.92	0.82	6.75	3.41	1.15	11.31	11.00	10.16	10.00	1.17	1.17	1.00	17081
0.14	0.20	0.60	0.80	1.74	1.64	5.30	2.88	0.99	9.17	9.00	8.18	8.00	1.99	1.99	2.00	17103
0.61	1.00	0.89	0.86	3.36	3.28	6.07	2.57	0.61	9.25	9.00	8.64	8.00	4.57	4.57	4.00	17336
1.58	0.09	0.37	2.34	4.38	4.10	2.04	4.24	0.51	6.79	6.00	6.28	5.00	0.68	4.31	4.00	17340
1.88	0.11	0.53	2.94	5.46	4.11	1.11	5.02	0.54	6.67	9.00	6.13	8.00	0.80	4.22	6.00	17464
0.18	0.89	0.58	0.57	2.22	2.46	5.70	2.23	0.68	8.61	9.00	7.93	8.00	3.04	3.04	3.00	17335
0.02	1.14	0.65	0.71	2.52	2.46	6.49	1.96	0.59	9.04	9.00	8.45	8.00	3.79	3.79	4.00	17337
1.62	0.10	0.06	2.38	4.16	4.10	4.68	3.62	0.50	8.80	8.00	8.30	7.00	0.44	2.10	2.00	17083
1.00	0.07	0.60	1.05	2.72	2.46	1.14	6.91	2.20	10.25	9.00	8.05	8.00	0.69	6.69	6.00	17462
1.60	1.07	0.33	1.22	4.22	4.10	5.56	4.04	0.43	10.03	9.00	9.60	8.00	6.62	6.62	7.00	17350
0.72	0.10	0.09	0.58	1.49	1.64	4.29	4.77	0.96	10.02	9.00	9.06	8.00	2.11	2.11	2.00	17078
0.27	0.57	0.30	0.58	1.72	1.64	5.12	4.07	0.87	10.06	9.00	9.19	8.00	2.33	2.33	2.00	17488
1.36	0.16	0.50	0.75	2.77	3.28	5.11	4.12	0.38	9.61	9.00	9.23	8.00	6.01	6.01	6.00	17082

TABLE XIV. NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station:		
	L. T. Frisbie Co., New Haven, Conn.—(*Continued*).		
17260	Market Garden	North Haven	$64.00
17155	Special Mixture	East Hartford	.....
17334	Special	New Britain	65.00
17333	Special Vegetable and Potato Grower	Stamford	70.00
17586	Special Vegetable and Potato Grower, 4–8–4	Wilson	45.00
17358	Special 4–10–6	Woodmont	58.00
17344	Superphosphate	Stamford	68.00
17353	Tobacco Grower	South Windsor	.....
17102	Tobacco Manure, 5–8–6	Hartford	.....
	International Agricultural Corporation (Buffalo Fertilizer Works), Boston, Mass.		
17349	Complete	East Granby	.....
16925	Complete Tobacco	East Granby	.....
17285	Buffalo Economy	West Suffield	52.00
17279	Buffalo Farmers' Choice	Litchfield	48.00
17284	Buffalo General Favorite	West Suffield	44.00
17282	Buffalo High Grade Manure	Glastonbury	68.25
17280	Buffalo New Englander Special	Litchfield	58.00
17354	Buffalo Tobacco Producer	Glastonbury	78.50
17287	Buffalo Vegetable & Potato	Tariffville	63.00
	Lowell Fertilizer Co., Boston, Mass.		
16924	2–8–3 for Vegetables and Grain	Rockville	50.00
17375	3–8–3 for Corn, Grain and Vegetables	Yantic	46.00
16820	4–8–4 for Potatoes, Corn and Vegetables	Wethersfield	62.75
17100	5–5–4 for Tobacco, Fruits and Vines	Rockville	83.00
17371	5–8–4 for Vegetables and Grain	Warehouse Point	77.00
16920	Animal Brand 3–8–4 for All Crops	Wallingford	60.00
17537	Animal Brand 3–8–4 for All Crops	Southington	68.00
17369	Bone Fertilizer 2–8–2 for Corn, Grain, Grass and Vegetables	New Britain	53.00
16813	Empress Brand 1–10–1 for Grain and Vegetables	New Britain	48.00
16926	Lawn and Garden Dressing 4–7–2	Hartford	.....
17380	Tobacco 5–7–2	Rockville	.....
	Mapes Formula and Peruvian Guano Co., New York City.		
17377	Connecticut Valley Special	South Glastonbury	90.00
17370	Corn Manure	Forestville	57.50
17393	Cotton Seed Tobacco Manure	Windsor	71.00
17079	General Truck Manure	Forestville	72.00

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.
%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	
....	....	....	....	2.92	3.28	....	....	0.47	9.47	9.00	9.00	8.00	....	5.88	6.00	17260
0.82	none	0.40	3.72	1.47	....	1.29	5.22	0.60	7.11	.....	6.51	.....	0.53	6.89	....	17155
0.43	0.45	0.74	0.70	2.32	2.47	5.02	3.96	0.50	9.48	9.00	8.98	8.00	3.88	3.88	4.00	17334
0.74	1.02	0.52	0.82	3.10	3.29	4.55	4.12	0.74	9.42	9.00	8.68	8.00	4.01	4.01	4.00	17333
0.78	0.92	....	....	3.46	3.28	....	....	0.64	9.77	9.00	9.13	8.00	....	4.22	4.00	17586
0.55	1.48	0.36	1.15	3.54	3.28	8.08	3.69	0.46	12.23	11.00	11.77	10.00	6.21	6.21	6.00	17358
0.64	0.50	0.56	0.66	2.36	2.46	4.41	4.26	0.96	9.63	9.00	8.67	8.00	3.02	3.02	3.00	17344
0.86	1.06	0.59	1.83	4.34	4.10	1.01	5.56	0.47	7.04	6.00	6.57	5.00	1.58	4.01	4.00	17353
1.76	0.14	0.93	1.23	4.06	4.10	5.78	4.06	0.46	10.30	9.00	9.84	8.00	1.02	6.31	6.00	17102
0.48	0.36	0.52	0.64	2.00	1.60	5.07	3.66	1.16	9.89	9.00	8.73	8.00	2.00	2.00	2.00	17349
0.82	0.46	0.21	1.85	3.34	3.30	1.47	3.34	0.37	5.18	5.00	4.81	4.00	0.64	3.76	4.00	16925
0.28	0.18	0.52	0.68	1.66	1.60	5.77	4.17	1.09	11.03	9.00	9.94	8.00	2.32	2.32	2.00	17285
0.11	0.14	0.37	0.34	0.96	0.80	5.77	3.99	1.18	10.94	11.00	9.76	10.00	2.23	2.23	2.00	17279
0.04	0.18	0.26	0.50	0.98	0.80	5.07	3.38	0.79	9.24	9.00	8.45	8.00	1.22	1.22	1.00	17284
1.00	0.52	0.37	1.38	3.27	3.30	4.70	3.91	1.29	9.90	9.00	8.61	8.00	5.87	5.87	6.00	17282
0.39	0.38	0.18	0.91	1.86	1.60	2.03	6.86	2.65	11.54	11.00	8.89	10.00	4.08	4.08	4.00	17280
0.78	1.26	0.20	2.04	4.28	4.10	0.55	3.68	0.35	4.58	5.00	4.23	4.00	0.62	3.36	4.00	17354
0.52	0.56	0.32	1.14	2.54	2.50	2.75	6.80	2.56	12.11	9.00	9.55	8.00	3.80	3.80	4.00	17287
0.04	0.16	0.69	0.79	1.68	1.64	5.51	2.27	1.18	8.96	9.00	7.78	8.00	3.09	3.09	3.00	16924
0.43	0.57	0.59	0.63	2.22	2.46	5.81	3.36	0.22	9.39	9.00	9.17	8.00	3.04	3.04	3.00	17375
0.72	1.00	0.81	0.87	3.40	3.29	5.68	2.90	0.63	9.21	9.00	8.58	8.00	4.36	4.36	4.00	16820
1.24	0.04	0.54	2.22	4.04	4.10	1.61	4.10	0.42	6.13	6.00	5.71	5.00	0.76	4.00	4.00	17100
1.28	0.16	0.99	1.17	3.60	4.10	5.52	2.62	0.93	9.07	9.00	8.14	8.00	2.14	3.69	4.00	17371
0.18	0.82	0.50	0.68	2.18	2.46	6.13	2.00	0.68	8.81	9.00	8.13	8.00	3.81	3.81	4.00	16920
....	....	....	....	2.02	2.46	....	....	0.58	8.64	9.00	8.06	8.00	....	4.02	4.00	17537
0.09	0.09	0.60	0.62	1.40	1.64	5.13	2.58	0.84	8.55	9.00	7.71	8.00	1.83	1.83	2.00	17369
none	0.14	0.30	0.30	0.74	0.82	5.96	3.17	1.71	10.84	11.00	9.13	10.00	0.94	0.94	1.00	16813
1.96	1.22	none	0.10	3.28	3.28	7.57	0.75	1.34	9.66	8.00	8.32	7.00	1.97	1.97	2.00	16926
1.16	0.04	0.43	2.27	3.90	4.10	4.48	3.73	0.46	8.67	8.00	8.21	7.00	0.54	2.19	2.00	17380
2.32	0.06	0.29	2.33	5.00	4.95	0.04	5.21	0.33	5.58	.....	5.25	4.00	1.40	6.25	7.00	17377
1.30	0.06	0.61	0.81	2.78	2.47	1.90	6.87	1.27	10.04	10.00	8.77	8.00	3.86	3.86	3.00	17370
1.79	0.06	0.07	2.32	4.24	4.12	0.49	3.55	0.51	4.55	.....	4.04	4.00	0.53	1.63	1.00	17393
3.70	0.04	0.26	0.72	4.72	4.12	1.12	5.43	1.57	8.12	8.00	6.55	6.00	2.43	5.39	5.00	17079

TABLE XIV. NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station:		
	Mapes Formula and Peruvian Guano Co., New York City—(*Continued*).		
17080	General Use Manure	Windsor Locks	.....
17392	General Tobacco Manure	South Windsor	.....
17372	Grain Grower	Suffield	$49.00
16816	Potato Manure	Forestville	67.00
16578	Tobacco Ash Constituents	Burnside	77.50
16837	Tobacco Ash Constituents	Warehouse Point	74.50
16579	Tobacco Starter Improved	Burnside	63.00
16815	Top Dresser	Forestville	87.50
17136	Top Dresser	Hartford	.....
	Miller Fertilizer Co., Baltimore, Md.		
17149	5–8–7	Newington	57.00
16684	Clermont	Ansonia	45.00
17577	Clermont	Wallingford	42.00
16752	No. 1 Potato and Vegetable Grower	Wallingford	57.00
16685	Standard Phosphate	Ansonia	54.00
17578	Standard Phosphate	Wallingford	52.00
	National Fertilizer Co., New York City.		
16929	Complete Tobacco Fertilizer	South Manchester	74.00
17262	Complete Tobacco Fertilizer	Somerville	77.43
16818	Eureka Potato Fertilizer	West Cheshire	65.00
16817	Market Garden Fertilizer Revised	Southington	59.00
17065	Potato Phosphate	Wallingford	.....
17388	Special Tobacco Revised	Somerville	75.50
17394	Tobacco Foundation	Warehouse Point	71.75
16812	Universal Phosphate	Wallingford	.....
17261	XXX Fish and Potash	Wallingford	.....
	New England Fertilizer Co., Boston, Mass.		
17048	2–8–3 for Vegetables and Grain	Meriden	54.00
17266	3–8–3 for Corn, Grain and Vegetables	Meriden	58.00
17071	4–8–6 for Potatoes and Vegetables	Putnam	65.00
17486	5–8–6	Glastonbury	70.00
17263	5–8–7 for Potatoes and Market Gardens	Putman	76.25
16930	Corn Phosphate for Grain and Vegetables	Rockville	54.00
17536	Potato, Vegetable and Grass, 4–8–4	Putnam	.....
17045	Superphosphate, 3–8–4, for all Crops	Rockville	64.00
17272	Tobacco Manure, 5–5–4	Ellington	.....

WITH POTASH—(*Continued*).

Nitrogen.						Phosphoric Acid.							Potash.			
				Total.					Total.		So-called "Available."					
In ammonia.	In nitrates.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As muriate.	Total.	Guaranteed.	Station No.
%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
1.52	0.04	0.27	0.71	2.54	2.47	0.12	6.61	2.06	8.79	8.00	6.73	6.00	0.93	4.02	4.00	17080
1.69	0.05	0.13	2.13	4.00	4.12	0.12	4.45	0.19	4.76	.....	4.57	4.00	0.39	5.59	5.00	17392
0.38	0.08	0.72	0.55	1.73	1.65	2.19	6.24	1.50	9.93	10.00	8.43	8.00	2.00	2.00	2.00	17372
2.58	0.08	0.30	0.64	3.60	3.29	1.76	5.61	2.02	9.39	8.00	7.37	7.00	3.15	4.98	5.00	16816
0.07	0.06	....	....	0.83	0.82	0.50	2.23	3.40	6.13	6.00	2.73	4.00	3.04	[1]2.47	15 00	16578
0.08	0.10	....	....	1.02	0.82	0.33	3.16	3.02	6.51	6.00	3.49	4.00	....	14 34	15 00	16837
2.42	0.30	....	....	4.30	4.12	3.21	3.83	1.61	8.65	8.00	7.04	6.00	0.44	1.72	1.00	16579
6.90	0.18	0.78	0.48	8.34	8.22	1.04	3.50	1.20	5.74	6.00	4.54	4.00	0.48	3.75	2.00	16815
....	....	....	....	8.46	8.22	....	....	0.63	6.20	6.00	5.57	4.00	....	3.41	2.00	17136
0.98	1.32	0.88	0.64	3.82	4.12	4.36	4.43	0.92	9.71	8.50	8.79	8.00	6.24	6.24	7.00	17149
0.14	0.14	....	....	1.18	0.82	5.30	4.19	1.05	10.54	10.50	9.49	10.00	2.01	2.01	2.00	16684
none	0.08	0.49	0.37	0.94	0.82	....	....	0.96	10.52	10.50	9.56	10.00	....	2.21	2.00	17577
0.80	0.68	0.78	0.70	2.96	3.30	3.18	4.97	1.27	9.42	8.50	8.15	8.00	3.90	3.90	4.00	16752
0.76	0.62	....	....	2.11	2.47	3.98	4.12	0.88	8.98	8.50	8.10	8.00	3.34	3.34	3.00	16685
0.62	0.27	0.93	0.42	2.24	2.47	....	....	0.84	9.27	8.50	8.43	8.00	....	3.07	3.00	17578
1.06	0.16	0.26	2.46	3.94	4.11	1.14	4.72	0.36	6.22	5.00	5.86	4.00	1.04	4.14	5.00	16929
0.84	0.10	0.09	3.07	4.10	4.11	2.28	2.23	0.26	4.77	5.00	4.51	4.00	0.37	5.55	5.00	17262
1.32	1.50	none	0.72	3.54	3.29	6.41	2.18	0.93	9.52	9.00	8.59	8.00	4.37	4.37	4.00	16818
0.88	1.32	0.16	0.40	2.76	2.47	5.68	2.56	0.97	9.21	9.00	8.24	8.00	4.02	4.02	4.00	16817
0.44	0.48	0.25	0.51	1.68	1.65	4.44	3.68	0.92	9.04	9.00	8.12	8.00	3.01	3.01	3.00	17065
0.15	1.07	0.58	2.62	4.42	4.11	0.68	4.73	0.40	5.81	5.00	5.41	4.00	0.74	3.59	3.00	17388
0.09	1.33	0.06	1.36	2.84	2.47	0.63	8.02	0.42	9.07	9.00	8.65	8.00	1.48	5.73	6.00	17394
0.02	0.24	0.38	0.42	1.06	0.82	3.59	4.62	0.95	9.16	9.00	8.21	8.00	2.39	2.39	2.00	16812
0.58	0.78	0.10	1.02	2.48	2.47	7.60	3.86	0.82	12.28	11.00	11.46	10.00	3.55	3.55	3.00	17261
0.02	0.12	0.76	0.72	1.62	1.64	5.43	2.75	0.99	9.17	9.00	8.18	8.00	3.07	3.07	3.00	17048
0.12	0.90	0.50	0.55	2.07	2.46	5.61	2.46	0.65	8.72	9.00	8.07	8.00	2.89	2.89	3.00	17266
0.86	0.94	0.45	0.68	2.93	3.28	5.33	2.90	0.70	8.93	9.00	8.23	8.00	6.04	6.04	6.00	17071
1.57	0.22	1.07	1.24	4.10	4.10	5.89	3.84	0.50	10.23	9.00	9.73	8.00	1.24	6.62	6.00	17486
1.04	1.14	0.78	1.02	3.98	4.10	5.16	3.49	0.73	9.38	9.00	8.65	8.00	7.63	7.63	7.00	17263
0.06	0.08	0.60	0.73	1.47	1.64	5.52	2.52	0.90	8.94	9.00	8.04	8.00	1.75	1.75	2.00	16930
....	....	....	....	3.21	3.29	....	....	0.75	8.80	.....	8.05	8.00	....	4.70	4.00	17536
0.20	0.92	0.72	0.74	2.58	2.46	6.64	2.14	0.74	9.52	9.00	8.78	8.00	3.73	3.73	4.00	17045
2.16	0.10	0.01	1.69	3.96	4.10	1.75	4.16	0.29	6.20	6.00	5.91	5.00	0.77	4.35	4.00	17272

[1] 7.36 as sulphate, 2.07 as carbonate.

TABLE XIV. NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station:		
	Nitrate Agencies Co., New York City.		
17074	Naco Brand, 2–8–2 Formula	Bristol	$50.00
17269	Naco Brand, 3–8–4 Formula	South Manchester	44.25
17073	Naco Brand, 4–8–4 Formula	Bristol	58.50
	Olds & Whipple, Hartford, Conn.		
17236	Complete Corn, Onion and Potato Fertilizer	South Windsor	61.00
16921	Complete Tobacco Fertilizer	South Windsor	70.00
17243	High Grade Starter & Potash Compound	Hartford	.....
16931	Special Complete Corn, Onion and Potato Fertz...	Ellington	.....
	Parmenter & Polsey Fertilizer Co., Boston, Mass.		
17072	1–10–1 for Grain and Grass	Plantsville	45.00
17241	2–8–2, for Farm and Garden	Plantsville	50.00
17247	4–8–4, for Potatoes, Corn and Vegetables	Wallingford	65.00
17239	Plymouth Rock, 3–8–4	Rocky Hill	.....
	Piedmont-Mt. Airy Guano Co., Baltimore, Md.		
16939	Brown's 5–8–7 Fertilizer	Putnam	60.00
16938	Brown's Corn and Grain Fertilizer	Putnam	38.00
16801	Brown's Fish, Bone and Potash	Green's Farms	48.35
16967	Brown's Fish, Bone and Potash	Putnam	49.00
16933	Brown's Market Garden Fertilizer	Putnam	52.00
16935	Brown's Top Dresser	Putnam	57.00
16803	Brown's Potato Phosphate	Green's Farms	43.00
17185	Brown's Potato Phosphate	Putnam	44.00
16936	Home Mixture	Putnam	45.12
	Providence Farmers' Exchange, Providence, R. I.		
17229	Exchange Brand, 2–8–2 Fertilizer	Waterbury	.....
17133	Exchange Brand, 3–8–4 Fertilizer	Waterbury	.....
17228	Exchange Brand, 4–8–4 Fertilizer	Waterbury	.....
16942	Exchange Brand, 5–8–5 Fertilizer	Brooklyn	58.00
	Quality Seed and Fertilizer Co., Stamford, Conn.		
17201	All Crop Fertilizer	Stamford	50.00
17200	Bartlett Special Tree Fertilizer	Stamford	60.00
17199	Potato Fertilizer	Stamford	65.00
	Rogers & Hubbard Co., Middletown, Conn.		
17191	Hubbard's Bone Base Fertilizer for Seeding Down	Middletown	.....
17070	Hubbard's Bone Base Oats and Top Dressing	Somers	.....

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.
%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	
0.10	0.54	0.27	0.81	1.72	1.64	6.87	2.33	0.45	9.65	9.00	9.20	8.00	1.63	2.04	2.00	17074
0.36	0.88	0.22	2.12	3.58	2.46	5.95	2.44	0.64	9.03	9.00	8.39	8.00	0.44	3.28	4.00	17269
0.98	1.14	0.25	0.89	3.26	3.20	6.60	2.39	0.81	9.80	9.00	8.99	8.00	0.49	4.29	4.00	17073
1.52	0.10	none	1.68	3.30	3.30	5.67	3.50	0.27	9.44	8.00	9.17	8.00	4.81	4.81	4.00	17236
0.82	0.08	0.47	2.95	4.32	4.11	0.96	4.05	0.17	5.18	4.00	5.01	4.00	0.94	4.42	4.00	16921
1.50	0.08	0.44	2.16	4.18	4.11	0.03	5.42	0.04	5.49	4.00	5.45	4.00	1.37	15.81	15.00	17243
1.66	0.14	none	1.02	2.82	2.45	5.33	3.56	0.63	9.52	8.00	8.89	8.00	2.42	2.42	2.00	16931
0.08	0.04	0.45	0.41	0.98	0.82	6.44	3.36	1.15	10.95	11.00	9.80	10.00	1.35	1.35	1.00	17072
0.14	0.06	0.67	0.79	1.66	1.64	5.38	3.00	0.97	9.35	9.00	8.38	8.00	2.12	2.12	2.00	17241
0.62	1.02	0.76	0.83	3.23	3.28	5.68	2.93	0.65	9.26	9.00	8.61	8.00	4.02	4.02	4.00	17247
0.28	0.80	0.57	0.63	2.28	2.46	6.71	2.56	0.61	9.88	9.00	9.27	8.00	3.82	3.82	4.00	17239
1.08	1.02	0.14	0.50	2.74	4.11	6.74	3.20	0.77	10.71	9.00	9.94	8.00	4.08	4.08	7.00	16939
0.20	0.52	0.09	0.63	1.44	1.65	5.11	3.26	0.88	9.25	.....	8.37	8.00	2.05	2.05	2.00	16938
0.10	1.36	....	....	3.30	3.29	6.84	1.76	0.79	9.39	.....	8.60	8.00	3.83	3.83	4.00	16801
....	....	....	....	2.86	3.29	....	....	0.74	9.01	.....	8.27	8.00	....	3.62	4.00	16967
1.42	0.62	0.16	0.54	2.74	2.88	3.33	4.36	0.77	8.46	.....	7.69	8.00	5.01	5.01	6.00	16933
1.50	0.86	0.32	0.54	3.22	4.94	5.84	4.32	0.91	11.07	.....	10.16	8.00	2.55	2.55	3.00	16935
0.16	0.70	0.25	0.67	1.78	2.47	5.07	3.36	0.82	9.25	.....	8.43	8.00	3.69	3.69	3.00	16803
1.04	0.20	0.15	0.44	1.83	2.47	3.92	4.24	0.73	8.89	.....	8.16	8.00	2.86	2.86	3.00	17185
1.80	0.54	0.30	0.98	3.62	4.12	6.24	3.70	0.95	10.89	.....	9.94	10.00	3.69	3.69	4.00	16936
0.28	1.08	none	0.59	1.95	1.65	5.27	2.40	0.63	8.30	8.50	7.67	8.00	2.48	2.48	2.00	17229
none	1.68	0.27	0.65	2.60	2.47	6.72	1.78	0.54	9.04	8.50	8.50	8.00	3.71	3.71	4.00	17133
0.10	2.08	0.28	0.75	3.21	3.29	6.63	2.07	0.69	9.39	8.50	8.70	8.00	3.52	3.52	4.00	17228
0.60	2.12	0.27	1.27	4.26	4.11	6.99	1.73	0.64	9.36	8.50	8.72	8.00	4.80	4.80	5.00	16942
0.82	0.06	none	1.12	2.00	1.65	2.34	7.29	1.04	10.67	8.50	9.63	8.00	2.68	2.68	2.00	17201
2.32	0.06	1.26	0.62	4.26	4.00	4.49	3.44	0.91	8.84	8.50	7.93	8.00	4.74	4.74	4.00	17200
2.76	0.08	0.12	0.75	3.71	3.29	3.01	5.81	1.02	9.84	8.50	8.82	8.00	2.47	4.29	4.00	17199
0.40	0.26	0.21	2.07	2.94	2.46	0.03	12.20	3.39	15.62	15.00	12.23	6.00	3.96	3.96	4.00	17191
6.64	0.06	0.50	1.02	8.22	8.22	none	5.99	2.43	8.42	8.00	5.99	3.00	3.27	4.00	4.00	17070

TABLE XIV. NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station:		
	Rogers & Hubbard Co., Middletown, Conn.—(*Con.*)		
16927	Hubbard's Bone Base Soluble Corn and General Crops Manure	Glastonbury	$56.00
17067	Hubbard's Bone Base Soluble Potato Manure	Milldale	81.00
17138	R. and H. 3–8–6 Brand	South Manchester	74.00
17184	R. and H. All Soils-All Crops Phosphate	Milldale	62.25
17189	R. and H. Climax Tobacco Brand	Glastonbury	71.25
17066	R. and H. Complete Phosphate	Middletown	45.50
17182	R. and H. Potato Phosphate	Glastonbury	50.00
17105	R. and H. Soluble Tobacco Manure	Somers	82.50
17140	Special Tobacco Mixture	South Manchester	67.00
17068	R. and H. Tobacco Grower Vegetable Formula	Glastonbury	82.00
	F. S. Royster Guano Co., Baltimore, Md.		
17203	Arrow Head Tobacco Formula	Glastonbury	60.00
16811	Bully Guano	Waterbury	57.00
17489	Bully Guano	Waterbury	57.00
17222	Fish, Flesh and Fowl	Thompsonville	54.00
16748	Fish and Potash	Thompsonville	51.00
17197	Trucker's Delight	New Canaan	70.00
17087	Quality Trucker	Watertown	80.00
17385	Valley Tobacco Formula	Glastonbury	70.00
	Sanderson Fertilizer and Chemical Co., New Haven, Conn.		
17223	Atlantic Coast Bone, Fish and Potash	Guilford	53.00
17069	Complete Tobacco Grower	Glastonbury	76.00
17225	Corn Superphosphate	West Cheshire	53.00
16819	Formula A	Guilford	63.00
17076	Formula B	Highwood	68.00
16832	Potato Manure	Stratford	59.25
17389	Top Dressing for Grass and Grain	New Haven	.....
17075	Kelsey's Bone, Fish and Potash	Highwood	.....
	M. L. Shoemaker and Co., Philadelphia, Pa.		
16751	Swift-Sure Superphosphate Tobacco and General Use	Hazardville	63.00
	Springfield Rendering Co., Springfield, Mass.		
17204	2–8–2 Fertilizer	Granby	40.00
17077	Animal Brand	Thompsonville	58.00

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.
%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	
0.98	0.74	0.05	0.75	2.52	2.46	1.36	7.43	0.59	9.38	10.00	8.79	8.00	4.08	4.08	4.00	16927
2.10	0.68	0.51	0.81	4.10	4.11	0.21	8.39	0.74	9.34	10.00	8.60	8.00	1.20	5.89	6.00	17067
1.28	0.50	0.08	0.43	2.29	2.46	none	8.50	1.13	9.63	9.50	8.50	8.00	0.90	5.72	6.00	17138
2.36	0.12	0.52	0.30	3.30	3.29	3.13	4.90	1.91	9.94	9.00	8.03	8.00	3.86	3.86	4.00	17184
1.08	0.22	0.39	2.61	4.30	4.11	0.09	6.43	1.37	7.89	5.00	6.52	4.00	0.53	3.04	3.00	17189
0.16	0.16	0.36	0.28	0.96	0.82	3.89	4.31	2.02	10.22	9.00	8.20	8.00	1.95	1.95	2.00	17066
0.92	0.18	0.25	0.37	1.72	1.64	4.47	4.88	1.74	11.09	9.00	9.35	8.00	3.60	3.60	4.00	17182
2.16	1.36	0.46	0.64	4.62	4.93	1.77	7.28	0.70	9.75	10.00	9.05	8.00	0.66	3.60	4.00	17105
....	....	....	....	4.13	....	....	....	1.19	7.73	.....	6.54	.....	0.51	3.18	....	17140
1.12	0.14	0.39	3.07	4.72	4.93	0.33	5.01	0.49	5.83	5.00	5.34	4.00	1.09	4.05	4.00	17068
0.48	0.82	none	2.74	4.04	4.11	2.73	1.74	0.14	4.61	4.50	4.47	4.00	0.15	2.79	3.00	17203
0.08	0.98	0.02	0.54	1.62	1.65	2.73	5.76	1.34	9.83	8.50	8.49	8.00	4.64	4.64	5.00	16811
0.13	1.00	none	0.53	1.66	1.65	2.41	5.77	1.52	9.70	8.50	8.18	8.00	4.64	4.64	5.00	17489
0.14	0.84	none	0.62	1.60	1.65	3.73	4.41	1.01	9.15	8.50	8.14	8.00	3.12	3.12	3.00	17222
0.16	0.92	none	0.57	1.65	1.65	5.62	2.71	0.69	9.02	8.50	8.33	8.00	1.11	1.11	1.00	16748
0.10	1.68	none	1.26	3.04	3.29	5.58	2.76	0.47	8.81	8.50	8.34	8.00	3.95	3.95	4.00	17197
0.10	1.68	none	1.16	2.94	3.29	5.83	2.15	0.40	8.38	8.50	7.98	8.00	7.04	7.04	7.00	17087
0.53	0.82	0.05	2.63	4.03	4.11	2.48	1.73	0.14	4.35	4.50	4.21	4.00	0.31	5.08	5.00	17385
0.12	0.52	0.28	0.88	1.80	1.65	3.75	5.59	1.25	10.59	9.00	9.34	8.00	3.54	3.54	3.00	17223
0.82	0.08	none	2.94	3.84	4.11	1.10	4.73	0.20	6.03	5.00	5.83	4.00	1.40	5.06	5.00	17069
0.56	0.20	0.41	0.67	1.84	1.65	3.56	5.71	0.99	10.26	9.00	9.27	8.00	1.16	2.35	2.00	17225
0.86	1.04	0.32	1.16	3.38	3.29	6.34	2.38	0.73	9.45	9.00	8.72	8.00	3.92	3.92	4.00	16819
0.82	1.62	0.26	0.84	3.54	3.29	0.73	8.23	2.16	11.12	9.00	8.96	8.00	1.79	5.60	6.00	17076
0.62	1.28	0.17	0.43	2.50	2.47	5.50	3.13	0.88	9.51	9.00	8.63	8.00	3.92	3.92	4.00	16832
2.72	0.86	0.66	0.88	5.12	4.94	4.37	2.92	0.45	7.74	7.00	7.29	6.00	3.91	3.91	4.00	17389
0.16	0.96	0.44	0.79	2.35	2.47	6.83	4.30	1.91	12.14	11.00	11.13	10.00	3.07	3.07	3.00	17075
1.40	0.10	0.50	1.64	3.64	2.46	6.37	4.12	1.78	12.27	12.00	10.49	10.00	0.48	1.88	3.00	16751
0.44	0.10	0.51	0.57	1.62	1.64	4.97	3.71	0.33	9.01	9.00	8.65	8.00	2.06	2.06	2.00	17204
0.48	0.58	0.74	0.70	2.50	2.46	4.96	4.55	0.49	10.00	9.00	9.51	8.00	4.22	4.22	4.00	17077

TABLE XIV. NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station:		
	Springfield Rendering Co., Springfield, Mass. (*Cont.*)		
17195	Special Potato, Onion and Vegetable	Suffield	$63.00
17600	Special Potato, Onion and Vegetable	Somers	.....
	Talfa Co., Boston, Mass.		
17418	Nature's Plant Food	New London	.....
	Virginia-Carolina Chemical Co., New York City.		
17150	Beaver Brand	Torrington	44.00
16745	Challenge Brand	Hartford	56.00
17580	Challenge Brand	Torrington	48.50
16830	Champion Brand	Hartford	68.00
16839	Cherokee Brand	Glastonbury	65.00
16831	Fish Phosphate and Potash Brand	South Manchester	.....
17196	Indian Chief Brand	Hazardville	73.00
17144	Plow Brand	South Manchester	42.00
17151	Marvel Brand	New Canaan	48.00
17384	Owl Brand	North Haven	50.00
16834	Perfection Brand	North Haven	61.50
17205	Plant Bed Brand	Granby	45.50
	What Cheer Chemical Co., Pawtucket, R. I.		
17153	Special Brand, 3–8–3	New London	42.00
17129	Shay's Potato Fertilizer	Middlefield	60.00
17130	Shay's Corn Fertilizer	Middlefield	52.00
17106	Shay's Special Fertilizer, 3–8–3	Middletown	48.00
	Wilcox Fertilizer Co., Mystic, Conn.		
17104	Corn Special	Ellington	53.00
17188	Fish and Potash	Mystic	46.00
16835	Grass Fertilizer	Branford	70.00
17224	Potato Fertilizer	Branford	51.50
17183	Potato and Vegetable Phosphate	Ellington	58.50
17187	Tobacco Special	Mystic	.....
	S. D. Woodruff & Sons, Orange.		
16833	Home Mixture	Orange	55.00
	Worcester Rendering Co., Auburn, Mass.		
17148	Corn and Grain Fertilizer	Putnam	50.00
17107	Royal Worcester Potato and Vegetable, 4–8–4	Putnam	55.00

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.
%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	
0.74	0.38	1.16	0.76	3.04	3.28	4.38	4.78	0.43	9.59	9.00	9.16	8.00	3.98	3.98	4.00	17195
0.60	0.58	....	....	3.47	3.28	....	....	0.63	9.61	9.00	8.98	8.00	....	3.95	4.00	17600
0.73	0.02	0.54	0.07	1.36	1.00	0.01	1.15	4.25	5.41	3.00	1.16	.....	5.80	5.80	2.00	17418
0.16	0.10	0.26	0.36	0.88	0.82	2.65	5.78	0.99	9.42	9.00	8.43	8.00	2.43	2.43	2.00	17150
0.06	0.38	0.11	0.29	0.84	0.82	6.15	3.26	0.79	10.20	10.00	9.41	9.00	2.72	2.72	3.00	16745
.....	.....	.....	.....	1.03	0.82	.....	.....	1.16	10.23	10.00	9.07	9.00	....	3.46	3.00	17580
0.22	2.08	0.22	0.94	3.46	3.29	6.50	1.90	0.58	8.98	9.00	8.40	8.00	4.90	4.90	4.00	16830
0.52	0.46	none	2.97	3.95	4.11	1.68	2.87	0.35	4.90	5.00	4.55	4.00	0.64	3.11	3.00	16839
0.10	0.60	0.15	0.93	1.78	1.65	3.23	5.33	1.51	10.07	.....	8.56	8.00	1.95	1.95	2.00	16831
0.48	0.62	0.10	2.82	4.02	4.11	1.50	2.88	0.37	4.75	.....	4.38	4.00	0.72	5.22	5.00	17196
0.04	0.06	0.26	0.60	0.96	0.82	3.45	4.71	0.56	8.72	.....	8.16	8.00	1.04	1.04	1.00	17144
0.06	0.20	0.17	0.54	0.97	0.82	3.56	4.92	0.87	9.35	.....	8.48	8.00	3.99	3.99	4.00	17151
0.18	0.65	0.25	0.96	2.04	1.65	6.12	2.00	0.41	8.53	.....	8.12	8.00	3.03	3.03	3.00	17384
0.09	1.58	0.11	0.80	2.58	2.47	7.88	1.12	0.45	9.45	.....	9.00	9.00	5.62	5.62	5.00	16834
0.70	0.88	0.25	1.40	3.23	2.47	6.36	2.36	0.67	9.39	10.00	8.72	9.00	0.23	3.44	1.00	17205
0.40	0.10	0.91	1.29	2.70	2.47	3.21	4.75	0.37	8.33	9.00	7.96	8.00	2.67	2.67	3.00	17153
0.76	0.06	0.55	1.78	3.15	3.28	2.61	5.27	0.63	8.51	9.00	7.88	8.00	4.29	4.29	4.00	17129
0.56	0.24	0.12	0.76	1.68	1.64	5.26	2.94	0.29	8.49	9.00	8.20	8.00	2.45	2.45	2.00	17130
0.54	0.08	0.37	1.29	2.28	2.47	2.67	4.60	0.33	7.60	9.00	7.27	8.00	3.20	3.20	3.00	17106
1.24	0.22	0.15	0.93	2.54	2.46	7.05	2.06	0.13	9.24	9.00	9.11	8.00	3.52	3.52	4.00	17104
0.70	0.24	0.06	1.72	2.72	2.46	4.31	2.39	1.37	8.07	7.00	6.70	6.00	3.00	3.00	3.00	17188
1.58	0.28	0.68	1.76	4.30	4.12	4.73	2.40	1.75	8.88	7.00	7.13	6.00	5.04	5.04	4.00	16835
0.12	0.36	0.40	1.26	2.14	1.65	5.53	3.98	2.90	12.41	9.00	9.51	8.00	0.29	2.10	2.00	17224
0.90	1.10	0.03	1.09	3.12	3.29	6.52	1.84	**0.26**	8.62	9.00	8.36	8.00	4.16	4.16	4.00	17183
1.28	0.04	0.04	3.28	4.64	4.11	0.54	4.78	2.62	7.94	5.00	5.32	4.00	1.36	4.97	5.00	17187
1.70	none	0.46	2.18	4.34	3.29	2.53	2.93	0.82	6.28	9.00	5.46	.....	5.64	5.64	3.00	16833
0.62	0.02	0.40	0.44	1.48	1.64	4.65	2.97	0.26	7.88	9.00	7.62	8.00	2.00	2.00	2.00	17148
1.38	0.14	0.14	0.90	3.16	3.28	4.39	3.60	0.33	8.32	9.00	7.99	8.00	4.33	4.33	4.00	17107

TABLE XIV. NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station:		
	Worcester Rendering Co., Auburn, Mass.—(*Cont.*)		
16986	Frisbie's 2–8–2	Rockville	$37.50
16985	Frisbie's 4–8–4	Rockville	50.00
17213	International Products Co., 4–8–4	New Haven	60.00
17006	Olds & Whipple's High Grade Starter and Potash Compound	Broad Brook	93.00
16981	Piedmont-Mt. Airy Guano Co., Brown's Top Dresser	Rockville	66.00
16983	Piedmont-Mt. Airy Guano Co., 4–8–4	Rockville	54.00
16334	Quality Seed Store's Bartlett Spec. Tree Fertz	Stamford	60.00
16808	Royster's 5–4–5	Suffield	89.00
17250	Rogers & Hubbard's Oats and Top Dressing	Suffield	.....
17249	Rogers & Hubbard's Potato Manure	Suffield	81.00
16483	[1]Royster's 5–4–5	Suffield	.....
16885	[1]Rogers & Hubbard's All Soils-1 All Crops	Middlefield	.....
17665	Virginia-Carolina Chem. Co.'s Indian Chief Brand	Suffield	81.50
17538	Virginia-Carolina Chem. Co's Indian Chief Brand	Suffield	81.50
17517	Virginia-Carolina Chem. Co's 5–4–5	Suffield	66.50
17118	H. B. Tobacco Special (Hackett Bros.)	Buckland	.....
17206	Woodruff's Home Mixture	Whitneyville	45.00
16982	Piedmont Special for Tobacco	Rockville	63.00
	Sampled by Purchaser:		
17235	Cornwall's Potato and General Use	Yalesville	60.00
17207	Eastern States Farmers' Exch., 5–4–5	Glastonbury	57.60

[1] 1920 stock.

17040. Sampled and sent by W. N. Peck, Mt. Carmel.

16987. Special mixture made by L. T. Frisbie Co. Sampled and sent by L. C. Skinner, Rockville.

16859. Sent by Prof. W. L. Slate, Jr., Storrs.

16404. Sampled and sent by C. E. Thresher, Buckland.

16862. Special mixture made by L. T. Frisbie Co. Sampled and sent by S. B. Wakeman, Fairfield.

VII. MISCELLANEOUS FERTILIZERS, AMENDMENTS AND WASTE PRODUCTS.

TOBACCO STEMS.

16235. Canadian Stems. Sold by J. J. Cahill; sampled and sent by Gordon Scholes; both of Warehouse Point. Cost per ton in car lot, $24.00, delivered.

TABLE XIV. NITROGENOUS SUPERPHOSPHATES 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.
%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	
....	....	....	....	1.48	1.64	....	....	0.91	9.34	9.00	8.43	8.00	....	2.06	2.00	16985
....	....	....	....	3.06	3.28	....	....	0.82	9.22	9.00	8.40	8.00	....	3.89	4.00	16958
1.18	1.02	....	....	2.08	4.00	2.01	6.52	0.68	9.21	.....	8.53	8.00	....	4.05	4.00	17213
....	....	....	....	4.22	4.11	....	....	0.26	5.03	4.00	4.77	4.00	....	16.02	15.00	17006
....	....	....	....	3.54	4.94	....	....	0.93	9.44	.....	8.51	8.00	....	3.33	3.00	16981
....	....	....	....	3.02	3.28	....	....	0.69	9.12	.....	8.43	8.00	....	3.52	4.00	16983
....	....	....	....	2.76	4.00	0.30	4.40	0.75	5.45	8.51	4.70	8.00	2.50	2.88	4.00	16334
....	....	....	....	5.30	4.11	1.92	....	0.32	4.22	4.50	3.90	4.00	....	5.42	5.00	16808
....	....	....	....	7.60	8.22	....	....	....	8.48	8.00	.....	.....	....	3.50	4.00	17250
....	....	....	....	4.01	4.11	....	....	....	9.16	10.00	.....	.....	....	5.82	6.00	17249
....	....	....	....	2.78	4.11	4.20	1.21	0.47	5.88	.....	5.41	4.00	....	3.74	5.00	16483
....	....	....	....	2.48	3.29	....	....	....	9.54	9.00	.....	.....	....	5.67	6.00	16885
....	....	....	....	4.18	4.11	....	....	....	4.75	.....	.....	.....	....	5.02	5.00	17665
....	....	....	....	4.24	4.11	....	....	0.41	5.01	.....	4.60	4.00	....	5.22	5.00	17538
....	....	....	....	4.44	4.11	....	....	....	4.64	.....	.....	.....	....	4.60	5.00	17517
....	....	....	....	7.06	....	0.29	5.84	0.88	7.01	.....	6.13	.....	....	1.19	....	17118
....	....	....	....	3.06	3.29	....	....	....	7.84	.....	9.00	.....	....	2.83	3.00	17206
....	....	....	....	3.80	4.12	....	....	....	4.75	.....	4.05	4.00	....	6.38	5.00	16982
....	....	....	....	3.28	4.50	7.46	3.11	1.11	11.68	9.00	10.57	.....	....	6.79	7.50	17235
....	....	....	....	4.00	4.11	....	....	....	5.81	5.00	.....	.....	....	5.90	5.00	17207

15885. Broken Tobacco Stems. Sold by Morgan & Dickinson, Windsor. Sampled and sent by B. A. Krick, East Granby.

ANALYSES OF TOBACCO STEMS.

	16235	15885
Station No.		
Percent of		
Nitrogen	1.04	1.48
Phosphoric acid	0.73	0.72
Potash	4.56	5.18

TOBACCO ASHES.

16977. Sent by Spencer Bros., Suffield, and stated to represent the residue from burned cased tobacco. They contain 2.30 per cent. of phosphoric acid and 20.16 per cent. of water-soluble potash.

TABLE XV. ANALYSES OF

Station No.	Maker or Sender.	Formula.							
		Nitrate of soda.	Cotton seed meal.	Acid phosphate.	Muriate of potash.	High grade tankage.	Low grade tankage.	Bone.	Fish.
16515	Conn. Sumatra Tobacco Co., Buckland	...	800	....	....	....	....	....	1200
16517	Conn. Sumatra Tobacco Co., Buckland	...	1200	....	....	....	....	....	....
16519	Conn. Sumatra Tobacco Co., Buckland	...	1200	....	....	....	....	....	....
16522	Conn. Sumatra Tobacco Co., Buckland	400	....	....	....	....	....	800	800
16841	Conn. School for Boys, Meriden	100	....	750	200	750	...	....	....
16663	Fassler & Silberman, Hartford	100	900	....	....	....	....	400	300
16664	Fassler & Silberman, Hartford	100	900	....	....	....	....	400	300
17289	H. C. Vibert, So. Windsor	...	....	....	....	....	....	1400	400
16507	C. L. Hevenor, Wapping	250	900	....	....	....	....	600	....
17041	W. N. Peck, Mt. Carmel	...	666	1334	....	....	....	....	....
17042	W. N. Peck, Mt. Carmel	...	666	1334	....	....	....	....	....
16910	A. E. Plant's Sons, Branford	200	....	1000	200	300	300	....	....
16911	A. E. Plant's Sons, Branford	100	....	1000	200	700	....	....	....
16821	Emil W. Woike, Little River	300	200	1000	160	340	....	....	....
16249	J. P. Graham, Suffield[1]	...	800	480	....	....	....	....	275

[1] Sold as a 5-4-5 formula made by Royster Guano Co., also contains 80 lbs. sulphate of ammonia.

DRIED AND PULVERIZED SHEEP MANURE.

Analyses of thirteen samples of this material are given in table XVII.

16749. Sold by American Agricultural Chemical Co. Sampled from stock of G. S. Phelps & Co., Thompsonville.

16866. Sould by the Apothecaries Hall Co., Waterbury. Sampled from stock of Stanley-Svea Coal Co., New Britain.

17018. Sold by Armour Fertilizer Works, New York, N. Y. Sampled from stock of Rockville Grain and Coal Co.

16699. Sold by Berkshire Fertilizer Co., Bridgeport.

16746. Sold by Natural Guano Co., Aurora, Ill. Sampled from stock of Cadwell & Jones, Hartford.

16581. Sold by Pacific Manure and Fertilizer Co., San Francisco, Cal. Sampled from stock of Cadwell & Jones, Hartford.

15883. A small sample received from the Proto-Feed and Guano Co., Chicago, Ill., by the F. T. Blish Hardware Co., South Manchester.

HOME MIXTURES.

Formula.			Percentage Composition.											
			Nitrogen.				Phosphoric Acid.				Potash.			
Precipitated bone.	Castor pomace.	Sulphate of potash.	In nitrates.	In ammonia.	Organic.	Total.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.	As sulphate.	As muriate.	Total.	Station No.
%	%	%	%	%	%	%	%	%	%	%	%	%	%	
....	....	....	.....	0.22	7.84	8.06	0.36	5.72	0.61	6.69	.....	.....	1.25	16515
300	300	200	.....	.....	.....	4.88	0.24	5.80	1.05	7.09	5.65	0.36	6.01	16517
300	300	200	.....	.....	.....	5.10	0.39	6.47	0.14	7.00	5.55	0.23	5.78	16519
....	....	....	2.50	0.17	5.18	7.85	0.29	7.78	4.20	12.27	.....	.....	.....	16522
....	....	200	0.50	0.26	1.67	2.70	5.28	4.41	1.80	11.49	5.66	5.13	10.79	16841
....	....	300	0.82	0.10	4.74	5.66	1.01	7.14	0.37	8.52	7.09	1.04	8.13	16663
....	....	300	0.80	0.10	4.65	5.55	0.98	6.84	0.29	8.11	7.73	0.86	8.59	16664
....	....	200	0.09	0.12	2.50	3.92	0.33	15.06	2.96	18.35	5.23	1.04	6.27	17289
....	....	250	1.96	0.04	3.82	5.82	0.12	8.81	0.09	9.02	6.68	0.39	7.07	16507
....	....	....	.....	.....	.....	2.00	11.26		1.06	12.32	.....	.....	.....	17041
....	....	....	.....	.....	.....	2.78	10.77		1.04	11.81	.....	.....	.....	17042
....	....	....	.....	.....	.....	3.46	11.55		1.32	12.87	.....	.....	5.04	16910
....	....	....	.....	.....	.....	2.85	11.45		1.65	13.10	.....	.....	5.67	16911
....	....	....	.....	.....	.....	3.98	7.97	1.98	0.26	10.21	.....	.....	5.67	16821
....	....	365	.....	1.00	2.22	3.22	2.96	3.07	0.52	6.55	4.22	0.90	5.12	16249

16693. Sold by Proto-Feed and Guano Co. Sampled from stock of the F. T. Blish Hardware Co., South Manchester.

17152. Master Brand Sheep Manure. Sold by the Proto-Feed and Guano Co. Sampled from stock of Quality Seed and Fertilizer Co., Stamford.

16739. Sold by the Proto-Feed and Guano Co. Sampled and sent by the Elm City Nursery Co., New Haven.

17483. Wizard Brand. Sold by the Pulverized Manure Co., Chicago. Sampled from stock of D. K. Allen, Greenwich.

17202. "Sheep Manure Tankage." Sampled from stock of Quality Seed and Fertilizer Co., Stamford.

16691. South American Sheep and Goat Manure. Sampled from stock of Sanderson Fertilizer and Chemical Co., New Haven.

As the analyses show and as is inevitable with any kind of manure, the composition is very variable. Five out of the thirteen fail in one respect or another to meet their guaranties.

On the average these samples contain 1.82 per cent. of nitrogen,

TABLE XVI. ANALYSES OF HOME-MIXED NITROGENOUS SUPERPHOSPHATES.

Station No.	Nitrogen.				Phosphoric Acid.					Potash.	
	In nitrates.	In ammonia.	Organic.	Total found.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total found.	So-called "Available" found.	As muriate.	Total found.
	%	%	%	%	%	%	%	%	%	%	%
16441	0.61	0.15	5.18	5.94	0.55	5.60	0.17	6.32	6.15	0.41	6.54
16440	0.10	0.12	5.74	5.96	0.53	5.20	0.14	5.87	5.73	0.50	6.08
16442	0.73	0.15	5.42	6.30	0.59	5.55	0.15	6.29	6.14	0.44	4.10
16402	....	0.13	6.53	6.66	0.60	6.36	0.22	7.18	6.96	0.54	5.79
16840	....	....	....	2.03	5.51	5.02	0.31	10.84	10.53	0.31	1.11
16863	....	....	....	3.34	6.86	4.54	0.59	11.99	11.40	....	6.33
16984	....	....	....	2.50	....	....	1.75	10.30	8.55	....	6.64
16861	....	....	....	4.80	5.94	3.68	1.32	10.94	9.62	0.62	0.62
16601	1.22	0.60	0.97	2.79	0.09	7.79	1.84	9.72	7.88	1.63	8.13
16563	0.58	0.10	5.58	6.26	0.68	5.01	0.23	5.92	5.69	0.54	6.29
16607	0.90	0.14	3.19	4.23	0.93	3.95	0.33	5.21	4.88	0.74	4.13
17040	....	....	....	2.38	....	....	0.82	10.26	9.44	....	7.59
16987	....	....	....	6.24	....	....	0.31	5.28	4.97	....	3.42
16859	....	....	....	8.66	....	....	....	9.90	....	....	0.72
16404	....	....	....	5.84	0.13	7.33	1.84	9.30	7.46	0.43	7.20
16862	....	....	....	3.40	7.64	3.20	0.38	11.22	10.84	....	6.39

1.11 of phosphoric acid and 2.65 of potash soluble in water. The average cost is $51.25. The composition of horse manure and of sheep manure is about as follows:

TABLE XVII. ANALYSES OF

Station Numbers	16749	16866	17018
Percentage Amount of			
Nitrogen as nitrates	0.14	....	....
" as ammonia	0.32	....	....
" organic	1.08	....	....
" Total	1.54	1.55	1.40
Phosphoric acid, water-soluble	0.12	....	0.12
" " citrate-soluble	0.72	....	0.61
" " citrate-insoluble	0.18	....	0.17
" " Total	1.02	0.92	0.90
Potash, water-soluble	3.21	3.18	3.24
Cost per ton	$57.00	$49.00	$50.00

	Sheep Manure.	Horse Manure.
Water	10.2	73.4
Organic and volatile matter	71.3	18.3
Mineral matter	18.5	8.3
	100.0	100.0
Nitrogen	1.82	0.69
Phosphoric acid	1.11	0.67
Potash	2.65	0.63

Sheep manure carries, per ton, less than twice as much phosphoric acid, three times as much nitrogen and four times as much potash and organic matter as horse manure contains.

When the price of sheep manure is more than four times that of horse manure there can be no advantage in using it as far as fertilizing value alone is concerned. Its dryness, fine mechanical condition, less offensive smell and ease of handling are items which must be considered in determining the economy of its use in individual cases.

WOOD ASHES.

Analyses of 15 samples are given in the following table. The origin of the samples, as far as known, is as follows:

From American Wood Rim Co., Onaway, Mich.:

15445. Sampled and sent by P. M. Barrows, Stamford.

From John Joynt, Lucknow, Canada:

16530. Car M. C. 99709. Sampled and sent by The Shaker Farms, Somers.

16567. Car S. B. 26490. Sampled and sent by The Shaker Farms. Bought of G. S. Phelps & Co., Thompsonville.

16597. Car G. T. 23355. Sampled and sent by G. S. Phelps & Co., Thompsonville.

SHEEP MANURE.

16699	16746	16581	15883	16693	17152	16739	17483	17202	16691
none	....	....	....	0.08	....	....	....	....	0.06
0.52	0.22	0.06	0.09	0.08	0.04	....	0.12	0.04	0.40
1.86	2.13	1.35	1.93	1.80	1.91	....	1.90	1.74	1.08
2.38	2.35	1.41	2.02	1.96	1.95	1.80	2.02	1.78	1.54
0.09	0.70	0.23	0.51	0.11	0.13	....	0.34	....	0.24
0.48	0.55	0.57	1.30	0.46	0.72	....	0.83	....	1.55
0.12	0.17	0.17	0.20	0.22	0.10	....	0.12	....	0.19
0.69	1.42	0.97	2.01	0.79	0.95	0.77	1.29	0.72	1.98
1.84	1.84	3.16	3.09	1.90	2.91	2.28	2.19	2.35	3.30
$45.00	$57.00	$57.00	.....	$45.00	$60.00	$50.00	$60.00	$40.00	$45.00

16608. Car G. T. 12676. Sampled and sent by American Sumatra Co., East Hartford.

16668. Sampled and sent by American Sumatra Tobacco Co., from Southwick Plantation.

16677. Sampled and sent by J. B. Rose, West Suffield.

16846. Sampled by Station from American Sumatra Tobacco Co., Hazelwood Plantation.

16964. Sampled by Station from stock of A. N. Shepard & Son, Hartford.

17176. Sampled and sent by A. N. Shepard & Son, Hartford.

From Sperry & Barnes, New Haven:

16915. Sampled and sent by George Augur, Northford.

From other sources

16300. Sent by A. N. Farnham, Westville.

17113. Sent by Hackett Bros., Buckland.

17477, 17509. Sent by F. E. Hitchcock, Woodbury.

Sample **15445** contained over 35 per cent. of moisture, which explains the low potash content.

Mr. Joynt states that there must be some mistake regarding sample **16008** as other lots from the same warehouse contained over 7 per cent. of potash. This sample contained over 37 per cent. of insoluble matters, which explains its low potash content. Another sample, supposed to be from the same lot as the other, **16846**, drawn by the Station agent, contained much less insoluble matter, but only half a per cent. more potash than the other sample.

It will be noted that Canada Ashes are very variable in composition and should be bought, as most of them apparently were this year, on the "unit" basis; that is, a price for each per cent of potash found on analysis.

The cost of water-soluble potash in ashes this year has ranged from 27½ to 32½ cents per pound.

TABLE XVIII. ANALYSES OF WOOD ASHES.

Station Nos.	15445	16530	16567	16597	16608	16668	16677	16846	16964	17176	16915	16300	17113	17477	17509
Percentage Amount of															
Phosphoric acid	1.11	1.91	2.24	1.46	1.42	2.09	1.62	1.96	.....	2.03	1.60	1.89	2.49	2.06	1.25
Water-soluble potash	0.80	4.82	5.28	4.69	2.00	6.22	4.19	2.53	6.39	6.06	4.78	7.93	5.83	3.44	1.78
Insoluble matters	8.39	11.41	15.25	10.77	37.47	10.90	10.68	11.16	10.22	8.82	20.26	4.08	14.57	16.58	18.02
Cost per ton	.....	$28.92[1]	$28.14[1]	$28.13[1]	.....	.....	$27.24[2]	.....	$35.15[3]	$33.33[3]	$25.00	.....	.....	.....	.....

[1] $6 per unit.

[2] $6.50 pet unit. [3] $5.50 per unit.

LIME.

Only four samples of this material have been sent for examination.

17212. English Cliffstone Whiting. Sent by Apothecaries Hall Co., Waterbury, from a manufacturing plant which found it unsuitable for its use. It was a very fine material, containing 55.29 per cent. of lime and 1.32 per cent. of insoluble matter—a very pure carbonate of lime.

16720. Ground limestone. Sold by the Grangers' Lime Co., Hartford, and sampled and sent by C. R. Treat, Orange, contained 37.19 per cent. of lime and 10.79 per cent. of insoluble matter.

15944. Refuse lime from a chemical plant. Sent by J. H. Fay, County Agent, Middletown; contained 36.80 per cent. of lime and 1.67 per cent. of insoluble matter.

16430. Sent by R. E. Eaton, Kent; contained 30.30 per cent. of lime and 2.30 per cent. of insoluble matter. It also contained considerable magnesia.

MUCK OR PEAT.

17539. Sent by E. S. Kepler, Wethersfield.

17291. Sent by William Deubel, Danbury. Stated to be from a large deposit of decayed leaves.

17157. Dried "humus" offered for sale as fertilizer. Sent by G. A. Drew, Greenwich.

17162, 17163. Sent by V. W. Bates, New Haven.

17396. Swamp muck. Sent by Wilfrid Scott, Niantic.

TABLE XIX. ANALYSES OF MUCK OR PEAT.

As Received.

Station No.	17539	17291	17157	17162	17163	17396
Percentage amount of						
Water	80.77	27.22	20.36	41.85	53.92	2.48
Organic and volatile matter	12.93	20.92	68.86	42.76	40.34	11.52
Mineral matter	6.30	51.86	10.78	15.39	5.74	86.00
	100.00	100.00	100.00	100.00	100.00	100.00
Nitrogen	0.30	0.64	2.80	1.18	1.64	0.56

Calculated Water-free.

Organic and volatile matters	67.30	28.66	86.44	73.54	87.53	11.80
Mineral matters	32.70	71.34	13.56	26.46	12.47	88.20
Nitrogen	1.56	0.88	3.50	2.03	3.55	0.57

The relative value of these peats can only be determined from their dry matter, excluding the very variable amounts of water in them.

The value lies chiefly in the organic or humus-forming material. The amounts of phosphates and potash are quite insignificant in such material. The nitrogen, of which **17157** and **17163** contain as much as most mixed commercial fertilizers, is only very slowly available. It is the residual nitrogen which has resisted decay and solution. Four of these samples have enough organic matter in them to be of value as absorbents and to mix with stable manure if they can be at least half dried economically.

DRIED SLUDGE

Four samples were analyzed for J. F. Jackson of the State Department of Health.

17364. A, Floated Sludge, dried on the ground for three weeks, about one inch deep.

17365. B, Floated Sludge, dried on the ground for three weeks, four inches deep.

17366. C, Floated Sludge, dried on the ground for three weeks, two inches deep.

17367. D, Floated Sludge, dried by heating in bucket over boiler.

TABLE XX. ANALYSES OF DRIED SLUDGE.

Station No.	17364	17365	17366	17367
Percentage of				
Nitrogen as ammonia	0.34	0.35	0.22	0.12
organic	4.76	4.03	3.80	4.98
total	5.10	4.38	4.02	5.10
Water-soluble phosphoric acid	0.09	0.03	none	0.02
Citrate-soluble phosphoric acid	2.47	2.41	2.42	2.93
Citrate-insoluble phosphoric acid	0.54	0.52	0.42	0.54
Total phosphoric acid	3.10	2.96	2.84	3.49
Total potash	0.31	0.27	0.13	0.15

The four samples are quite similar in composition and value. Both the nitrogen and the phosphoric acid are in readily available form and the dried sludge would no doubt be an excellent fertilizer.

MISCELLANEOUS.

A sample of factory waste, **16730**, sent by A. N. Farnham, Westville, contained 1.34 per cent. of nitrogen. A sample of by-product from a factory, **17292**, sent by C. E. Pease, Thompsonville, contained 4.02 per cent. of nitrogen. Of five samples of waste products from a silver-plating company, sent by N. G. Wheeler, Winsted, only one, **16726**, had any considerable fertilizer value. It was a brown powder containing 41.40 per cent. potash as carbonate, muriate and sulphate in about equal proportions. A sample of clay, **17516**, sent by Miss A. B. Platt, Shelton, thought to be of value as a filler in fertilizers, had no fertilizing value. 95.3 per cent. of it was sand and soil.

A sample of clinkers, **16466**, sent by A. N. Pierson, Inc., Cromwell, to determine whether they had any fuel value, contained moisture 0.15 per cent., organic and volatile matter 1.75 per cent., mineral matter 98.10 per cent.

In seven samples of soil the lime requirement was determined by the Jones method, the amount of actual lime needed ranging from 1620 to 4500 pounds per acre.

VARIOUS FUNGICIDES AND INSECTICIDES.

17319 and **17320** are samples of Reynolds' Paris Green and Leggett's Paris Green. The quantities of arsenious acid found in them were 56.50 and 56 per cent. respectively, and of copper oxide 26.60 and 26.80. Both were of normal composition.

A sample of Lead Arsenate, **17119**, sent by John Gotta, Portland, contained 28.53 per cent. of arsenic as arsenic acid, which is about the normal amount.

A sample of anhydrous copper sulphate, **16364**, sent by E. M. Ives, Meriden, was found to be 90.15 per cent. pure. 97.1 per cent. was finer than a 200 mesh.

A sample of formaldehyde solution, **16946**, submitted by Dr. Clinton of this Station, contained 33.65 per cent. by weight of formaldehyde.

A sample of "Sulco-V. B.," **16420**, submitted by Dr. Garman of this Station, contained 3.97 per cent. of pure phenol.

A sample of Niagara Contact Special Dusting Mixture, **16740**, was found to contain 1.62 per cent. of nicotine, equivalent to 2.10 per cent. of nicotine sulphate, calculated as the monacid salt.

A sample of tobacco dust, **16741**, sent by E. M. Ives, Meriden, contained 0.71 per cent. nicotine.

Four nicotine mixtures, submitted by Dr. Britton of this Station, contained respectively 0.29, 0.30, 0.84 and 0.71 per cent. of nicotine.

TWENTY-FIRST REPORT

OF THE

STATE ENTOMOLOGIST

OF

CONNECTICUT

FOR THE YEAR 1921

(Being Bulletin 234, Connecticut Agricultural Experiment Station)

BY

W. E. BRITTON, PH.D.

State Entomologist

NEW HAVEN, CONN.

1922

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

OFFICERS AND STAFF

January, 1922

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Donald F. Jones, S.D., *Plant Breeder in Charge.*
P. C. Mangelsdorf, B.S., *Assistant.*

In charge of the Tobacco Station.
G. H. Chapman, Ph.D., Windsor, Conn.

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NOTE REGARDING AUTHORSHIP.

For bibliographical purposes, all matter in this Report (Bulletin 234) except where otherwise indicated, should be credited to W. E. Britton.

BULLETIN 234

TWENTY-FIRST REPORT

OF THE

State Entomologist of Connecticut

To the Director and Board of Control of the Connecticut Agricultural Experiment Station:

Herewith, I transmit my twenty-first annual report as State Entomologist of Connecticut. The financial statements are for the State fiscal year ending June 30, 1921, but in other matters this report covers the activities of the department for the full calendar year of 1921. This publication contains reports on the various lines of regulatory work placed upon the office by Statute, such as inspecting nurseries, imported nursery stock, and apiaries, and suppressing the gipsy moth. It also includes articles dealing with the mosquito elimination work of the year, the asparagus beetles, injury to tobacco plants by the seed corn maggot, outbreak of the arbor vitae leaf-miner, the corn ear worm, investigations on the violet gall midge, and the European red mite, the tulip-tree scale, the terrapin scale, the pine leaf scale, the euonymus scale, and the cottony maple scale. Short articles and miscellaneous notes are given regarding many other insects.

Respectfully submitted,

W. E. BRITTON,
State and Station Entomologist.

REPORT OF RECEIPTS AND EXPENDITURES OF THE STATE ENTOMOLOGIST, FROM JULY 1, 1920, TO JUNE 30, 1921.

RECEIPTS.

From E. H. Jenkins, Treasurer	$7,500.00	
Account of 1920, Balance	850.44	
Transferred from Gipsy Moth Account by Board of Control	321.23	
State Comptroller, Gipsy Moth Account	148.87	
M. P. Zappe, Automobile mileage	11.16	
Interest on Bank Deposits	9.59	
		$8,841.29

EXPENDITURES.

For Field, Office and Laboratory Assistance:		
B. H. Walden, salary	$2,000.01	
M. P. Zappe, salary	1,949.98	

Philip Garman, salary	$2,166.71	
Gladys M. Finley, salary	895.50	
Other assistance	224.00	
		$7,236.20
Printing and Illustrations		72.80
Postage		90.72
Stationery		33.06
Telephone and Telegraph		2.33
Office Supplies		59.36
Library		122.25
Laboratory Supplies		58.29
Express, Freight and Cartage		5.01
Tools and Supplies		77.43
Traveling Expenses		316.30
Insurance		92.98
Automobile repairs and Equipment		669.56
Miscellaneous		5.00
		$8,841.29

MEMORANDUM:—This account has been audited by the State Auditors of Public Accounts. The item of $148.87 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 the work of inspecting imported nursery stock.

SUMMARY OF INSPECTION AND OFFICE WORK.

311 samples of insects received for identification.
97 nurseries inspected.
76 regular certificates granted.
30 duplicate certificates furnished to be filed in other states.
83 parcels of nursery stock inspected and certified.
65 orchards and gardens examined.
21 shipments, containing 126 cases, 1,228,560 plants, imported nursery stock inspected.
10 shipments or 47.6 per cent. found infested with insects or fungi.
751 apiaries, containing 6,972 colonies inspected.
30 apiaries and 88 colonies found infested with European foul brood.
19 apiaries and 39 colonies found infested with American foul brood.
2,067 letters written on official work.
108 circular letters.
192 post cards.
25 reports of inspection to Federal Horticultural Board.
1,505 bulletins, etc., mailed on request or to answer inquiries.
94 packages sent by mail or express.
29 lectures and addresses at institutes, granges and other meetings.

PUBLICATIONS OF ENTOMOLOGICAL DEPARTMENT, 1921.

By W. E. Britton:

Twentieth Report State Entomologist of Connecticut (Bulletin 226), 84 pages, 13 figures, 12 plates; 10,500 copies distributed in April, 1921.

Spray Now to Kill the European Red Mite, Bulletin of Immediate Information No. 13 (mimeographed), 3 pages, 600 copies distributed March 10, 1921.

Check-List of the Insects of Connecticut, Bulletin 31, State Geological and Natural History Survey, 397 pages, distributed in spring by State Librarian at Hartford.

The European Corn Borer, Report Connecticut Board of Agriculture for 1919-1920, page 92; 4 pages, 1921.

Report of Committee on Injurious Insects, Proceedings 30th Annual Meeting Connecticut Pomological Society, page 36.

Report of Committee on Insects and Diseases, Insects; Report Connecticut Vegetable Growers' Association, page 21, 1921.

First Report of the Tree Protection Examining Board (Bulletin 231), 12 pages, 11,500 copies distributed in November, 1921; 1,000 copies in the form of a separate to be used by the Board.

The House Fly as a Carrier of Disease Germs and How Controlled, 12 pages, 2 figures; published as an unnumbered bulletin of the State Department of Health. (Revised Edition.)

By W. E. Britton and G. P. Clinton:

Spray Calendar (Bulletin 224), 44 pages, 95 figures; 11,500 copies distributed in March, 1921.

By W. E. Britton and L. O. Howard:

William Hampton Patton, Entomological News, Vol. XXXII, page 33, February, 1921, 8 pages, 1 plate.

By B. H. Walden:

Progress of Anti-Mosquito Work in Connecticut, Proceedings 7th Annual Meeting New Jersey Mosquito Extermination Association, page 92, 1920.

By M. P. Zappe:

Aphis Control, Report Connecticut Board of Agriculture for 1919-1920, page 96, 1921.

By Philip Garman:

A Study of the Bulb Mite (Bulletin 225), 20 pages, 3 figures, 3 plates; 10,500 copies distributed in March, 1921.

The Grass-Feeding Frog-Hopper or Spittle-Bug (Bulletin 230), 12 pages, 3 figures, 2 plates; 10,500 copies distributed in November, 1921.

The Relation of Certain Greenhouse Pests to a Geranium Leaf Spot (Bulletin 239, Maryland Agr. Expt. Station), 30 pages, 7 figures, October, 1920.

The European Red Mite *Paratetranychus pilosus* Can. & Fanz., in Connecticut, Journal of Economic Entomology, Vol. 14, page 355, 1921.

By Philip Garman and F. L. Stevens:

The Genus *Septoria* Presented in Tabulation with Discussion, Trans. Ill. State Acad. Science, Vol. XIII, page 176, 44 pages, 1920.

DEPARTMENT STAFF AND WORK.

W. E. BRITTON, PH.D., *State and Station Entomologist.*
B. H. WALDEN, B.AGR., *Photographic and General Work.* } *Assistant*
M. P. ZAPPE, B.S., *Inspection and General Work.* } *Entomologists.*
PHILIP GARMAN, PH.D., *Research Work.*
JOHN T. ASHWORTH, *Deputy in charge of Gipsy Moth Work.*
JAMES A. MCEVOY, *Assistant in Gipsy Moth Work.*
SAMUEL T. SEALY, *Deputy in Charge of Mosquito Work.*
MISS GLADYS M. FINLEY, *Clerk and Stenographer.*

H. W. COLEY, Westport, } *Apiary Inspectors.*
A. W. YATES, Hartford, }

No changes in the personnel of the department staff have occurred during the year, except that Mr. Ashworth who was at first appointed acting deputy in charge of moth work has been promoted to deputy and his appointment made permanent, and Mr. McEvoy has been made assistant in gipsy moth work. Mr. Ashworth, who resides at Danielson, has been in charge of the field work of suppressing the gipsy moth in the eastern end of the State. This work has been done in co-operation with the Federal forces and is described more fully elsewhere in this report.

Mr. Walden has been in charge of the department in the absence of the Entomologist, has done a large part of the photographic work, has aided in making records of the results of the spraying and dusting experiments, and has made field and laboratory studies on the raspberry fruit worm, *Byturus unicolor* Say, and has continued collecting leafhoppers.

Mr. Zappe has been in charge of the inspection of nurseries and of imported nursery stock, and has co-operated with the botanical department in carrying out the series of orchard experiments in dusting and spraying for the control of the chief insect and fungous pests of apple and peach. Mr. Zappe has made studies on the life history of the false apple red bug, the apple leafhopper, the arbor vitae leaf-miner, and has devoted considerable time to rearranging the Coleoptera in the station collection.

Dr. Garman has devoted most of his efforts to research. He has finished a study of the bulb mite and the results were published as Bulletin 225. He has also made studies of the life history and control of the European red mite, *Paratetranychus pilosus,* a pest of orchards discovered in Connecticut last season. He has completed his study of the grass-feeding spittle-bug, and published the results as Bulletin 230. Other species of spittle-bugs (Cercopids) and the violet midge are now being studied. Dr. Garman is preparing a paper on the dragon flies (Odonata) of Connecticut, to be published by the State Geological and Natural History Survey, and the manuscript is nearly completed. Another paper dealing with the mites of Connecticut, also to be published by the Survey, is now in progress, but will require two or three years of study before it can be finished. Dr. Garman's work was interrupted in May by an operation for appendicitis, but he soon recovered and resumed work.

The Entomologist, in addition to the correspondence and other routine work, has devoted much time to the reading of proof on the Check-List of the Insects of Connecticut, which appeared in the spring as Bulletin 31 of the State Geological and Natural History Survey. This is a publication of 397 pages, and has met a favorable reception from entomologists. Much work on the manuscript of the Hemiptera of Connecticut, another paper to be published by the Survey, has been done during the year. All of the necessary editorial work has been done in this office, and the Entomologist is the author of the manuscript of two families, the Aleyrodidae (white flies) and the Coccidae (scale insects). The entire manuscript is now nearly completed, the illustrations are almost finished and it is expected that it will go to the printer shortly. This paper is an important one, much needed in entomological literature which is now very much scattered, and the list of authors contains sixteen names, all specialists.

The Entomologist has devoted considerable time to the work of the Tree Protection Examining Board of which he is chairman. This Board examines applicants and issues certificates to those qualified who wish to conduct the business of protecting trees. The first report of this Board, prepared by the chairman, was published in the report of this Station for 1920, pages 339-350.

The Entomologist has also revised his bulletin on the house fly for the State Health Commissioner, and a new edition has been published.

Mr. Sealy has continued as deputy in charge of mosquito work, and has seen that the ditches have been maintained in each town receiving State aid, and has supervised the small amount of new work which has been done.

Miss Finley has continued to serve as clerk and stenographer of the department.

Messrs. Coley and Yates as heretofore have inspected the apiaries on a *per diem* basis.

From August 1 to September 10, Messrs. Frank D. Luddington, Edward R. Barton and Robert C. Botsford were employed to assist Mr. Zappe in the work of inspecting nurseries.

All members of the staff have worked faithfully and efficiently, and the Entomologist hereby expresses his appreciation of their services.

ENTOMOLOGICAL FEATURES OF 1921.

The preceding winter was one of the mildest on record, and spring came early. Vegetation was advanced two to three weeks ahead of normal, yet no warm weather came until late in May. On the whole it was rather cold and wet during the first half of the season, and though some crops could be started early, those needing a high temperature did not thrive in advance of the normal season. Corn and Lima beans had to be planted over and much seed was destroyed by seed maggots, low temperature and abundance of moisture in the soil.

Apples and pears were in full bloom on April 24, but the weather was cool with a number of cloudy and rainy days, making it unfavorable for bees to work the flowers. On May 12, there was a frost in some parts of the State which injured or entirely ruined the fruit crop, which on the whole was a light one.

The first half of the season was moist but August and September were months of light precipitation, and backward crops had a chance to mature as there were no early frosts.

One of the chief entomological features of the season was the discovery that the apple and thorn skeletonizer *Hemerophila pariana* Clerck, is now distributed nearly all over the State, and specimens were received from, or the work of the insects observed in, many localities. This insect is discussed in greater detail on page 186.

In the apple orchards everywhere, curculio injury was very prominent and it was particularly noticeable in our experiments in spraying and dusting apple orchards. One apple showed 40 curculio marks.

The tent caterpillar, which has been very scarce for several years, is on the increase again and may be expected to become prevalent soon.

The apple aphids were present in the orchards early in the season, but did not do much damage and soon disappeared.

The Oriental peach moth *Laspeyresia molesta* Busck, which was found at Stamford in 1918, has not been noticed in the State during the season, though the members of this department have been on the watch for it.

The peach borer *Synanthedon exitiosa* Say, has been very abundant and destructive during the year and tests of Paradichlorobenzene are now being conducted in the peach orchard at the Station farm for controlling this pest.

The fall canker-worm *Alsophila pometaria* Harr., seems to be on the increase again. Though usually locally abundant this pest has been comparatively scarce for the past three or four years.

San José scale *Aspidiotus perniciosus* Comst., which almost disappeared from orchards a few years ago, was noticeable on the fruit in several orchards in 1921, and was more abundant in nurseries than for several years.

There was practically no injury, at least in the orchards where our dusting and spraying experiments were conducted, from the attacks of the red-banded leaf-roller *Eulia velutinana* Walker, and the lesser apple worm *Enarmonia prunivora* Walsh. Both these insects were abundant in 1920, and caused considerable surface injury to the maturing fruit, late in the season.

The European red mite *Paratetranychus pilosus* Can. & Fanz., which was so injurious in certain orchards in 1920, was much less so in those same orchards in 1921, but was present and caused some damage in other places.

The apple maggot *Rhagoletis pomonella* Walsh, was present in about the usual proportions.

The false apple red bug *Lygidea mendax* Reut., was abundant locally as is the case nearly every year.

The apple seed chalcid *Syntomaspis druparum* Boh., was for the first time discovered in the State at Milford and Cornwall.

The brown-tail moth was not found anywhere within the State during 1921, and no portion of Connecticut is now quarantined on account of this insect.

Gipsy moth scouting this fall shows that there was a considerable wind-spread last May resulting in several towns being added to the infested area in Connecticut.

There was an outbreak of the arbor vitae leaf-miner *Argyresthia thuiella* Packard, around New Haven, and many trees were seriously injured.

The box leaf-miner or midge *Monarthropalpus buxi* Labou, was received from Norwalk.

The oyster-shell scale, *Lepidosaphes ulmi* Linn., continues to be the most prevalent insect pest found in nurseries, and though it infests apple orchards, does not injure them seriously in Connecticut. Many shade and forest trees and cultivated shrubs are attacked and severely injured, and occasionally killed by this insect. The trees and plants most commonly injured are ash, birch, silver maple, butternut, willow, poplar and lilac. It is thought by some entomologists that there are two species of oyster-shell scale, that found upon apple differing somewhat in appearance, as well as in times of hatching and moulting, and in the number of circumgenital pores, from the scale occurring on the other trees named above. Whether correct or not, it is a fact that much damage is done and that control measures must be practiced, especially in nurseries, in order to prevent the destruction of much infested stock annually. All badly infested trees or branches should be cut out and burned, and the remaining portions sprayed about June 10 (in Connecticut) with a contact insecticide like kerosene emulsion or nicotine soap solution to kill the young.

Another sucking insect which seems to be on the increase each year in the spruce gall aphid *Chermes abietis* Kalt. Norway and other kinds of spruces in nurseries are often infested and sometimes seriously injured. One nurseryman has controlled the pest by clipping off and burning the galls as soon as noticed. This practice kept up throughout the season gave good results, and the young trees were remarkably free from galls. Another method is to spray with a contact insecticide either in late fall or in early spring to kill the adults which live over winter on the twigs. At one nursery, for several seasons the spruces have been sprayed in early spring with Scalecide, one part in twenty parts water, with satisfactory results.

The seed corn maggot *Hylemyia cilicrura* Rond., caused serious injury to the newly-set plants in a tobacco field in Windsor in May. Wireworms also injured plants in some plantations.

The cabbage maggot *Chortophila* (*Phorbia*) *brassicae* Bouché,

was present in about the usual numbers and injured early-set plants. The cabbage aphid *Brevicoryne brassicae* Linn., was unusually abundant and infested nearly every field. As the infested plants fail to head or make only loose heads, considerable injury resulted.

The turnip aphid *Aphis pseudobrassicae* Davis, was prevalent during the season and injured turnips in various portions of the State.

The potato aphid *Macrosiphum solanifolii* Ashm., appeared in some fields but shortly disappeared without doing much damage. In one case at least the aphids disappeared after a heavy rain.

Perhaps the outstanding entomological feature of the season was the abundance of the corn ear worm *Chloridea obsoleta* Fabr., which was very prevalent in all parts of the State on late maturing corn, doing considerable damage. This invasion extended throughout all of the northeastern United States.

The asparagus beetle *Crioceris asparagi* Linn., was abundant and unusually destructive in 1921.

White grubs, *Phyllophaga sp.,* were reported as doing injury from several localities. In some cases they injured lawns, and in others they attacked corn and potatoes.

More detailed accounts of some of the most important of these insect pests will be found in the following pages.

INSPECTION OF NURSERIES.

This work was commenced on August 3, and finished on October 1: it was in charge of Mr. M. P. Zappe, who was assisted from August 1 to September 10, by Messrs. F. D. Luddington, E. R. Barton and R. C. Botsford. Mr. Walden inspected seven small nurseries, where certificates were needed, while the other inspectors were examining the larger nurseries.

The new Ford touring car was used by Mr. Zappe for this work, and on account of good weather satisfactory progress was made.

The general condition of the nurseries was found to be about the same as in 1920, some being clean and well cared for, and others showing signs of neglect.

Pests.

In 25 nurseries no pests were found. These were for the most part small nurseries and some were newly established, where with small-sized stock, pests have not yet become prevalent. The principal pests with the number of nurseries infested by each are given below:

Insects: Oyster-shell scale, 36; spruce gall aphid, 31; San José scale, 28; tulip-tree scale, 7; pine leaf scale, 7; scurfy scale, 6; rose scale, 4; *Chermes cooleyi,* 3; terrapin scale, 2; elm scale, 2; white elm scale, 2; euonymus scale, 1; imported pine sawfly, 2; rhododendron lace bug, willow borers, poplar borers, and white pine weevil, 1 each.

Plant Diseases: Poplar canker, 21; crown gall, 4; blister rust on currants, 2; fire blight, 1.

Comparing the above figures with those of last year, it will be noticed that San José scale was found in 28 nurseries instead of in 11 last year; spruce gall aphid in 31 instead of 21 last year, and the poplar canker was present in 21 nurseries as against 13 in 1920. In 25 nurseries instead of 46 last year no pests were found. The proportions of other infestations run about the same as in former years, the oyster-shell scale continuing in the lead.

Five new nurseries have been started during the year. Two of these were inspected in the spring and certificates issued, and they were again inspected in September. These are marked (2) after the names on the list. Two nurseries have gone out of business and the name of one has been changed. One did not clean out the infested stock in time to receive a certificate before this report went to the printer.

Eighty-three separate parcels of nursery stock have been inspected and certificates granted to accommodate shippers.

The nurseryman's list for 1921 contains 94 names, as follows:

Nursery Firms in Connecticut Receiving Certificates in 1921.

Name of Firm.	Address.	Acreage.	Certificate Issued.	No. of Certificate.
Barnes Bros. Nursery Co.	Yalesville	150	Aug. 25	1176
Barnes Nursery & Orchard Co.	Wallingford	20	Aug. 13	1165
Beattie, Wm. H.	New Haven	1	Sept. 6	1186
Benbow, A.	Norfolk	1	Oct. 29	1234
Bertolf Bros.	Sound Beach	25	Sept. 28	1207
Brainard Nursery & Seed Co.	Thompsonville	10	Aug. 31	1182
Braley & Co.	Burnside	1	Aug. 24	1170
Bretschneider, A.	Danielson	2	Aug. 25	1175
Bristol Nurseries, Inc.	Bristol	8	Oct. 3	1216
Burr & Co., C. R.	Manchester, Ellington and Durham	500	Aug. 26	1177
Burroughs, Thos. E.	Deep River	3	Sept. 20	1197
Canner Court Flower Garden Co.	New Haven	2	Sept. 20	1200
Chapman, C. B.	Groton	1	Oct. 8	1218
Chapman, C. E.	North Stonington	4	Oct. 3	1213
Conine Nursery Co.	Stratford	50	Sept. 3	1184
Conley, L. D.	Ridgefield	12	Sept. 29	1210
Conn. Agricultural College (Prof. S. P. Hollister)	Storrs	1	Aug. 25	1172
Conn. Agr. Experiment Station (W. O. Filley, Forester)	New Haven	1	Oct. 22	1229
Crofut & Knapp Farm	Norwalk	20	Dec. 19	1255
Cross Highway Nurseries	Westport	6	Nov. 10	1246
Dallas, Inc., Alexander	Waterbury	2	Oct. 20	1226
Dowd, F. C.	Madison	1	Sept. 15	1194

Name of Firm.	Address.	Acreage.	Certificate Issued.	No. of Certificate.
Elm City Nursery Co., Woodmont Nurseries, Inc.	Woodmont and New Haven	155	Aug. 31	1183
Evergreen Nursery Co.	South Wilton	11	Aug. 30	1180
Fairfield Landscape & Nurseries Co.	Cannondale	5	Nov. 7	1241
Falcon's Flight Farms Nursery (B. Austin Cheney, Prop.)	Litchfield	1	Nov. 7	1240
Gardner's Nurseries	Rocky Hill	1	Nov. 12	1247
Geduldig's Greenhouses	Norwich.	1	Oct. 26	1231
Glenn Terrace Ornamental Nursery (James H. Everett, Prop.)	Mount Carmel	4	Aug. 9	1164
Hartford Park Commissioners	Hartford	1	Nov. 4	1238
Heath & Co.	Manchester	5	Aug. 30	1179
Hilliard, H. J.	Sound View	1	Oct. 3	1213
Hiti Nurseries (J. H. Bowditch, Prop.)	Pomfret Center	8	Aug. 25	1171
Holcomb, Irving	Simsbury	1	Sept. 3	1185
Horan & Son, Jas.	Bridgeport	1	Nov. 3	1235
Houstons' Nurseries	Mansfield	4	Aug. 25	1174
Hoyt's Sons Co., Inc., The Stephen	New Canaan	300	Sept. 26	1205
Hunt & Co., W. W.	Hartford	10	Sept. 9	1187
Isselee, Charles	Darien	10	Oct. 21	1228
Kajok, George	New Haven	1	Sept. 16	1196
Kelley, James J.	New Canaan	1	Nov. 8	1245
Kellner, Herman H.	Danbury	1	Sept. 29	1211
Keso Nursery (J. J. Kelsey, Prop.)	Clinton	1	Sept. 15	1193
Ladd & Nichols, Inc.	Greenwich	2	Nov. 4	1237
Laddin's Rock Nursery (W. L. Marks, Prop.)	Stamford	5	Nov. 15	1248
Langenbach, F. J.	Norwich	1	Oct. 3	1215
Larkin, P. J.	New London	1	Oct. 14	1223
Long, Mrs. J. A.	East Haven	1	Oct. 10	1221
Mallett Co., George A.	Bridgeport	1	Nov. 4	1236
Maplewood Nurseries (T. A. Peabody, Mgr.)	Norwich	1	Oct. 3	1217
Marigold Farm (H. Kelley, Prop.)	New Canaan	4	Sept. 24	1204
Meier, A. R.	West Hartford	1	Nov. 7	1242
Millane Tree Expert Co., The	Middletown	1	Oct. 27	1232
Munro, Charles	New Haven	1	Dec. 31	1256
New Haven Nurseries Co., The	New Haven	10	Oct. 25	1230
New Haven Park Commissioners (G. X. Amrhyn, Supt.)	New Haven	30	Aug. 20	1168
New London Cemetery Association (Ernest E. Rogers, Pres.)	New London	1	Oct. 8	1220
New London County Nurseries (W. J. Schoonman, Prop.)	New London and Stonington	7	Oct. 15	1224
North-Eastern Forestry Co.	Cheshire	20	Aug. 9	1163
Norwalk Nursery	Norwalk	5	Sept. 26	1206
Oakland Nurseries	Manchester	5	Aug. 26	1178
Ouwerkerk & Van der Stam (2)	Yalesville	4	Sept. 29	1208
Palmer, Est. of L. M.	Stamford	5	Sept. 23	1203
Park Gardens	Bridgeport	1	Dec. 3	1252
Pequod Nursery Co.	Yalesville	15	Aug. 17	1167
Phelps, J. Wesson	Bolton	1	Aug. 25	1173
Phelps & V. T. Hammer Co., The J. W.	Branford	2	Dec. 9	1254
Pierson, A. N., Inc.	Cromwell	65	Aug. 22	1169
Polish Orphanage (Rev. L. Bojnowski, Mgr.)	New Britain	1	Sept. 20	1199

Name of Firm.	Address.	Acreage.	Certificate Issued.	No. of Certificate.
Pomeroy, Edwin C.	Northville	1	Sept. 29	1209
Quality Seed Store	Stamford	2	Nov. 8	1243
Reck, Julius	Bridgeport	1	Nov. 8	1244
Rockfall Nursery Co. (P. Marotta, Prop.)	Rockfall	10	Aug. 17	1166
Saxe & Floto	Waterbury	1	Sept. 16	1195
Scheepers, Inc., John	Sound Beach	10	Sept. 15	1191
Schleichert, F. C.	Bridgeport	1	Dec. 3	1253
Scott, J. W.	Hartford	5	Nov. 16	1249
Seely, C. H.	Darien	1	Nov. 16	1250
Sierman, C. H.	Hartford	5	Sept. 15	1190
South Wilton Nurseries	South Wilton	5	Aug. 30	1181
Stannard Hill Greenhouse (J. E. Brooks, Prop.)	Westbrook	1	Oct. 20	1227
Steck, Charles A.	Bethel	2	Oct. 13	1222
Stratfield Nursery Co.	Bridgeport	5	Nov. 28	1251
Traendly & Schenck	Rowayton	2	Nov. 5	1239
Upson, R. E.	Marion	1	Sept. 15	1192
Van Wilgen & Co.	Branford	4	Sept. 13	1188
Verkade's Nurseries	New London	8	Oct. 19	1225
Vidbourne & Co., J.	Hartford	7	Sept. 20	1198
Wallace Nursery	Wallingford	2	Oct. 27	1233
Watrous, Arthur J. (2)	Meriden	1	Sept. 29	1212
Wild, Henry	Riverside	2	Sept. 13	1189
Wilson & Co., C. E.	Manchester	18	Sept. 23	1202
Yale University Forest School	New Haven	1	Sept. 22	1201
Young, Mrs. Nellie A.	Pine Orchard	1	Oct. 8	1219
Total acreage		1,632		

INSPECTION OF IMPORTED NURSERY STOCK.

Though there has been a great decrease in the quantity of nursery stock entering Connecticut since Federal Quarantine No. 37 went into effect, in 1919, the amount received in 1921 considerably exceeded that of the preceding year, not only as regards the number of shipments but also the number of cases and plants, as the following figures show:—

Year.	No. of Shipments.	No. of Cases.	No. of Plants.
1920	17	87	814,491
1921	21	126	1,228,560

This stock was nearly all Manetti rose stock though a few cases contained fruit tree seedlings all of which is to be grafted or budded. Most of the inspection work was done by Mr. Zappe, only one shipment being inspected by Mr. Walden. The time required to make these inspections aggregates 185.5 hours or slightly less than a month of 26 working days of seven and one-half hours each. The cost, amounting to $173.13, was paid out of the appropriation for supressing gipsy and brown-tail moths and inspecting imported nursery stock.

The sources of this imported stock were as follows:

SOURCES OF IMPORTED NURSERY STOCK, 1920-1921.

	No. Shipments.	No. Cases.	No. Plants.
France	5	59	641,000
Holland	10	53	400,060
England	6	14	187,500
	21	126	1,228,560

The following table shows the quantity of stock as inspected by months:—

Month.	No. Shipments.	No. Cases.	No. Plants.
December	7	28	307,750
January	9	56	560,565
February	3	32	296,000
March	1	4	27,245
April	1	6	37,000
	21	126	1,228,560

Two shipments (number of cases not given) containing 4,000 plants reached their destination and were unpacked and distributed by the consignee in the belief that they had been inspected at the port of entry, New York City. This was a mistake as the cases there were examined only by the custom house inspectors; but as notice of shipment was not sent to this office until after the stock had been distributed, it was not inspected.

One shipment of two cases and 30,000 plants was reshipped into New York State, and therefore was neither unpacked or inspected in Connecticut.

No attempt was made to inspect bulbs as was done in 1919, as this work is now done by Federal inspectors at the port of entry.

Of the 21 shipments, 10 shipments or 47.6 per cent. were found to contain insects or other animals, or plant diseases, some of which are well-known pests. Details of these infestations are as follows:—

PESTS FOUND ON IMPORTED NURSERY STOCK.

10 Shipments Infested.

INSECTS.

Calophasia lunula Hubn., pupa. (1 shipment) Louis Leroy's Nurseries, Angers, France.

Cryptophagid beetle on Manetti rose. (1 shipment) Louis Leroy's Nurseries, Angers, France.

Emphytus cinctus Linn. (5 shipments) A. M. Gielen, Oudenbosch, Holland; Vincent Lebreton's Nurseries, La Pyramide, France; Louis Leroy's Nurseries, Angers, France; T. Bidersons, Ltd., Farnham, England; King's Acre Nursery, Hereford, England.

Euproctis chrysorrhoea Linn. Brown-tail moth on apple seedlings. (3 shipments) Georges Benard, Orleans, France; Franco-American Seedling Co., Nantes, France.

Nest of Lepidopterous larvae. (1 shipment) Georges Benard, Orleans, France.

VERTEBRATE ANIMALS.

Frog. (1 shipment) A. M. Gielen, Oudenbosch, Holland.

Mice. (1 shipment) A. M. Gielen, Oudenbosch, Holland.

PLANT DISEASES.

Crown Gall on rose. (5 shipments) A. M. Gielen, Oudenbosch, Holland; Georges Benard, Orleans, France; King's Acre Nurseries, Hereford, England; S. Bide & Sons, Ltd., Patenham, England.

INSPECTION OF APIARIES.

This work has been conducted in the same manner as in preceding years, Mr. H. W. Coley of Westport inspecting in Fairfield, New Haven, Middlesex and New London Counties, and Mr. A. W. Yates of Hartford inspecting in Litchfield, Hartford, Tolland and Windham Counties, each being employed at the rate of six dollars per day and expenses.

Though the preceding winter was a mild one, and most bees gathered ample stores in 1920 to carry them through the winter, warm weather came early and started heavy brood rearing; this later led to starvation in unfed colonies which were short of food. This was the apparent cause of the most excessive swarming known in years, resulting in the increased number of colonies per apiary, for the inspections show that the apiaries are larger, the average being 9.2 instead of 6.5 colonies per apiary as in 1920. Thus in 1921, fewer apiaries were inspected than in 1920, yet the number of colonies was much greater, as the following figures show:—

Year.	No. Apiaries.	No. Colonies.	Average No. Colonies per Apiary.
1920	762	4,797	6.5
1921	751	6,972	9.2

In making these inspections, 122 towns were visited as against 119 towns in 1920. No apiaries have ever been inspected in the towns of Union (Tolland County) and Eastford (Windham County).

Inspections were made in the following 28 towns not visited in 1920:

Fairfield County: Bethel, Newtown and Redding. *New Haven County:* Ansonia and Oxford. *Middlesex County:* Killingworth and Portland. *New London County:* Groton, North Stonington, Old Lyme and Stonington. *Litchfield County:* Plymouth. *Hartford County:* Avon, Canton, Manchester, Windsor and Windsor Locks. *Tolland County:* Somers, Stafford, Tolland and Willington. *Windham County:* Ashford, Chaplin, Hampton, Pomfret, Putnam, Thompson and Woodstock.

On the other hand, inspections were made in 1920 in the following 25 towns, not visited in 1921:—

Fairfield County: Bridgeport, Brookfield, Darien, New Fairfield, Sherman and Weston. *New Haven County:* Bethany and East Haven. *New London County:* Colchester, Griswold and Voluntown. *Litchfield County:* Bridgewater, Canaan, Cornwall, Goshen, New Milford, Norfolk, North Canaan, Roxbury, Salisbury, Sharon and Torrington. *Hartford County:* Bloomfield, Hartland and Rocky Hill.

European foul brood has decreased each year since the inspection service was established in 1909, and in 1921 the percentage of infested apiaries was 3.99 instead of 4.3 in 1920. In 1921 this disease was found in the following 21 towns:

Fairfield County: Greenwich, New Canaan and Stamford. *New Haven County:* Cheshire, Hamden, New Haven, North Haven, Prospect and Wallingford. *Middlesex County:* Durham, Middletown and Saybrook. *New London County:* Old Lyme. *Litchfield County:* Thomaston. *Hartford County:* Manchester, New Britain, Southington and Windsor Locks. *Tolland County:* Coventry and Mansfield. *Windham County:* Pomfret.

American foul brood was present in 2.5 per cent. of the apiaries visited, and in .56 per cent. of the colonies as against 1.18 per cent. and .25 per cent. respectively for 1920. It appeared in 1921 in the following 11 towns:—

Fairfield County: Greenwich and Stamford. *New Haven County:* Derby, Hamden and Wallingford. *Middlesex County:* Durham. *New London County:* East Lyme. *Litchfield County:* Washington. *Hartford County:* Bristol and Simsbury. *Tolland County:* Mansfield.

The statistics of the apiaries inspected in 1921 in each of the 122 towns visited, are arranged by counties in the following pages, and summarized on page 131.

APIARIES INSPECTED IN 1921.

	No. Apiaries Inspected.	No. Apiaries Diseased.	No. Colonies Inspected.	No. Colonies Diseased.
Fairfield County:				
Bethel	9	0	65	0
Danbury	3	0	108	0
Easton	3	0	118	0
Fairfield	5	0	63	0
Greenwich	10	2	54	5**
Monroe	4	0	90	0
New Canaan	5	1	57	8†
Newtown	1	0	44	0
Norwalk	5	0	67	0
Redding	3	0	40	0
Ridgefield	2	0	44	0
Shelton	2	0	55	0
Stamford	21	3	263	5***
Stratford	2	0	26	0
Trumbull	4	1	45	1‡
Westport	6	0	80	0
Wilton	1	0	18	0
	86	7	1,237	19

†European Foul Brood.
**3 American Foul Brood and 2 European Foul Brood.
***3 American Foul Brood and 2 Sacbrood. ‡Sacbrood.

	No. Apiaries Inspected.	No. Apiaries Diseased.	No. Colonies Inspected.	No. Colonies Diseased.
New Haven County:				
Ansonia	4	0	27	0
Beacon Falls	1	0	22	0
Branford	4	1	31	1‡
Cheshire	4	2	44	4†
Derby	5	1	70	1*
Guilford	2	1	39	2‡
Hamden	5	2	36	3**
Madison	5	0	26	0
Meriden	26	0	215	0
Middlebury	1	0	40	0
Milford	1	0	45	0
Naugatuck	7	0	61	0
New Haven	5	2	42	9†
North Haven	5	1	55	25†
Oxford	1	0	12	0
Prospect	5	3	79	4†
Seymour	1	0	22	0
Wallingford	26	10	149	23***
Waterbury	7	0	49	0
Woodbridge	2	0	40	0
	117	23	1,104	72
Middlesex County:				
Chester	5	0	41	0
Clinton	3	0	29	0
Cromwell	6	1	39	1‡
Durham	8	3	159	6****
East Haddam	1	0	12	0
Essex	2	0	30	0
Haddam	3	0	26	0
Killingworth	2	0	11	0
Middlefield	4	0	55	0
Middletown	7	2	97	3†
Old Saybrook	2	0	28	0
Portland	6	0	9	0
Saybrook	3	1	13	1†
Westbrook	1	0	8	0
	53	7	557	11
New London County:				
Bozrah	2	0	22	0
East Lyme	3	1	48	3*
Franklin	4	0	29	0
Groton	5	0	26	0
Lebanon	2	1	21	1‡
Lisbon	1	0	12	0
Montville	1	0	4	0
New London	7	1	77	1‡

*American Foul Brood.
**2 American Foul Brood and 1 European Foul Brood.
***14 American Foul Brood and 9 European Foul Brood.
**** 3 American Foul Brood and 3 European Foul Brood.

	No. Apiaries Inspected.	Diseased.	No. Colonies Inspected.	Diseased.
North Stonington	1	0	3	0
Norwich	10	0	510	0
Old Lyme	3	1	43	2†
Preston	2	0	8	0
Stonington	1	0	16	0
Waterford	4	0	29	0
	46	4	848	7
Litchfield County:				
Barkhamsted	3	0	71	0
Colebrook	2	0	13	0
Harwinton	1	0	6	0
Litchfield	1	0	10	0
Morris	4	0	32	0
New Hartford	1	0	6	0
Plymouth	4	0	7	0
Thomaston	14	1	97	1†
Washington	5	1	163	4*
Watertown	13	0	88	0
Winchester	17	0	88	0
	65	2	581	5
Hartford County:				
Avon	1	0	10	0
Berlin	21	1	187	1‖
Bristol	5	1	38	3*
Burlington	2	0	15	0
Canton	7	0	70	0
East Granby	8	0	43	0
East Hartford	12	0	75	0
East Windsor	11	0	110	0
Enfield	8	0	47	0
Farmington	17	0	90	0
Glastonbury	25	0	125	0
Granby	6	0	59	0
Hartford	23	0	130	0
Manchester	19	2	134	6†
Marlborough	2	0	32	0
New Britain	16	1	134	1†
Newington	8	0	78	0
Plainville	2	0	7	0
Simsbury	9	2	57	2*
Southington	16	1	153	1†
South Windsor	1	0	5	0
Suffield	8	0	66	0
West Hartford	21	0	118	0
Wethersfield	12	1	76	1‡
Windsor	17	0	102	0
Windsor Locks	2	1	14	1†
	279	10	1,975	16

‖Paralysis.

	No. Apiaries Inspected.	Diseased.	No. Colonies Inspected.	Diseased.
Tolland County:				
Andover	2	0	15	0
Bolton	3	0	16	0
Columbia	1	0	5	0
Coventry	8	1	83	1†
Ellington	15	0	73	0
Hebron	1	0	6	0
Mansfield	7	2	76	3**
Somers	5	0	29	0
Stafford	8	0	23	0
Tolland	4	0	27	0
Vernon	1	0	1	0
Willington	11	0	52	0
	66	3	406	4
Windham County:				
Ashford	1	0	8	0
Chaplin	1	0	5	0
Hampton	1	0	5	0
Pomfret	14	2	89	5†
Putnam	5	0	37	0
Thompson	8	0	42	0
Windham	3	0	39	0
Woodstock	6	0	39	0
	39	2	264	5

Summary.

County.	No. of Towns.	No. Apiaries. Inspected.	Diseased.	No. Colonies Inspected.	Diseased.
Fairfield	17	86	7	1,237	19
New Haven	20	117	23	1,104	72
Middlesex	14	53	7	557	11
New London	14	46	4	848	7
Litchfield	11	65	2	581	5
Hartford	26	279	10	1,975	16
Tolland	12	66	3	406	4
Windham	8	39	2	264	5
	122	751	58	6,972	139

	No. Apiaries.	No. Colonies.
Inspected	751	6,972
Infested with European foul brood	30	88
Per cent. infested	3.99	1.26
Infested with American foul brood	19	39
Per cent. infested	2.5	.56
Sacbrood	8	11
Bee paralysis	1	1
Average number of colonies per apiary		9.2
Cost of inspection		$1,981.70
Average cost per apiary		$2.638
Average cost per colony		.24

**1 American Foul Brood and 1 with 1 colony Sacbrood and 1 European Foul Brood.

REPORT OF GIPSY MOTH WORK.

Season of 1920-1921.

By John T. Ashworth and W. E. Britton.

The policy pursued in former years has been continued in work against the gipsy moth. The co-operation between our men and those of the Federal Bureau of Entomology has been most satisfactory and has resulted in greater effectiveness than would be the case if any other system were followed. In general the Federal men have scouted those towns along the border of the infested territory to prevent further spread, while most of the State appropriation has been expended in the towns which were known to be infested.

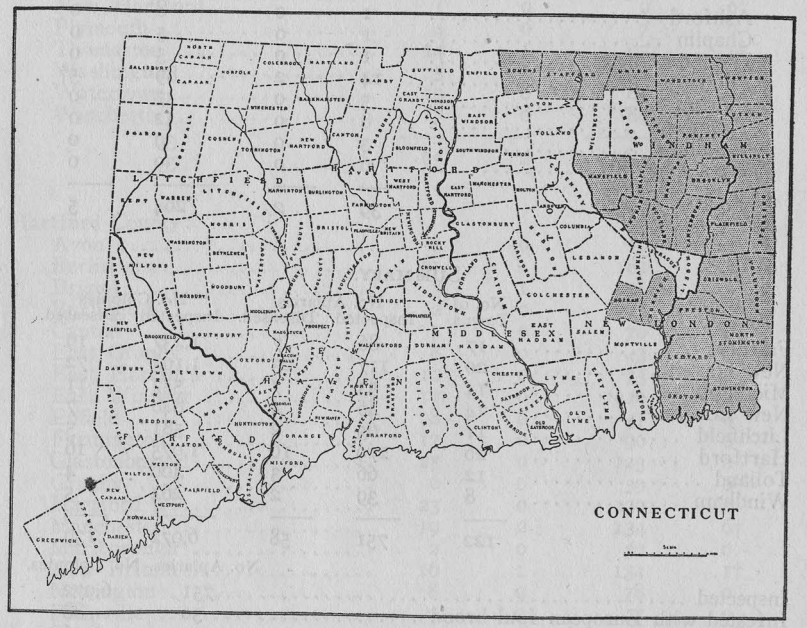

Figure 1. Map of Connecticut showing area now quarantined on account of the gipsy moth.

Mr. Ashworth was promoted to the position of deputy in charge of moth work, in place of Mr. Davis who resigned in June 1920, and has been in immediate charge of all field work. Mr. James A. McEvoy was promoted to the place of Assistant formerly held by Mr. Ashworth.

Infestations were found for the first time in the towns of Somers and Stafford. Mansfield, Windham, Groton and Stonington, which were formerly infested, were not found infested in 1919-1920. Infestations have formerly occurred in Franklin and Sprague, but nothing was found in these towns in 1920. The quarantined area is shown on the accompanying map (see figure 1).

As in former years, single egg-clusters were not counted as infestations in the older and more heavily infested towns, but have been included in the border towns.

All of the work described in this report relates to the gipsy moth. The brown-tail moth has been very scarce for the past few years; though a watch has been kept for infestations, none were found and no control measures are needed at present in Connecticut.

New Equipment.

During the season of 1920-1921 some of the old equipment has been replaced by new. The Ford car that was converted into a truck in 1918, also the two purchased in 1919, were exchanged for two new Ford trucks with delivery bodies.

The Buick touring car bought in 1919, having been driven over 27,000 miles at a cost of about $30.00 for renewed parts, and quite a large outlay being needed in the near future, it was thought an act of economy to turn it in, and purchase a new one, which was done; this brings the motor equipment of the commission up to a high standard for the coming year.

One thousand feet of rubber-covered one-inch spraying hose was also purchased from the Acme Rubber Company of Boston, Mass., it being the policy of those in charge to renew some of the hose each year so as to keep a certain amount of hose on hand; no suction hose was bought as it was thought there was enough on hand at present.

Details of Gipsy Moth Work by Towns.

The following pages give a detailed account of the conditions in each town in the infested area:

Thompson—119 Infestations—2,605 Egg-clusters.

In scouting Thompson this season an agreeable surprise was met as we expected, on account of the deep snow of last year, to find an increase in the number of infestations this year; but instead there was a drop of 15 colonies and 1,737 egg-clusters. However, with this substantial drop, Thompson is still the most heavily infested town in the State.

Scouting was started in Thompson the last of December and finished the first of February, two crews working, one in the eastern and one in the western half of the town. The town is generally

infested throughout, although the northern part adjoining Massachusetts is more heavily infested. There were no very large colonies, but three may be noted as being the largest in the town. The first contained 96 egg-clusters, and was on land owned by the Grosvenordale Mill Co., and is situated on woodland about one-half mile northwest of the mill at Grosvenordale. The second contained 93 egg-clusters, on land owned by L. A. Logee, and situated about one mile west of the lower end of Quadick Reservoir, three apple trees and a stone wall being infested. The third contained 88 egg-clusters, and was on land situated on north side of railroad about three-quarters of a mile west of the road known as the Brandy Hill road, owned by E. C. Bixby. Of these colonies, 90 were sprayed by State crews during June.

Woodstock—33 Infestations—862 Egg-clusters.

The number of infestations in Woodstock was smaller this year than last, although the number of egg-clusters was nearly as great, there being a larger number of single egg-clusters located this year than ever before. This is due to the high winds of last spring. There were only two colonies large enough to mention, one containing 79 egg-masses on two large oaks in a pasture owned by H. I. Hibbard and located about one mile north of the North Woodstock store on the road to Southbridge, Mass., and about 50 yards west of the road. The second was located on land owned by Mr. Anderson just southeast of the Woodstock Fair grounds and consisted of 94 egg-masses on six oaks in a pasture. Twenty-seven of these infestations were sprayed during May and June, 51,400 gallons of poison liquid being used.

Union—32 Infestations—35 Egg-clusters.

Union was scouted by State men this year during April, and 32 infestations were found. All but two of these were single egg-clusters, and were scattered over the entire town. This condition is accounted for by the fact that there was a general wind spread to the west in Massachusetts, New Hampshire and Vermont last spring. The southern end of the spread seemed to end in northern Connecticut, as in the southern portion no trace of the gipsy moth was found west of Groton. No spraying was done in Union as it was thought unnecessary.

Stafford—11 Infestations—12 Egg-clusters.

Stafford was only partly scouted this year, as the men had to be withdrawn before the work was completed. In fact, the larvae were hatched, and feeding, before this was done. However the entire northern half of the town was covered. In all, about 54

miles of roadway were scouted. The result of this work was the finding of 11 colonies, all of which were single egg-masses except one. This contained two egg-masses, and was located in an apple orchard owned by Fred Bonden, situated about a quarter of a mile from the Massachusetts line, in the extreme northeastern corner of the town. Two of the colonies were sprayed by State men during June, as larvae were found feeding at these colonies.

Somers—2 Infestations—2 Egg-clusters.

Somers was the last town to be finished during the scouting season, Federal men doing the work. Two colonies of one egg-cluster each were found. At the one found in the orchard owned by C. H. Withington, larvae were found feeding, so a crew of State men were sent there and the colony was sprayed, 100 gallons of poison being used, after which no trace of the pest was found during the remainder of the season.

Putnam—37 Infestations—877 Egg-clusters.

Last year Putnam was scouted by men on snow-shoes, the snow in some places being so deep that they had no difficulty in going across country, as they could easily step over fences and walls. Therefore it can easily be seen that many egg-clusters were hidden from sight, and this condition explained the increase of colonies in Putnam. Most of these colonies are small, and the old (or hatched) egg-clusters were below the snow-line. Only three colonies are large enough to mention, the first being on land owned by George Page and located in some oak and apple trees, and stone walls in a pasture situated about half way between the Foster Hill road and State road from Putnam to Danielson, and contained 102 egg-clusters. The second contained 87 egg-clusters, and was found in woodland owned by Warren Bradway, near the Thompson line about two miles east of the Windham County Children's Home. The third contained 56 egg-clusters and was in woodland owned by Leverett Burrell about one mile northeast of East Putnam four corners. Thirty-five of the 37 colonies were sprayed during June by State men, and after spraying 189 larvae were found and destroyed.

Pomfret—8 Infestations—188 Egg-clusters.

Pomfret was scouted during November and December, only eight colonies of five egg-clusters or more each being found. Of these only two are large enough to mention, the first contained 56 egg-clusters. Fifty-three of them were old ones. All the egg-clusters at this colony were in a stone wall near a scrub apple tree in a pasture owned by H. Anderson, situated on the north side of the

road known as the Pomfret Landing road. It was very fortunate that the scout turned over a stone at the foot of the apple tree, as there was a pupa case on the under side of the stone, which led to the discovery of this colony. There was no trace of the gipsy moth on the trees or brush around there, but on looking over the wall the men found 56 egg-clusters. The second contained 23 egg-clusters and was in an old apple tree on land owned by Louis Daigle, situated in the northeast corner of the town, about one and one-half miles from the Putnam and Woodstock line. Five of the eight colonies were sprayed in the early part of May, and in looking over the colonies after spraying, seven of the 52 larvae found in the town were found and destroyed.

Eastford—6 Infestations—120 Egg-clusters.

Eastford was the first town scouted by the State men this year. The work was completed November 3d, a total of six infestations containing 101 egg-clusters, also 19 singles were discovered. Of these colonies only one is considered dangerous, that being the one on land owned by Mr. William Warren in woodland on the north side of the road leading east from the cemetery on State road from Phoenixville to Eastford, and containing 28 egg-clusters. The infested area this year is all in the northeastern part of the town or within two and one-half miles of Eastford Post Office. Only three single egg-clusters were found north of Crystal Pond. These were near the village of North Ashford, and in the section south of Phoenixville no trace of the gipsy moth was found. Five of the six colonies were sprayed during May.

Ashford—10 Infestations—13 Egg-clusters.

Ashford was scouted by State scouts the last of April and the first of May. Ten colonies were found, seven of these containing one egg-cluster each, and the other three had two egg-clusters each, all of which were new. This fact, as in other towns, is laid to the high northeast winds during the hatching season of 1920. No spraying was done as the men could not find any larvae, and it was not thought necessary.

Killingly—46 Infestations—653 Egg-clusters.

Killingly was scouted during the latter part of March and the first of April by State crews, two crews being used, one in the northern and one in the southern half of the town.

The results of scouting this year show a drop to less than half the number of egg-masses found last season. The whole town is generally infested throughout, and although no large colonies were discovered, three might be mentioned. The first and second are in woodland owned by John Kussino and Mrs. Cora Shekelton,

respectively, and located in the extreme northeastern corner of the town. The first contained 84 egg-clusters and the second 88 egg-clusters. The third colony was on land owned by T. E. Hopkins and contained 52 egg-masses. This colony was in woodland located on the south side of the old Hartford and Providence Turnpike, via East Killingly.

Forty-four of the colonies were sprayed during May and June; 6,505 larvae were destroyed in Killingly this year, very few of which were found after spraying.

Brooklyn—14 Infestations—232 Egg-clusters.

Brooklyn was scouted by State men this year as in previous years, and no large colonies were located, as can be seen by the large decrease in egg-clusters from the season of 1919, a drop of more than 50% in the total number of egg-clusters found. The infestations are all small and are distributed over the entire town. The largest is one of 29 egg-clusters, and is located on land owned by Mr. Oscar Atwood, situated on the top of Tatnic Hill. This colony is spread over about six acres, in which the brush and small trees have been cut and burned during the past two seasons. Twelve of the colonies were sprayed during the latter part of May by a State crew. One thousand, one hundred and eleven larvae were found in the town, 1,094 being located before spraying and 17 afterwards.

Hampton—4 Infestations—11 Egg-clusters.

State men scouted about two-thirds of this town, then as the eggs hatched early and larvae were crawling, the scouting work was stopped, and the men began applying tanglefoot bands. Four colonies were located, all small, the largest one contained six egg-masses and found on land owned by J. W. Cartwight, about one-half mile west of Hampton village. Two of the colonies were sprayed during June by Federal men.

Chaplin—6 Infestations—35 Egg-clusters.

Chaplin was scouted by Federal scouts this year during the early winter, and six colonies were found. Two of these are worthy of mention. One (Number 2) was in woodland owned by C. W. Morey of Hampton, and situated in the northeastern corner of the town, east of the Natchaug River. This colony contained 23 egg-clusters. The other (Number 3) was in woodland owned by H. H. Darling, about two miles north of the Chaplin Post Office, on the east side of the Ashford road; six egg-masses were found here. Two other colonies of two egg-masses each were also found. These four colonies were sprayed by Federal men in early June.

Mansfield—6 Infestations—5 Egg-clusters—1 Pupa.

Mansfield was scouted by Federal scouts. Six colonies were located, all of which were single egg-clusters except one, that being the one found in an orchard at the Connecticut Agricultural College, and consisted of one female pupa case.

During the month of June, State men went to Mansfield and visited these colonies and found larvae feeding at the colony on land owned by I. J. Wilcox at Merrow Station. One of the State sprayer trucks was sent out and sprayed the territory around this section, and no trace of the pest has been found there since.

Sterling—11 Infestations—139 Egg-clusters.

The scouting in Sterling was completed on December 18, by State men. Eleven infestations containing 92 egg-clusters, and 47 single egg-clusters, making a total of 139 egg-clusters, were found and destroyed. No large colony was found in the town, the largest containing only 16 egg-clusters, and was on land owned by Carl Gallup in the southwest corner of the town, near the Plainfield line. Although only 11 colonies were found, these and the singles were scattered over the entire town. At most of the colonies the trees were banded with tree tanglefoot as they were on high, wind-swept ground, and all of the colonies in Sterling were sprayed during the first of May by State crews. In all, 50 larvae were found and destroyed both before and after spraying.

Plainfield—26 Infestations—368 Egg-clusters.

Scouting was started the last of January and completed the first of March. Twenty-six colonies of five egg-clusters or more each, were located. None are large or dangerous. There are only two that contain over 25 egg-clusters, Number 6 and 7. Number 6 had 48 egg-clusters and was in an apple orchard owned by A. Dearnley and situated in the eastern edge of Plainfield village. Number 7 contained 27 egg-clusters in apple and shade trees on land owned by Edward Pike in Plainfield village.

The territory infested in Plainfield this year was mostly a belt across the entire town extending from Moosup west to the Canterbury line, at what is known as the Black Hill district, although there are two other small groups, one in the northwestern corner and another in the village of Plainfield. One hundred and ninety-four trees at the colonies most open to wind-spread were banded with tanglefoot, and during the latter part of May all but one of the 26 colonies were sprayed by State men. Six thousand, two hundred and three larvae were found and destroyed during the season, only 67 of which were found after spraying.

Canterbury—6 Infestations—127 Egg-clusters.

The scouting of Canterbury was completed on November 12 by State men. The colonies this year are practically in two groups, one in the southwest corner or the Woodchuck Hill district, and the other in the northwest section, near the Hampton line. The first group contained the largest colony found in the town, 51 egg-clusters, and was located in an old apple tree on land owned by Fred L. Hyde. This tree has been pruned and the brush cut and burned. Only three single egg-clusters were found in the eastern half of the town, these being near the Brooklyn line. None of the colonies are considered very dangerous. Thirty-three tanglefoot bands were used at the colonies where it was thought necessary, and during the middle of May, five of the colonies were sprayed.

Scotland—2 Infestations—2 Egg-clusters.

Scotland was scouted by Federal scouts, only two colonies of one egg-cluster each being located, one in the northeastern corner of the town, near the Hampton line, and the other about the center of the Scotland-Windham town line. No spraying was done in this town, but a close watch was kept of the colonies during larva season.

Windham—1 Infestation—1 Egg-cluster.

Windham was scouted by Federal men, one single egg-cluster being located in an apple tree on land owned by Mrs. Francis Campbell, situated in Windham Center, on road to South Windham. It was not thought necessary to spray here, but a close watch was kept of the colony during the summer season.

Voluntown—3 Infestations—45 Egg-clusters.

Voluntown was scouted this year by a State crew during February and the early part of March. All three colonies were found in the southern half of the town, the largest one containing only 23 egg-clusters, in woodland owned by L. B. and F. P. Kinne, situated about two miles south of Voluntown village and near the Griswold line. All three of the colonies were sprayed by State men in May, and in looking over the work during July, only one dead larva was found.

Griswold—7 Infestations—7 Egg-clusters.

Griswold was scouted by State men this year, during the last of March and the first of April. Seven colonies of one egg-

cluster each, were discovered. No spraying was done, as it was not thought necessary.

Preston—5 Infestations—11 Egg-clusters.

Federal men scouted most of Preston during the latter part of December and the first of January. Lack of funds compelled the stopping of the work on January 15. The work was taken up and completed by State men in March. A total of five colonies containing 11 egg-clusters was the result. Of these only one, containing six egg-masses, was thought serious enough for mention. This colony was in woodland owned by Albert Benjamin about two miles southeast of Long Society. This colony and another on land owned by Charles Prue, near Amos Lake, were sprayed the latter part of May by Federal men. Since spraying, the colonies have been inspected and no living larvae, but one dead one, found.

Norwich—5 Infestations—17 Egg-clusters.

Norwich was scouted by State men this year, five colonies being discovered. Two of these are worthy of mention. The first contained eight egg-clusters and was located on an oak on land owned by Charles O'Neill, situated about one mile west of what is known as East Great Plain. The second contained five egg-masses, and was on a large oak on land owned by Mrs. William B. Wilcox, situated about a mile and a half north of the Norwich Reservoir. These two and two others were sprayed during the first of June by a Federal crew.

Lisbon, Sprague, Bozrah, Franklin.

These towns were scouted by Federal crews and no trace of the gipsy moth was found.

North Stonington—9 Infestations—26 Egg-clusters.

North Stonington was scouted by Federal men in December and January. Nine infestations containing 26 egg-clusters were discovered, six of them being single egg-cluster infestations. The other three are described as follows: one contained three egg-clusters and was in an orchard owned by Frank Minor, situated about two and one-half miles west of the North Stonington Post Office, on the road to Ledyard. The second contained 10 egg-clusters, and was in an orchard owned by Dorice G. Lewis, situated in the southeast corner of the town, about a quarter of a mile from the Westerly, R. I., town line. The third was on an oak in a pasture owned by George Brown, situated near the west end of

Spalding Pond, and contained seven egg-clusters. The three colonies mentioned were banded, and sprayed in the summer by a Government sprayer.

Ledyard—3 Infestations—20 Egg-clusters.

As in the case of Preston, Ledyard was partly scouted by Federal men and finished by State men. The result was the finding of three colonies with a total of 20 egg-masses. Two of the colonies contained more than one egg-cluster each. The first was found in an orchard owned by A. J. Sheldon, on a high ridge just east of Rose Hill. This colony contained 17 egg-masses. The other colony was found in an orchard owned by F. Green situated on the west side of the road running north from Vinegar Hill, and contained two egg-masses. Both of the above-mentioned colonies were sprayed during May by Federal men.

Stonington—20 Infestations—29 Egg-clusters.

Stonington was scouted by Federal men. Twenty colonies were discovered, 18 of these being of one egg-cluster each, but as several of them were broken, the colonies were visited by State men during the larva season and close watch kept for signs of feeding and larvae. The largest of the other two colonies was found in an orchard owned by C. R. Johnson, situated on the road running over Hinkley Hill, about a mile west from the State line, and contained seven egg-masses. The other contained four egg-masses, and was in an apple tree on land owned by Harry Mitchell at 19 Mass St., Stillmanville. Both of these colonies were sprayed by Federal men, as was also one of the single egg-cluster colonies, where larvae had been located by State men.

Groton—11 Infestations—13 Egg-clusters.

Groton was partly scouted by Federal men in the early winter, about 15 miles of road being done by them. Later State men were sent to finish the town, and discovered 11 infestations, all except one of them being singles. This one consisted of three egg-clusters in white oaks and stone wall, on land owned by Carl Willis, and situated about a mile northwest of Pequot Hill. This colony was sprayed by Federal men the latter part of May.

New London—No Infestations—No Egg-clusters.

New London was scouted by State men during the latter part of March, and no trace of the gipsy moth found.

Waterford—No Infestations—No Egg-clusters.

Owing to the early season this year Waterford was not fully

scouted. About half (the eastern half) was scouted by State men during the last of March and the first of April, and so not having found any trace of the gipsy moth, the men were moved north.

Montville—No Infestations—No Egg-clusters.

As in the case of Waterford, Montville was only partly scouted this year. A line was drawn north and south through the town west of the village of Fair Oaks, and the territory east of that line was scouted by State men. No trace of the gipsy moth was located in this section of the town.

STATISTICS OF INFESTATIONS.

Town	No. of Infestations found	No. of Egg-Clusters destroyed	No. Tangle-foot bands applied	No. Colonies sprayed	Lead-arsenate used, lbs.	No. Larvae killed
Thompson	119	2,605	0	90	2,301	132
Woodstock	33	862	0	27	503¼	1,848
Union	32	35	0	0	0	6
Putnam	37	877	51	35	624¼	189
Killingly	46	653	174	44	981¼	6,505
Pomfret	8	188	61	5	94	52
Eastford	6	120	64	5	89	383
Brooklyn	14	232	177	12	234	1,111
Hampton	4	11	71	3	37¾	27
Ashford	10	13	0	0	0	0
Sterling	11	139	146	11	172	50
Plainfield	26	368	194	25	318½	6,203
Canterbury	6	127	33	5	81¼	577
Scotland	2	2	0	0	0	1
Windham	1	1	0	0	0	0
Chaplin	6	35	35	4	125	11
Mansfield	6	5 & 1 pupa	0	1	31	15
Voluntown	3	45	0	3	56¼	1 dead
Griswold	7	7	0	0	0	0
Preston	5	11	16	2	25	1 dead
Ledyard	3	20	27	2	6¼	357
Norwich	5	17	5	4	25	9
North Stonington	9	26	21	3	87½	24
Stonington	20	29	32	3	25	50
Groton	11	13	68	1	12½	0
New London	0	0	0	0	0	0
Waterford	0	0	0	0	0	0
Montville	0	0	0	0	0	0
Stafford	11	12	0	2	4	20
Somers	2	2	0	1	6¼	25
Lisbon	0	0	0	0	0	0
Sprague	0	0	0	0	0	0
Bozrah	0	0	0	0	0	0
Franklin	0	0	0	0	0	0
27 Towns Infested	443	6,455*	1,175	288	5,840	17,597

*Plus one pupa.

In comparing the statistics in the foregoing table, with corresponding figures for last year, it will be seen that the number of infestations, number sprayed, and number of larvae destroyed, are somewhat greater, though the number of egg-clusters destroyed is less than last year. It will be seen that no infestations were found in the towns of New London, Waterford, Montville, Lisbon, Sprague, Bozrah and Franklin, though Bozrah was infested last year and is still included in the quarantined area shown in figure 1.

The newly infested towns of Somers and Stafford adjoin Massachusetts, and the pest has spread into these towns from Massachusetts.

The following table gives the grand totals of the statistics of the infestations for the past five years:—

TOTALS OF THE INFESTATIONS FOR FIVE-YEAR PERIOD.

Year	Total No. of Infestations	No. of Egg-Clusters Destroyed	No. Tanglefoot Bands Applied	No. of Infestations Sprayed	No. of Larvae Destroyed
1916	210	3,135	13,165	60	31,671
1917	1,257	6,182	17,690	91	37,800
1918	870	18,393	3,298	392	2,852
1919	312	8,144	3,044	212	12,188
1920	350	9,224	2,314	236	7,612
1921	443	6,455	1,175	288	17,597

PARASITES.

A full account of the parasites colonized in Connecticut may be found in the Report of this Station for 1920, page 162. As mentioned therein, it is the policy of those in charge of control work in the State to liberate parasites or natural enemies in sections of the State where there is infestation enough to warrant it. This year, through the courtesy and co-operation of Mr. S. S. Crossman of the Federal laboratory at Melrose, Mass., we were enabled to liberate another egg parasite, *Schedius kuvanae* How., in the northeastern part of the State. The following table gives the names of the towns, and number of parasites liberated in each:

Thompson,	768,000
Putnam,	386,465
Woodstock,	337,960
Killingly,	106,350

These figures show a total of 1,598,775 of these little workers which were liberated in the most thickly infested territory in the State. Although very minute they are very active. It was reported by Mr. McEvoy, who liberated them, that as soon as free, they started to work immediately on egg-masses in the immediate vicinity, 81 being counted on one egg-cluster. From observa-

tions and statistics gathered in the southern part of Massachusetts, an average of 40 per cent. of the eggs gathered in five towns were parasitized, so great things are expected of this parasite.

Financial Statement.

RECEIPTS.

Appropriation for biennial period ending June 30, 1921		$70,000.00
Expended, year ending June 30, 1920	$33,081.11	
Transferred to Insect Pest Account by Board of Control	321.23	33,402.34
Amount available for year		$36,597.66

CLASSIFIED EXPENDITURES FOR THE YEAR ENDING JUNE 30, 1921.

Salaries and Wages:		
John T. Ashworth	$1,800.00	
J. A. McEvoy	1,500.00	
K. E. Buffington	1,316.60	
F. C. Rich	1,206.44	
W. P. Colvin	1,136.40	
C. W. Roth	1,067.90	
J. W. Longo	995.63	
D. La Belle	983.39	
A. J. Gilbert	982.16	
R. G. Newton	980.10	
T. J. Perreault	952.53	
E. Fortin	941.47	
J. W. Thomas	938.60	
D. J. Mondor	898.32	
H. F. Wheeler	879.28	
H. Sweet	697.32	
H. Woodmancy	680.48	
J. H. Higgins	672.56	
H. E. Cook	658.96	
O. Fortin	650.68	
R. A. Spencer	456.56	
J. L. Knight	391.04	
R. Franklin	358.35	
J. Mills	324.60	
Other Labor	4,011.78	
		$25,481.15
Printing and Illustrations		19.74
Postage		11.77
Stationery		2.47
Telegraph and Telephone		6.55
Office Supplies		64.05
Express, Freight and Cartage		92.96
Machinery, Tools and Supplies		2,461.81
Insurance		861.37
Rental and Storage		313.50
Traveling Expenses, Gasoline, Oil, etc.		1,877.43
Automobile Repairs, Tires, etc.		3,762.05
Inspection of Imported Nursery Stock		173.13
Heat and Light		47.77
Miscellaneous		12.75
Total		$35,188.50
Balance, unexpended		$1,409.16

Quarantine Inspections.

Federal quarantines have been established over the infested territory as is shown by the accompanying map, figure 1, page 132. All nursery stock, forest and quarry products shipped from the quarantined area outside of the area into other states must be inspected and certified by Federal inspectors. This applies only to interstate shipments.

In 1920, the State of Connecticut established quarantines on the same area that is covered by the Federal quarantines, so that nursery stock and forest products going from the infested area into uninfested parts of the State, cannot be shipped unless inspected and certified as with the interstate shipments. The Federal inspectors have made most of the inspections, and there have been 527 shipments of forest products and 23 of nursery stock inspected and certified. The present law gives no authority for quarantining quarry products.

NOTES ON THE EUROPEAN RED MITE.

Paratetranychus pilosus C. & F.

By Philip Garman, Ph.D.

In the spring of 1921 a number of spray materials were tested for control of the European red mite in the egg stage. A general report of the work was given by Dr. Britton in Bulletin of Immediate Information Number 13. More complete records are given herein together with a few observations on the habits of the mite which appear to be important.

Eggs began hatching in the field April 13, 1921, at which time apple leaves were about one inch long and the delayed dormant sprays had been applied in most orchards. Mites from eggs which hatched April 13 were observed frequently until May 12, 1921. On May 9 adult males and females were seen, but no eggs. On May 12, the mites began to deposit eggs. Here was a period of a month before egg-laying began. The time for the pink bud application fell about April 21 in 1921, and if applied at this time would have had considerable value in killing the mites. If made later in the season, nicotine-lime-sulphur sprays are less effective unless repeated several times, because of the presence of eggs. Sprays applied then are less likely to be thorough because of increased foliage and are more costly since more spray is required. This is confirmed in part by field tests made in 1920.[1]

An unexpected turn of affairs became evident in early summer, 1921, when it was found that orchards in which the mites had been particularly destructive in 1920, had few, whereas in other orchards, having few in 1920, they became abundant: and this in spite of spraying operations or the lack of them. Such a condition may be attributed to adverse weather conditions which included a rather dry fall, mild winter and early spring with continued cool weather until June; or it may be due to the appearance of numbers of predaceous mites in 1920. The latter is a more plausible explanation in view of the fact that red mites were abundant in 1921 in orchards where they were not numerous in 1920. These orchards might easily have had fewer predaceous enemies than the more heavily infested ones, but they could not easily have been subjected to different weather conditions.

The tests tabulated below were conducted in the laboratory, the twigs being kept in moist jars, and were checked with similar tests in which the twigs were hung outside in the branches of a small apple tree. Twigs with eggs were selected, cut into short lengths, examined with a binocular and clear or dead eggs removed with a needle. The twigs were then dipped in or sprayed with the desired solution.

[1] Report Conn. Agr. Expt. Station for 1920, page 189.

In the tables, the names of a number of proprietary compounds appear, and the following explanation in regard to their general composition and source is necessary. Such compounds as lime-sulphur, B. T. S., and Scalecide are too well known to need comment.

"Jarvis Compound."—A miscible oil containing phenol; manufacturer J. T. Robertson; obtained from Apothecaries Hall Co., Waterbury, Conn.

"Kero-spray."—A commercial kerosene emulsion; manufacturer, Kero-Spray Co., 198 9th St., Jersey City, N. J.

"Keresol."—An oil spray containing 70 per cent. kerosene; obtained from Mr. A. A. Claasen, Mascher and Turner Streets, Philadelphia, Pa; effect of spray on trees unknown.

"Sulco V. B."—A spray containing fish-oil and small per cent. phenol; manufactured by Cook & Swan Co., 148 Front St., New York; obtained from Apothecaries Hall Co., Waterbury; effect on apple trees unknown, probably safe.

"Wormol."—A miscible oil recommended for use against peach borers by the General Chemical Company; obtained from General Chemical Company, 25 Broad St., New York , N. Y.; effect upon apple trees unknown.

Tables Showing Results of Treating Eggs of European Red Mite With Different Insecticides.

TABLE I.

Exp. No.	Treatment	Total Number of Eggs Used	Number Hatched	Per Cent. Hatched	Date Treated	Date Examined
1.	Kerosene emulsion (10 per cent. kerosene)	660	402	60.9	Mar. 16	Apr. 29
2.	Kero-spray 1 part-25 parts water	298	166	56.0	"	"
3.	Sulco V. B. 1 part-25 parts water	502	255	50.7	"	"
4.	Keresol 1 part-18 parts water	442	265	59.9	"	"
5.	Jarvis Compound 1 part-15 parts water	104	6	5.7	"	"
6.	Scalecide 1 part-15 parts water	237	22	9.2	"	"
7.	Lime-sulphur 1 part-9 parts water	652	253	38.8	"	"
8.	Dry lime-sulphur 12 lbs.-50 gals. water	418	125	29.9	"	"
9.	B. T. S. 12 lbs.-50 gals. water	349	162	46.4	"	"
10.	Scalecide 1 part-25 parts water	341	115	33.7	"	"
11.	Check no treatment	265	151	56.9	"	"
12.	Scalecide 1 part-15 parts water	150	8	5.3	Apr. 7	Apr. 29

Exp. No.	Treatment	Total Number of Eggs Used	Number Hatched	Per Cent. Hatched	Date Treated	Date Examined
13.	Scalecide 1 part-15 parts water	669	9	1.3	Apr. 7	Apr. 29
14.	Scalecide 1 part-35 parts water	838	53	6.3	"	"
15.	Scalecide 1 part-25 parts water	744	68	9.1	"	"
16.	Scalecide 1 part-50 parts water	462	47	10.1	"	"
17.	Check no treatment	253	164	65.0	"	"
18.	Check no treatment	100	45	45.0	"	"

TABLE 2.

	Lime-sulphur 1-9					
1.	Nic. Sulphate 1-500	649	189	29.1	Dec. 29	Feb. 23
2.	" " "	2,166	544	25.1	Feb. 8	Mar. 2
	Lime-sulphur					
3.	1 part-9 parts water	403	45	11.1	Apr. 5	Apr. 15
4.	" " "	378	18	4.7	Mar. 12	Mar. 28
5.	" " "	773	268	34.6	Dec. 29	Feb. 23
	Lime-sulphur 1-9					
6.	Nic. Sulphate 1-500	165	80	48.4	Apr. 13	Apr. 28
7.	" " "	221	54	24.4	Apr. 13	Apr. 29
	Lime-sulphur					
8.	1 part-9 parts water	526	351	66.7	Dec. 29	Apr. 28
9.	" " "	652	253	38.8	Mar. 16	Apr. 29
10.	" " "	449	132	29.4	Feb. 17	May 3
11.	" " "	299	83	27.7	Mar. 10	May 2

TABLE 3.

	Dry lime-sulphur					
1.	½oz.-1 pint water	302	114	37.7	Apr. 5	Apr. 15
2.	" " "	274	6	2.1	Mar. 12	Mar. 28
3.	" " "	197	74	37.5	Mar. 4	Mar. 25
4.	" " "	418	125	29.9	Mar. 16	Apr. 29

TABLE 4.

	B. T. S.					
1.	½ oz.-1 pint water	1,047	368	35.2	Feb. 8	Mar. 2
2.	" " "	374	124	33.2	Apr. 5	Apr. 15
3.	" " "	438	35	7.9	Mar. 12	Mar. 28
4.	" " "	234	34	14.5	Mar. 4	Mar. 25

Notes.

Table 1. Eggs in tests 1-11 were taken from the same branch. Those in 12-18 were from another branch. All eggs dipped in the different solutions, not sprayed.

Table 2. Nos. 1-5 were kept indoors after treatment; 6-11 outdoors. Nos. 5 and 6 were sprayed, others dipped.

Table 3. Nos. 1-3 kept indoors, 4 outdoors.

Table 4. Nos. 1-4 kept indoors, 5 and 6 outdoors.

Exp. No.	Treatment	Total Number of Eggs Used	Number Hatched	Per Cent. Hatched	Date Treated	Date Examined
5.	½ oz.-1 pint water B. T. S. ½ oz.-1 pt. water	349	162	46.4	Mar. 16	Apr. 29
6.	N.S. 1 part-500 parts water	282	126	44.6	Apr. 5	Apr. 29

TABLE 5.

1.	Scalecide 1-15[1]	773	27	3.5	Dec. 29	Feb. 23
2.	" 1-15	1,078	0	0.0	Feb. 8	Mar. 2
3.	" 1-15	412	0	0.0	Apr. 5	Apr. 15
4.	" 1-15	67	0	0.0	Mar. 12	Mar. 28
5.	" 1-25	173	0	0.0	Mar. 16	Apr. 4
6.	" 1-50	356	11	3.0	Mar. 16	Apr. 4
7.	" 1-15	119	0	0.0	Mar. 4	Mar. 25
8.	" 1-15	409	135	33.0	Dec. 29	Apr. 28
9.	" 1-15	104	6	5.7	Mar. 9	Apr. 29
10.	" 1-25	341	115	33.7	Mar. 9	Apr. 29
11.	" 1-50	150	8	5.3	Apr. 7	Apr. 29
12.	" 1-15	669	9	1.3	Apr. 7	Apr. 29
13.	" 1-25	744	68	9.1	Apr. 7	Apr. 29
14.	" 1-35	838	53	6.3	Apr. 7	Apr. 29
15.	" 1-50	462	47	10.1	Apr. 7	Apr. 29
16.	" 1-15	326	55	16.8	Feb. 17	May 3

[1] Proportions of Scalecide to water.

TABLE 6. (CHECKS)

Exp. No.	Total Number of Eggs Used	Number Hatched	Per Cent. Hatched	Date Obtained	Date Examined
1.	1,956	345	17.6	Dec. 29	Feb. 23
2.	527	263	49.9	Feb. 9	Mar. 4
3.	60	45	75.0	Feb. 10	Mar. 4
4.	2,421	1,477	61.0	Feb. 8	Feb. 23
5.	334	326	97.6	Apr. 5	Apr. 15
6.	359	324	90.2	Apr. 8	Apr. 28
7.	208	185	88.9	Mar. 4	Mar. 25
8.	402	223	55.4	Mar. 10	Mar. 28
9.	403	333	82.6	Mar. 11	Mar. 28
10.	430	342	79.7	Mar. 12	Mar. 28
11.	255	209	81.9	Mar. 16	Apr. 4
12.	421	181	42.9	Dec. 29	Apr. 28
13.	265	151	56.9	Mar. 16	Apr. 29
14.	253	164	64.8	Apr. 7	Apr. 29
15.	100	45	45.0	Apr. 7	Apr. 29
16.	162	109	67.3	Apr. 13	Apr. 28
17.	120	20	16.6	Apr. 4	Apr. 28
18.	155	85	54.8	Apr. 5	Apr. 29
19.	531	337	63.4	Feb. 17	May 3
20.	188	114	60.6	Mar. 10	May 2

Notes.

Table 5. Tests 1-7 were kept indoors after treatment; 8-16 were kept outdoors. Numbers 10-15 were sprayed, others were dipped in spray solutions.

Table 6. Eggs listed here were not treated with any insecticide. Numbers 1-11 were kept indoors in moist jars; 12-20 outdoors.

COMPARATIVE MORTALITY OF TREATED EGGS OF EUROPEAN RED MITE, KEPT OUTDOORS AND INDOORS AFTER TREATMENT.

TABLE 7.

Treatment	Hatched Per Cent.	Possible Kill Per Cent.	Number of Eggs Used	
Check, no treatment	61.0	0	7,355	Indoors
	54.9	0	2,195	Outdoors
Kero-spray	86.5	0	445	Indoors
	55.7	0	298	Outdoors
Sulco V. B.	49.9	18.6	879	Indoors
	48.0	12.5	958	Outdoors
Keresol	34.2	44.0	385	Indoors
	59.9	0	442	Outdoors
Linseed oil Emulsion	56.0	8.4	841	Indoors
	26.1	52.5	352	Outdoors
B. T. S.	26.7	56.3	2,093	Indoors
	45.6	16.8	631	Outdoors
Lime-sulphur; liquid 1-9	22.1	63.8	3,596	Indoors
	43.1	21.4	2,515	Outdoors
Lime-sulphur; dry	25.0	59.0	773	Indoors
	29.9	45.5	418	Outdoors
Kerosene emulsion	31.6	48.2	227	Indoors
	60.9	0	660	Outdoors
Wormol, 1 part in 15 parts water	5.4	91.1	419	Indoors
	14.7	73.2	292	Outdoors
Scalecide	1.2	98.1	2,978	Indoors
	9.9	81.8	4,043	Outdoors
Jarvis Compound	0	100	792	Indoors
	6	89.1	104	Outdoors

Notes.

Table 7. The percentages in the column headed "possible kill" were obtained by comparing each with the check hatch, obtaining the actual hatch, and subtracting this number from 100, thereby obtaining the per cent. killed. Where the per cent. hatched is higher than the check it is obvious that the insecticide has no killing power.

SUMMARY OF VARIOUS TREATMENTS.

TABLE 8.

Exp. No.	Treatment	Hatched Per Cent.	Possible Kill[1] Per Cent.	Number of Eggs used
1.	Check, no treatment	55.2	0	9,550
2.	Kero-spray	74.1	0	743
3.	Sulco V. B.	49.2	10.9	1,837
4.	Keresol	47.9	13.3	827
5.	Linseed oil emulsion	46.3	16.2	1,193
6.	B. T. S.	31.1	43.7	2,724
7.	Lime-sulphur (liquid)	30.8	44.3	6,111
8.	Lime-sulphur (dry)	26.3	52.4	1,191
9.	Kerosene emulsion	12.9	76.7	887
10.	Wormol	9.2	83.4	711
11.	Scalecide	7.6	86.2	7,021
12.	Jarvis compound	.6	99.0	896

In order to check more fully the results obtained in the foregoing tests, twigs with eggs were collected from an orchard which had been given a delayed dormant spray of Scalecide. Of 434 eggs examined, 35.9 per cent. had been killed. Another batch of eggs showed 71 per cent. and another 95.7 per cent. mortality.

A few tests were conducted in August partly to check results obtained in 1920. Linseed oil emulsion[2] was tried and found very effective. The results of these tests are given in Table 9.

TABLE 9.

Exp. No.	Treatment	No. Live Mites	No. Dead	Per Cent. Killed	Date Treated	Date Examined	Air Temp. During Test	Temp. of Solution Applied
	Lime-sulphur 1-40							
1.	N. S. 1-500	2	36	95.0	Aug. 15	Aug. 16	60-79° F.	71° F.
2.	" "	18	141	88.7	Aug. 17	Aug. 18	60-79° F.	73° F.
	Borax soap							
3.	4 lbs.-48 gals. water	26	128	83.1	Aug. 17	Aug. 18	60-79° F.	89° F.
	Linseed oil emulsion	2						
4.	1 part-20 parts water	5	81	94.1	Aug. 17	Aug. 18	70-74° F.	84° F.
5.	Check, no treatment	84	2	2.3	Aug. 17	Aug. 18	60-79° F.	

Note:—Table 9. Showing results of four different treatments for controlling the European red mite; not in egg stage.

The results of these tests point to the value of miscible oils as ovicides, but it must be remembered that such oils if used in excessive quantities may become dangerous to apple trees, especially if long continued. Some growers have used them for many years with good success and without apparent injury, while others have not had as good success. In the case of miscible oils, therefore, it is best to examine each barrel or can before using, rejecting those which are not completely emulsified when water is added, and

[1] Calculated as in Table 7.

[2] Made according to directions in Mass. Agr. Expt. Station, Bulletin 179, pages 175-176, 1917.

mixing thoroughly, before dilution, the contents of those that are used.

The greatest amount of injury is done to the trunk and larger limbs (it may be several years in appearing) indicating that these parts should be avoided as much as possible in spraying with miscible oils. Again there is danger to the flower buds in the very late sprays, more than with lime-sulphur or substitutes, since the oil works in more among the buds. All these facts, together with the prevailing high price of oil sprays, make many skeptical of their value, but with care and only occasional use, they should prove valuable as orchard sprays.

In the light of present information, it is advisable to apply miscible oils for control of the European red mite in Connecticut before the buds open (late dormant spray), in March or early April. If lime-sulphur delayed dormant spray is used it should be applied as late as possible since it kills young mites after hatching.

We suggest in general the following procedure: follow the usual spray calendar recommendations unless red mite eggs are numerous. If numerous, apply miscible oil as a late dormant spray, to the outer twigs and smaller branches avoiding the trunks and larger branches as much as possible. By no means omit the pink spray with nicotine since this is important in control of newly hatched mites. Apply this spray as thoroughly as possible.

THE VIOLET GALL MIDGE.

Phytophaga violicola (Coquillett).

By Philip Garman, Ph.D.

During the fall of 1920, attention was called to the injuries of this insect by W. W. Thomson and Co., of West Hartford, Conn. At this time it had become numerous enough in their greenhouses to require continual hand picking and was causing a yearly loss estimated at about $1,000.00. The owners were trying to control it by intermittent fumigation with hydrocyanic acid gas (HCN) and by dusting with lime, both of which measures were ineffective. Hand picking infested leaves was also unsatisfactory. Evidently there was something about the insect which required study and the following notes relate to information obtained by the writer (with the aid of W. W. Thomson and Co.) which bear on its life history and control.

History of the Insect in the United States.

The violet gall midge or gall-fly has been known in the United States since about 1896 when it was discovered near Washington,

D. C. It has been reported from Virginia and New York by Chittenden and from Minnesota by Washburn. The New York localities include Nyack, Tappan, Cornwall-on-the-Hudson[1] and Rheinbeck[3] which are not greatly distant from West Hartford. It is not known definitely how it entered the United States or whence it came but it is thought to be tropical in origin and has perhaps been introduced from abroad.

Regarding life history, Chittenden[1] thinks that the maggots do not enter the soil to pupate. Felt[3] observes that the infestations

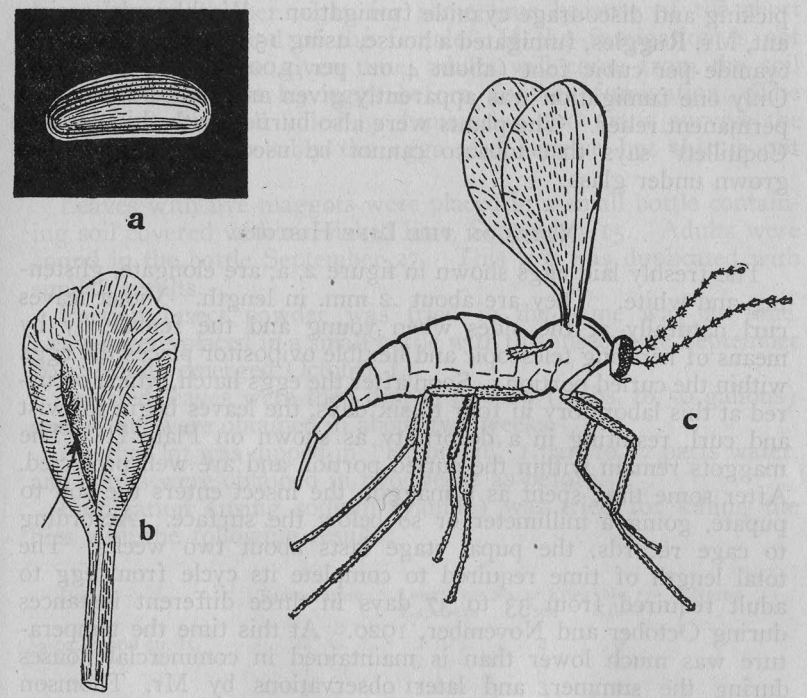

Figure. 2. Violet gall midge. a. egg, enlarged about 100 times; b. young violet leaf with edge rolled back, showing eggs; c. adult female fly, enlarged about 24 times.

in New York houses are local and their relative abundance is largely due to temperature; further that the insects prefer recently opened leaves, apparently laying eggs in such leaves and that there is a marked periodicity in appearance of the larvae. He says that adults rarely leave the plants and few are to be found on the windows; that infested leaves placed on the soil gave forth adults in 10-16 days; and that the maggots enter the soil to pupate.

There is some difference of opinion among authors as to the proper methods of control. Chittenden[1] suggests the use of

hydrocyanic acid gas, but did not test it. He discourages hand picking infested leaves because of injury to the crown of the plant. He suggests the use of air slaked lime thrown into and about the plants, and the free use of buhach or persian insect powder when adults are numerous. Felt's[3] suggestions include care in avoidance of infested plants for setting out, and in keeping the temperature as low as possible in early fall, since the insects are not troublesome at low temperatures. He discourages[4] the use of hydrocyanic acid gas, but thinks it possible that it has value in killing the adult flies. Slingerland and Crosby[6] recommend hand picking and discourage cyanide fumigation. Washburn's[7] assistant, Mr. Ruggles, fumigated a house, using 15 grams of potassium cyanide per cubic foot (about 4 oz. per 1,000) for 35 minutes. Only one fumigation was apparently given and this did not give permanent relief. The plants were also burned with this dosage. Coquillett[2] says that tobacco cannot be used safely on violets grown under glass.

Notes on the Life History.

The freshly laid eggs shown in figure 2, a, are elongate, glistening and white. They are about .2 mm. in length. Violet leaves curl naturally at the sides when young and the female fly by means of her long telescopic and flexible ovipositor places the eggs within the curled portion. Soon after the eggs hatch, which occurred at this laboratory in four to six days, the leaves begin to twist and curl, resulting in a deformity as shown on Plate II. The maggots remain within the curled portion and are well protected. After some time spent as a maggot, the insect enters the soil to pupate, going a millimeter or so below the surface. According to cage records, the pupal stage lasts about two weeks. The total length of time required to complete its cycle from egg to adult required from 33 to 37 days in three different instances during October and November, 1920. At this time the temperature was much lower than is maintained in commercial houses during the summer, and later observations by Mr. Thomson indicate a shorter cycle, possibly three weeks.

Eggs were obtained from adults, in two instances, two days after emergence from the soil (September 27-29, 1920). Emergence of adults takes place during the day or night according to observations made November 2 to 3. A small bottle containing emerging flies was cleared of the latter at 6:00 P. M., November 2. One fly emerged by 8:00 P. M., but no more had emerged by 10:00 P. M. One additional fly had emerged by 8:00 A. M. the next morning, and between 8:00 and 10:00 A. M. a third fly emerged. The flies thus seem to come from the soil at different times during the day or night and are not confined in this regard to any fixed period.

Notes on Control.

Owing to the location of the eggs and maggots within the curled leaves, it seemed inadvisable to use sprays of any sort for their control. It was thought that the maggots or pupae might be killed by applications of insecticide to the soil and to this end insect powder and dry lime were tried without results. Another available method was found in systematic fumigation with hydrocyanic acid gas (HCN) which proved satisfactory from the standpoint of the grower. This treatment kills the adult fly, but must be repeated every other night for some time because of the short preoviposition period of the female. If the fumigation is not repeated within the given time, adults will come from the soil and will mate and lay eggs before another fumigation. The maggots are not all killed by fumigation and many survive the usual dosage. Probably the eggs also survive but this is not certain.

Leaves with live maggots were placed in a small bottle containing soil covered with air slaked lime, September 15. Adults were found in the bottle September 27. This test was duplicated with similar results.

Persian insect powder was tried in the same way as lime. Leaves were placed in a small bottle with this insecticide September 29. Adults emerged October 14.

Infested leaves were then dipped in soap (2 lbs. to 50 gallons) and adults were obtained in about two weeks.

Another lot was dipped in "lemon oil" 1 part to 12 parts water, and adults were obtained in two weeks as before.

Fumigation (using sodium cyanide) was tried for killing the flies with the following results:

Dosage	Temperature	Length of Exposure	No. of Flies Used	No. Killed	Notes
⅛ oz.-1,000 cu. ft.	22° C.	2 hrs.	4	0	
" " " "	14° C.	8 hrs.	3	0	
" " " "	17-19° C.	15 hrs.	3	1	
⅙ oz.-1,000 cu. ft.	15-22° C.	2 hrs.	4	0	
⅙ oz.-1,000 cu. ft.	15-22° C.	2 hrs.	4	0	
⅓ oz.-1,000 cu. ft.	16-19° C.	3 hrs.	2	0	Both apparently dead but revived.
⅓ oz.-1,000 cu. ft.	22° C.	2 hrs.	4	3	
1 oz.-1,000 cu. ft.	19-22° C.	2 hrs.	4	4	All apparently dead; one revived.

All tests were made in a small fumigating box and the atmosphere was dry. While limited in extent the tests show that it is not advisable to reduce the dosage of sodium cyanide much under 1 ounce per 1,000 cubic feet. With leaky houses it would probably require 1-2 ounces to kill the fly.

Violets withstand a heavier dosage than some other plants, but care must be taken with this amount, not to leave the house closed over night.

During June, 1921, the gall midge appeared in considerable numbers in the West Hartford houses. The owners began systematic fumigation every other night, using ¾ to 1 ounce of sodium cyanide to 1,000 cubic feet, and keeping this up until July. An inspection June 8 showed that nearly every plant had injured leaves due to the gall fly. Two 180 foot houses, with 12,000 plants each, were treated. From one of these houses a bed was transplanted to a third house and remained without regular fumigation. An inspection of the houses August 10, 1921, showed that two of the houses were entirely free of the pest, while the bed of plants transplanted to the third house had about one infested or injured leaf to every ten plants. Shortly after August 10, systematic fumigation was started in the third house, and inspections were made regularly until September. It was noted that the galls did not become more numerous but were constantly reduced in numbers. On September 24 none could be found.

As a contrast to their condition in 1920, the plants now had good crowns and were much better able to produce flowers than a year ago. A good many plants died during the summer, but this seemed to be localized and was attributed to other causes. The only injury to the plants from the fumigation was a very slight burning of the margins of some of the leaves, which, however, did not retard the growth of the plants and did not compare with the injury caused by continual hand picking.

In drawing conclusions from the above notes, it is well to consider their incomplete nature. The fact should also be emphasized that fumigation with hydrocyanic acid gas (HCN) is dangerous to plant life and should be done with care. Directions for such work are found in Farmers' Bulletin 880 of the U. S. Department of Agriculture, with which every grower should provide himself. However, it is believed that careful systematic fumigation offers an economical and satisfactory relief from the injuries of a troublesome pest.

Literature.

[1] Chittenden, F. H., U. S. Department of Agriculture, Bureau of Entomology, Bulletin 27, page 48, 1901.

[2] Coquillett, D. W., U. S. Department of Agriculture, Bureau of Entomology, Bulletin 22, page 51, 1900.

[3] Felt, E. P., U. S. Department of Agriculture, Bureau of Entomology, Bulletin 67, page 41, 1907.

[4] —— 22nd Report New York State Entomologist, page 61, 1906.

[5] —— 30th Report New York State Entomologist, pages 204-205, 1914 (Description).

[6] Slingerland, M. V., and Crosby, C. R., New York (Cornell) Agricultural Experiment Station, Bulletin 252, page 346, 1908.

[7] Washburn, F. L., 9th Report State Entomologist of Minnesota, pages 189-190, 1904.

AN OUTBREAK OF THE ARBOR VITAE LEAF MINER.

Argyresthia thuiella Packard.

By W. E. Britton and M. P. Zappe.

Some injured arbor vitae twigs were first sent to the Station from New Haven early in April and referred to the botanical department. As no signs of plant diseases were found and small exit holes were noticed, the material was brought to the entomological department on April 12 by Dr. F. A. McCormick. Some of the leaves had been mined and were partly transparent when held up to the light, and small Lepidopterous larvae were found in the mines. On April 13, the authors visited the locality and collected material which was taken to the laboratory and placed in rearing cages in the insectary. More material was gathered May 2. On May 9, pupae were present in the leaves, and on May 20, small moths emerged. There was little difficulty in identifying the species as *Argyresthia thuiella* Packard, and this identification was later confirmed by Mr. August Busck of the United States National Museum, through the kindness of Dr. L. O. Howard, Chief of the Bureau of Entomology.

Injury.

The narrow leaflets were completely mined so that almost all of the chlorophyll was destroyed in the most extreme cases. Large specimen trees were so badly injured that they appeared brown instead of green, and were noticeable from a distance. Practically all of the leaves on the lateral branches had been mined, wholly ruining them as specimen trees. A block of pyramidal trees six to seven feet tall were badly injured and were brown except for the lower branches and the topmost leaves, which were green. Two rows of trees about three feet tall had hardly a green twig left, and from a short distance away looked entirely dead, but close examination showed that new leaves were starting out from the main trunk. These trees are shown on Plate IV, a. Of course all degrees of injury were noticed from the extreme cases cited to only a trace of infestation. Some degree of infestation was observed in many places, on both hedges and specimen trees, but in no other place visited was the injury so marked as in the locality described in New Haven. If a hedge should become badly infested, its beauty would be destroyed for a season at least. Felt[2] states that usually the operations of this pest are confined to a terminal half inch of the leaves here and there, and sometimes its work is so restricted as to involve only one-half or a portion of the leaflet.

Distribution.

The work of this insect was observed in several sections of New Haven and on June 24 at Norwalk and Riverside. Other towns in Connecticut known to be infested by this insect are Wallingford, Milford, Fairfield, Branford, Hamden and Cheshire.

It has been recorded from Canada,[4] Maine,[7] New York,[2] Pennsylvania,[1] New Jersey,[11] Missouri,[9] and the Middle Atlantic States.[14]

Life History and Habits.

Apparently the insect spends the winter as a larva in the mines of the leaflet. It reaches maturity early in May and pupates. The adults begin to emerge about May 20, and keep it up for some time, as on June 1 and June 4 there were many adults present and even more on June 9. They were resting on the trees or perhaps laying eggs, and on being disturbed fairly flew away in swarms from the trees. On June 9, the first egg was found. On June 21, eggs had hatched and young larvae had begun to mine the leaves. They enter the leaves by crawling under the edge of the base next to the twig and in this axil feed their way into the tissues and tunnel between the upper and lower epidermal layers. On July 1, larvae were about three-sixteenths of an inch long, had just finished mining one leaflet and starting on the adjoining one.

Description.

Egg:—Length about .33 mm., thickness about .17 mm., yellowish green, slightly paler than the leaf, more or less irregular in shape because it is nearly always placed between the tip of one leaflet and the base of the adjoining one and fits the available space. Egg is usually laid from 2-5 leaflets below the tip and can scarcely be seen with the naked eye. Under a miscroscope the surface appears roughly sculptured. The appearance of an egg is shown on Plate V, d.

Larva:—Length about 5 mm., thickness about .5 mm., light green varying to darker green with decided reddish tinge. Head, shiny black, cervical shield, black with median pale line, legs and anal plate black; a black spot on each side of last segment just above anal prolegs. Abdominal prolegs light green like body. A narrow black transverse mark on dorsum of penultimate segment. Head bearing light-colored bristles. Each segment bears dorsally a transverse row of short bristles; these are longer on the first and last two segments.

Pupa:—Length 3-4 mm.; thickness about .7 mm., general color leaf green, head light brown, wing sheath narrow and pointed, extending beyond base of fifth abdominal segment. Head smooth, bluntly rounded.

Adult:—Wing-expanse about 8 mm., forewings light-gray, marked with brown as shown on Plate V, c; rear wings light fuscous without markings. Palpi head and face, white; antennae white ringed with brown. Legs and body yellowish-white.

Parasites.

Dr. Felt[2] records a Chalcidid parasite *Pentacnemus bucculatricis* Howard, reared from the infested leaves in New York State.

This parasite was originally described from Missouri.[9] Two Hymenopterous parasites have been reared from the larvae or pupae of the arbor vitae leaf miner in our breeding cages. One is the Chalcidid *Pentacnemus bucculatricis* Howard, just mentioned, and the other a Vipionid, *Apanteles bedelliae* Viereck.

Control Measures.

Several remedies have been suggested for the control of this insect, but very little work along this line has been recorded. During the outbreak of this pest in Connecticut in the summer of 1921, several remedies were tried. One of the nearby nurseries had quite a serious outbreak and the owners were willing to co-operate with us in the test of control measures. A block of about 1,000 small trees four to six feet tall was used in the experiments. About one week after the experimental sprays were applied, the owners sprayed all their other arbor vitae trees, and by some mistake this block was also sprayed. The application contained nicotine sulphate (1 pint to 50 gallons) and soap.

The following sprays were applied in our tests:—

Lead arsenate, 1 pound to 8 gallons of water. This made a very concentrated poisonous spray and was thought to be of some value in killing the young larvae as soon as they hatched from the eggs.

Lime-sulphur, 1 part to 8 parts water, was sprayed on another plot.

Scalecide, 1 part to 8 parts water, showed a very little burning on the new and tender growth.

Kero-spray, 1 pint to 8 gallons. This is a commercial kerosene emulsion which is on the market under the name of "Kero-spray."

Fish-oil emulsion, 1 part to 20 parts water.

Carbolic emulsion, 1 part to 20 parts water.

These two emulsions were made up as follows:

Soap	4 ounces
Water	1 quart
Fish-oil (or carbolic acid) ...	4 ounces

Dissolve the soap in a quart of hot water, add the fish-oil and churn until a thick emulsion is produced. The carbolic emulsion is made just the same except that crude carbolic acid is substituted in place of the fish-oil.

Nicotine sulphate, 2 teasponnsful to 1 gallon of water, was another spray used.

All plots were sprayed twice except the carbolic acid and lead arsenate plots.

The sprays were applied on May 24 and June 4. At this time some of the moths had emerged and were flying around the arbor

vitae trees or resting on the leaves. Two small plots were treated with each of the sprays. In one plot the regular nursery trees were used and in the other smaller trees (less than three feet high) were used that had been transplanted near the larger trees.

On the smaller trees all the old infested leaves were cut off.

In the fall careful counts were made of the number of larvae in leaves of the younger trees, with the following result:

Treatment	Living Larvae
Lead arsenate	14
Lime-sulphur	18
Scalecide	18
Kero-spray	12
Fish-oil emulsion	10
Carbolic acid emulsion	8
Nicotine sulphate	13
Check* (nicotine sulphate and soap)	10

The adult moths are very frail and many of them were killed by being struck by the sprays. It is very easy to hit them with spray because when a tree on which they are resting is touched they immediately fly away. Although the results do not show much difference in the number of larvae present for each kind of spray, the total amount of injury is certainly less than it was early in the spring, so possibly all of these sprays are of some value in controlling the arbor vitae leaf miner.

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*The trees left as checks as well as all others in the experiment were sprayed by the nursery owners with nicotine sulphate and soap. Of course all the treatments given above really had their original treatments plus a spraying of nicotine and soap a week later.

INJURY TO YOUNG TOBACCO PLANTS BY THE SEED CORN MAGGOT.

Hylemyia cilicrura Rond.

On May 25, I was called by telephone by Mr. J. B. Stewart of the Windsor Tobacco Growers' Corporation, at Windsor, and informed that a small maggot was injuring his tobacco plants in one section of the field by tunneling in the stem. As this seemed from his description to be a new or unusual trouble, I stated that I would like to visit his field. It happened that Director Jenkins had planned to visit his field the following day and on Mr. Stewart's invitation I accompanied him.

The field was in light sandy soil, and the plants had been set perhaps two weeks. The whole field was covered with cheese cloth as is the practice where shade grown tobacco is raised. The particular section worst infested was a strip of some twenty acres in area not far from one of the big tobacco sheds. This ground was covered with clover, which was plowed under last spring. We pulled and dug up many plants, thousands of which had been injured. The burrow was usually small and inconspicuous, often escaping notice at first and extended from the outside into the pith just below the surface of the ground. Frequently the burrow was considerably enlarged inside the stem, involving perhaps the whole pith and in some cases extending upwards or downwards for a half inch or more. Injured plants are shown on Plate VI, a. The week preceding our visit, Mr. Stewart was able to find a maggot in nearly every injured stem, but though we cut open many plants not a single stem had a larva in it. Mr. Stewart found one larva in the soil close to the plant, and after a long search, I found a Dipterous pupa in the soil. Twenty or thirty of these were found during the course of the day.

The preceding week Mr. Stewart examined and counted 100 plants and found between 80 and 90 infested. He was able from the general appearance to distinguish the injured plants from those not attacked.

It seemed to the writer that many of the infested plants were so slightly injured that they stood a good chance of recovering, but Mr. Stewart states that any injury to the pith is sufficiently serious so that the plant will never develop a good crop of wrapper leaf tobacco, and this opinion seems to be shared generally by the leading growers. Consequently the twenty acres were reset and no injury from this insect was noticed on the later set plants.

Other growers at various times have noticed similar injury to their tobacco plants, but the exact data have not been collected.

From the pupal material gathered on May 26, several adults

emerged on May 31st, and following, and proved to be a small two-winged fly of the Dipterous family Anthomyiidae. Specimens were sent to the Bureau of Entomology at Washington, where the insect was identified as *Hylemyia cilicrura* Rond., also known as *Phorbia* (or *Pegomyia*) *fusciceps* Zett., and commonly called the "seed corn maggot" and "bean maggot." This insect is closely allied to the cabbage maggot *Chortophila* (*Phorbia*) *brassicae* Bouché, the onion maggot, *Phorbia ceparum* Meigen, and the spinach leaf miner, *Pegomyia hyoscyami* Panz. It attacks a great number of different kinds of plants and its literature is extensive, yet I have so far been unable to find tobacco mentioned as subject to its attacks.

Tucker[11] has recorded similar injury by this insect to young tomato, potato, corn, pea, onion and cauliflower plants in Louisiana. The maggots generally feed upon planted seeds like corn, beans, peas, etc., and sometimes in cold wet seasons prevent the seeds from producing plants. Frequently, however, the plant appears above ground but as the terminal bud has been destroyed it fails to grow and produce leaves. The maggots have also been found feeding upon seed potatoes and onions, and attack cabbages and allied plants in much the same manner as the cabbage maggot, with which this maggot is often associated.

In the spring of 1917, the bean crop was seriously injured in New York State by this insect. "In five townships of one county there was a loss of $15,000.00 for seed destroyed, and in another county the loss on 16,000 acres planted was estimated to be between 50 and 75 per cent."[5] Many growers lost their entire crop.

It seems to be the consensus of opinion that clover and alfalfa or even a heavy application of manure, plowed under, make a favorable breeding place for the seed corn maggot. When these conditions are combined with heavy rainfall and low temperature there is apt to be serious injury from the seed corn maggot. The longer the seeds are in the ground before growth starts the greater the danger.

Shallow covering of seeds in cold wet seasons will materially reduce injury from the seed corn maggot.

The adult is a small grayish fly which closely resembles that of the cabbage maggot, and is shown on Plate VI, b. It occurs throughout the Eastern United States and is the species commonly responsible for injury to cabbage and onions in the southern states according to Chittenden.[2] Hawley[5] states that there are two broods annually and a possible third in certain seasons in western New York.

Some of the more important papers appearing in recent years and dealing with the life history and habits of this insect are as follows:-

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TESTS OF MATERIALS FOR THE CONTROL OF WIREWORMS.

BY M. P. ZAPPE.

In the spring of 1921 shortly after the tobacco plants had been set in the fields, the owners noticed that many plants were being attacked by wireworms. Some of the growers had pet remedies which they tried themselves or recommended to their neighbors.

The growers went to considerable expense to control this insect with various preparations. One of the most highly recommended remedies was to dissolve gum camphor in alcohol and dilute with water. This solution was then used to water the plants.

Several complaints were made to the Experiment Station about the damage caused by wireworms and it was suggested that tests be made to determine the value of some of the remedies that were being used by the tobacco growers. Mr. C. A. Huntington of Windsor, agreed to furnish the wireworms and tobacco plants if we would make some tests at the Station. The plants were set on June 1, 1921, in two rows, 30 in one and 31 in the other. There were 12 plants for each treatment, six in each row, except the check plot which only had seven plants, and the naphthalene plot which had only six plants, three in each row. There were five different treatments, besides the check plot.

The treatments used were turpentine emulsion, fish-oil emulsion, carbolic acid emulsion, gum camphor mixture and naphthalene flakes. The mixtures were made up as follows:

Soap	4 ounces
Turpentine	4 ounces
Water	1 quart

The soap was dissolved in the water by heating and when all dissolved, turpentine added and the mixture was churned until a creamy emulsion was produced. The fish-oil and carbolic acid emulsions were made in the same way except that fish-oil or crude carbolic acid was substituted for the turpentine. The gum camphor mixture was made in a different manner. Gum camphor was dissolved in alcohol until saturated. On a large scale, 8 ounces of this saturated solution was poured into a 50 gallon barrel of water. This diluted mixture was then to be used in watering the tobacco plants.

The trouble with this mixture is that the gum camphor is insoluble in water and when the saturated alcoholic camphor solution is added to water all the camphor is thrown out of the solution and settles in the bottom of the barrel as a precipitate. Then when water is drawn out all the camphor comes at once and the remaining portion of the contents is clear water.

All the treatments were applied soon after the plants were set. The turpentine, fish-oil and carbolic acid emulsions were diluted, 1 part of emulsion to 32 parts of water. The plants were watered with these dilute emulsions, using about 8 ounces to each plant. The naphthalene flakes were scattered around the base of each plant and then covered with a little soil. About one-fourth ounce was used for six plants. A little of the soil was removed from around each plant and replaced after the treatment had been applied.

Four hours after the treatment was applied two worms were placed at the base of each plant with the exception of four plants in the check plot. The supply of wireworms was limited so that four plants in the check plot only received one worm each. The worms immediately worked their way down into the soil at base of plants.

The results of the treatments are shown in the following table:-

	Number Plants Killed	Killed by Wireworms	Cut off by Cutworms
Turpentine emulsion	4	2	2
Fish-oil emulsion	4	1	3
Carbolic acid emulsion	1	1	0
Camphor mixture	2	1	1
Naphthalene flakes	0	0	0
Check	0	0	0

All the injured plants showed injury within a week after they were set. After that time there was no further noticeable injury. The trouble with this experiment was the fact that it was not on a large enough scale. If more worms could have been secured and the experiment carried on more extensively, the results perhaps would have meant more. The only thing the experiment shows

is that the remedies tried were of no value. The plants in the check plot having no treatment of any kind were untouched by the worms. The plants treated with naphthalene were also left untouched while the plants in the camphor and the emulsion plots (which were thought to have some value) were killed by wireworms and cutworms.

THE CORN EAR WORM.

Chloridea obsoleta Fabr.

One of the outstanding features of the year so far as insects are concerned, was the wide-spread distribution and comparative abundance of the corn ear worm. Specimens were received many times and from all counties of the State, and many inquiries by letter and telephone were answered, which were not accompanied by specimens. A brief account of this insect appeared in the Report of this Station for 1919, page 188, with illustrations of injury, larva and adult shown on Plate XXVIII. Of course this insect is a common species which has long been known in Connecticut, and it occurs somewhere in the State nearly every year, though perhaps not noticed in the same locality in successive

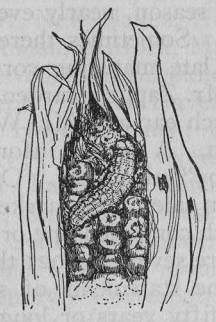

Figure 3. Corn ear worm in characteristic feeding position, much reduced.

seasons. It is the same insect which is known in the South as the cotton boll worm (not boll weevil), the tomato boll worm because it eats holes into ripening tomatoes, and the tobacco bud worm because it eats into the tips of growing shoots and seed pods of the tobacco plant. Scientifically this insect was formerly called *Heliothis armigera* Hübner, but more recently *H. obsoleta* Fabr., and now specialists agree in placing it in the genus *Chloridea*, making its name *Chloridea obsoleta* Fabr.

Injury to Corn and Other Food Plants.*

In the southern states where there are several generations each year and where the corn ear worm is very abundant, the larvae eat holes in the corn leaves as shown by Garman,[7] but in Connecticut the damage is confined to the ears late in the season, usually September and October. The larvae feed upon the soft immature kernels at the tips of the ears, though an occasional one works its way down under the husk between the rows nearly to the base of the ear. In most seasons sweet corn which was planted late or which matures late is the only crop damaged. But when abundant, as in the present season, it attacks field and ensilage corn and is often found feeding on the kernels which are mature and hard. The most of the injury is at the tip of the ear and the tip kernels are often all destroyed or injured so that they must be discarded for seed or for human food. In the canning factories, it is necessary also to cut out with a gouge the injured kernels on the side of the ear. The loss from this insect cannot be accurately measured by the kernels actually eaten or mutilated; the injury from moulds or other fungi which gain an entrance through the depredations of the corn ear worm, must also be taken into account. Garman[7] regards this as being quite as important as the loss from the kernels actually eaten or mutilated, and mouldy corn is considered unsafe to feed animals.

In some gardens this season, nearly every ear contained at the tip one or more larvae. Sometimes there would be four or five per ear. Some of the late maturing corn at the Station Farm, Mount Carmel, and in Mr. Zappe's garden not far away had from one to four larvae in each ear and Mr. Walden found six in one ear at the Station Farm. A grocer informed the writer that all sweet corn was "grubby" this year. On October 8, 1919, the writer saw sweet corn on sale in the market in Washington, D. C., nearly every ear of which contained one or more large caterpillars. That this injury was more severe in 1921 than usual in Connecticut may be evidenced by the statements of several farmers, one of whom had farmed for fifty years or longer, that they had never seen these worms before. Yet frequently infested corn is sent to the Station from some point in the State.

Sanderson[17] estimates that the corn ear worm destroys annually from two to three per cent. of the corn crop of the United States, thus causing a loss of between $30,000,000.00 and $50,000,000.00.

In the southern states this insect seriously injures cotton by eating into the base or side of the bolls, thus destroying or staining the fibers so that the cotton from these bolls must be discarded. With tomatoes the larvae eat holes into the fruits near the stem

* To learn the extent of injury in Connecticut in 1921, 5,100 ears were examined from five plantations, and the percentages of injury were as follows: 11.8, 6.1, 6.4, 1.33, 17.2. In the middle west the injury ran as high as 50, 75 and even 100 per cent.

or on the side of green and ripe tomatoes of all sizes. Whenever a tomato is mutilated by being eaten in such a manner, rot usually sets in, thus destroying it. With tobacco the larvae eat holes into the tips of the new growth and also into the seed pods, yet this insect is not considered an important pest of tobacco.

In addition to corn, cotton, tomato and tobacco, the larvae may feed upon many other vegetable and field crops some of which are:—peas, beans, pumpkin, squash, cucumber, egg-plant, pepper, okra, potato, asparagus, peanut, collard, sorghum, sugar-cane, vetch, cow peas, alfalfa, clover and millet. It also can live upon the wild plants such as bindweed, cocklebur, hemp, horse nettle, wild sunflower, ground cherry and Jamestown weed, and it occasionally attacks such cultivated plants as geranium, gladiolus, mignonette, rose and morning glory. Sometimes the caterpillars attack ripening plums and peaches.

Distribution.

The corn ear worm is found all over the United States, in southern Canada, Mexico and southward to Argentina, the West Indies, throughout Europe, Africa, southern Asia, the East Indies, Australia and New Zealand. In Connecticut it has been received at the Station at various times from nearly all parts of the State as follows:—Bethany 1908; Kensington 1909; New London 1910; Wilton 1913; Westport, New Haven, Northford, Rockville, Colchester, 1919; New Canaan, Milford, Middlebury, Vernon, 1920. In 1921 it has been received from Brookfield Center, Stratford and Shelton, Fairfield County; New Haven, Hamden, Middlebury and Wallingford, New Haven County; Cromwell and East Haddam, Middlesex County; Ledyard, New London County; Roxbury, Woodbury and Lakeville, Litchfield County; Bristol, Unionville, Collinsville, Simsbury, West Hartford, Southington, New Britain, Melrose, South Manchester and Glastonbury, Hartford County; Columbia, Tolland County; Putnam, Pomfret, Killingly, Windham County. Correspondence and telephone communications indicate that it also occurred in Norwich, Fairfield, Wilton, West Cornwall, Thompsonville, Suffield, Hartford, Danbury, Newtown, Redding, Ridgefield and New Canaan. No doubt it has occurred this year in every town in the State. It has also occurred the past season throughout the northern states and in southern Canada.

Life History and Habits.

The adult females lay their eggs on the silk of the corn and the young larvae at first feed upon the silk and later find their way to the kernels. According to Crosby and Leonard[6] the eggs are deposited singly, and though the corn silk seems to be the preferred place, may be laid upon the leaves and tassels and upon the leaves and stems of cotton, tomato, tobacco and other plants if

corn silk is not available. Early emerging moths must necessarily oviposit elsewhere before corn silk is available. Each female is said to lay from 500 upwards to 2,500 eggs. The time required for hatching varies from a week in spring to two weeks in late fall, while in the summer only two or three days are necessary, depending upon the temperature. Likewise the length of the larval stage varies according to temperature and food, ranging from eleven days in hot weather to perhaps a month in spring and late fall. Usually the caterpillars pass through six moulting stages but sometimes pupate after the fifth stage.

When mature the caterpillar goes into the ground from two to seven inches deep, then makes a tunnel lined with silk almost to the surface for the emergence of the adult moth. It then descends to the lower and larger portion of the burrow and pupates. The pupal stage varies from two weeks in summer to three in cooler weather and those transforming late in the fall live through the winter as pupae in the soil. The number of annual generations varies with the latitude and altitude or to make it plainer, with the temperature. Thus in most of the cotton-growing states, there are probably four generations, but in southern Texas and Florida there may be as many as seven. In New Jersey, there are three broods in the southern half of the State, but only two in the northern half. Though its life history has not been thoroughly worked out for Connecticut, it has been called single brooded here, though in certain seasons a partial second brood may be expected.

This insect is never noticed on corn in Connecticut except late in the season or after September 1. If there is only one brood annually and the pupae live through the winter, why shouldn't the adults emerge in May or June? Also if there are two broods, why shouldn't the larvae feed upon the usual host plants in June and July? Some entomologists believe that our invasion late in the fall may be due chiefly to a flight of moths from the southern states. Apparently no one has observed such a flight, but possibly the moths would escape notice as they are not attracted to lights like the cotton moth *Aletia argillacea* Hubn. It is hoped that further observations on the life history of this insect in Connecticut may be recorded next season.

Description.

Egg:—About .5 mm. in diameter, nearly globular, flattened at base and tip; white or yellowish, marked with ridges radiating from the center of the tip.

Larva:—From 1.5-2 inches in length when full-grown, varying from light green to dark brown, but striped longitudinally as follows:—a dark median stripe divided by a narrow white line, a broad stripe above the spiracles, and a pale stripe in the region of the spiracles, margined above with black. The skin has a distinctly granular appearance. Head and legs vary from light to dark tan, under surface varies from nearly white to gray or tan, usually with a pinkish tinge. Each segment bears small tubercles and weak short hairs.

Pupa:—From .75-1 inch in length, smooth, brown, with a pair of caudal setae or spines.

Adult:—From 1.5-1.75 inches wing-spread, ground work buff in color, forewings marked with darker and more brownish suffusions and rather indistinct bands: rear wings paler with veins and submarginal band or cloud of brown. Head, antennae and thorax, light brown: abdomen and legs slightly paler. Under surface paler than upper with discal dots and subdistal transverse bands of forewings showing. Male closely resembles female, though smaller.

Larval, pupal and adult stages are shown on Plate VIII.

Natural Enemies.

Dr. Garman[7] records a bacterial disease of the larvae and seven insect enemies of the corn ear worm in Kentucky. One, *Trichogramma minutum* Riley (*pretiosa*), is a Hymenopterous parasite of the eggs, and the others are all predatory upon the eggs or larvae. Two species of lady beetles, the spotted lady beetle, *Ceratomegilla fuscilabris* Mulsant, and the convergent lady beetle *Hippodamia convergens* Guer.-Men., feed upon the eggs; a Telephorid larva was observed devouring the caterpillars; two true bugs, *Coriscus ferus* Linn., and *Triphleps insidiosus* Say, feed upon the eggs; the larva of the lace wing fly or aphis lion *Chrysopa oculata* Say, was also recorded as a common enemy of the corn ear worm.

Quaintance and Brues[16] give several other enemies of *Chloridea obsoleta* occurring in the South, among which are the following: a Hymenopterous egg-parasite *Telenomus heliothidis* Ashm., two Hymenopterous parasites of the larva, *Microplitis nigripennis* Ashm., and *Perilampus hyalinus* Say; eight species of Tachinid flies, *viz. Frontina armigera* Coq., *F. frenchii* Will., *F. aletiae* Riley, *Winthemia quadripustulata* Fabr., *Exorista ceratomiae* Coq., *Euphorocera claripennis* Macq., *Gonia capitata* DeG., and *Archytas piliventris* Van der Wulp, which are parasitic in the caterpillars or pupae. These authors also mention several species of ants, ground beetles, bugs, toads and birds which are common around cotton fields and which occasionally feed upon some stage of *C. obsoleta*. Some kind of wilt has been noticed in connection with the larvae in Connecticut. A number have been found dead in the ears and others have died in the breeding cages; such larvae usually become soft, turn dark colored and die.

Control Measures.

As a rule control measures have not been practiced in Connecticut, because of the uncertainty of damage. In ordinary seasons the injury has been so slight that control measures are unwarranted. In 1921, however, the damage has been quite severe and if we knew that it would be repeated next year, control measures would certainly be warranted. As it is by no means certain that

this insect will be destructive in Connecticut corn fields next season, the writer hesitates to recommend any form of treatment, though the owners can practice some of the methods if they think best.

Fall plowing will uncover many of the pupae in the soil so that they will be eaten by poultry, wild birds or other animals. As they are not far beneath the surface, most of the pupae will be uncovered or disturbed by this practice. Thorough harrowing will crush some of them and uncover many more.

In New Jersey,[11] sweet corn has been satisfactorily protected by dusting the silk, soon after it appears, with powdered lead arsenate and sulphur, equal parts. As the eggs are laid upon the silk and the young larvae feed upon it, there is an excellent prospect of poisoning them before they can find their way through the husks to the kernels. Perhaps this treatment would not be practicable in large areas of field or ensilage corn, but would be well worth carrying out in the home garden or where corn is grown for seed.

Literature.

The literature regarding this insect is exceedingly voluminous. As much of it applies particularly to cotton, it need not be mentioned here. The following are only a few of the more helpful and readily accessible references:

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THE ASPARAGUS BEETLES.

Nearly all asparagus plantations in Connecticut are each year to some extent infested with the common asparagus beetle *Crioceris asparagi*. Just nineteen years ago a brief account of this insect was printed in the Report of this Station (1902, page 172) but more recent control methods have now supplanted those advised at that time. That same year the twelve-spotted asparagus beetle made its appearance within the State and a note to that effect may be found in the Report of this Station for 1902, page 174. Now the adults of both species may be found together on asparagus plants, both injuring them in much the same manner, though the common or blue asparagus beetle is usually much more abundant than the red or twelve-spotted species. These beetles have been mentioned and control measures advised, in each of the several editions of the Station Spray Calendar.

Both species have been common pests of asparagus in Europe since our earliest records. Both are now widely distributed and well established in the United States, and must be reckoned with, wherever asparagus is grown.

During 1921, asparagus beetles were unusually abundant and caused considerable injury to plantations, one report of serious injury to a large plantation near New Haven being brought to the office with specimens on May 24.

Common Asparagus Beetle.

Crioceris asparagi Linn.

History and Distribution.

Though long known in Europe, this species was not present in this country until about 1856,[3] when it appeared at Astoria, Long Island, near New York City, having apparently been introduced from Europe, though in what manner is unknown. It soon reached the large asparagus plantations of Long Island, and by 1862, it was said to have destroyed more than one-third of the crop in certain localities, occasioning a loss of $50,000.00.[3] It now covers an area reaching from Canada on the north to Cape Hatteras on the south, and westward to the Mississippi River. Separate colonies have also appeared further westward, one in Colorado and three in California.[3] Probably it will soon extend its distribution over the entire northern portion of the United States and perhaps Canada. It remains to be seen whether it continues to spread southward.

The natural means of spread is by the flight of the adults, but undoubtedly hibernating beetles or pupae have been shipped in asparagus roots or in other materials, and perhaps carried long distances.

Life History and Habits.

There are said to be at least two complete annual generations in the northern states, and possibly three or four, further south. In Connecticut the adult beetles appear in May soon after the cutting season begins, and feed and presently lay their eggs upon the tender shoots as shown on Plate IX, c. or upon the more slender growth that comes from young seedlings in or around the bed as shown on Plate IX, a. These eggs are dark brown, elongated-oval, thickness about one-third the length, which is nearly one-sixteenth of an inch. Each egg is fastened endwise to the leaf or stem, and projects from it nearly at a right angle, as shown on Plate IX, a. It is not uncommon to see one egg fastened end to end on top of another as shown in the illustration.

The eggs hatch in a few days and the grubs, "slugs" or larvae which are lead-gray with black shiny heads and legs, begin to feed upon the new foliage. The larvae are soft and wrinkled, gray in

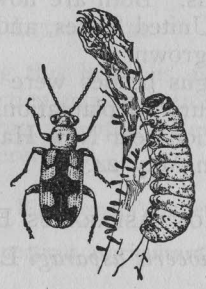

Figure 4. Common or blue asparagus beetle and larva, about twice natural size; the eggs are shown on the new shoot.

color, and present a disgusting appearance as shown on Plate IX, d. As a rule they feed only upon the slender leaves which they are able to clasp, and are not found upon the thick and tender sprouts. Injury to the sprouts is usually the work of the adult beetles.

When fully grown, the larva enters the ground and forms a rounded cell in which it transforms to the pupa and from which the adult beetle emerges in about a week. On Long Island the complete life cycle requires about 30 days but this period may be considerably lessened in a warmer climate and much lengthened in a colder one.

The beetles when abundant often eat holes into the sprouts, but seem particularly fond of the delicate foliage after that has developed, and also eat the bark or rind of the mature plants. Perhaps the most serious injury occurs on new beds or plantations where the plants must grow for a year or two and become strong before cutting begins. In such places both larvae and adults will soon

strip the plants of their leaves and perhaps devour the epidermis of the stems. This greatly weakens the plants so that they do not form strong shoots for later cutting. All new beds, and seedling plants, should be protected from injury and the foliage preserved.

Description of Adult.

The adult of the common asparagus beetle is a striking and beautiful insect about one-fourth of an inch in length and showing a combination of dark blue, yellow and orange red colors. The under side of body, head, antennae, legs and a portion of the wing covers are a dark metallic blue, nearly black. Thorax and outer margins of wing covers are orange red. The inner margins of wing covers and usually three cross bars are dark blue: these cross bars alternate with lemon yellow bars or patches, usually three on each wing cover, one narrow longitudinal one at the base and two about equi-distant from the first and the orange red apical area. There is great variation, however, in the arrangement and size of the yellow and blue areas, grading from forms almost wholly dark blue to those which appear yellow with narrow blue markings. A form common in Connecticut is shown on Plate IX, b.

Twelve-Spotted Asparagus Beetle.

Crioceris duodecimpunctata Linn.

This species is a native of Europe, where it is widely distributed, and though common is not particularly destructive. It was first noticed in this country near Baltimore in 1881,[4] but has spread rapidly until it now covers the entire northeastern United States and extends into Canada. This species was first discovered in Connecticut at New Haven in 1902.[1]

In some localities the twelve-spotted asparagus beetle is reported as being more abundant than the common species, but in Connecticut, so far as my observations go, it is found nearly everywhere with the common species but it is never so abundant and is much less injurious.

Life History and Habits.

The eggs of the twelve-spotted asparagus beetle are laid singly, and in preference upon the old and fruiting plants. Instead of being fastened endwise to the stem or leaf as are the eggs of *C. asparagi,* they are attached sidewise. The larvae feed chiefly upon the pulp of the berries,[5] and therefore are not of great importance as destroyers of foliage. It is where the plant is grown for seed that this species is particularly destructive. The adult beetles feed upon the tender shoots in early summer, and later upon the leaves and eat out irregular areas in the bark of the stems.

The life history is very similar to that of the common species and probably there are the same number of annual generations. The adults pass the winter under rubbish in much the same manner.

Description of Adult.

This beetle, called the red asparagus beetle, is about the same length as *C. asparagi* but is somewhat broader and thicker. The color is uniform reddish-brown above, with six black spots on each wing cover. Antennae, eyes, legs and under surface, blackish. It has been noted that the beetles match the berries very closely in color. The appearance of this species is shown on Plate IX, e.

Natural Enemies of Asparagus Beetles.

If poultry have the run of the asparagus bed they will take care of the beetles early in the season, but later after the plants have reached their growth, some of the beetles will be out of the reach of poultry. However, where poultry have access to the asparagus plantation it will seldom if ever be necessary to spray for the control of the beetles. In the writer's own garden one summer, a neighbor's flock of ducklings entered one day and in a few minutes cleaned the plants of all beetles and larvae.

There are many kinds of predaceous insects that devour the larvae and adults. Lady beetles are prominent among these, and the spotted lady beetle *Ceratomegilla fuscilabris* Muls., and the convergent lady beetle *Hippodamia convergens* Guer., have been recorded as feeding upon the larvae. The spined soldier bug *Podisus maculiventris* Say, and the bordered soldier bug *Stiretrus anchorago* Fabr., both impale the larvae and occasionally the adults on their beaks and suck out the juice. The common wasp, *Polistes pallipes* LeP., and a small dragon fly *Ischnura posita* Hagen, are known to prey upon the larvae of asparagus beetles. A small Hymenopterous or four-winged fly *Tetrastichus asparagi* Crawford, lays its eggs in those of the common asparagus beetle; the eggs hatch and the parasites live in the bodies of the larvae of the host, which die after entering the ground to transform.

In addition to the natural agencies mentioned above, temperature changes occasionally aid the grower in checking the pest. Asparagus beetles are very susceptible to sudden and violent changes in temperature, and in 1896, the intense heat of the first half of August killed many of the larvae in the vicinity of Washington, D. C. In Concord, Mass., hibernating beetles have been killed in immense numbers where a severe cold spell followed a warm one.

Thus it will be seen that under certain favorable conditions these natural agencies are of material assistance in checking the numbers of asparagus beetles.

Artificial Control Methods.

On all newly set beds and where young plants are grown from seed it will usually be necessary to employ some artificial means of keeping the plants free of beetles. If chickens or ducks have the run of the asparagus bed on low plants no other form of control will be needed.

Hand picking may be practiced in very small garden areas, and air-slaked lime dusted upon the plants when wet with dew will kill the larvae. Pyrethrum or insect powder is also of some value in killing the larvae when dusted upon the plants.

The larvae are rather delicate and when knocked or brushed off the plants in hot weather, often die when they reach the hot soil. Frequent syringing with a forceful spray from the garden hose will knock them from the plants and many are unable to return.

In the large cutting fields, it is probably best to make clean cuttings, in which case the beetles are forced to lay their eggs upon the new shoots which are in turn cut in a day or two so that the eggs are destroyed. Another method is to allow certain slender and worthless shoots to grow as trap plants to be cut and burned after they are well infested or to be sprayed with poison before the larvae begin to feed.

I have known several successful growers to practice clean cutting as long as the season lasts, and this in some years would be all that is necessary. In case defoliation threatens the plants, after the cutting season is over a thorough spraying or dusting with lead arsenate will destroy the beetles and save the plants from defoliation. In spraying asparagus it should be borne in mind that the leaves are very narrow and do not readily catch and hold the poison. Hence it is necessary to use a fine spray and to direct it against each plant or row from both sides with plenty of force back of the nozzle in order to coat the leaves as completely as possible. For this purpose it is well to use a strong mixture containing at least six pounds of paste or three pounds of powdered lead arsenate to 50 gallons of water. If the poison is applied as a dust it should be blown upon the plants in early morning when they are wet with dew or just after a shower before they have become dry.

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THE TULIP-TREE SCALE.

Toumeyella liriodendri Gmelin.

This insect occurs throughout the State on tulip trees and each year specimens are received at the Station, and it is also found each year in late summer in the nurseries by the inspectors, when making the annual inspection required by law. This scale was mentioned in Bulletin 151, page 9, with illustrations from a photograph, and both the note and the illustration were reprinted in the Report of this Station for 1905—page 239, and Plate IV, f. As both the report and the bulletin have long been out of print, a new and more complete account of the insect is given here.

This scale occurs chiefly on the lower branches of wild and cultivated tulip trees. Sometimes these branches are killed, but I have never seen cases where the entire tree died from the attacks of the scale, though Professor A. J. Cook states that in 1870, the insect was so abundant on the grounds of the Agricultural College at Lansing, Michigan, that some of the trees were killed outright and others much injured. In Connecticut many tulip trees have lost their lower branches from its attack. Magnolias are also occasionally infested.

This scale is one of our largest species of soft scales; the females are hemispherical in shape, sometimes reaching a diameter of eight millimeters or about one-third of an inch. These are

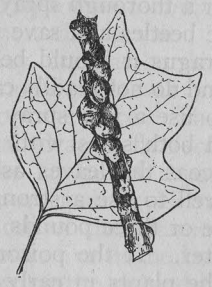

Figure 5. Tulip-tree scale, much reduced.

brown in color and are usually crowded together on the twigs as shown on Plate X, a. The smaller light-colored objects are the shells from which the males have emerged. Some twigs will show a preponderance of females, others of males, though in many cases the sexes are about evenly divided.

There is usually a copious exudation of honey dew which drips upon the foliage underneath, or upon the ground, making it look as if a coating of varnish had been applied. In the honey dew a black fungus or sooty mold grows, giving the surface a blackened

appearance. A fungus grows in the dead bodies of the females, which often adhere for a long time to the twigs, and its white threads of mycelium are rather conspicuous against the brown scales.

The tulip-tree scale was reported as causing severe injury at Hartford in 1895, by Dr. W. C. Sturgis of this Station. Since that time it has been received from many localities in the State. Records of the samples have been kept for twenty years, and it is interesting to note that no specimens of tulip-tree scale were sent to the Station in the years 1908, 1918 and 1919. More specimens were sent in 1902 and 1913 than any other years.

This insect has been received from, or observed in the following localities: Hartford, 1895; Berlin, 1898; South Windsor, 1901; Brookfield Center, Danbury, Bridgeport, New Haven, Southington, Hartford, 1902; New Haven, Hamden, Middletown, 1903; Suffield, Wilton, 1904; Columbia, 1905; Green's Farms, Branford, 1906; New Haven, 1907; Greenwich, Stamford, Waterbury, 1909; Danbury, New Britain, Norwich, 1910; Brookfield Center, Bridgeport, New Haven, Hamden, 1911; New Haven (on magnolia), Columbia, Waterford, Greenwich, Fairfield, 1912; Newtown, Rowayton, Bristol, Plainville, Woodbridge, West Haven, Middletown, Killingworth, Chester, Norwich, 1913; Ridgefield, Deep River, Lyme, New London, East Hartford, 1914; Danbury, Plantsville, Norwich, 1915; Woodbury, Naugatuck, Wilton, Bridgeport, New Haven, 1916; New Canaan, Springdale, New Haven, Middletown, Hartford, Talcottville, Rockville, Pomfret Center, 1917; Stamford, Norwalk, Stratford, Branford, 1919; Fairfield, Stratford, New Haven, Branford, Haddam, 1920; New Haven, Hamden, Guilford (on magnolia), Meriden, Branford, Stratford, Bridgeport, Norwalk, Stamford, 1921.

This scale was described as *Coccus liriodendri* by Gmelin[7] in Europe in 1789, but Cook[3] supposing the American form to be distinct, described it in 1878 as *Lecanium tulipiferae,* and it is under the latter name that the insect is mentioned in the earlier American literature. In fact, the European and American forms were considered as distinct species until 1909, when Sanders[11] after a careful study decided that they were identical, and belonged in the genus *Toumeyella.* Gmelin's name *liriodendri* having priority must be retained. Several writers, notably King and Mrs. Fernald, have placed this insect in the genus *Eulecanium,* where, according to Sanders,[11] it does not belong.

Only one parasite, *Coccophagus flavoscutellum* Ashm., recorded by Dr. L. O. Howard, is known to attack this scale. Houser[8] mentions the fact that a small lady beetle *Hyperaspis signata binotata* Say, was observed at Mineral, Ohio, July 12, 1916, associated with this scale. It is probable that other lady beetles may prey upon the newly-hatched scales.

Life History.

Though the yellow oval eggs were described by Professor Cook, young are found here underneath the female shells, so evidently the species is viviparous in Connecticut, as well as further south as observed by Dr. C. V. Riley.[10] The young appear here early in September according to our observations extending over a period of more than twenty years, and crawl about for a time but soon locate on the bark of the twigs and begin to suck the sap. At first the young are yellow but they soon change to brown. They are nearly black by the time winter approaches, and hibernate when about one-fourth grown.

Remedies.

Spraying the trees as soon as the leaves drop in autumn, with concentrated liquid lime-sulphur, one part in nine parts water, is believed to be the best form of treatment. Probably this mixture would also be effective during the winter and early spring, but possibly it would be more so in the fall before the insects reach the condition in which they pass the winter. At any rate, this lime-sulphur spray applied in the fall has been used successfully by some of the tree-protecting firms.

It is possible that kerosene emulsion, nicotine soap solution, or some other contact insecticide, may also prove effective. Houser[8] obtained good results in Ohio with Scalecide, one part in 15 parts water, applied in March, but miscible oils are not recommended for Connecticut, because there is some evidence to show that the tulip tree, like the sugar maple, is rather susceptible to oil injury.

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THE COTTONY MAPLE SCALE.

Pulvinaria vitis Linn.

Perhaps the most conspicuous of all the scale-insects, particularly during the egg-forming season of early summer, is the cottony maple scale. During the dormant season it is found upon the bark and closely resembles any other large brown soft scale, but after the trees begin to grow the formation of eggs causes the posterior end of the insect to become raised and the egg-sac begins to protrude. This shows as a white cotton-like mass of wax, and increases in size until when fully developed is as long as the insect itself, as is shown on Plate XI, b.

This scale was formerly described as *innumerabilis* by Rathvon and in most of the American literature it occurs under that name. In 1909, Sanders[10] after a careful study proved it to be identical with the European *P. vitis* Linn., and this name having priority must stand. It occurs in the United States and Canada and also in Europe.

In most cases this insect is found sparingly here and there on various host trees and shrubs, but there has been an infestation of silver maples south of the railroad at Sound Beach near Stamford which has persisted for eight or ten years and which has caused considerable injury to the trees and has necessitated control measures. The Connecticut records for the cottony maple scale are as follows:—Norwich, 1905 and 1909; Branford, 1906; New Haven, 1910 and 1917; Milford, 1913; Bridgeport, 1910, 1912 and 1913; South Norwalk, 1912; Sound Beach, 1921; Danbury, 1914; Cheshire, 1913; Wethersfield, 1916; Hartford, 1910. In most of these cases the scales were on silver maple, but the hosts also include red maple, sugar maple, euonymus, black locust, honey locust, and gooseberry. Other reported hosts are: Norway maple, box elder, hercules club, osage orange, red mulberry, apple, pear, plum, peach, hawthorn, currant, gooseberry, lilac, poplar, willow, linden, alder, oak, hackberry, sycamore, grape, rose, sumac, elm, beech, Virginia creeper and poison ivy.

Each female deposits about 3,000 eggs, which are oval, light-colored with a reddish-yellow tinge. The eggs hatch late in June or early in July, and the young at first go to the leaves and establish themselves mostly on the under side along the mid-rib and veins. The males are frail two-winged creatures which mature in August or September, fertilize the females and perish. The females migrate to the twigs just before the leaves drop, and pass the winter on the bark in a partially grown condition.

In some parts of the country the injury caused by this insect is so severe as to kill many trees. Dr. S. A. Forbes[5] ventures the

opinion that in Illinois destructive outbreaks of this insect may be expected to last about eight or ten years, with corresponding periods of scarcity in sections where it becomes established. The disappearance of the insect he considered due to parasites and predaceous insects.

Six Hymenopterous or four-winged flies are known to be parasitic on this scale. All are very small species, and known only by their scientific names as follows: *Coccophagus lecanii* Fitch, *C. flavoscutellum* Ashmead, *Atropates collinsi* Howard, *Aphycus pulvinariae* Howard, *Comys fusca* Howard and *Eunotus lividus* Ashmead. A Dipterous parasite, *Leucopis nigricornis* Egger, has been reared from the cottony maple scale, and the larva of a moth, *Laetilia coccidivora* Comstock, feeds upon it. Three lady beetles, *Rhizobius ventralis* Erichson, *Hyperaspis signata binotata* Say, and the twice-stabbed lady beetle *Chilocorus bivulnerus* Mulsant, have been recorded as preying upon it, the second being abundant at Wooster, Ohio, in July 1916,[6] both larvae and adults devouring the eggs. Both adults and larvae of the third feed upon this insect.

A *Chrysopa* larva and two species of assassin bugs have been observed feeding upon the scales, and the nymphs of *Corizus hyalinus* Fabr. were found working among the egg-masses at Denver.[8] Miss Murtfeldt observed harvest mites feeding upon the eggs in Missouri. One bird, the common English sparrow, has been observed feeding upon the cottony egg-masses.

In regard to remedies for the cottony maple scale, on account of the difficulty of making a thorough application where trees are in foliage, it is best to spray the dormant trees when the twigs and branches can be thoroughly covered. Mr. F. A. Bartlett informs the writer that in his experience the lime-sulphur mixtures have not proven effective against this insect, due perhaps to poor penetrating powers. On the other hand the miscible oils like "Scalecide" diluted at the rate of one part in 15 parts of water, are satisfactory in destroying the partially grown females. Houser[6] also recommends this treatment in the spring just before the buds open. Forbes[5] found that a strong kerosene emulsion containing from 10-12 per cent. of kerosene applied in the summer would kill a majority of the scales, but that one treatment in winter with a 20 per cent. emulsion destroyed more scales than two summer treatments with a 10 per cent. emulsion.

In the use of miscible oils or strong kerosene emulsions, it should be borne in mind that maples may be injured if too much of the oily mixture is allowed to run down the trunks and settle in the ground at the base. The sugar maple especially is very susceptible to oil injuries, but the silver maple is apparently in much less danger of being injured.

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THE PINE LEAF SCALE.

Chionaspis pinifoliae Fitch.

During recent years in Connecticut, it has been rather common to find young pine trees of several species infested with a scale which resembles the scurfy scale of apple and pear, except that it occurs only on the leaves instead of on the bark. Apparently this insect does not gain a foothold on the larger trees, and is not able to persist upon the infested trees after they reach a certain size. The most common habit of this insect is to infest the leaves of small trees which are overshadowed by larger ones. The writer once saw small white pine seedlings four or five years old under a grove of large native pines, which had been killed evidently by this scale. Nearly every year this insect is found in nurseries, when the annual inspection is being made.

This insect occurs throughout the State, and is found in all of the northern United States. It is usually more prevalent around towns and cities than in the open country.

According to our observations and records, the pine leaf scale has occurred in Connecticut as follows:—South Manchester, 1902; Hartford, 1903, 1905; Thompson, 1906; Rainbow, 1907; Hartford, New Haven, 1908; South Manchester, New Haven, 1909; Hartford, 1910; Riverside, 1911; Greenwich, New Canaan, 1912; New Haven, Cos Cob, 1913; Avon, South Manchester, Cos Cob, Bridgeport, 1914; Bridgeport, 1915; New Haven, Norwalk, Hartford, Bristol, 1916; Stamford, New Haven, Hartford, 1917; Wallingford, Cromwell, Bristol, Hartford, Manchester, 1918; Greenwich, New Haven, Hartford, Manchester, 1919; New Haven, Meriden, New Canaan, Cromwell, Westbrook, Hartford, West Hartford, Bristol, Manchester, 1920; New Canaan, Bridge-

port, Meriden, Cromwell, Bristol, Hartford, Simsbury, Rockville, Sharon, Thompsonville, 1921.

In a majority of cases this scale has been found upon Mugho pines in nurseries and ornamental plantings, but it has occurred also on red, Scotch, Austrian, jack, stone and white pines and on *Pinus densiflora* and hemlock. On four occasions, in 1908, in 1909, in 1913 and in 1920, this scale has been sent to the Station on the leaves of hemlock, and on October 23, 1907, the writer examined a tree on the estate of the late J. M. Greist, Westville, where several branches had lost their leaves from the attacks of this insect.[3] Several species of spruce have been recorded as hosts, but the writer has never found this scale on spruce in Connecticut.

There are supposed to be two generations each year in Connecticut, though its life cycle has not been followed closely through the season. The parent female deposits under her shell oval purple eggs and in this stage the insect passes the winter. These eggs were present in specimens received at the Station on September 17, 1921. They begin to hatch during May, but the hatching period is quite a long one so that the two broods are not distinct but overlap somewhat. The scales of both sexes are similar, pear-shaped and white with a yellow pellicle at the narrow end, the males being somewhat smaller. The appearance of this scale is shown on Plate XI, a.

The following two parasites have been reared from the pine leaf scale: *Aphelinus mytilaspidis* LeBaron, and *Perissopterus pulchellus* Howard. The Nitidulid beetle *Cybocephalus nigritulus* Lec., the twice-stabbed lady beetle, *Chilocorus bivulnerus* Mulsant, the painted lady beetle *Harmonia picta* Randall, *Scymnus* sp., and a species of golden eye or lace wing *Chrysopa* sp., have been recorded as being predatory upon the pine leaf scale.

Control measures for the pine leaf scale have not been thoroughly tested for Connecticut. The worst infested branches can be removed and burned and this is usually advisable with any species of scale insect. Probably the best treatment will be to spray during the summer months with kerosene emulsion or with a nicotine soap emulsion. An application soon after the eggs hatch (about June 10) will readily kill the young, but as the young of this species do not all hatch at the same time, it will probably be necessary to repeat the treatment in order to get most of the first brood. Additional treatments should be made after the young of the second brood appear, but until the life history of this species has been worked out for Connecticut, no definite dates can be given for the hatching of the second brood. Houser[9] reports his experience in Ohio in spraying with a weak kerosene emulsion when the young of the first brood were hatching, followed by an application of whale-oil soap in late summer when the young of the second brood appeared. The combined treatment was effective in reducing the infestation.

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THE TERRAPIN SCALE.

Lecanium nigrofasciatum Pergande.

This insect occurs in Connecticut chiefly upon the smaller twigs of the silver maple and the red maple, but occasionally we find it on sugar maple and Norway maple. The writer has received specimens on peach from Philadelphia, Pa., where it is reported as being quite a pest of the peach orchard. It is also recorded as attacking plum, cherry, apple, quince, *Crataegus*, sycamore, Carolina poplar, olive, blueberry, spice bush and *Bumelia*. It occurs throughout the eastern United States westward nearly to the Rocky Mountains, and has been reported from Ontario, Canada.

This insect is commonly known as the terrapin scale, but is sometimes called the black-banded scale, and is one of the smaller of the soft scales, varying from one-sixteenth to one-eighth of an inch in length. It is longer than broad, and of a color varying from reddish-brown to black. Usually it is reddish-brown mottled or banded with black, but occasionally we find one that is uniformly red or black. The scales are usually crowded on the twigs giving the general appearance shown on Plate X, b.

This scale is quite convex with a smooth brown area in the center with ridges radiating from it and becoming more and more pronounced as they reach the margin. The eggs are deposited under the bodies of the females during June and the females soon die. The males appear in August and are very delicate winged creatures, seldom noticed unless reared in the breeding cage. The young establish themselves on the smooth bark of the smaller twigs and branches, usually on the under side, but sometimes entirely encircling them. According to Houser[5] they sometimes migrate

later to a more favorable situation. There is only one generation each year and the winter is passed by the females only, in a partially mature state.

The injury caused by this insect is due to sucking the sap from the twigs throughout the active season and from the leaves for a portion of the summer. Thus a badly infested tree is severely injured. As in the case with a number of scale insects, honey dew is exuded and drips from the twigs, and a black fungus or sooty mold grows therein, giving the foliage a blackened appearance.

In Connecticut, this insect has been identified on silver maple, except where otherwise indicated, from the following localities: Forestville, 1905; Deep River, 1906; Hartford (2) once on sugar maple, South Glastonbury, 1907; New Haven, 1908; Norwich, on red maple, 1909; Thompsonville, 1911; Hartford, Bristol, 1914; New Haven, 1915 and 1916; New Haven, Seymour, Middletown, Danbury, 1920; Milford, Bridgeport, (on red maple), New Haven, Durham, Hartford, Watertown, 1921.

According to Houser[5] a number of minute four-winged flies or Hymenopterous parasites have been reared from the terrapin scale. These are: *Coccophagus lecanii* Fitch, *C. cinguliventris* Gir., *C. longifasciatus* How., *Aphychus stomachosus* Gir., *A. cognatus* How., *Angyrus nubilipennis* Gir., and *Encyrtus* sp. The twice-stabbed lady beetle *Chilocorus bivulnerus* Mulsant, feeds upon the young, and a fungus, probably *Cordyceps clavulata,* is reported as attacking the mature scales.

Control measures against the terrapin scale must be practiced for the most part while the trees are dormant. Summer sprayings to kill the young have been suggested, but as the eggs continue to hatch over a long period, several treatments would be necessary. On account of the foliage, it is difficult to make a thorough application. The most satisfactory time is perhaps in early spring just before the buds open. Badly injured branches should be cut off and burned, and the remaining portions of the tree sprayed. For this purpose, Sanders[9] recommends kerosene emulsion containing from 20-25 per cent. of kerosene. Houser[5] states that the miscible oils applied at the rate of one part in 15 parts of water are entirely satisfactory.

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THE EUONYMUS SCALE.

Chionaspis euonymi Comstock.

This scale injures the species and horticultural varieties of euonymus, all of which are grown for ornament, though it is reported as infesting orange, *Althea,* and bitter sweet *Celastrus scandens,* in some localities. In Connecticut it is perhaps most commonly noticed on the climbing evergreen *Euonymus radicans,* which it often kills in large patches on walls, rendering it unsightly. It is found in the Atlantic States from Massachusetts to Georgia, and has been recorded from Ohio, Mississippi, Texas and California. It was first described by Comstock[3] from Norfolk, Va., in 1880. Outside of the United States it has been reported from Cuba, France, Italy and Japan.

From the records of the State Entomologist's office, the euonymus scale may be reported from Connecticut as follows: Hartford, 1905; Middlebury, 1906; Greenwich, 1910; New Haven, 1912; Stratford, 1913; Bridgeport, 1915; Norwalk, New Haven, Bantam, 1916; Greenwich, Stratford, 1919; New Haven, Wilton, 1920; New Canaan, Saugatuck, Stratford, New Haven, 1921.

Thickly infested plants often look as though covered with snow on account of the pure-white males which are small with parallel margins, and extremely abundant on certain plants or parts of plants. The females are much less abundant, larger and broader, about one-sixteenth of an inch in length, pear-shaped, and dull gray or brown in color. Both sexes are shown on Plate X, c.

Apparently the insect passes the winter as a mature female in New Haven and Washington, D. C., notwithstanding the statements made in some publications that it winters in the egg stage. One minute four-winged Hymenopterous parasite, *Aphelinus fuscipennis* Howard, has been reared from the euonymus scale.

The life history of the euonymus scale has not been worked out in Connecticut, but according to Houser[7] there are at least two broods each season. In 1920 a large plant of *Euonymus radicans* in New Haven was sprayed with kerosene emulsion, containing two gallons of kerosene, one-half pound of soap and one gallon of water, diluted at the rate of one part emulsion to three parts water, thus containing about 16 per cent. of kerosene. On May 15 this was applied to a portion of the vine. Two days later, the

vine was examined and no injury to the foliage was apparent. At this time no young had appeared. On July 1, many young were present on the unsprayed portion, but no young appeared on the branches which were sprayed May 15. On July 8, the entire vine was sprayed with the same kind of mixture used on May 15. At this time the growth was nearly complete and the blossoms had dropped ten days before. The effect of this treatment was not followed up, but the vine had already been considerably injured and the owner had it cut back to the ground the following spring.

Sanders[10] recommends for summer application a kerosene emulsion containing not more than 15 per cent. of kerosene, or a solution of whale-oil soap, a pound in a gallon of water. During the winter or dormant season, a stronger emulsion may be used, up to 20 per cent. on the evergreen species and up to 25 per cent. on the deciduous species of *Euonymus*. He warns against allowing the oily emulsion to collect at the base of the plants on account of danger of injury.

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RAPID SPREAD OF THE APPLE AND THORN SKELETONIZER.

Hemerophila pariana Clerck.

In the Report of this Station for 1920, page 190, may be found a brief account of this insect and its discovery in the State. At the time this article was written, the insect was known to occur in Connecticut only at Greenwich and Stamford. The season of 1921 had not progressed very far before we learned that this insect was much more widely distributed in Connecticut. In addition to the towns mentioned above, the insect was sent to this office from the following towns in 1921: New Canaan, Danbury, West Haven,

Wallingford, Portland and West Cornwall. Entomologists from this department have collected or observed the insect in New Haven, Milford, Hamden, Cheshire, Durham, Hartford, Bantam, Litchfield, Mansfield and Groton. It is therefore known to be present in all of the eight counties of the State except Windham County, but as Mansfield borders on Windham County, it may be considered as being distributed all over the State. Though the work of this insect has been chiefly upon apple, sweet cherry trees in New Canaan were partially defoliated in 1921. On June 24, Mr. Zappe and the writer visited Stamford, Greenwich and Port Chester, N. Y. At that time the moths had just emerged and when disturbed fairly swarmed about some of the infested apple trees in Port Chester. They were also resting upon flowers in the field, nearly every daisy blossom having one or more moths upon it. Smaller numbers of the moths were seen in Greenwich.

The larvae feed upon the upper surface of the leaves, partially and sometimes entirely skeletonizing them. The larva spins a

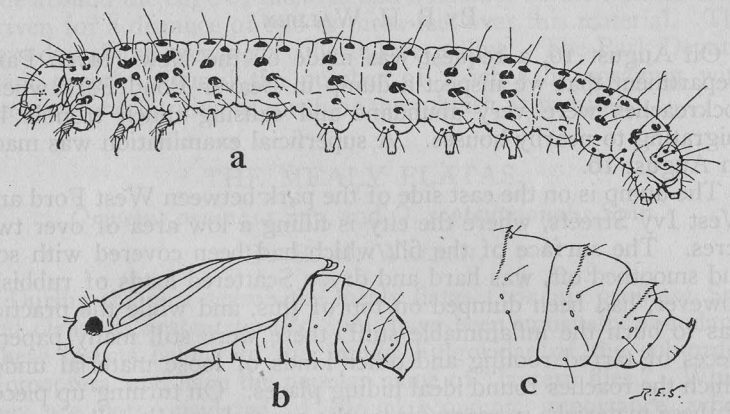

Figure 6. Apple and thorn skeletonizer. a. larva; b. female pupa; c. caudal extremity of male pupa, all greatly enlarged. Drawing lent by U. S. Bureau of Entomology.

light web over the center of the leaf, curling it upward and drawing the margins together especially toward the tip. The leaves are not webbed together like those in the nest of the fall web-worm. In badly infested districts, unsprayed orchards may be completely defoliated. In fact some of the trees in Port Chester observed by the writer on June 24 were quite brown from the attacks of the larvae, and no doubt the injury from later broods would be even more severe because the insects are usually more abundant. Adults were also present and fairly common around New Haven the last days of October, and several were observed on the laboratory windows. Mr. Zappe found the adults to be fairly common

at New Canaan, while inspecting nurseries, and larvae of all sizes were observed. A Tachinid fly *Exorista pyste* Walk. was reared from the pupae.

The structures of the larvae and pupa are shown in the drawing, figure 6. and the appearance of the adult, larva and pupa, is shown on Plate IV, b and c. Further studies will be necessary to ascertain the exact life history of this insect in Connecticut.

Spraying with lead arsenate is the remedy, though it may be necessary to make applications late in the season to prevent injury from the late brood, as the poison applied in May or June is sometimes washed off or new leaves may grow so that the larvae are able to feed upon them without being killed by the poison.

ABUNDANCE OF THE GERMAN ROACH IN A CITY DUMP.

Blattella germanica Linn.

By B. H. Walden.

On August 16, a request was made by the New Haven Park Department that we inspect a dump in Beaver Pond Park where cockroaches were very abundant and causing much trouble by migrating to nearby houses. A superficial examination was made on August 16.

The dump is on the east side of the park between West Ford and West Ivy Streets, where the city is filling a low area of over two acres. The surface of the fill, which had been covered with soil and smoothed off, was hard and dry. Scattered loads of rubbish, however, had been dumped on top of this, and while the practice was to burn the inflammable stuff, there were still many papers. pieces of tarred roofing and other kinds of loose material under which the roaches found ideal hiding places. On turning up pieces of these materials, in many places the ground was literally covered with all stages of the German roach or croton bug, *Blattella germanica* Linn. A few days later a more careful examination was made. It was found that the roaches were well scattered over the dump although they were more numerous near the north edge where there was a bank covered with bushes and small trees. Here the roaches were found in numbers under loose bark and in cavities in the trees. Several specimens of the large American roach *Periplaneta americana* Linn., were also found in similar places in the trees. Associated with the German roaches on the dump were a number of the European house-crickets, *Gryllus domesticus* Linn., which is the second record of the occurrence of this species in the State.

The roaches were active at night and swarmed on the nearby houses and street trees. Roaches were found fully a block away from the dump.

A resident of a house at the end of one of the streets adjoining the park told of killing a great number of the roaches on the side of the house with a proprietary roach powder and called attention to a small shade tree in front of the house on which he killed over one hundred in one evening.

Tests to kill the roaches were made by turning over the material under which they clustered and spraying them with kerosene oil. All of the roaches hit with the oil died in a few minutes.

A proprietary spray was tried in the same manner and while it may have killed the roaches more quickly than kerosene, it did not appear to be any more effective and the cost was about twenty times as much.

Sodium fluoride was given a trial by placing a band about three inches wide around a colony of roaches and driving them through it. Twenty of these roaches were placed in a jar and on the following morning all but one were dead.

The Park Department had spread a quantity of calcium chloride around the edge of the area and a number of the roaches were driven for a distance of two to three feet over this material. The next day all the specimens collected were alive. The Park Department greatly reduced the number of roaches by spraying with kerosene and burning as much of the rubbish as possible.

THE MEALY FLATAS.

Ormenis pruinosa Say, and *O. septentrionalis* Spin.

By B. H. Walden.

During the past season the mealy flatas *Ormenis pruinosa* Say and *Ormenis septentrionalis* Spin. have been unusually abundant. These insects belong to the family Fulgoridae of the sub-order Homoptera, and have the popular name of "lantern flies." While they are not considered of special economic importance, when abundant more or less injury must be caused by their sucking the juice from the stems of the large variety of plants which they attack.

The adult of *Ormenis pruinosa* Say is about one-third of an inch in length, with broad wings folded vertically against the sides of the body. With the wings spread these insects have somewhat the appearance of small moths, though the flight is usually short and feeble. The color is dark gray or brownish, covered with a light, powdery substance giving the insect a pale bluish gray appearance.

The eggs are laid in late summer or early fall in long slits just under the bark of twigs, and are placed end to end, forming ridges in the bark an inch or more in length. According to Riley, these eggs hatch about the middle of May. The nymphs and pupae are

greenish white in color and are covered with a whitish, waxy secretion which often remains on the host plant for several weeks after the insects disappear. The adults emerge early in July. There is only one brood during the season. *O. pruinosa* attacks a number of shrubs and plants, having been recorded on about thirty different plants. Specimens sent to this office were attacking grape, currant and gooseberry.

The adult of *Ormenis septentrionalis* Spin. is slightly larger than *O. pruinosa.* The color is a pale bluish green. The habits are probably similar to those of *O. pruinosa* although our records would indicate that *O. septentrionalis* occurs somewhat later in the season. Both species have been found together on the same plant. Adults of *O. pruinosa* in our collection have been taken from July 5 to September 12. The records for *O. septentrionalis* are from August 6 to October 3.

Where these insects are abundant and causing injury to cultivated plants, the treatment would be to spray throughly with a contact insecticide such as kerosene emulsion or 40% nicotine sulphate.

The mealy flatas were much more abundant this season on some grape vines that were not pruned in the spring than they were in an adjoining yard where the vines were pruned to one or two buds of the previous season's growth. This would indicate that these insects can be controlled by pruning to destroy the eggs. The eggs of *O. pruinosa* and the adults of both species are shown on Plate XII.

MOSQUITO CONTROL WORK.

Season of 1921.

By S. T. Sealy.

All of the salt marsh areas in the towns of Branford, East Haven, Fairfield, Guilford, Groton, Madison, New Haven, Orange and Stamford that have previously been drained for mosquito control have been carefully inspected, patrolled and maintained during the season of 1921.

Many of the ditches that were cut a few years ago had to be almost entirely recut, as drainage had been completely stopped, due to growing vegetation. Several hundred feet of new ditches have been installed to drain low places caused by the meadow sinking.

About 250 acres of marsh land in the Shippan Point section, town of Stamford, that were drained for mosquito elimination by private subscription, were approved and accepted by the Deputy in Charge of Mosquito Work. The maintenance and control work has been done under State supervision this season.

No new work has been done under the State law this year.

Some prominent citizens of Clinton and Westbrook are trying to interest their townspeople in the project of draining the salt marshes in these towns. A preliminary survey and estimated cost of drainage has been prepared for them. A stream that drains off a large amount of the storm water from Westbrook Center has caused considerable trouble. The sand shifted by the winds and tide has repeatedly closed up the outlet, making it necessary to dig it out. The labor costs, which have been rather expensive, have been paid by property owners along the shore. The water held back by a closed outlet flooded a large area, making a serious breeding place for mosquitoes. A survey was made of the brook, and plans and estimates were submitted to Mr. Wilson, a property owner on the shore front. The proposed plan calls for a 24-inch wood pipe-drain, from a point north of the beach in the deep part of stream to go in a straight line through the beach to the low water mark. Both ends of pipe line are to be anchored with concrete bulkheads. The outer end is to be fitted with a suitable tide gate and inner one with a grill to keep rubbish from entering drain. Plan also calls for a clean-out chamber to be placed in the pipe line, so as to make it possible to clean out any sand that might work its way in.

Details of the maintenance work in each town are given below:—

Branford.

The tide-gates at Indian Neck, which have seriously hindered mosquito control in that section in the past, have been replaced by new ones. It is now possible to keep the salt water from flooding the area east of the State road. This area when flooded breeds untold numbers of mosquitoes.

The gates are hung on the new road bridge and are of standard construction. They will undoubtedly last a number of years without repairs.

Mr. L. E. Rice has furnished labor and supervised the cleaning of all drainage ditches on the marshes.

The stone dike in the eastern or Stony Creek section of the town is in need of repairs. It is planned to do some repair work on this dike next season in co-operation with the dike association.

East Haven.

The marshes that are drained have been inspected and ditches cleaned. Building operations and land development along the shore west of Cosey Beach have created several extensive mosquito breeding areas by stopping the natural drainage.

Fairfield.

Maintenance work has been under the immediate direction of Mr. Nicholas Matinck. All the salt marsh ditches have been inspected and cleaned. All low swampy places were oiled with fuel oil when necessary.

Several fresh water breeding areas have been permanently eliminated, and all fresh water streams of any importance have been cleaned or oiled. The labor costs of fresh water operations were paid directly by the town.

Guilford.

Maintenance work on the Guilford marshes has been done by Mr. Frank Blatchley. The drainage ditches are in excellent condition.

On July 18, 1921, a complaint was received at this office saying that mosquitoes were very numerous in Guilford Center. The writer made an inspection of the marshes and a night collection was taken to determine what species of mosquitoes were causing the annoyance.

Following is report of inspection and collection: Inspection made on the marshes July 20, 1921. All ditches draining and in proper condition, scattered surface breeding.

Result of night collection of ten minutes duration taken at Guilford Green:

Mosquitoes taken	15	specimens
Salt marsh species	6	"
Fresh water species	9	"

The heavy infestation of mosquitoes at this time was due to heavy rainfall and exceedingly high tides, causing water to stand in places that under normal conditions would be dry.

Groton.

Salt marsh was regularly inspected and ditches cleaned as often as necessary.

Madison.

Mr. Russell Bartlett has been employed on the marsh land which is not included in the Hammonassett State Park Reservation.

Mr. Joseph P. Synnott has directed the work on the marshes controlled by the State Park Commission and several new ditches have been installed for better drainage.

New Haven.

The marsh along West River from Congress Avenue to Derby Avenue was found to be in very poor shape: several large breeding areas had been formed from lack of proper drainage. This area was inspected and ditches installed wherever necessary to insure good drainage. All other marsh areas in New Haven were inspected, patrolled and the ditches kept cleaned throughout the season.

Orange. (West Haven)*

Several hundred feet of new ditches were installed in the marsh area between Beach Street and Blohm Street, West Haven. The pipe drain at Peck Avenue was cleaned out several times during the season.

It will be necessary to repair or build a new tide-gate at Beach Street next season, as it is now impossible to keep the tide water from flooding the meadow and forming mosquito breeding areas.

Stamford.

The marsh lands in the Shippan Point section of Stamford have been inspected, patrolled and the ditches cleaned several times during the season. It has been necessary to use a considerable amount of fuel oil on the low swampy places and some of the long drainage ditches.

Cost of Maintenance, Season 1921.

Madison	$ 207.00
Guilford	421.50
Branford	1,179.00
Fairfield	1,624.85
New Haven	796.85
Orange	152.00
West Haven	130.10
Groton	72.00
Stamford	258.15
East Haven	90.00
Total	$4,931.45

The total cost for the season is $4,931.45, of which one-fourth, or $1,232.86, is borne by the State. The other three-fourths, or $3,698.59, is collected by the State Comptroller from the towns.

*The town of Orange was divided by the Legislature, and after July 1, 1921 all of the shore portion where this work was done has been called West Haven.

MISCELLANEOUS INSECT NOTES.

Dog Biscuit Infested with Drug Store Beetle:—On June 20, samples of dog biscuit were brought to the Station which had been attacked by the drug-store beetle, *Sitodrepa panicea* Linn. One cake was riddled with holes. This insect is known to attack a large number of stored vegetable foods, and certain plant products used as drugs. Frequent heating or fumigating with carbon disulphide are the remedies.

A Leaf Roller of Hickory:—A number of leaf rollers were collected from a large hickory tree near Forest and Chapel Streets, New Haven, on June 9, by Messrs. Britton and Zappe. The larvae were about an inch in length, yellowish-green, and rolled the leaves in a conspicuous manner. On June 21, three adults emerged. These had a wing-expanse of about an inch, were dark brown, with darker oblique bands on the forewings. Specimens were sent to the Bureau of Entomology, Washington, D. C., and identified by Mr. Carl Heinrich as *Eulia juglandana* Fernald, a species not hitherto recorded from Connecticut.

The Stalk-Borer:—Considerable injury was done to corn and other vegetable crops in 1921, by the stalk-borer, *Papaipema nitela* Guen., which was received from New Britain, Middletown, and Hamden in corn and from Hockanum, Windsor and Cromwell in tobacco. Though we may expect to find the larva of this insect in all kinds of herbaceous stems, these are the first specimens that the writer has seen injuring tobacco plants. A full account of this insect, with illustrations, may be found in the Report of this Station for 1919, page 180.

An Enemy of Japanese Iris:—During June, Mr. F. A. Bartlett of Stamford informed the writer that the blossoms of his Japanese iris plants had been injured and some of them ruined by small black weevils which ate the petals. He was asked to send specimens, and on returning home hunted for some but could not find a single specimen. Later in the season he discovered what he took to be the same species, breeding in the seed pods, and he sent specimens. It proved to be *Mononychus vulpeculus* Fabr., a weevil known to breed in the seed pods of the native flag *Iris versicolor*.

A Curious Caterpillar on Bayberry:—On June 5, Miss G. M. Finley brought to the laboratory some peculiar larvae which were found feeding upon the leaves of bayberry in Hamden. They were about the same color as the leaves, and in outline were notched or serrated. They pupated on June 18, making a loose cocoon of bits of leaf webbed together. Later the adults emerged,

and proved to be beautiful little Geometrid *Aplodes mimosaria* Guenee. Wing-expanse about one inch, color pale green, both front and rear wings being crossed by two narrow whitish lines; fringe pale yellow, costal margin of forewings white, antennae, legs and abdomen white.

Paria canellus Injuring Japanese Walnut:—On April 26, specimens were received from Dr. W. C. Deming of Wilton, with a statement that the beetles were feeding upon the tender terminal leaves of Japanese walnut, thus checking the growth and injuring the trees. The beetles received represented three varieties of the strawberry root worm or borer, *Paria canellus* Fabr., as follows: *aterrimus* Oliv., *gilvipes* Dej., and *quadrinotatus* Say. These beetles are usually abundant and feed upon a large number of plants. Spraying the buds and new leaves frequently with arsenate of lead will prevent extensive injury.

A Bayberry Beetle:—On June 24, Messrs. Zappe and Britton observed that many bayberry bushes along the railroad between Saugatuck and South Norwalk had been defoliated by small shiny green beetles. Many were collected and proved to be *Colaspis favosa* Say, a species accredited to Dakota and Florida, and not previously recorded from Connecticut. These beetles vary in color, some being bluish, some greenish, but all have a bronzy metallic luster. The wing-covers are deeply and regularly punctate. There is also considerable variation in size, the average being about three-sixteenths of an inch in length. As the bayberry is not cultivated except perhaps in parks and on large private estates, this beetle cannot be said to be causing injury. Spraying with lead arsenate will prevent defoliation.

Larvae Feeding Upon Witch Hazel:—On June 2, some curious coiled larvae were found on witch hazel in North Branford by Messrs. Walden and Zappe. They were greenish-white with noticeable granular wax secretion and about one and one-half inches long. They were not carefully examined at the time but on account of their coiled resting position, were supposed to be saw fly larvae and put in a rearing cage. They were nearly full grown and pupated in due season. On October 4, two Noctuid moths emerged which we identified as *Conistra indirecta* Walker, commonly labeled in collections as *Scopelosoma moffatiana* Grote. The forewings are bright rust red with three narrow darker transverse bars. Wing-expanse, about one and one-fourth inches. Larvae are shown on Plate XIII, a.

A New Pest of Willows:—On June 24, Messrs. Britton and Zappe visited several localities in Fairfield County, and in company with Mr. F. A. Bartlett of Stamford, examined several willow trees in Greenwich and Port Chester, N. Y., which had been

partially defoliated by the larvae and adults of a small bluish-green leaf beetle, *Plagiodera versicolora* Laich. This insect is about three-sixteenths of an inch long and is an European species which has recently appeared in the vicinity of New York City; from this point it has now spread into Connecticut and New Jersey. It feeds upon willow and poplar, and injured leaves are shown on Plate XIII, b. Spraying with arsenical poisons is an effective means of control.

An Engraver Beetle Injuring Pine:—On August 30, there was brought to the laboratory, a section of the wood and bark of the trunk of a large white pine tree which had recently died, at Putnam. There were many holes in the bark, and some of these contained Scolytid beetles which were identified as *Ips calligraphus* Germ. This is the largest Scolytid occurring in the north-eastern states and is usually found in dying trees and logs. According to Swaine[1] it enters trees green enough to form pitch tubes, and may at times be considered a primary enemy. Apparently the owner considered that the beetles were responsible for the death of the tree, but no examination was made from this office, and possibly the tree was first injured by some other cause.

Larkspur Plants Injured by Mites:—For a number of years, the writer has observed in his own garden and elsewhere an occasional plant with the newer leaves curled and swollen unnaturally, and that such plants failed to blossom. At first this was thought to be of bacterial origin, but on referring specimens to the botanical department, the report came back that no bacteria or fungi were found. Specimens of such plants were received from Ansonia on May 31, and from New Haven on June 1 and June 3, and are shown on Plate XIV, a. On examining the tissues a few mites were noticed and these were afterward examined by Dr. Garman who identified them as belonging to the genus *Tarsonemus* and probably being *T. pallidus* Banks, the same species known to attack and cause similar injury to chrysanthemum, snap-dragon and cyclamen.[2] If this proves to be true, possibly the plants may be saved by several thorough sprayings with nicotine solution and soap(1 teaspoonful in 1 gallon of water).

The Barberry Web-Worm:—On September 9, twigs of Japanese barberry containing webs and nearly full-grown larvae, were received from Mr. Walter Shaw, New Haven, with a request for information regarding the identity and habits of the insect. The adult is a moth belonging to the family Pyralidae, and bearing

[1] Swaine, J. M., Canadian Bark-Beetles, Part II, 112, 1918.
[2] Report of Connecticut Agricultural Experiment Station for 1914, page 176.

the name of *Omphalocera dentosa* Grote. A full account of this insect with illustrations appeared in an earlier report of this Station.[1] The larvae are black, checkered with white and are less than an inch long when fully grown. They live in tube-like cases formed of leaves and excrement webbed together. The adult moth has a wing-expanse of between one and one and one-fourth inches, and is of a dusty brown color, with a darker area near the center of the costal margins of the forewings. This insect was quite abundant in 1911 and 1912, and defoliated some barberry hedges around New Haven. Apparently it shows a preference for the common barberry *Berberis vulgaris,* but also occasionally attacks the Japanese barberry *B. Thunbergii.* Spraying with lead arsenate will prevent injury by this insect.

The Bumble Flower Beetle Injuring Corn:—On August 29, an ear of sweet corn was received from Mr. C. D. Clark, County Agricultural Agent, Danbury, Conn., from the field of H. M. Knapp, containing a specimen of the bumble flower beetle *Euphoria inda* Linn., which was eating the immature kernels as shown on Plate XV, a. This beetle usually feeds upon fermenting sap, decaying fruits, etc., and is sometimes found in connection with injury caused by other insects. We might expect to find it following the work of the corn ear worm, but in this case it appeared to be the primary cause of injury; it has also been recorded[2] as injuring unripe corn in this manner. On September 12, another specimen was received from the field of G. N. Peterson of Unionville, through B. G. Southwick, County Agricultural Agent, Hartford, on the same ears where corn ear worm was feeding. The beetle is yellowish-brown, sprinkled with small black dots. It is about half an inch in length, and appears in late summer and early fall. There is only one generation each year and the insect breeds in rotting turf, manure, and other decaying vegetable matter. Hand picking is the best remedy for the control of this insect on sweet corn.

The Box-Wood Leaf Miner in Connecticut:—On December 15, 1921, when the manuscript of this report was nearly finished, specimens of the box-wood leaf miner or midge *Monarthropalpus buxi* Labou., were received from South Norwalk. This is an European pest discovered in this country in 1910, but not previously recognized as occurring in Connecticut. The adults emerge the latter part of May and first of June, and lay their eggs. The winter is passed by the larvae which are nearly grown. The most

[1] The Pyralid (*Omphalocera dentosa* Grote), A Pest of Barberry Hedges, Report Connecticut Agricultural Experiment Station for 1911, page 292.
[2] Manual of Vegetable-Garden Insects, by C. R. Crosby and M. D. Leonard, page 231, 1918.

promising control measures should be applied at the time that the adults begin to emerge. Hamilton[1] found that spraying both upper and under surfaces of the leaves with common molasses, one part in three parts water, caused nearly all the adult flies to become entangled in the sticky spray before they could lay eggs. Also spraying once with Black Leaf 40 and once with Black Leaf resinate, each diluted one part to 500 parts water, killed about 80 per cent. of the flies, but this should be repeated every four or five days during the period while the adults are emerging.

The Resplendent Shield-Bearer:—During the season it has been rather common to find apple leaves with several holes through them, caused by the mines of the resplendent shield-bearer, *Coptodisca splendoriferella* Clem. The writer noticed this form of injury on his own grounds, and the winter cases of the insect were received from Danielson, March 15. In preceding years this insect was received from Newtown, February 13, 1913, and from Greenwich on cherry November 17, 1920. It was first recorded from Connecticut by Dr. W. C. Sturgis[2] in 1893, as injuring quince trees in Cheshire. This insect occurs throughout the northern United States from Maine to Minnesota and has been reported from Canada.

The adult is a beautiful gray moth with golden head and ends of forewings marked with gold, silver and dark brown streaks. The eggs are laid on the leaves in May and the young larvae make a blotch-shaped mine in the leaf nearly one-fourth of an inch in diameter. When nearly full grown each larva lines its mine with silk and cuts out the case in the shape of a shield, and goes to the bark. These little cases are fastened to the bark of trunk and twigs and inside the larvae pass the winter. The mines and the winter cases are shown on Plate XIV, b. Very little has been published about this insect and one of the best accounts is by Comstock.[3] A good recent account, though brief, is given by Slingerland and Crosby.[4] There are two broods each season. Where orchard trees are thoroughly sprayed with lead arsenate including nicotine sulphate, probably there will be little or no injury from this curious little insect.

Flea Beetles and Tobacco Wild Fire:—During the tobacco wild fire epidemic in the tobacco seed beds in the spring of 1921, quit a number of flea beetles, *Epitrix cucumeris* Harris, were present. It has long been known that insects often carry diseases

[1] C. C. Hamilton, Journal of Economic Entomology, Vol. 14, page 359, 1921.
[2] Report Connecticut Agricultural Experiment Station for 1893, page 80.
[3] Report U. S. Department of Agriculture for 1879, page 210.
[4] Manual of Fruit Insects, page 75, 1914.

from plant to plant. With this in mind, several attempts were made to transmit the wild fire disease from diseased to healthy plants by means of flea beetles.

Dr. Florence A. McCormick of the botanical department and the writer carried on a few simple co-operative experiments to see if this could be done. Beetles were captured from infected seed beds and then confined in cages containing healthy plants. Others were captured on tomato plants and were confined in petrie dishes containing leaves on which there were large diseased areas. They were then transferred to cages containing healthy plants. In every case the beetles had first eaten diseased plants and later healthy ones. Seventeen attempts were made to transmit the tobacco wild fire disease in this way, but in no case were we successful in producing the disease on healthy plants. These experiments are altogether too meager to be conclusive and should be continued.

M. P. Zappe.

Apple Seed Chalcid in Connecticut:—The presence of the apple seed chalcid *Syntomaspis druparum* Boh., in Connecticut, was discovered August 19, 1921, by Dr. Philip Garman, at Cornwall, where some wild apples were badly infested, nearly every fruit showing the external punctures. Dr. Garman afterwards found a few cultivated apples in Mr. Frank N. Platt's orchard at Milford which had been attacked by this insect. The punctures resemble those of the false red-bug, but on cutting open the apple a hard streak will be found connecting each puncture with a seed. This insect is an European species first discovered in this country by Prof. C. R. Crosby at Ithaca, New York, in 1906. It is known to occur throughout the northeastern United States at least as far west as Michigan, and as far south as Virginia. Most of the commercial varieties are not subject to attack but the lady apple and crab apples are often injured. Though there is only one generation each season, and the winter is passed by the larvae in the seeds, it has been found that only a part transform and emerge as adults the following spring. In fact more than half (55 per cent.)[1] lived over two winters in the seeds before transforming. About the only artificial means of control consist in destroying all drop fruit and culls, especially of the wild seedling apples and crab apples. If made into cider the pomace should be destroyed in order to kill the larvae in the seeds, which would probably not be crushed in the press.

Termites Injuring Telephone Wires:—During a damp spell of weather in July 1921, the Southern New England Telephone Company reported insects eating the insulation from their tele-

[1] *Syntomaspis druparum* Boh., The Apple Seed Chalcid, by R. A. Cushman, Journal of Agricultural Research, Vol. VII, page 487, 1916.

phone wires. The writer and one of the Telephone Company's engineers visited the scene of the trouble, which was in the basement of the office building of the New York, New Haven and Hartford Railroad Company. The wires from their switchboard went down to the basement and then up to the various offices in the building. All of the wires were insulated first with rubber and then a fabric covering over the rubber. It was necessary to have all the wires pass from a corridor into another room in the basement before going upstairs. The wires were all massed together, wrapped with tape and conducted through a hole in the top of the door frame. At this point the termites had chewed off the insulation and in some cases exposed the copper wire. Wherever the wire was completely bare, moisture would collect and electrolysis set in, and caused trouble with the telephone service. See Plate XVI, a. The door frame was taken apart and the colony of termites found. The building is built entirely of steel and masonry, and all the termites were in this single wooden door frame. Nobody knew where they came from unless they were in two large boxes of sawdust that were stored nearby. It was recommended that the entire door frame be taken apart and sprayed either with kerosene or hot water and soap.

Late in the fall inquiries were made at the office of the Telephone Company, and the reply stated that no further trouble had been reported. Specimens were not taken for identification, but probably this insect was *Reticulitermes flavipes* Kollar, a species common in this locality. M. P. Zappe.

Rhododendron Lace Bug:—During the summer of 1921, one of the Connecticut nurseries had a serious outbreak of the rhododendron lace bug *Leptobyrsa rhododendri* Horv. The nursery firm thought that the insects were brought in on rhododendrons which they had bought from a North Carolina nursery. This insect is not new to Connecticut, having been taken in Rockville, South Manchester, Middlebury, Greenwich, New Haven and Hamden.

The nursery was visited on July 6, 1921. At this time the insect was in the adult stage. Eggs were also present but no nymphs. Other visits were made during the summer but no nymphs were found at any time. Apparently there is but one brood in Connecticut, although two broods have been recorded from New Jersey. Injured leaves are shown on Plate XV, b. The insects cause injury to the leaves by sucking out the juices from the under side. The injured leaves show whitish spots or lines scattered all over the surface. Often the leaves have a tendency to curl and in extreme cases turn brown and drop off. The under side of the leaves are disfigured by brownish spots along the midrib under which the eggs may be found, also by the excrement of the insects.

Several sprays were tried as control measures. As this is a sucking insect and feeds on the under side of the leaves, a contact spray must be used and must be applied to the under side of the leaves to hit and kill the bugs. One pound of common laundry soap to eight gallons of water sprayed on the under side of the leaves killed all lace bugs that were hit.

Nicotine sulphate (2 teaspoonsful to 1 gallon of water) and one-half ounce of soap was a very effective remedy and killed all that were reached by the spray.

Kerosene emulsion made as follows:

Kerosene	2 gallons
Water	1 gallon
Soap	½ pound

Dissolve soap in hot water, add kerosene and churn until a creamy emulsion appears. Dilute nine times. This was also effective in controlling this insect but more trouble to prepare than some of the other sprays.

Scalecide, 1 part in 25 parts of water, was also tried, but most of the insects ten minutes after spraying were still alive and crawling around on the leaves. Some were killed, but the majority escaped.

This is not an especially hard insect to kill, but perhaps it may be necessary to spray twice in order to kill them all. A few might escape the first treatment which would be killed by the second.

M. P. Zappe.

Parandra Borer Injuring Maple Tree:—On August 10, 1921, the writer examined a sugar maple street tree in front of the premises of Mr. T. S. Allis, 54 Atwater Avenue, Derby. This tree had been injured in preceding years by the maple borer, but in the spring had leafed out well and later the leaves dried up and dropped, only a few green ones remaining. In the trunk which was nearly all dead there were many (perhaps 40-50) exit holes. These holes were nearly circular, but slightly flattened, and in some of them were found living or dead specimens of *Parandra brunnea* Fabr. One beetle was crawling upon the bark of the trunk. The illustrations on Plate XVI, b, show the holes in the trunk and the appearance of the adult beetle. The borer belongs to the Order Coleoptera and family Cerambycidae, and is known to attack and kill various fruit and shade trees, particularly if they have been injured previously. It usually lays its eggs in the dead or decaying wood where a tree has been mutilated or otherwise injured. Chestnut telephone poles are occasionally damaged by this borer, which has also been recorded from ash, black walnut, hickory, beech, chestnut, chinquapin, oak, elm, willow, tulip tree, locust, ailanthus, maple, bass-wood, apple, pear, plum, wild and

cultivated cherry, and pine. According to F. E. Brooks,[1] old apple, pear and cherry trees are especially liable to attack, particularly if they have hollow bases, cavities or decaying areas in the trunk, or if storms have broken their larger branches. Hart[2] calls this insect the heart-wood borer because it tunnels in the heart wood, but its attacks are not confined to the heart wood but may involve the sap wood, either dead or living. Most of the injury is usually in the main trunk or in case of telephone poles according to Snyder,[3] near the ground line or from one to two feet above it.

On July 26, 1905, this beetle was received from South Manchester, where it was found boring in the trunk of an oak tree.

The Parandra borer is a flattened brown beetle nearly three-fourths of an inch in length and emerges during July and August. The female lays eggs in small punctures in the wood around wounds and decayed places, in groups of ten or twelve. The egg is creamy-white, oblong-ovate, and about 1.5 mm. long by .5 mm. thick. It hatches in two or three weeks, and the larva is yellowish-white with a black head. The galleries are very crooked and long but the larva never gets very far away from its hatching point, and when mature, pupates in a cell at the terminus of its burrow. No sawdust is thrown out from the burrows of this beetle, and it is thought that three years are required for this insect to pass from the egg to the adult stage.

As the attacks of this borer always or nearly always follow some other injury or mutilation, the trees should be kept in the best possible condition; remedial measures should be directed against other borers, and if a tree is injured or mutilated, the wounds should be given attention and all cavities cleaned out and filled. All unprotected wood surfaces should be dressed with paint. If all of these matters are given thorough and prompt attention there will be little chance for the entrance of the Parandra borer.

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[1] The Parandra Borer as an Orchard Enemy, Bulletin 262, U. S. Department of Agriculture, 1915.

[2] The Heart-Wood Borer, 26th Report of the State Entomologist of Illinois, page 68, 1911.

[3] The Chestnut Telephone-Pole Borer, Bulletin 94, Bureau of Entomology, U. S. Department of Agriculture, page 3, 1910.

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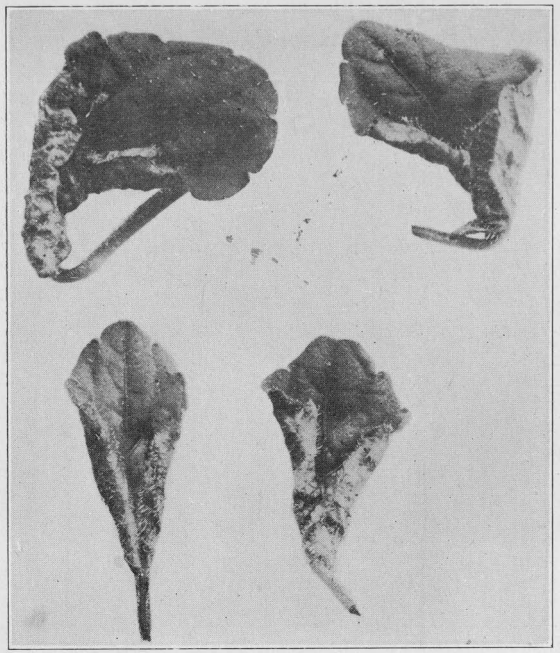
ILLUSTRATIONS.

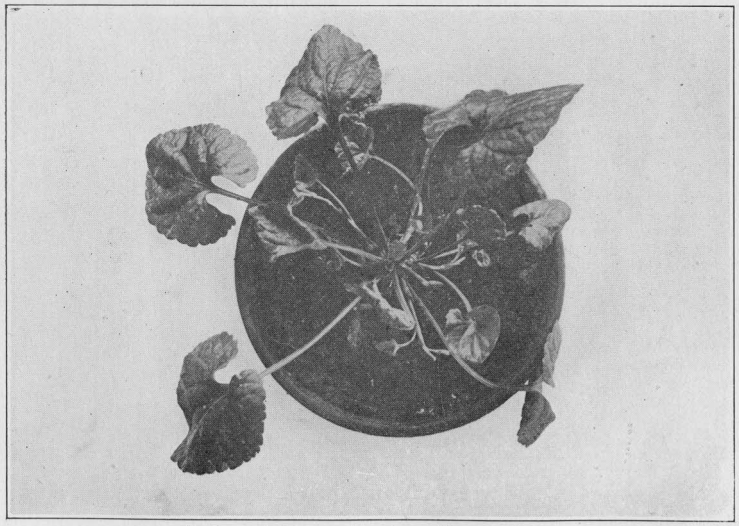
The illustrations in this report (Bulletin 234) are from the following sources:—text figures are all from drawings as follows:—Figure 1, map drawn by A. E. Moss; Figure 2 drawn by Philip Garman; Figures 3, 4 and 5, from Spray Calendar drawn by Mrs. E. L. Beutenmüller; Figure 6, drawn by R. E. Snodgrass, lent by the U. S. Bureau of Entomology. The Plates are all from photographs; Plates I, III, a, IV, a, by W. E. Britton; Plate II, by Philip Garman; Plates IX, a, c, and d, X, a, by H. A. Doty; Plate XIV, b (except inserts), from the report for 1893 by W. C. Sturgis; all others by B. H. Walden.

a. Spraying nearby foliage with auto power sprayer, Mechanicsville.

b. Spraying a tall tree with auto power sprayer, Mechanicsville.



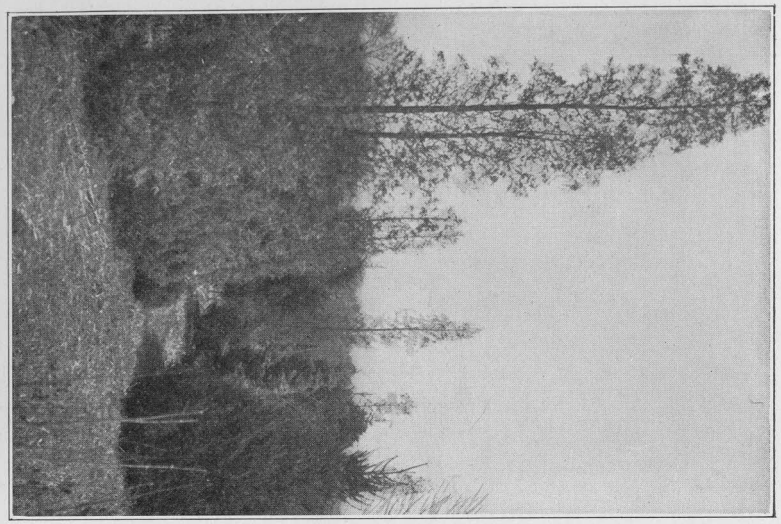
a. Infested and distorted leaves or "galls." About natural size.



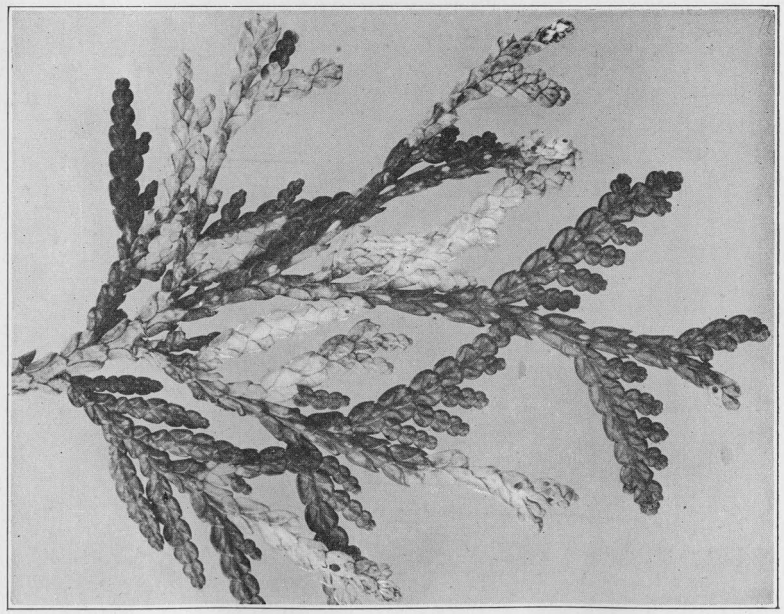
b. Infested plant showing distorted leaves.

VIOLET GALL MIDGE.

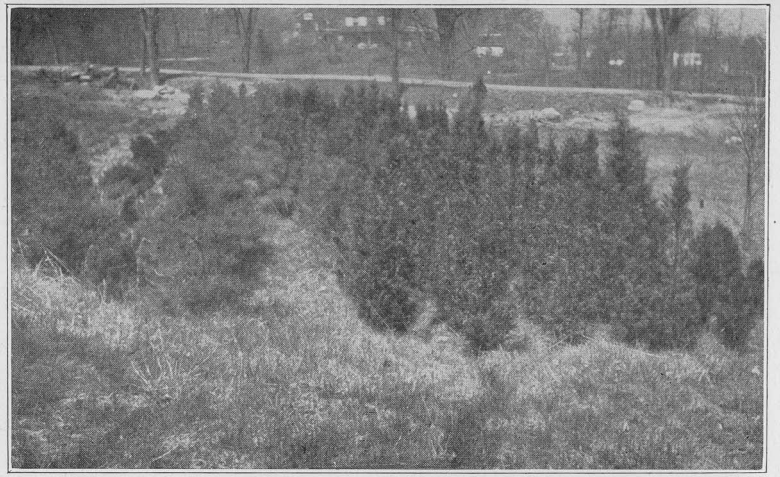
a. Large trees in nursery which were seriously injured and turned brown.



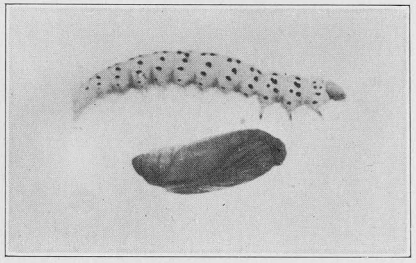
b. Twig of arbor vitae showing mined leaflets. Twice enlarged.



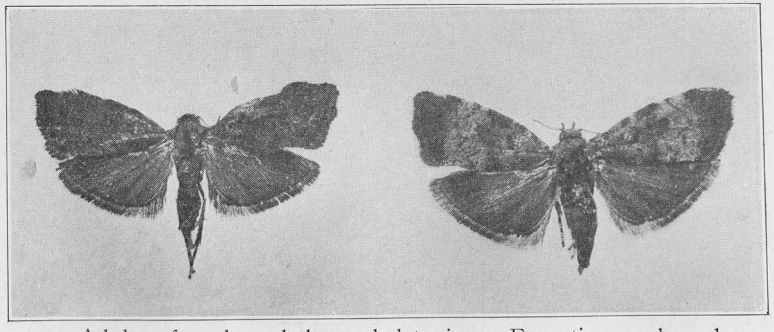
ARBOR VITAE LEAF MINER.



a. Block of pyramidal arbor vitae where experiments were conducted.

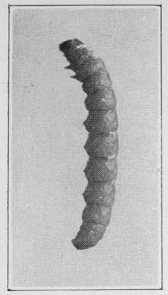


b. Larva and pupa of apple and thorn skeletonizer. Four times enlarged.

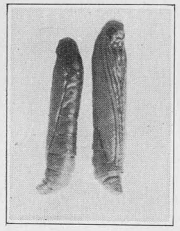


c. Adults of apple and thorn skeletonizer. Four times enlarged.

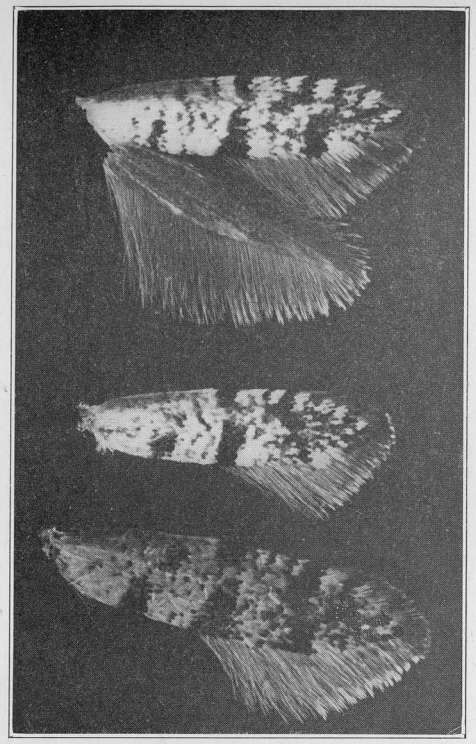
ARBOR VITAE LEAF MINER AND APPLE AND THORN SKELETONIZER.



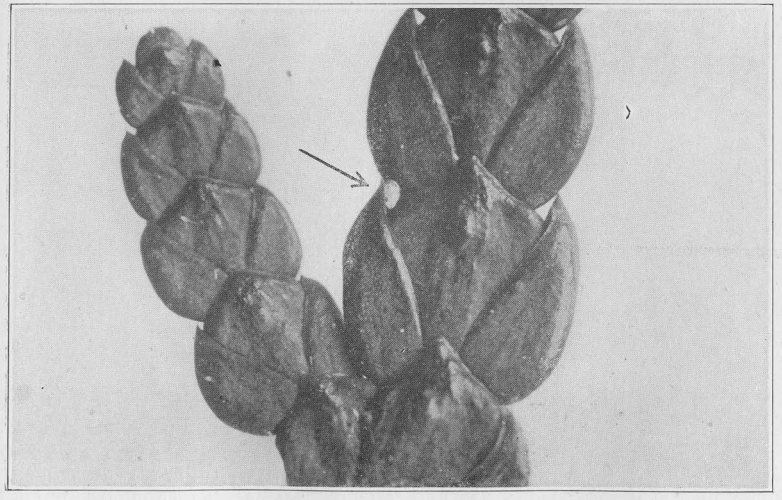
a. Larva. Six times enlarged.



b. Pupae. Six times enlarged.



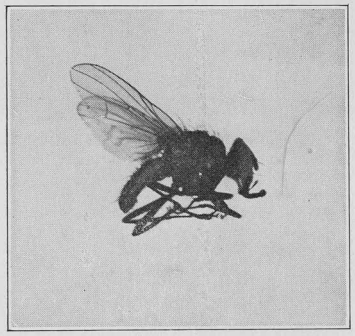
c. Wings of adults. Twelve times enlarged.



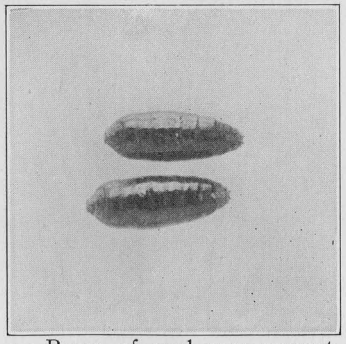
d. Egg on leaflet. Twelve times enlarged.

ARBOR VITAE LEAF MINER.

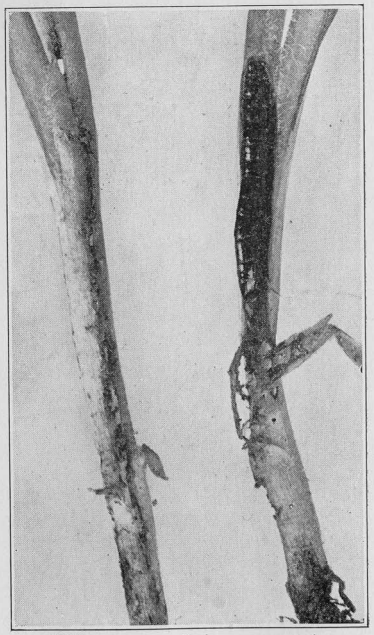
a. Stems of newly-set tobacco plants, showing injury by seed corn maggot. Twice enlarged.



b. Adult of seed corn maggot. Four times enlarged.

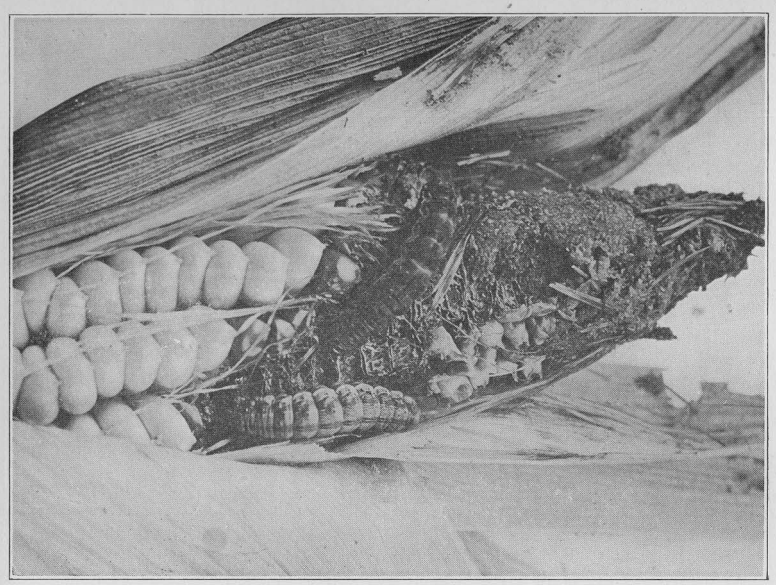


c. Pupae of seed corn maggot. Four times enlarged.

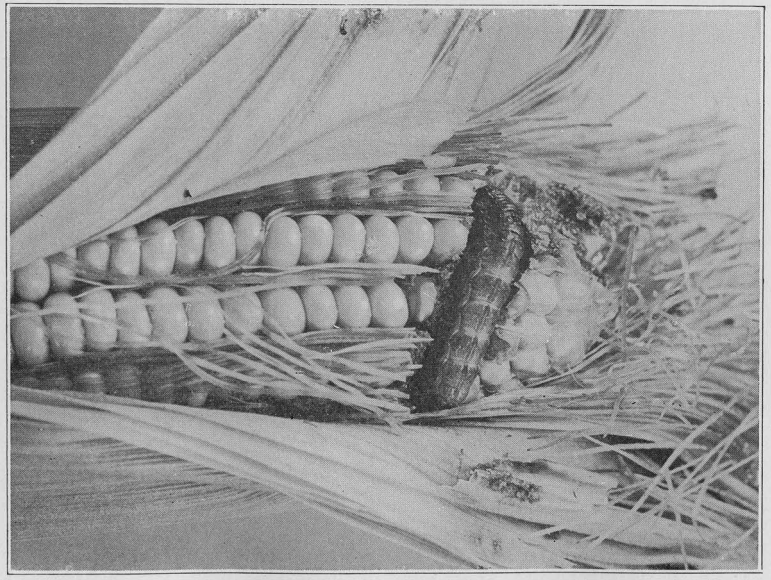


d. Wire worm injury on tobacco plants. Twice enlarged.

TOBACCO PLANTS INJURED BY SEED CORN MAGGOT AND WIREWORMS.

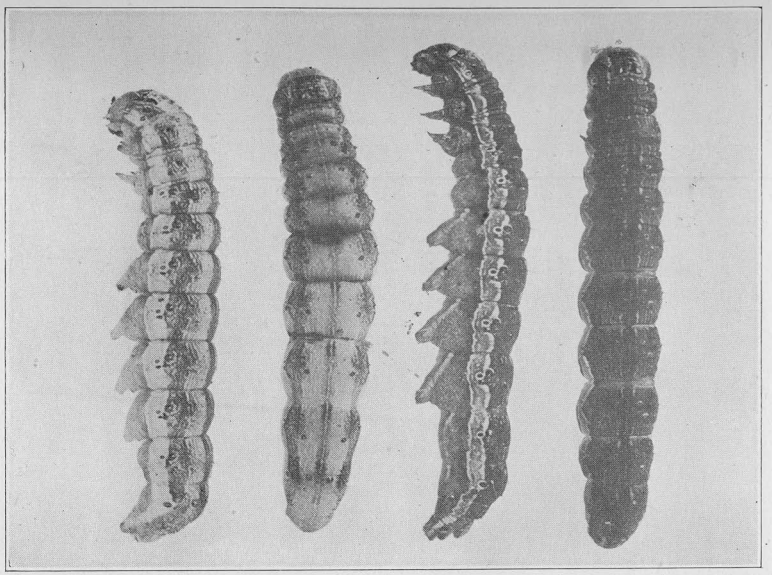


a. Light and dark larvae, feeding at tip of ear. Natural size.

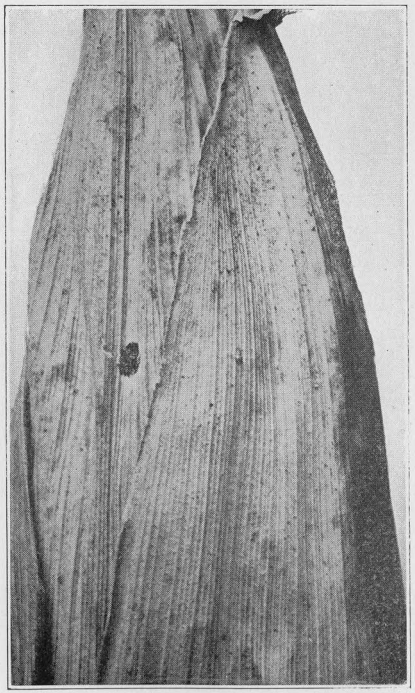


b. Medium colored larva. Natural size.

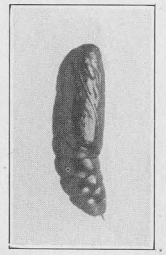
CORN EAR WORM.



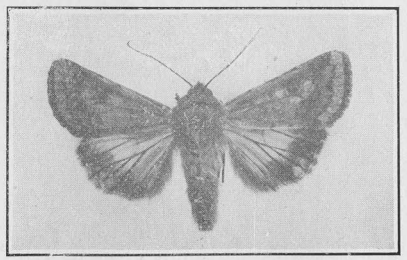
a. Larvae, dorsal and lateral views showing variations in color and markings. Twice enlarged.



b. Tip of ear of corn showing where a half-grown larva has eaten through the husk. Natural size.

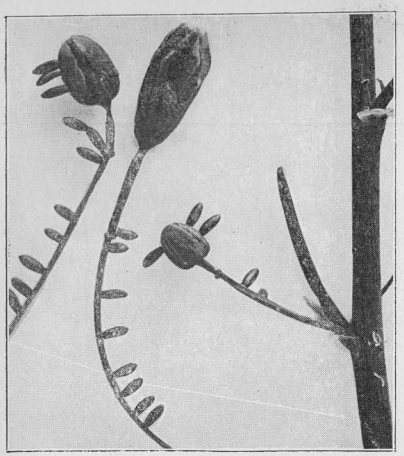


c. Pupa.
Natural size.

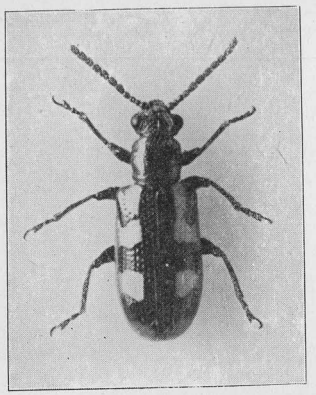


d. Adult moth. Natural size.

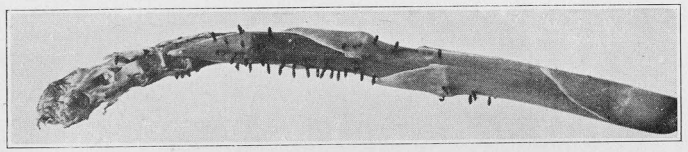
CORN EAR WORM.



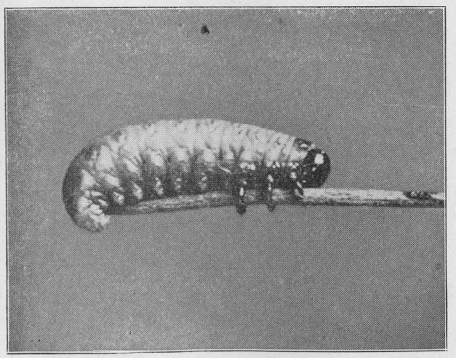
a. Eggs of common asparagus beetle as laid upon mature stems. Much enlarged.



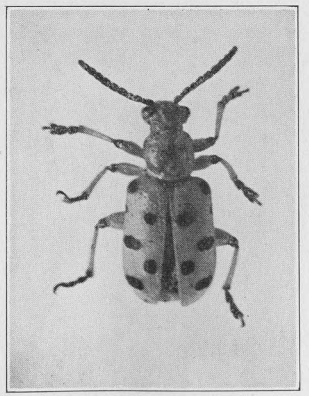
b. Common or blue asparagus beetle. Enlarged about five times.



c. Eggs of common asparagus beetle as laid upon tender shoot. Natural size.

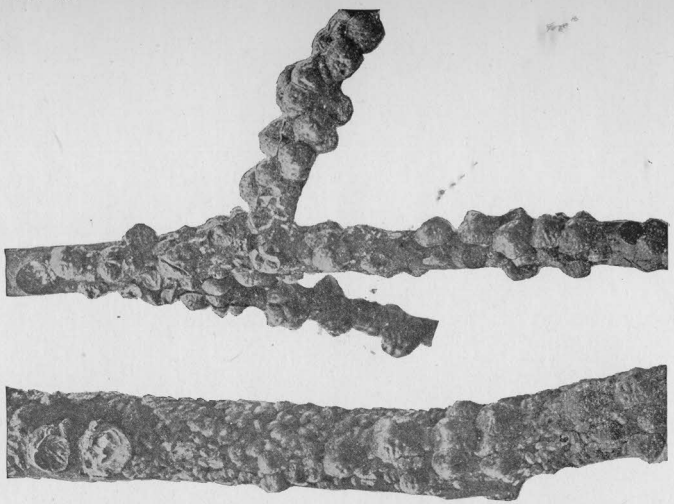


d. Larva of common asparagus beetle. Much enlarged.

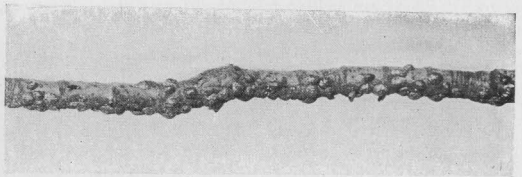


e. Red or 12-spotted asparagus beetle. Enlarged four times.

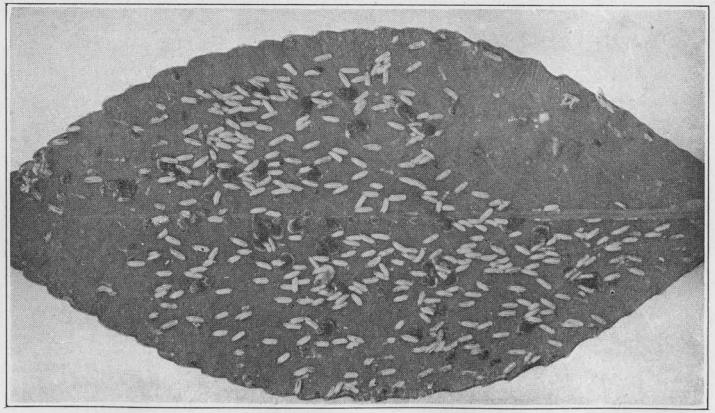
ASPARAGUS BEETLES.



a. Tulip-tree scale. The large brown hemispherical shells are the females, and the smaller gray shells on lower twig are those of the males. About natural size.



b. Terrapin scale. Natural size.



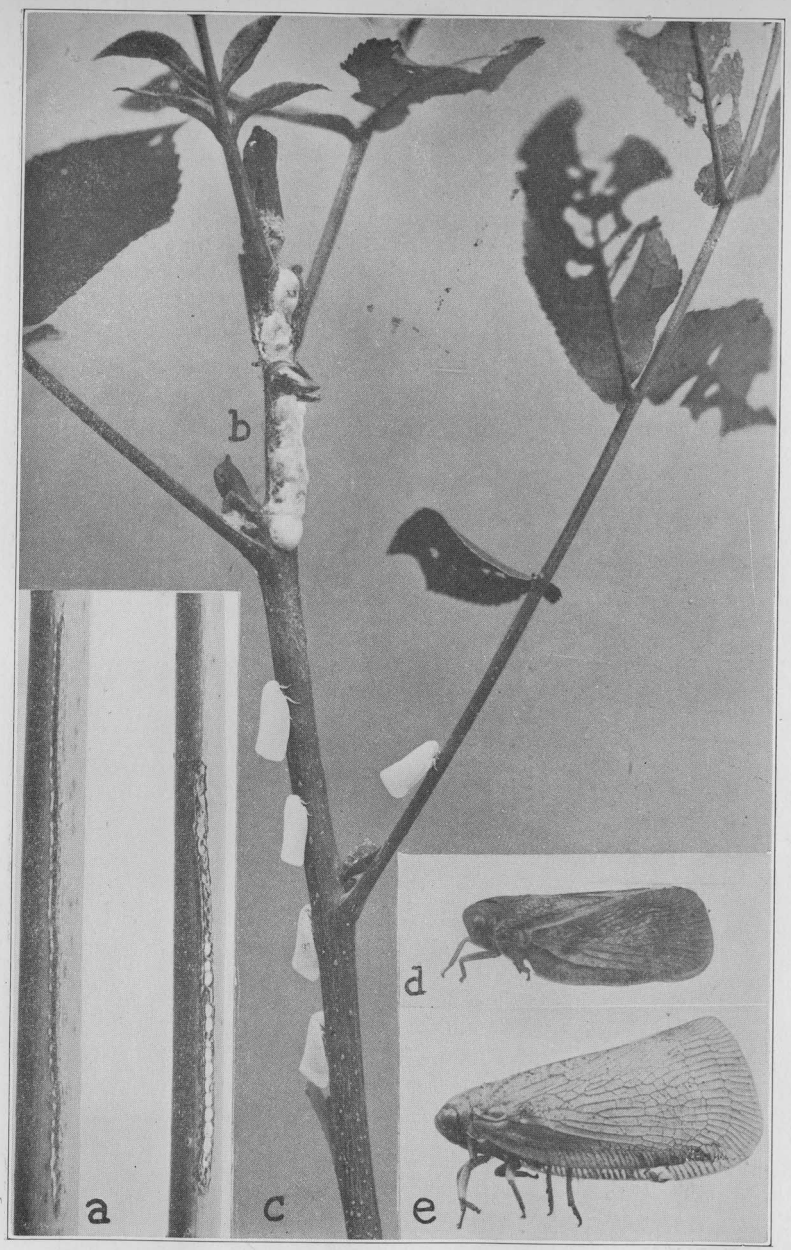
c. Euonymus scale. The narrow white shells are those of the males: the larger pear-shaped gray ones are females. Twice natural size.

SCALE INSECTS.

a. Pine leaf scale. Twice enlarged.

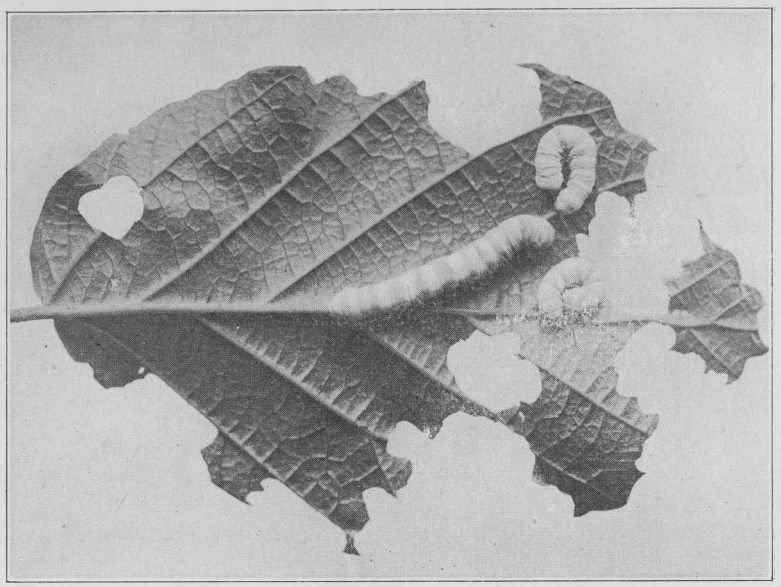
b. Cottony maple scale. Natural size.

SCALE INSECTS.

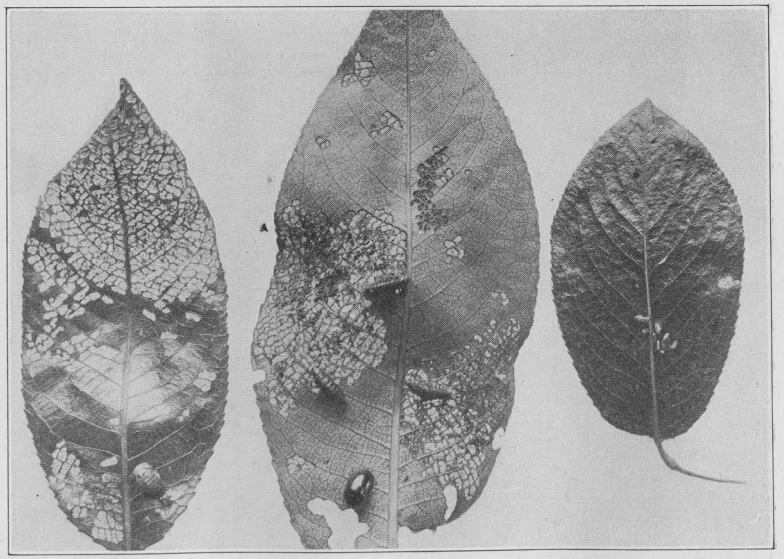


a. Egg-punctures of *Ormenis pruinosa,* twice enlarged; b. Froth masses of *Ormenis septentrionalis,* natural size; c. Adults of *O. septentrionalis,* natural size; d. Adult of *O. pruinosa,* four times enlarged; e. Adult of *O. septentrionalis,* four times enlarged.

THE MEALY FLATAS.



a. Larvae of the moth, *Conistra indirecta* Walker, feeding upon hazel. Natural size.



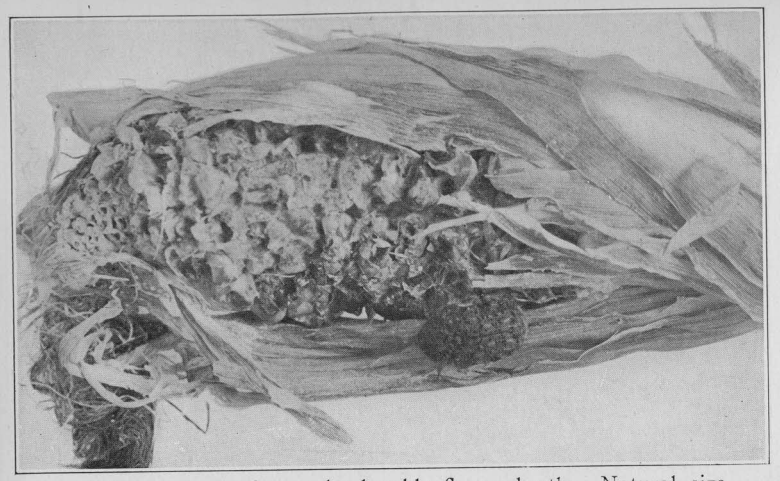
b. Larvae, pupa and adult of *Plagiodera versicolora* Laich., and injury to willow leaves. Slightly enlarged.

INSECTS ATTACKING HAZEL AND WILLOW.

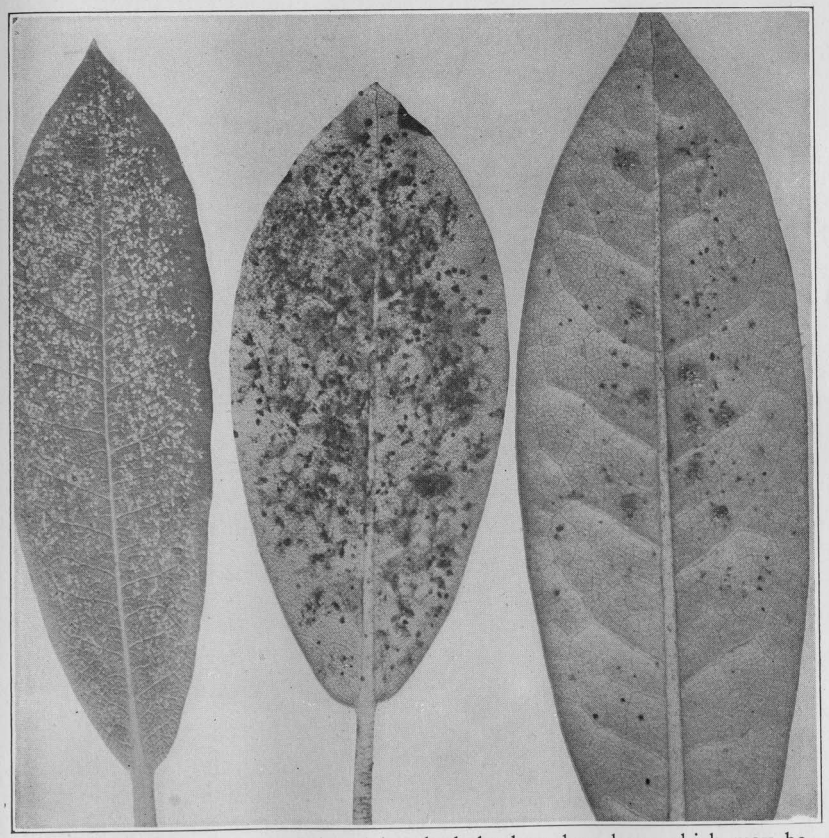
a. Larkspur leaves curled by mites, healthy leaf at left. Somewhat reduced.

b. Quince leaves injured by resplendent shield bearer: insert at left shows mines; insert at right shows winter case of larva. Both greatly enlarged.

LARKSPUR INJURED BY MITES; RESPLENDENT SHIELD BEARER.



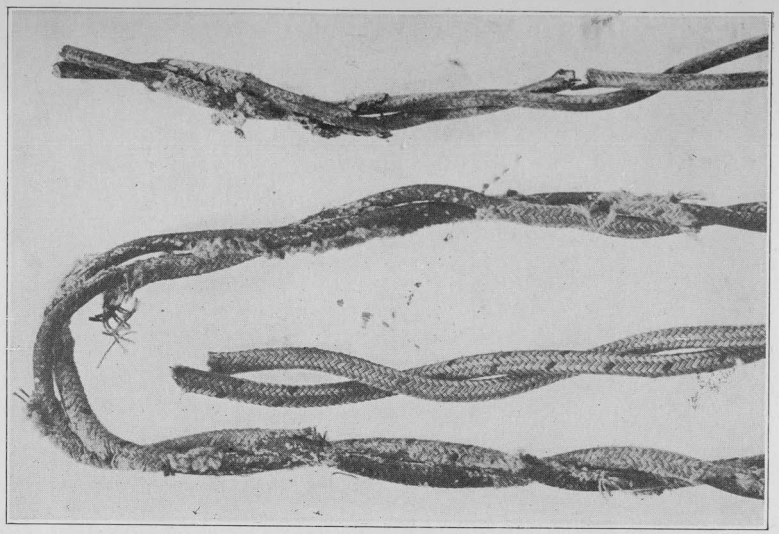
a. Injury to ear of corn by bumble flower beetle. Natural size.



b. Rhododendron leaves injured by rhododendron lace bug, which may be seen on lower surface at right. Leaf at left shows appearance on upper surface.

BUMBLE FLOWER BEETLE AND RHODODENDRON LACE BUG.

PLATE XVI.



a. Inside telephone wires showing how the covering and insulation was eaten off by white ants. Natural size.

b. Maple tree with exit holes of the Parandra borer: beetle, natural size.

TELEPHONE WIRES INJURED BY WHITE ANTS; PARANDRA BORER.

CONNECTICUT
AGRICULTURAL EXPERIMENT STATION
NEW HAVEN, CONN.

BULLETIN 235 **FEBRUARY, 1922**

EXPERIMENTS IN DUSTING VERSUS SPRAYING ON APPLES AND PEACHES IN CONNECTICUT IN 1921.

BY W. E. BRITTON, M. P. ZAPPE AND E. M. STODDARD.

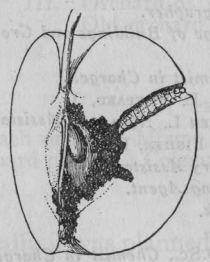


Figure 7. Apple Worm or Codling Moth.

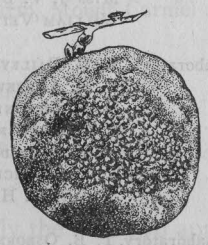


Figure 8. Brown Rot of Peach.

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The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

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February, 1922.

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G. H. Chapman, Ph.D., Windsor, Conn.

Experiments in Dusting versus Spraying on Apples and Peaches in Connecticut in 1921.

By W. E. Britton, M. P. Zappe and E. M. Stoddard.*

The series of experiments with dusts in comparison with liquid sprays for controlling the common insect and fungous pests of apple orchards in Connecticut, was begun in 1920, and the results printed in the Report of this Station for that year, pages 168-177. This project, considerably enlarged and including peaches, was continued in 1921. In 1920 the tests were all made in one orchard, while in 1921, experiments were conducted in four apple orchards and two peach orchards, as follows:—

APPLE ORCHARDS.

Orchard No. I.	Young orchard, Station Farm, Mount Carmel	96 trees
" " II.	Orchard of W. F. Platt, Orange	97 "
" " III.	Orchard of F. N. Platt, Milford	524 "
	Old orchard, Station Farm, Mount Carmel	40 "
		757 trees

PEACH ORCHARDS.

Station peach orchard, Mount Carmel	150 trees
Peach orchard of M. L. Coleman, Cheshire	113 "
	263 trees

Originally it was planned to use only the first two apple orchards and the peach orchards, but later we were offered the use of the third apple orchard. We desire to express our appreciation and thanks to the owners of orchards No. II and III and to Messrs. M. L. and Raymond Coleman for their co-operation in this work; also to Mr. B. A. Porter in charge of the Wallingford field station of the Bureau of Entomology, for the use of the dusting machine, and for aiding us in making some of the applications, and in scoring the fruit. Mr. George E. Graham of the botanical department of this Station assisted in applying some of the treatments, and Messrs. B. H. Walden and Philip Garman of the entomological department, and F. D. Luddington, E. R. Barton, R. C. Botsford and J. R. Pedersen, temporary employees, aided in gathering and scoring the fruit.

The owners of the orchards furnished spray outfits with team and driver for each of the spray applications in orchards II and III.

* The planning of these experiments and the preparation of this paper are the joint work of the writers. The applications were made by Messrs. Zappe and Stoddard, who also supervised and took part in the harvesting and scoring of the fruit.

Apples.

MATERIALS USED.

Sprays:—

The liquid spray for all treatments in each of the three apple orchards was made as follows:—

Liquid lime-sulphur	3 gallons
Lead arsenate (dry)	3 pounds
Nicotine sulphate (Black Leaf 40)	¾ pint
Water	100 gallons

Dusts:—

SULPHUR-LEAD DUST.

Powdered sulphur	90 parts
Lead arsenate (dry)	10 parts

This dust was used only in the eastern part of orchard No. III, and as no treatment was given until after the bloom was over and as aphids and red bugs were rather scarce, the nicotine was omitted.

SULPHUR-LEAD-NICOTINE DUST.

Powdered sulphur	90 parts
Lead arsenate (dry)	10 parts
Nicotine sulphate (Black Leaf 40)	1 per cent.

This dust was purchased and should have contained one per cent. nicotine sulphate. During the course of making the applications, there seemed to be considerable difference in the color and odor of the material in some of the containers. Assuming that this might mean a difference in nicotine content, samples were submitted for analysis to Dr. E. M. Bailey of the chemical department, who reported them as follows:

Sample	Nicotine
No. 1	.29 per cent.
" 2	.30 " "
" 3	.84 " "
" 4	.71 " "

It will be noticed that none of these samples contained the full amount of one per cent. of nicotine. As it happened, red bugs, aphids, and leafhoppers were not seriously abundant in any of the orchards where this dust was used.

SANDERS DUST.

Hydrated lime	86 parts
Dehydrated copper sulphate	10 "
Calcium arsenate	4 "

This dust was used only in orchard No. III for the purpose of comparing it with the sulphur-lead dust.

Cost of Dust Mixtures.

The 1921 prices for the dust mixtures were as follows:

Sulphur lead dust and nicotine	$13.50 per hundred
Sulphur lead dust without nicotine	8.50 " "
Sanders dust	8.00 " "

In the dusting operations, between three and four pounds of dust were used per tree for each treatment. The cost of dusting an orchard at the present price of materials is about three times as great as spraying even though the time required to apply the dust is very much less than the time required to spray. If the price of farm labor drops it will mean a still greater saving in favor of the liquid spray.

Apparatus Used.

The dusting machine used in all three orchards was a Niagara duster owned by the Federal Bureau of Entomology, and used at its field station in Wallingford. The machine was constructed to be drawn by a team of horses, but this method was too slow when moving the outfit from orchard to orchard, so the machine was mounted on a Ford ton-truck, thus saving considerable time on the road and in the orchard. The Ford truck had no trouble in pulling this outfit through the orchards (see Plate XIX, a). When the machine was not in use it could easily be unloaded from the truck and stored in a shed.

An Arlington X. L. gasoline power sprayer was used for applying the liquid spray in orchard No. I. This was a new outfit, and the pressure was not very high, running at about 100 lbs. most of the time. Two lines of hose were used with a single nozzle on each rod.

In orchard No. II, the liquid spray was applied with a Friend gasoline power sprayer equipped with a tank holding 150 gallons. Two spray rods were used with two nozzles on each rod, and carrying a pressure of about 200 lbs. One man sprayed from the ground and another sprayed from a tower on the spray rig.

The spray outfit used in orchard No. III was identical with that employed in orchard No. II, except that instead of two lines of hose with double nozzles, a single line of hose with a "spray-gun" was used. The pressure was about 175 lbs., which is about as high as can be used without danger of mechanical injury to the foliage.

Number and Dates of Applications.

Two treatments after blossoming were given in each of the three orchards.

Orchard No. I had a delayed dormant spray of lime-sulphur on April 7. On April 21, the pink treatment of spray and dust was

applied. The calyx treatment was given on May 18 and 19 and the next or young fruit treatment was made on June 20.

Orchard No. 11 had a dormant spray of miscible oil applied by the owner. The pink treatment was given April 22. The calyx treatment was made May 16, and the next or young fruit treatment was given on June 13.

In orchard No. III, no dormant treatment was given by the owner, and no pink treatment was made, as it was too late before the orchard was offered to us for experiment. The calyx treatment was applied on May 16 and 17, and the next application or young fruit treatment was given on June 14, 15 and 16.

Method of Recording Data.

Certain trees promising a crop and situated inside the border of each plot, and representing the chief varieties upon which the tests were made in each orchard, were selected and marked as count trees. In orchard No. I, all trees were used as count trees in obtaining data. In orchard No. II, count trees were as follows:—8 sprayed, 6 dusted, and 7 checks. In orchard No. III, the following number were used as count trees:—12 sprayed, 12 sulphur-lead-nicotine dust, 8 Sanders dust, and 7 checks. For the sulphur-lead-no nicotine treatment, 2 Baldwin trees were used and a composite sample of Greenings from several trees because the crop on this variety was very light. As a rule the count trees were selected near the center of each plot and not adjacent to a plot having a different treatment, on account of the danger of spray or dust getting on to trees that were not intended to be so treated. With the liquid spray there is little danger of this, but the dust is quite apt to drift or be blown upon adjoining trees.

The green dropped fruit from each of the count trees was gathered, counted and examined for insect and fungous injuries, and the data recorded for each tree, at three different times during the season, as follows: July 11 and 12, July 25 and 26, and August 8 and 9. At harvest time the picked fruit was scored in the same manner. Each individual apple was carefully examined and a record made of each insect and fungous injury. Apples that were called "good" were absolutely free from any signs of insects or fungous diseases and might better be called "perfect" for they were free from pests and were perfect except possibly as to size. An apple showing the work of more than one pest would be checked as many times as there were kinds of insect injury or fungous diseases. This very often gave a greater number of injuries than there were apples and in order to get the true amount of any kind of injury all the apples had to be counted, and this number used to compute the percentage of injury or the percentage of good fruit. This scoring of the fruit involved examining separately 150,296 individual apples, equivalent to about 334 barrels.

The figures given in the tables of results from the various plots are percentages of perfect fruit or of injuries even if very slight, and cannot be compared with any commercial grading. For instance an apple that had been bitten by a curculio might only have one or two small blemishes and would be counted as a "curculio" apple, but in a commercial grading of the fruit would easily go as a No. 1 apple. The same is true of other injuries, especially small spots of scab, sooty blotch or fruit speck. After scoring the apples by the above method, all the fruit on several trees was graded as it would be for market. The results obtained by the commercial grading method are of the greatest importance to the fruit grower, and tell at a glance which treatment gives the highest per cent. of No. 1 fruit. See Plates XVII and XVIII. The other method of scoring is of value in showing just where certain treatments fail.

The following table has been prepared to show how the different treatments compare by both methods of recording data.

Scoring for Injuries versus Commercial Grading.

	Scoring Apples Singly					Commercial Grading		
Tree	Good Per Cent.	Codling Moth Per Cent.	Curculio Per Cent.	Other Insects Per Cent.	Fungous Diseases Per Cent.	No. I Per Cent.	No. II Per Cent.	Culls Per Cent.
O1 Sprayed	48.4	.4	42.4	10.4	5.6	82.	15.8	2.2
B7 Nicotine Dust	4.95	.89	24.9	21.1	83.6	46.25	46.25	7.5
B11 Sanders Dust	.99	.43	20.8	18.1	97.5	60.7	32.7	6.6
B15 & C16 Check	0	8.43	32.8	21.5	97.7	20.	60.	20.
D8 Sprayed	33.2	1.46	58.5	9.9	4.38	83.	14.2	2.8
D14 Nicotine Dust	20.2	6.81	61.4	12.1	33.05	66.3	22.1	11.6
D9 Check	0	19.09	73.9	12.6	100.	11.1	33.3	55.6

Orchard No. I.

Orchard No. I was the ten year old Experiment Station orchard located at Mount Carmel. This orchard is just beginning to bear, and consists of 96 trees on a side hill sloping to the west. All trees bearing fruit were used as count trees to check up results. The varieties were Baldwin, Rhode Island Greening, Roxbury Russet, McIntosh, Gravenstein, Duchess of Oldenburg, Fall Pippin, Northern Spy, Sutton Beauty, King, Wealthy, Hurlbut and Stark.

This orchard was divided into three plots. The north plot was treated with liquid spray and the south plot with the 90-10 nicotine dust. The remaining plot in the center of the orchard was used as a check.

NUMBER AND DATES OF APPLICATION.

The spraying and dusting in each orchard was usually done on the same day or on the following day if there was not time enough to finish the work on the first day.

Before the dusting operations began this orchard had a delayed dormant spraying of lime-sulphur on April 7 over the entire orchard. The pink spray was applied on April 21. The weather conditions were very favorable for dusting and spraying on this day, there being a very light breeze from the southeast. The dust flowed very freely and drifted through the orchard for quite a distance.

The calyx treatment was applied on May 18 and 19. The spray was put on in the afternoon of May 18, the dust on the morning of the 19th. The third treatment or young fruit spray was applied on June 20th. At this time there was no wind and the dust could be blown in almost any direction and would hang in the orchard like a fog.

RESULTS OF SPRAYING AND DUSTING.

	Good Per Cent.	Red Bug Per Cent.	Aphis Per Cent.	Curculio Per Cent.	Codling Moth Per Cent.	Other Chewing Insects Per Cent.	Scab Per Cent.	Sooty Blotch Per Cent.	Fruit Speck Per Cent.
Spray	39.9	.02	1.	48.2	5.78	10.5	1.28	1.7	.27
Dust	32.5	.00	.99	55.4	6.48	7.2	7.39	1.39	1.40
Check	24.8	.078	1.09	55.6	22.0	10.5	12.3	15.7	18.0

DISCUSSION OF RESULTS.

The liquid spray gave a higher percentage of good fruit than the dust, and the dust gave more good fruit than where no treatment was applied. With curculio and codling moth the spray gave better control, while with the other chewing insects the dust was a little better and for some unaccountable reason the spray and check plots gave the same result. The amount of aphis and red bug injury was so small that the figures are of no particular value. In the control of the fungous diseases, the spray was of more value than the dust, but the dust was much better than the check.

Orchard No. II.

This is the same orchard and some of the same plots of trees that were used in the season of 1920. The orchard is about 27 years old and has been very well kept. The varieties in the experimental plots were Greening and McIntosh, Fall Pippin and one tree of Hurlbut. The crop was very light this year.

There were 97 trees under experiment, 39 in the spray plot, 49 in the dusted plot and 9 in the check.

TIME OF APPLICATIONS.

The entire orchard had a dormant spray of oil which was applied by the owner. The pink spray was applied on April 22 and the first dust treatment was also applied on this date. The calyx treatment was made on May 16, both liquid and dust being applied on this day. On June 13, another treatment was given.

In this orchard fruit was picked and scored from 21 trees, with the following result:

RESULTS OF SPRAYING AND DUSTING.

	Good Per Cent.	Red Bug Per Cent.	Aphis Per Cent.	Curculio Per Cent.	Codling Moth Per Cent.	Other Chewing Insects Per Cent.	Scab Per Cent.	Sooty Blotch Per Cent.
Spray	48.2	.04	.02	14.7	1.9	4.5	33.3	.04
Dust	19.8	.78	.56	14.3	2.4	5.3	70.	3.25
Check	1.57	9.7	.68	43.7	12.3	11.7	76.	66.5

DISCUSSION OF RESULTS.

As far as the insects are concerned in this orchard, there is not much difference between the dust and the liquid spray. The liquid spray gave over twice the percentage of good fruit that the dust produced, which difference was largely due to the number of scabby apples in the dust treatment. In this orchard neither the spray nor the dust were very effective in controlling scab, due to the fact that the pink treatment was delayed too long on account of inclement weather.

Orchard No. III.

This orchard is located about two miles north of the village of Milford and is divided by a highway running north and south through it. The trees are about 17 years old and are on a fairly level piece of land with woods on two sides. The trees had dense crowns making it rather difficult to reach the centers with spray or dust.

The varieties in this orchard are Baldwin, Greening, Gravenstein, McIntosh and Hurlbut. This orchard had no dormant spray, and afterwards had one treatment less than the others, the pink spray being omitted.

TIME OF APPLICATION.

The first treatment was made at the time the petals had all dropped, on May 16 and 17. The second application was given on June 14, 15 and 16. The wind on these days was very strong and the dusting work was delayed a little on this account.

RESULTS OF SPRAYING AND DUSTING.

	Good Per Cent.	Red Bug Per Cent.	Aphis Per Cent.	Curculio Per Cent.	Codling Moth Per Cent.	Other Chewing Insects Per Cent.	Scab Per Cent.	Sooty Blotch Per Cent.	Fruit Speck Per Cent.
Spray	44.7	5.47	1.18	33.9	5.98	5.98	4.97	3.36	3.28
Sulphur Dust	27.4	3.72	.647	24.3	1.85	6.72	2.08	34.10	38.40
Nicotine Dust	22.6	12.37	.706	40.9	3.63	9.43	10.56	14.83	19.70
Sanders Dust	16.9	8.17	2.03	36.3	10.91	11.13	13.13	33.69	40.70
Check	4.6	16.70	1.24	60.1	26.73	30.09	34.98	29.87	35.25

DISCUSSION OF RESULTS.

As in the other orchards the spray is again better than any kind of dust. There are no striking differences in the results between the three kinds of dust used. The figures show less scab when sulphur dust was used, but the varieties in this particular plot, Baldwins and Greenings, are not ordinarily very susceptible to scab, especially Baldwins. All kinds of dust were less effective than the spray in controlling the fungous diseases.

Comparison of Different Sprays.

In addition to the work on the comparison of dusting and spraying, an experiment was conducted on an orchard of 40 forty-five-year old Baldwin and Greening trees at the Station Farm in Mount Carmel in which four different sprays were compared. This experiment has been conducted for three years, but as the 1921 results are representative of the two previous season's results, only the work and results of this season will be discussed.

MATERIALS USED.

The sprays used in this experiment were liquid lime-sulphur, dry lime-sulphur, B. T. S., and Bordeaux mixture.

LIQUID LIME-SULPHUR.

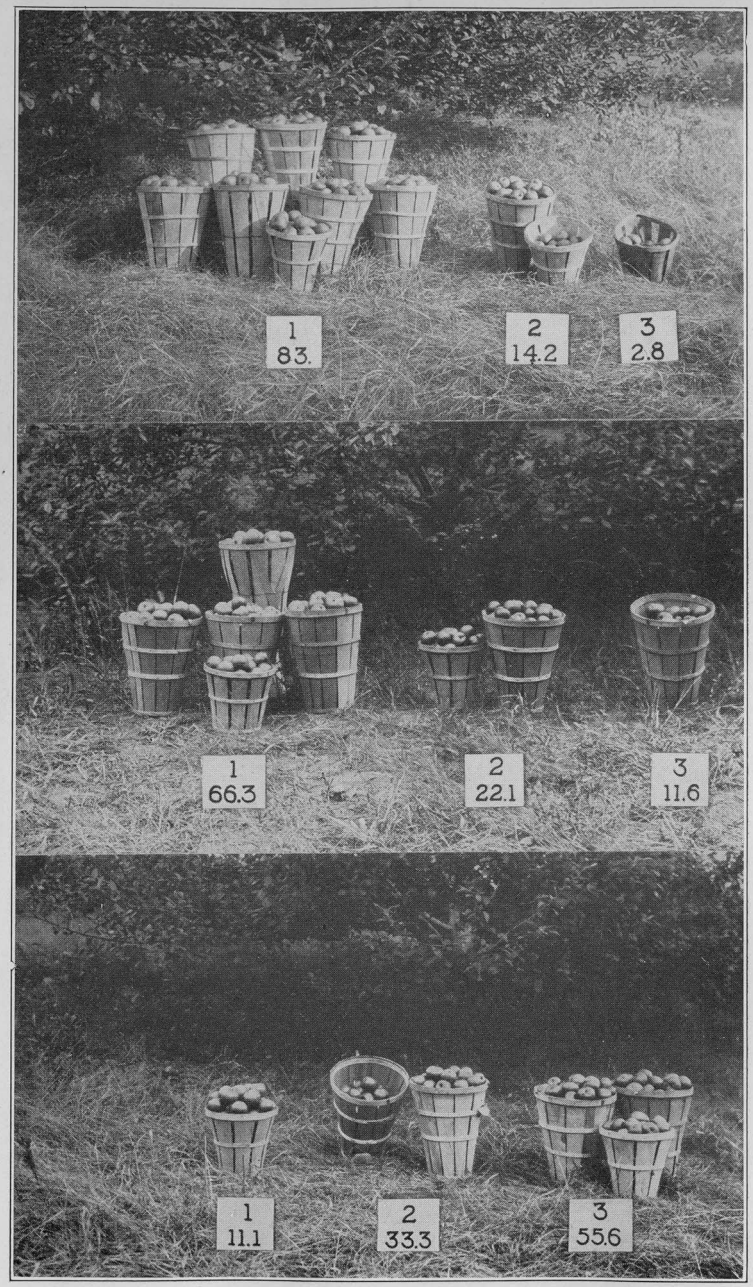
Lime-sulphur	1½ gallons
Lead arsenate (powder)	1½ pounds
Water	50 gallons

DRY LIME-SULPHUR.

Dry lime-sulphur	3 pounds
Lead arsenate (powder)	1½ pounds
Water	50 gallons

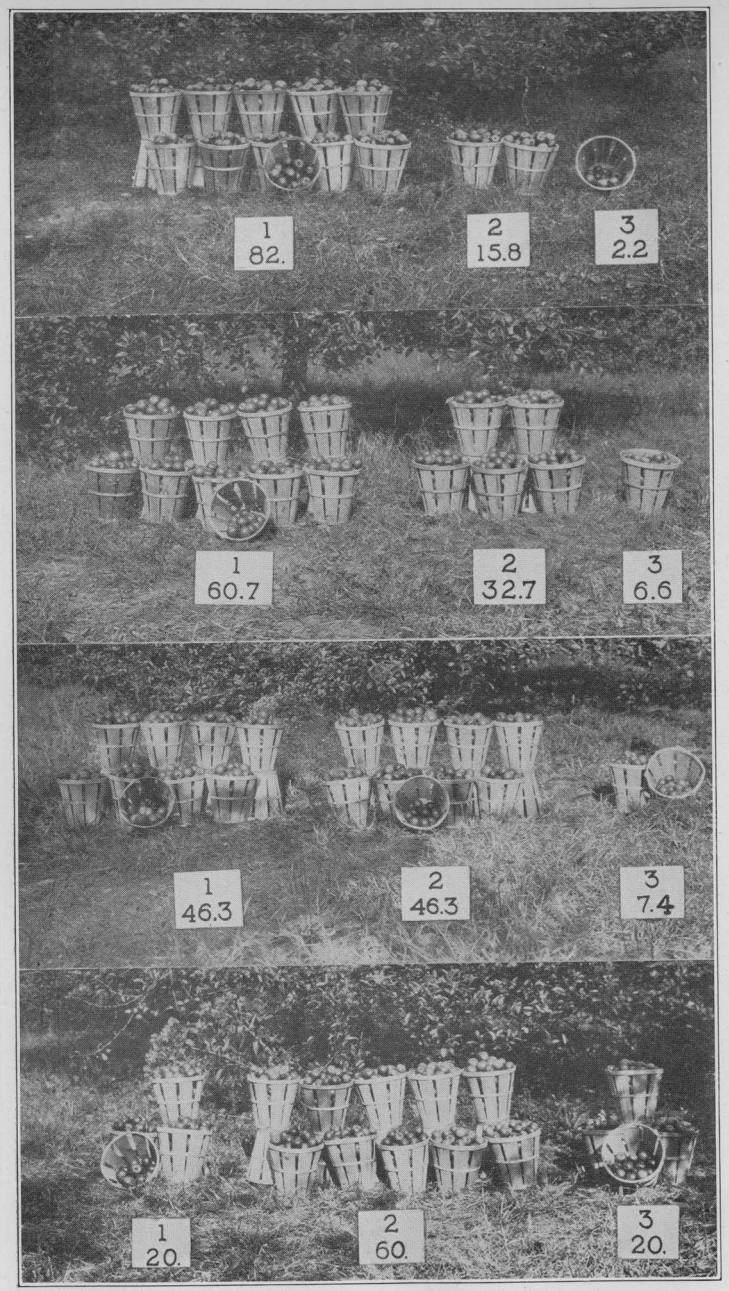
B. T. S.

B. T. S.	1½ pounds
Lead arsenate (powder)	1½ pounds
Lime	3 to 4 pounds
Water	50 gallons



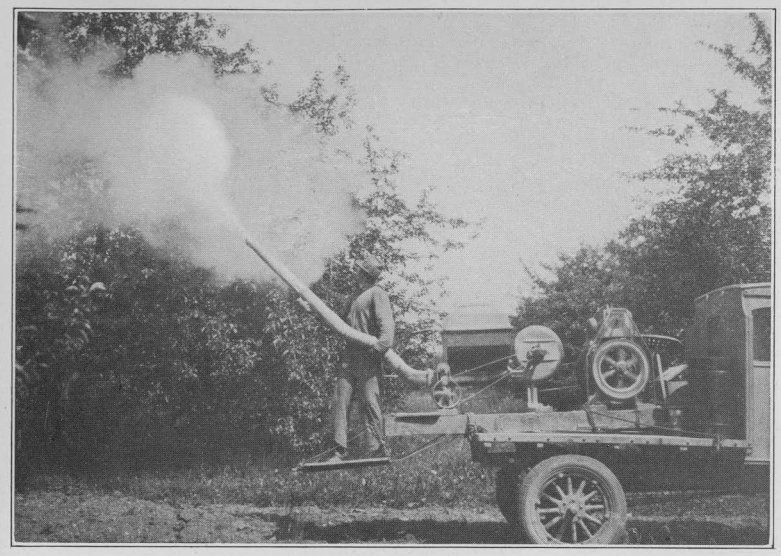
Harvested fruit from orchard No. I. Sprayed fruit at top, dusted fruit in center, and check or untreated fruit at bottom. The percentage of fruit in each grade is shown on the labels.

COMMERCIAL GRADING OF APPLES FROM EXPERIMENT PLOTS.



Harvested fruit from orchard No. III. Sprayed fruit at top, Sander's dust in second view, sulphur-lead-nicotine dust in third view, and check or untreated fruit at bottom. The percentage of fruit in each grade is shown on the labels.

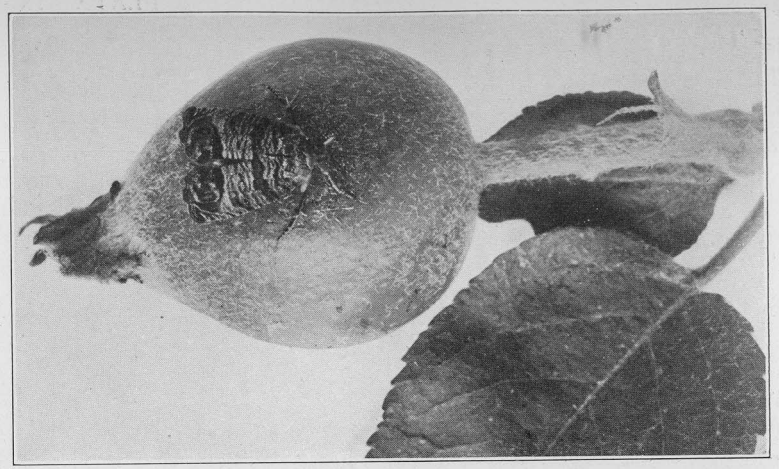
COMMERCIAL GRADING OF APPLES FROM EXPERIMENT PLOTS.



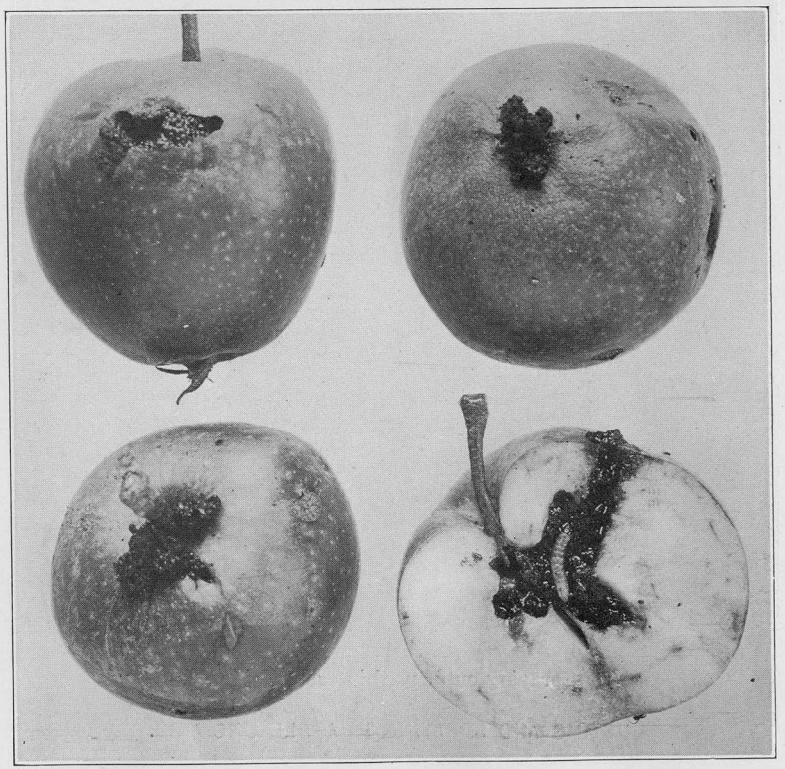
a. Dusting outfit used in experiments.

b. Spraying outfit used in orchard No. II.

DUSTING AND SPRAYING IN APPLE ORCHARD.

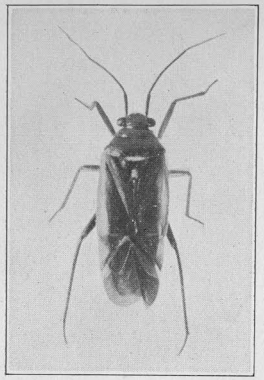


a. Adult moth resting on young apple, twice enlarged.

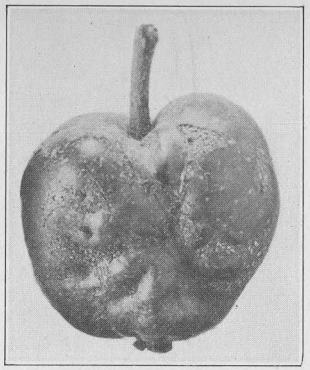


b. Stem, calyx and side injury: section of fruit showing larva in burrow. Natural size.

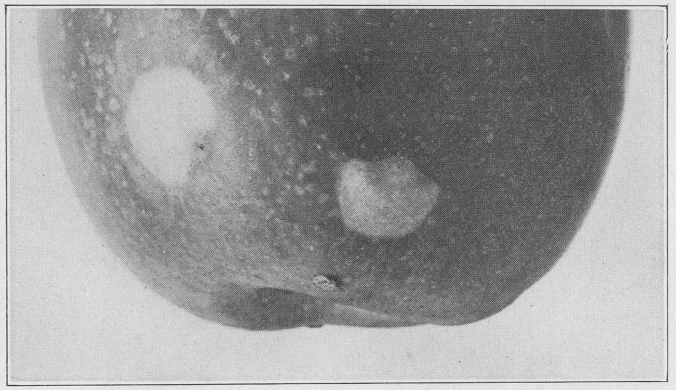
CODLING MOTH.



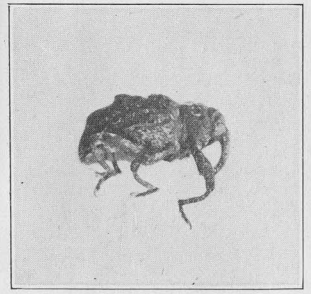
a. Adult red bug. Four times enlarged.



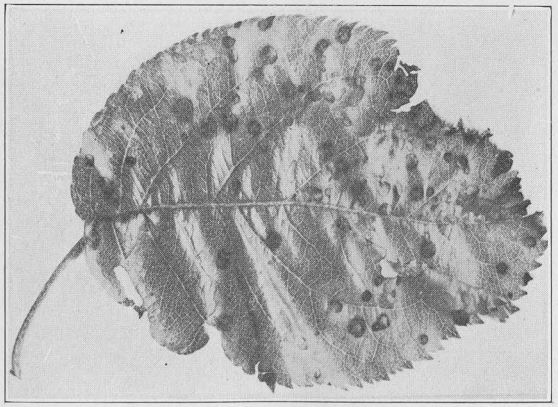
b. Apple injured by red bugs. Natural size.



c. Curculio egg-scars as they appear at harvest time. Natural size.



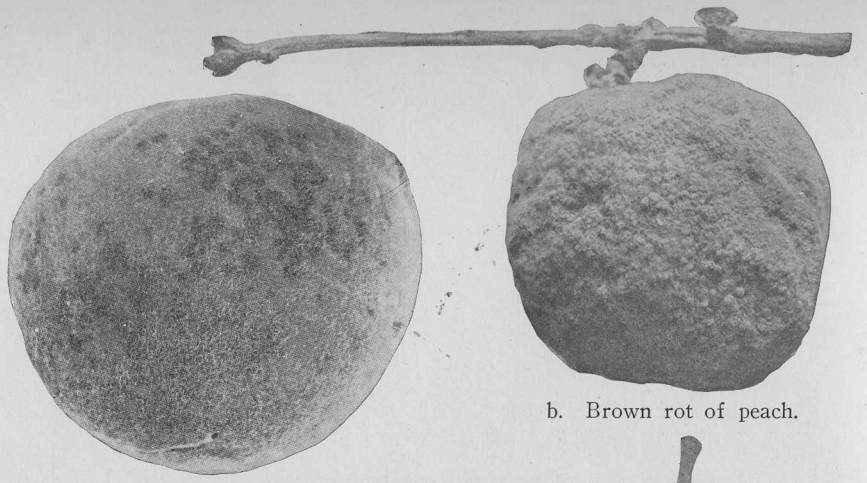
d. Plum curculio side view. Four times enlarged.



e. Spots on apple leaf caused by black rot fungus. Natural size.

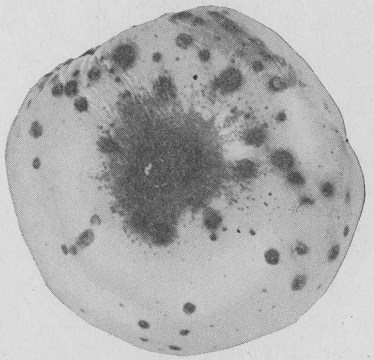
RED BUG, CURCULIO AND BLACK ROT.

PLATE XXII.

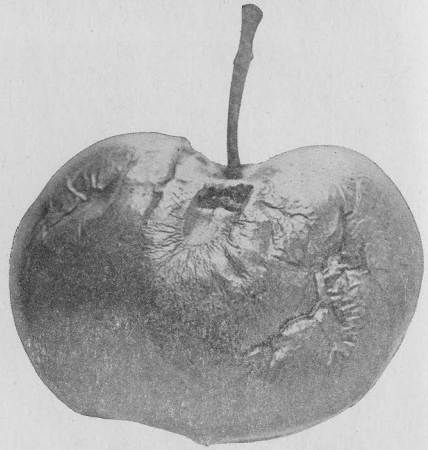


a. Peach Scab.

b. Brown rot of peach.



c. Fruit speck of apple.



d. Black rot of apple.

e. Apple scab.

f. Sooty blotch of apple.

FUNGOUS DISEASES OF PEACH AND APPLE.

BORDEAUX MIXTURE.

Copper sulphate	1 pound
Lime	4 pounds
Lead arsenate (powder)	1½ pounds
Water	50 gallons

APPARATUS USED.

All the applications were made with an Arlington X. L. outfit, using two lines of hose and rods with one Friend nozzle to each rod. This outfit maintained a pressure of 125 pounds.

DATES OF APPLICATION.

The entire orchard had a delayed dormant spray of lime-sulphur 1-9 on April 7. As scab was known not to be abundant in this orchard, the pink spray was omitted. The calyx spray was put on May 19 and the young fruit spray on June 20.

The following table shows the results obtained.

RESULTS OF SPRAYS.

	Good Per Cent.	Red Bug Per Cent.	Aphis Per Cent.	Curculio Per Cent.	Codling Moth Per Cent.	Other Chewing Insects Per Cent.	Scab Per Cent.	Sooty Blotch Per Cent.	Fruit Speck Per Cent.
Dry Lime-Sulphur	72.5	.13	1.24	10.70	.66	8.7	.03	8.42	3.64
Liquid Lime-Sulphur	53.6	.14	1.67	21.76	5.43	17.70	.66	5.24	2.66
B. T. S.	54.2	.34	3.09	22.92	4.92	11.64	.34	13.24	4.57
Bordeaux	52.0	.25	1.8	23.82	8.29	11.85	1.78	9.08	3.86

DISCUSSION OF RESULTS.

In this experiment the dropped fruit was not scored and records were made from harvested fruit from all trees, otherwise the data was taken as described elsewhere in this paper. The check trees did not bear any fruit so no comparison could be made with untreated trees. It will be seen that the dry lime-sulphur gave the highest per cent. of good fruit, this also being true in the two previous seasons' work with this material. Not only was there a higher per cent. of good fruit but the appearance and finish of the fruit was superior to that from the other plots. The B. T. S. gave about the same control of fungous and insect pests as did the lime-sulphur but the fact that it caused considerable injury to the foliage makes it an undesirable material to use. It was estimated that it caused a drop of from 30 to 40 per cent. of the foliage, as compared with no injury from any of the other treatments.

Usually there has been considerable russetting of the fruit on the Bordeaux plot and probably this year was no exception, but on account of the fact that late frosts caused more or less russetting of the fruit on all of the plots, it was not possible to get any data on this point. Because of its tendency to russet the fruit, we do not recommend Bordeaux as a spray for apples.

Chief Pests Attacking the Fruit of Apple Orchards.

INSECTS.

Codling Moth:—This is the chief insect attacking apple orchards and though varying in abundance is present every year in every orchard. It passes the winter as a larva in the cocoon, transforming to a pupa in the spring. The moths emerge soon after the trees blossom and lay their eggs chiefly on the leaves, though sometimes on branches and developing fruit. The egg-laying period extends over several weeks, and in about a week these eggs hatch, and the larvae feed slightly on the foliage but tunnel into the fruit mostly through the calyx. They eat their way to the core, and later burrow to the surface making the traditional worm hole, as shown on Plate XX, b. From 20 to 30 days are required for larval development, when the worms leave the fruit usually before it falls, and seek a protected place to spin the silken case or cocoon. Of those assuming this stage in mid-

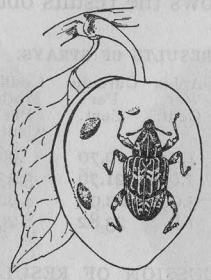


Figure 9. The Plum Curculio.

summer, a portion transform the same season, while those going into their cocoons late in summer or autumn do not emerge as adults until the following season. There is usually one full generation, and a partial second each year in Connecticut.

The codling moth is usually less injurious in orchards which are sprayed each year with arsenical poisons.

Plum Curculio:—The adult is a weevil or snout beetle which hibernates in rubbish heaps, hedgerows, woodlands, *et cætera,* where it can find protection. It appears on trees soon after the buds open, and soon after the fruit sets and the petals drop begins to puncture the young fruit. Two kinds of punctures are made, one for feeding and the other for depositing eggs. The latter are crescent-shaped and the egg is placed just under the skin of the flap on the concave side of the crescent. Egg-laying may extend over nearly the whole season, though most of them are laid during the first month after the blossoms fall. The feeding punctures are small cavities eaten into the surface of the fruit and usually occur in clusters. They may be made late in the season. There is only one generation each year, and this insect usually breeds in

stone fruits. The larvae do not develop in the apple, and the only injury is that caused by the punctures. Plate XXI, c, shows the egg-scars as they appear on the fruit at harvest time. The application of poisons, though of some benefit, is not a satisfactory control for this insect. Much more can be accomplished by abolishing its hibernating places, like rubbish heaps, hedgerows, *et cætera,* in or near the orchard.

Other Chewing Insects:—Many insects might be included under this head, but only a few will be mentioned in connection with the orchards where our experiments were conducted.

Apple Maggot:—This was not a serious pest in these orchards, though present and causing some injury on certain varieties. Later treatments, so that the foliage and fruit will be coated with poison during July, may be effective in poisoning the adults before they lay eggs.

Leaf-Rollers:—In 1920, there was considerable surface injury to fruit late in the season caused by the red banded leaf-roller *Eulia velutinana* Walker, and the lesser apple worm *Enarmonia prunivora* Walsh. Consequently some later treatments were given a portion of some of the plots, but these insects were not noticed in 1921, and the treatments gave no benefit.

Aphids:—The green apple aphid *Aphis pomi* DeGeer, and the rosy aphid *Anuraphis malifoliae* Fitch (*Aphis sorbi* Kalt.) were not prevalent in the experiment orchards in 1921. Some eggs hatched, but the aphids soon disappeared, perhaps on account of cold storms, lady beetles, or other natural agencies, and caused no appreciable injury. For this reason no marked benefit can be shown by the treatment against these insects. The eggs hatch at about the time that the leaf buds begin to unfold. Nicotine sulphate in the delayed dormant, pink and calyx treatments should control these aphids.

Red Bug:—The false apple red bug *Lygidea mendax* Reut. was not abundant in any of the experiment orchards in 1921, but was more prevalent in orchard No. III than elsewhere. Here and also in orchard No. II the check plots showed much more injury than the treated ones. The eggs hatch just before the blossoms open and nicotine sulphate in the pink treatment and in the calyx treatment, if thoroughly applied, should kill most of the nymphs.

FUNGOUS DISEASES.

Scab:—Scab was very prevalent during the past season in most orchards. This can probably be accounted for in two ways; first, the mild winter, which allowed the fungus to carry over in good condition on the old leaves and mature a large crop of spores which infected the young foliage early in the spring, and second the fact that there was a rainy spell which was most favorable for

scab infection and which prevented putting on the pink spray at the proper time. Under Connecticut conditions the pink spray is the important spray for scab control and on varieties which are particularly susceptible it would seem desirable to put on two sprays after the leaves come out and before the blossoms open. It seems to be the consensus of opinion among plant pathologists that it is not feasible to attempt to treat or destroy the leaves under the trees, on which the scab carries over winter, but rather to control it by proper and timely spraying. See Plate XXII, e.

Black Rot:—Black rot was more prevalent, especially on the foliage, during 1921 than usual. This disease was present to a greater or less extent in all the orchards which were observed during the season and probably these represent a general condition throughout the State. Usually Baldwin was the variety most susceptible, although other varieties showed some infection. In one orchard only was any serious damage done and in this only a small number of trees were severely attacked.

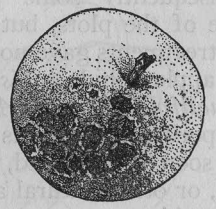


Figure 10. Apple Scab.

On the leaf the black rot fungus makes small dark brown circular spots and later causes the leaf to turn yellow and drop prematurely. This fungus also attacks the fruit, making a brown rotting of the flesh of the apple, which form of infection was noted in a few cases, but nowhere did any serious damage result. The Hurlbut seemed to be more susceptible to fruit infection.

This fungus does not usually do any great amount of damage in Connecticut and if present should be controlled by the ordinary spraying schedule. The infection on the foliage evidently takes place early in the season, making the pink spray important in its control. This fungus is shown on the leaf on Plate XXI, e, and on the fruit on Plate XXII, d.

Fruit Speck:—Fruit speck or "Brook's spot" is a fruit disease and causes the very small irregular black spots on the skin of the apple which on light skinned varieties are usually bordered with red, the spots occurring most abundantly near the calyx end. This disease should not be confused with "Baldwin spot" which is a physiological trouble characterized by brown corky spots

scattered through the tissue of the fruit. Fruit speck, being a fungous disease, can be controlled by spraying with a fungicide while the "Baldwin spot" is not affected by such applications. To control fruit speck successfully, the spraying should be done very thoroughly. The fruit speck fungus does not injure the quality of the fruit but spoils its appearance, and makes an entrance for various decay organisms.

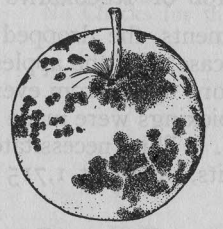


Figure 11. Sooty Blotch of Apple.

Sooty Blotch:—This disease is one of the most common apple diseases and is probably one of the easiest to control by spraying, yet it seems to be true that less attention is paid to it than to other troubles, for instance, a grower will be much alarmed at a heavy scab infection but will almost consider sooty blotch a necessary adjunct to the finish of his fruit. The sooty blotch fungus grows entirely on the skin of the apple and does no harm except to injure its appearance seriously, as is shown on Plate XXII, f.

PEACHES.

In addition to the experiments with dusts and sprays in apple orchards, experiments were conducted to test the comparative values of dusting and spraying on peaches. Two orchards were used, one at Mount Carmel owned by this Station, and the other in Cheshire, owned by Mr. M. L. Coleman.

Apparatus and Materials Used.

In the spraying of both orchards, an Arlington X. L. power sprayer with a 100 gallon tank was used, carrying two lines of hose with one nozzle on each rod, at a pressure of about 125 pounds. The dusting machine used at Mount Carmel was a Niagara duster, being the same one that was used in the apple dusting experiments. The duster used at Cheshire belonged to Mr. Coleman, and was also a Niagara machine.

The spray material used in both orchards was atomic sulphur, at the rate of 10 pounds to 100 gallons of water. The dust used at Mount Carmel was ordinary dusting sulphur, and at Cheshire the dust used for the first two applications was a 70-20-10 mixture, 70 parts of sulphur, 20 parts of lime and 10 parts of lead arsenate. For the third dusting at Cheshire, the lead arsenate and lime were omitted.

Method of Recording Data.

In the peach experiments, the dropped fruit was not gathered and scored as was the case with the apples. No count trees were selected here, but a record taken from every tree which bore fruit. In harvesting, several pickings were made and each fruit examined and injuries recorded. This necessitated the examination of 120,063 individual fruits, or about 1,715 baskets.

Mount Carmel Orchard.

This orchard is ten years old, planted on the brow of a hill sloping toward the west, and comprises 150 trees planted in five rows of 30 trees each. The varieties which were used in this orchard are Elberta, Carman, Champion, Mountain Rose and Greensboro. The orchard was divided into three plots, the north plot was sprayed, the south plot dusted and the center plot left untreated for a check.

Three applications of spray and dust were made in this orchard, the first on May 18th when the "shucks" had all dropped from the young fruit; the second on June 16th and the last on July 13th and 14th. The dust used was the regular dusting sulphur with no lead arsenate or lime added. The liquid spray used was atomic sulphur, 10 pounds to 100 gallons of water, with no lead arsenate. As no arsenical poison was used in this orchard, and as there was practically no scab, the only injuries recorded were those caused by brown rot.

RESULTS OF TREATMENT.

		Good Fruit Per Cent.	Rot Per Cent.
Elberta:			
	Spray	98.6	1.34
	Dust	99.6	.36
	Check	99.6	.38
Carman:			
	Spray	93.	7.2
	Dust	97.5	2.5
	Check	No Checks for this variety	
Champion:			
	Spray	89.3	10.7
	Dust	98.4	1.6
	Check	96.5	3.4
Mt. Rose:			
	Spray	88.2	11.8
	Dust	99.2	.88
	Check	98.5	1.6
Greensboro:			
	Spray	79.9	20.1
	Dust	87.5	12.7
	Check	No Checks for this variety	

Discussion of Results.

On all varieties the dust was more effective in controlling brown rot than the spray. The amount of scab and curculio injury was so slight that no data was taken. The check trees in this orchard had better fruit than the sprayed trees because the trees were close together and the check trees were north of the dusted plot and at every application of dust the wind was from the south or southwest, thus blowing the dust onto the check trees.

Cheshire Orchard.

This orchard is about the same age as the Mount Carmel peach orchard. Because of the size of the orchard, only a portion containing two varieties, Carman and Elberta, was used in the spraying and dusting tests. Mr. Coleman, the owner of the orchard, has been dusting peaches for several years with satisfactory results, and this year he dusted all of his orchard except that portion where the sprayed plot was located. The records of the dusting were taken from a portion of the orchard adjacent to the sprayed plot. A few trees on the edge of the orchard at the end of the sprayed plot were left without treatment as checks. One hundred and thirteen trees were included in the three plots.

This peach orchard, like the other, was given three treatments of spray and dust, on the following dates: May 22, June 18 and July 13. The spray used was atomic sulphur, 10 pounds to 100 gallons of water. No lead arsenate was used in the liquid spray.

The liquid spray was applied with the same outfit as was used at Mount Carmel. The outfit was carried to Cheshire on a Ford truck to save time. On arriving at Cheshire the sprayer was unloaded and a horse used to draw it about the orchard, as the trees were too close to allow the truck to pass through the orchard. Five pickings were made of Carman, August 10, 12, 14, 16 and 19, and four of Elberta, September 2, 5, 7 and 9. There was considerable scab in this orchard, so records were made of light and heavy infestations of scab, together with rot and curculio.

RESULTS OF TREATMENT.

		Good Per Cent.	Rot Per Cent.	Light Scab Per Cent.	Heavy Scab Per Cent.	Curculio Per Cent.
Elberta:						
	Spray	65.	2.66	27.39	1.2	5.52
	Dust	69.9	5.24	22.4	.94	3.24
	Check	17.4	5.81	58.4	17.6	2.91
Carman:						
	Spray	37.4	7.15	43.2	12.12	4.61
	Dust	56.	4.92	27.4	9.4	5.12
	Check	27.3	16.5	38.2	21.7	4.53

It will be noted that on both varieties the dust gave a higher percentage of good fruit than the spray, largely through the more effective control of rot and scab. The lead arsenate in the dust did not control curculio to any appreciable extent. For some unknown reason the curculio injury was less in the check plot in both varieties than in either the dusted or sprayed plot. Peaches scored as "light scab" had only a small amount of scab, and would be graded as No. I. Those scored "heavy scab" would not be included in a No. I grade. Most of the peaches in the curculio column would undoubtedly be included in a No. I grade.

Cost of Dusting and Spraying Peach Orchards.

The price of dusting sulphur without lead arsenate used for dusting the peach orchards was $3.75 per 100 pounds in 1921, and the cost of atomic sulphur in 100 pound lots was $12.75. Allowing one pound of dust and one gallon of spray per tree the cost is, dust 3¾ cents per tree, spray 1¼ cents per tree for one treatment only. There would be quite a saving of time in favor of the dust which would partly offset the higher cost of material and make the treatments more nearly equal in price. However, it is doubtful if it would pay to dust peaches unless a large acreage was to be treated so that enough time could be saved to make an appreciable cut in the labor cost. It would be necessary to have a spray outfit for the dormant treatment and the extra cost of the duster would probably not be offset by the saving of time and slightly better results on a small orchard.

Pests of the Fruit of Peach Orchards.

INSECTS.

Plum Curculio:—The curculio is unquestionably the most important insect attacking the fruit of the peach. This insect has already been discussed on page 218 as an apple pest. In the peach fruit, the larvae develop to maturity and transform. Most of the infested fruits drop early and therefore do not show at harvest time, though the egg-laying and feeding punctures are often apparent. Curculio can best be controlled by getting rid of all hibernating places near the orchard. Arsenical applications, though a help, should not be depended upon as the only means of control.

FUNGOUS DISEASES.

Brown Rot:—Brown rot is the most serious fungous disease that the peach grower has to contend with, but it can be controlled by thorough and timely treatment. Usually this is a disease of the fruit but under favorable conditions such as obtained in the spring of 1921, serious infection of the blossoms on early varieties is likely to take place. Such infection not only kills the blossom but forms a canker which often girdles and kills the entire branch.

The blossom and twig infection seems to be worst in orchards where spraying or dusting has not been regularly practiced, and there are large quantities of mummied fruits on the ground and in the trees to spread the disease early in the season.

Peach Scab:—Peach scab does the larger part of its damage on the fruit, but the fungus infects the twigs and leaves as well. It is from the twigs that the scab fungus is spread to the fruit by the spores falling and being washed onto them by rain. In this connection it is interesting to note that scab spots are always on the upper surface of the fruit. Like many fungous diseases an important factor in scab control is to prevent it from getting a start in the orchard. If an orchard is well sprayed or dusted from the start, scab probably will not be especially abundant.

SUMMARY.

1. Dusting experiments in comparison with spraying were conducted in Connecticut in 1921 in four apple orchards containing 757 trees, and in two peach orchards containing 263 trees. This involved the scoring of 150,296 apples, equivalent to about 334 barrels, and 120,063 peaches, or about 1,715 baskets.
2. The dusts were all applied with Niagara dusting machines, and the sprays with Friend and Arlington X. L. power sprayers. In each case two treatments were given after blossoming on apples, and three treatments on peaches.
3. The dusts used in the apple orchards were the sulphur-lead dust, sulphur-lead-nicotine dust, and Sanders' dust. The liquid spray used for comparison in all apple orchards contained liquid lime-sulphur, lead arsenate and nicotine sulphate. In one orchard comparative tests were made between liquid lime-sulphur, dry lime-sulphur, B. T. S., and Bordeaux mixture, with lead arsenate added to each.
4. In nearly all cases the best apples were obtained from the sprayed plots. Both spray and dust gave fairly good control as regards codling moth, and other chewing insects; neither controlled curculio; the spray was more effective in controlling the fungous diseases. In the sprayed orchard dry lime-sulphur gave a larger percentage of good fruit than liquid lime-sulphur, B. T. S., or Bordeaux mixture.
5. The chief pests attacking the fruit in these apple orchards in 1921 were codling moth, plum curculio, apple maggot, various chewing insects, aphids, red bug, scab, black rot, fruit speck and sooty blotch.
6. On peaches the only spray was atomic sulphur, and the dusts were sulphur, and sulphur-lime-lead arsenate dust.
7. In all the peach orchards the dusted plots gave slightly better fruit than the sprayed plots. Peach scab and brown rot were controlled by both dust and spray.
8. The chief pests attacking the fruit in these peach orchards in 1921 were curculio, brown rot and peach scab.
9. At present dusting is more costly than spraying in both peach and apple orchards.

Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

BULLETIN 236 JANUARY, 1922

BEING THE

Twenty-Sixth Report

ON

Food Products

AND

Fourteenth Report on Drug Products.

By E. M. BAILEY.

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

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January, 1922

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The Twenty-sixth Report on Food Products and the Fourteenth Report on Drug Products, 1921.

By E. M. Bailey.

This report summarizes examinations of foods, drugs and miscellaneous materials which have been made in this laboratory during the past year. Much of the time of the department is necessarily occupied with control work required by statutes relating to fertilizers and feeding stuffs and with other analytical work in connection with field experiments as well as with human foods and drugs. However, as much time as can be spared is devoted to the study of methods and the investigation of special subjects.

Practically all of the food and drug control work done in the past year has been upon samples submitted by the Dairy and Food Commissioner. Soft drinks, market milk, ice cream and drugs listed in the Pharmacopoeia or National Formulary have been the items of chief importance. A new law regulating the manufacture and sale of beverages of the soda water type prohibits the use of saccharin in these products and it has resulted in greatly diminishing the occurrence of this artificial sweetener which heretofore has been rather widely used in this state.

An investigation of the cryoscopy of milk has been made, involving analyses and freezing point determinations of authentic milk from individual cows and herds for the purpose of establishing the freezing point range of normal milk to serve as a basis for the detection of added water in market milk. This has been done in collaboration with Dr. Hortvet of the Minnesota State Dairy and Food Department, who is the author of the freezing point method we have used, and with Dr. Menge of the Milk Products Department of the Libby, McNeill and Libby Company. The data secured have been included in a report of the writer as associate referee on this subject to the Association of Official Agricultural Chemists and an abstract of the same is published here. The writer has also collaborated with the Council on Pharmacy and Chemistry of the American Medical Association upon questions pertaining to diabetic and other special foods and has prepared and submitted to the Council tentative standards for dietetic casein and calcium caseinate.

Mr. Andrew has served during the year as referee on tea for the Association of Official Agricultural Chemists and has submitted a report to the Association an abstract of which is given in this bulletin. He has also collaborated in the study of methods for the assay of certain drugs.

Three educational exhibits have been arranged. One of these was a part of the general exhibit of this Station at the Farmers' Week Fair at Hartford in January and the others were made jointly with the Biochemical laboratory at the meeting of the American Medical Association at Boston in June and at the meeting of the American Child Hygiene Association at New Haven in November.

During the last few years the volume of work required by the department of the Dairy and Food Commissioner has greatly increased. Charged as we are with analytical work required by other branches of control and investigation, our time and facilities often would be seriously overtaxed were it not for the generous efforts of the Commissioner and his staff to correlate the work of his department with that of ours, so far as it is possible to do so, and we appreciate this coöperation. Under this plan the work of both departments proceeds with an efficiency that otherwise would not be possible.

Acknowledgment is made to the chemists of this laboratory, Messrs. Andrew, Shepard, Edmond, Nolan, Fisher and Merwin, to whom credit for the analytical work herein reported is due, for their efficient coöperation; and to Miss Moss for her valuable assistance in the compilation of data and the preparation of reports and bulletins.

I. FOODS.

CARBONATED BEVERAGES, ETC.

One hundred and fifty-three samples of beverages of the soda water type have been examined for saccharin and of that number twenty-one, representing products of fourteen manufacturers, were found to be adulterated for the reason that they contained that substance. A recent act of the Legislature[1] expressly prohibits the use of saccharin in non-alcoholic beverages and a previous act[2] likewise prohibits its use in ice cream. These are the only instances of specific legislation against this artificial sweetener, which, however, has heretofore been regarded as an adulterant under the provisions of the general food and drug law and by rules and regulations[3] pertaining thereto, made jointly by the Director of this station and the Dairy and Food Commissioner.

In the inspection made in 1920, 40.5 per cent. of the samples examined contained saccharin, as compared with 13.7 per cent. found in the inspection of 1921. There is reason to believe that an even smaller percentage would be found at the present time.

Saccharin was found in the following samples:

[1] Public Acts 1921, Chap. 159, Sec. 3.
[2] Public Acts 1919, Chap. 260.
[3] Regulation 7.

D. C. No.	Brand.	City or Town	Manufacturer or Dealer.
20662	Cherry Soda.	*Ansonia:*	L. Yolin.
18172	Cherry Soda.	*East Norwalk:*	Morris Sopshin.
20033	Strawberry Soda.		Morris Sopshin.
20030	Birch Soda.		Morris Sopshin.
20045	Cherry Soda.	*Greenwich:*	Barney Tunick.
20772	Strawberry Soda.	*Jewett City:*	Jewett City Bottling Works
20674	Strawberry Soda.	*New Britain:*	Peerless Bottling Works.
18178	Lemon Soda.	*New Canaan:*	Gray Bros.
20027	Lemon Soda.		Gray Bros.
18179	Peach Soda.		Gray Bros.
20028	Peach Soda.		Gray Bros.
20679	Cherry Soda.	*New Haven:*	New Haven Bottling Works.
20682	Cherry Soda.		D. Chiaramonte.
19871	Strawberry Soda.	*New London:*	Benj. Manoff.
20666	Cream Soda.	*Shelton:*	Derby Bottling Works.
18529	Cream Soda.	*Stamford:*	Isaac Silver.
18530	Strawberry Soda.		Isaac Silver.
18531	Strawberry Soda.		Morris Alterwitz.
18532	Creme Soda.		Morris Alterwitz.
19878	Strawberry Soda.	*Thompsonville:*	Thompsonville Bottling Works.
20651	Cherry Soda.	*Waterbury:*	C. Mascola Bottling Works.

CASEIN AND CALCIUM CASEINATE.

A number of preparations of casein and calcium caseinate, designed for clinical purposes, have been examined for the Council on Pharmacy and Chemistry of the American Medical Association and tentative standards for these products suggested.

Dietetic casein is the purified protein separated from milk by the action of acids or of enzymes. It finds limited use in the feeding of infants, in the nutrition of convalescents and undernourished individuals and in the dietotherapy of diabetes. It should contain not less than 15 per cent. of nitrogen, on the moisture-free basis, with other specifications as will appear in New and Non-Official Remedies.[1] The proximate composition of casein prepared by various commercial and laboratory methods is shown by data published from the Forest Products laboratory[2] and by analyses of a number of pure preparations made in the Biochemical laboratory of this station and used by Doctors Osborne, Mendel and Wakeman in studies on nutrition. Analyses of these last named preparations are given in Table I.

Calcium caseinate is also used in medicine for such disorders as can be treated by dietetic measures.

Five preparations of calcium caseinate including three commercial products and one natural preparation made in the Biochemical laboratory of this station have been analyzed and the results are given in Table II.

[1] Published by the Am. Med. Assoc., 1922.
[1] Jour. Ind. Eng. Chem., 11, 11, 1029, 1919.

TABLE I. PROXIMATE ANALYSES OF CASEIN.

Sample No.	1	2	3	5	6	7
	%	%	%	%	%	%
Moisture	7.89	7.75	8.86	6.40	9.68	6.23
Ash	0.55	0.61	0.52	0.38	0.60	1.30
Fat	0.80	0.40	0.23	1.00	0.50	0.75
Nitrogen	14.08	14.08	13.84	14.36	13.82	14.34
Casein (N x 6.38)	89.83	89.84	88.30	91.60	88.16	91.48
M. F. A.—free material[1]	90.76	91.24	90.39	92.22	89.22	91.72
Diff. between Casein and M. F. A.—free material	0.93	1.40	2.09	0.62	1.06	0.24
Lactose	none	none	none	none	none	none
Undetermined	0.93	1.40	2.09	0.62	1.06	0.24
Acidity, cc. N/10 alk. per gm. original material	10.0	10.5	11.4	10.4	10.0	6.7
Acidity, cc. N/10 alk. per gm. M. F. A.-free material	11.0	11.5	12.6	11.2	11.2	7.3

[1] Moisture, fat and ash-free material.

TABLE II. ANALYSES OF CALCIUM CASEINATE.

		Moisture %	Nitrogen %	Protein (Nx6.38) %	CaO. %	P_2O_5 %	Fat %	Moisture-free Nitrogen %	Moisture-free Protein %
17029	No. 4 T. B. O.	9.75	13.68	87.28	1.65	1.95	0.43	15.16	96.71
17030	Larosan	10.38	13.06	83.31	2.37	1.69	2.36	14.58	93.02
17031	Larosan	9.87	13.12	83.71	2.16	1.65	2.57	14.56	92.89
17024	Protolac	8.90	12.72	81.15	2.66	1.80	0.75	13.96	89.07
17025	Casec	7.60	12.48	79.62	1.50	1.54	2.40	13.50	86.13

CIDER.

Four samples of cider were submitted by the Dairy and Food Commissioner. Three of these, **20358, 20359** and **20920**, were so-called sweet cider. They contained 5.75 per cent., 5.93 per cent. and 4.16 per cent. of alcohol respectively showing in all cases an advanced stage of fermentation which marked them as hard ciders. One sample, **19414**, Veribest, made by Armour & Co., contained only a trace of alcohol and was free from saccharin, and salicylic, benzoic and sulphurous acids.

COCOA.

Three samples have been submitted by the Dairy and Food Commissioner and two by the New Haven County Farm Bureau. The samples were D. C. Nos. **19874**, Hershey's, **19875**, Van Houten's, **19876**, Lowney's and Sta. Nos. **15963** and **15964**, brands unknown, but sold by D. M. Welch and The Mohican Company, New Haven, respectively.

Partial analyses were made as follows:

D. C. or Sta. No.	19874	19875	19876	15963	15964
	%	%	%	%	%
Moisture	5.80	5.95	4.80	6.22	5.05
Ash, total	7.12	4.60	4.60	5.10	5.10
insol. in water	1.78	2.90	2.65	3.15	2.85
Nitrogen	3.50	3.50	3.49	3.74	3.74
Crude Fiber	.....	.....	.....	5.38	5.35
Fat	24.24	24.58	25.08	21.23	21.06

COFFEE.

One sample of coffee substitute and one of modified coffee have been examined. The brands were Delisco, **16373**, prepared by the Delisco Corporation Ltd., Boston, and Kaffee Hag, **15682**, made by the Kaffee Hag Corporation of Cleveland, Ohio.

Our analysis of the coffee substitute is as follows:

Moisture 5.08 per cent; ash 4.25 per cent; ash soluble in water 3.01 per cent; phosphoric acid (P_2O_5) in insoluble ash 0.49 per cent, in soluble ash 0.43 per cent; alkalinity of ash 3.15 cc N/10 acid per gram; nitrogen 2.25 per cent; soluble solids 27.95 per cent; fat (ether extract) 9.13 per cent; fiber 12.43 per cent; caffeine by weight 0.76 per cent, from nitrogen 0.72 per cent.

This product is declared by the manufacturers to be a combination of cereals and other vegetable substances with a percentage of the finest coffee. Assuming 1.25 per cent. caffeine as an average for pure coffee this product contains about 60 per cent. of coffee.

Kaffee Hag was examined for caffeine only and was found to contain 0.09 per cent. of caffeine by weight and 0.05 per cent. calculated from nitrogen. This product has been examined by us on two previous occasions when 0.03 per cent. and 0.10 per cent. of caffeine were found. Data submitted by the manufacturers show a range over a considerable control period of from 0.03 per cent. to 0.08 per cent; our range for the three market samples examined is from 0.03 per cent to 0.10 per cent.

DIABETIC, SPECIAL AND MISCELLANEOUS FOODS.

Sixty-four samples of diabetic, special and miscellaneous foods have been examined. Some of these were submitted by manufacturers or distributors at our request and some have been referred to us by physicians or others interested.

Three samples of gluten bread made by the American System of Bakeries, Hartford, Conn., were submitted by Dr. W. R. Miller and by Mr. W. J. Hardie.

Two samples, Cassava Breakfast Food and Cassava Cakes, both said to be starchless, were submitted by Arnaud, Inc., New York.

One sample of gluten bread made by Brusson Jeune, Villimur, France and distributed in this country by Gustave Müller, 18 South William St., New York, was sent by John Gilbert and Son, New Haven.

To determine the efficiency of the washing method of preparing washed bran two samples of bran, one unwashed and one washed, were submitted by J. G. Dilworth, Nurse-in-charge, Clifton Springs Sanitarium, Clifton Springs, New York.

For experimental purposes three samples of bread were made in this laboratory using cottonseed, almond and soybean flours respectively.

A sample of gluten bread, **17687**, made by the Howland Co., Bridgeport, was submitted by Mrs. F. A. Doolittle, Bridgeport.

Three samples of Croustils, **16491, 16492** and **16493** made by Laporte and Gauthier, Somerset, Manitoba, distributed by Charles Horstmann, Clifton, N. J., were referred to us by the American Medical Association.

One sample of Allison flour, **17910**, made by the Schulenburg Oil Mill, Schulenburg, Texas, was also submitted by the American Medical Association.

Eleven samples of Ch. Heudebert products made by La Societé L'Aliment "Essentiel," Nanterre, France, distributed by Park and Tilford, New York, were sent by the distributors with the exception of **16277** which was submitted by the American Medical Association.

Dr. B. H. Ragle, Boston, submitted products of the Woman's Baking Co., Boston. A number of similar products were examined in this laboratory last year.

A sample of Passover Bread, **16255**, said to be made from Duggan gluten flour, was submitted by Mr. Samuel Lapides, New Haven. Further information regarding the manufacturer of the gluten flour could not be furnished us.

The Diaprotein Company, Columbus, Ohio, submitted fourteen samples "Dieta Brand" specially prepared canned fruits and vegetables.

Seven samples of Ch. Heudebert products recommended for infants, invalids and convalescents were submitted by the distributors, Park and Tilford, New York.

A sample of India Peas, **16485**, was referred to us by Dr. E. P. Joslin, Boston, for analysis.

A sample of dahlia bulbs, **18640**, grown and submitted by Mr. F. C. Sheldon of this laboratory, was examined.

Analyses of these products are given in Table III.

The three samples of gluten bread made by the American System of Bakeries show reasonable uniformity in composition and a substantial reduction in carbohydrates as compared with ordinary wheat bread. It requires 124 parts of sample **15449**, for example, to equal 100 parts of ordinary bread according to Janney's method of comparison and 173 parts are required according to von Noorden's method. The success of this, or any other diabetic bread, will depend entirely upon the patient's carbohydrate tolerance.

Cassava Breakfast Food and Cassava Cakes, made by Arnaud, Inc., are not labeled as diabetic foods but are labeled "starchless" which is certain to attract the interest of the diabetic patient. Each product contains about 70 per cent. of available carbohydrate a large portion (over 90 per cent.), of which is starch and shows the microscopic characteristics of cassava starch. The labeling of this product is utterly deceptive.

The composition of Brusson Jeune gluten bread is substantially the same as shown by previous analyses made in this laboratory[1] indicating a very uniform product.

Sample **16078** represents a commercial hygienic bran and sample **16336** the same bran after thoroughly washing with water to remove starch. Comparison shows that the readily available carbohydrates i. e., starch and soluble reducing materials, have been reduced from 12 per cent. to 2 per cent., approximately, by this method of treatment.

Breads made from cottonseed-wheat, almond-gluten and soybean flours for our own experimental purposes were made according to recipes suggested by others and do not represent in any way specific suggestions on our part for diabetic dietaries. The soybean bread was, however, particularly palatable and the analysis shows a low content of available carbohydrate. The glucose yield of soybean protein in metabolism has not been determined so far as we know, but assuming it to be equal to that of wheat protein it would require about 2 parts of this bread to yield the same amount of glucose in metabolism as 1 part of ordinary wheat bread according to Janney's method of comparison.

Of the three samples of Croustils made by Laporte and Gauthier it appears from the advertising literature that only the "glutenized" form is recommended or prescribed for diabetic patients. Our analyses show that glutenized croustils, **16493**, contain more protein and less starch than other forms yet this product contains about 50 per cent. of starch and soluble reducing sugars as dextrose combined.

Allison cottonseed flour conforms to the substance and quality shown by our earlier analyses.[2]

The three samples of Heudebert "Essentiel" gluten bread, submitted from different sources and at different times, show a satisfactory degree of uniformity in composition. Our analysis of

[1] Conn. Exp. Sta. Bull. 220, p. 318.
[2] Conn. Exp. Sta. Bull. 220, p. 311.

TABLE III. ANALYSES OF DIABETIC,

No.	Manufacturer and Product
	FLOUR, BRAN, BAKED PRODUCTS, ETC.
	American System of Bakeries, Hartford
15449	Gluten Bread
15933	Gluten Bread A
15934	Gluten Bread B
	Arnaud Inc., New York
17908	Starchless Breakfast Food
17909	Cassava Cakes
	Brusson Jeune, Villimur, France
17609	Gluten Bread
	Experimental
16078	Bran, unwashed
16336	Bran, washed
16112	Cottonseed-Wheat Bread
16114	Almond-Gluten Bread
16113	Soybean Bread
	Howland Co., Bridgeport
17687	Gluten Bread
	Laporte and Gauthier, Somerset, Manitoba
16491	Croustils, Dechloridized
16492	Croustils, Simple
16493	Croustils, Glutenized
	Schulenburg Oil Mill, Schulenburg, Texas
17910	Allison Flour (Cotton Seed)
	La Societe L'Aliment "Essentiel," Nanterre, France
17612	Heudebert, Bread of Gluten
16250	Heudebert, Bread of Gluten
16277	Heudebert, Bread of Gluten
16252	Heudebert, Aleurone Bread
17610	Heudebert, Aleurone Bread
.....	Guaranty
16251	Heudebert, Special Diabetic Bread
17611	Heudebert, Special Diabetic Bread
.....	Guaranty
16253	Heudebert, Rolls with Gluten
16254	Heudebert, Rusks of Gluten
16266	Heudebert, Surazotized Gluten Flour
16267	Heudebert, Gluten Flour with Cacao

SPECIAL AND MISCELLANEOUS FOODS.

No.	Moisture	Ash	Nitrogen	Protein		Fiber	Nitrogen-free Extract			Ether Extract
				N x 6.25	N x 5.70		Starch	Sugar as Dextrose	Other N-free Extract	
	%	%	%	%	%	%	%	%	%	%
15449	35.29	1.65	6.52	.....	26.16	0.30	22.78	1.01	6.84	5.97
15933	30.43	1.79	6.60	.....	27.75	0.41	25.25	2.33	6.12	5.92
15934	30.85	1.60	6.81	.....	28.54	0.43	25.56	1.93	5.65	5.44
17908	10.39	2.06	0.32	2.00	.....	4.16	64.13	6.72	10.33	0.21
17909	10.42	2.16	0.28	1.75	.....	4.83	66.77	2.76	11.08	0.23
17609	10.31	0.71	5.93	.....	33.80	0.15	35.63	9.32	0.38	3.77
16078	6.05	6.31	2.62	16.38	.....	6.05	9.02	3.19	46.86	6.14
16336	.....	.....	.....	.....	.....	.....	1.43	0.86	.....	.....
16112	42.22	2.23	3.10	11.63	.....	0.95	31.52	1.74	8.08	1.63
16114	25.58	6.70	5.81	27.98	.....	0.92	11.43	1.74	8.26	17.39
16113	37.70	5.88	5.38	21.75	.....	0.88	3.70	2.52	9.53	18.04
17687	31.74	2.25	5.80	.....	23.51	0.41	32.28	1.88	7.01	0.92
16491	7.55	1.25	2.66	16.63	.....	0.44	54.45	10.30	3.32	6.06
16492	7.62	1.67	2.74	17.13	.....	0.38	60.36	5.68	3.75	3.41
16493	7.88	1.50	4.84	30.25	.....	0.46	44.55	5.36	3.29	6.71
17910	6.65	6.20	8.07	50.44	.....	4.83	0.56	8.25	15.18	7.89
17612	10.11	2.71	10.78	.....	61.45	0.51	9.96	1.24	8.04	5.98
16250	6.83	2.62	10.82	.....	61.67	0.31	13.59	1.10	7.03	6.85
16277	6.33	2.66	10.94	.....	62.36	0.32	14.32	0.93	7.40	5.68
16252	7.00	2.81	12.07	.....	68.80	0.21	6.51	0.15	8.23	6.19
17610	9.82	3.19	10.39	.....	59.22	0.76	13.56	2.72	6.73	4.00
.....	.....	.....	.....	.....	61.73	.....	10.50		.....	1.62
16251	7.01	2.91	10.48	.....	59.74	0.57	16.12	1.52	5.38	6.75
17611	11.19	3.04	9.01	.....	51.36	0.41	18.76	2.36	7.79	5.09
.....	.....	.....	.....	.....	62.00	.....	30.00		.....	0.50
16253	7.51	2.32	1.70	.....	9.69	0.43	59.12	6.98	5.20	8.75
16254	6.56	1.62	1.90	.....	10.84	0.44	58.05	9.30	5.56	7.63
16266	7.79	3.36	10.75	.....	61.28	0.30	12.71	1.32	10.94	2.30
16267	7.46	3.63	9.40	.....	53.58	1.00	12.30	1.46	14.73	5.84

TABLE III. ANALYSES OF DIABETIC,

No.	Manufacturer and Product
	FLOUR, BRAN, BAKED PRODUCTS, ETC.—(*Continued*).
	Woman's Baking Co., Boston, Mass.
17555	Washed Bran
17552	Bran Cookies, Anice
17550	Bran Cookies, Caraway
15320[1]	Bran Cookies, Caraway
17551	Bran Cookies, Cocoa Nib
15315[1]	Bran Cookies, Cocoa Nib
17553	Bran Cookies, Spice
15316[1]	Bran Cookies, Spice
17556	Bran Muffins
15257[1]	Bran Muffins
17554	Cellu Biscuit
15319[1]	Cellu Biscuit
15258[1]	Cellu Cookies, Caraway
17548	Cellu Cookies, Lemon
15259[1]	Cellu Cookies, Lemon
17544	Cellu Cookies, Vanilla
15317[1]	Cellu Cookies, Vanilla
15260[1]	Cellu Kisses
17557	Cellu Muffins
15256[1]	Cellu Muffins
15314[1]	Cellu Nuts
17549	Cellu Soup Wafers
15318[1]	Cellu Soup Wafers
	Unknown
16676	Passover Bread
	FRUITS AND VEGETABLES, CANNED.
	The Diaprotein Co., Columbus, Ohio
16385	Apple Sauce
16394	Blackberries
16388	Cherries, Red, Pitted
16387	Cherries, White[2]
16395	Peaches, Yellow
16397	Pears, Bartlett
16392	Raspberries, Red
16389	Strawberries
16393	Beans, Cut, Wax
16391	Beans, Refugee, Green

[1] Analysis of 1920.
[2] Analysis of edible portion.

SPECIAL AND MISCELLANEOUS FOODS—(*Continued*).

No.	Moisture	Ash	Nitrogen	Protein		Fiber	Nitrogen-free Extract			Ether Extract
				N x 6.25	N x 5.70		Starch	Sugar as Dextrose	Other N-free Extract	
	%	%	%	%	%	%	%	%	%	%
17555	9.13	.....	1.79	11.19	.....	.....	4.59		.....	7.39
17552	16.12	.....	1.18	7.39	.....	.....	1.72	3.47	.....	25.87
17550	15.29	.....	1.30	8.13	.....	.....	3.48		.....	23.36
15320[1]	12.24	6.90	1.30	8.13	.....	2.62	3.15	3.34	38.61	25.01
17551	13.41	.....	1.30	8.13	.....	.....	2.41	3.73	.....	27.80
15315[1]	14.87	6.30	1.33	8.33	.....	6.05	6.19	5.05	29.17	24.04
17553	15.04	.....	0.98	6.11	.....	.....	2.21	4.11	.....	26.75
15316[1]	16.31	6.43	1.12	6.99	.....	6.90	4.44	7.77	32.48	18.68
17556	28.41	.....	1.33	8.33	.....	.....	4.76		.....	6.11
15257[1]	41.51	6.50	1.00	6.26	.....	6.72	1.54	4.83	27.03	5.61
17554	29.31	.....	0.48	3.00	.....	.....	4.76		.....	11.81
15319[1]	32.81	6.33	0.53	3.34	.....	14.26	1.60	1.41	25.65	14.60
15258[1]	14.16	5.48	0.89	5.58	.....	16.53	1.51	2.33	31.95	22.46
17548	12.28	.....	0.65	4.10	.....	.....	3.12		.....	27.35
15259[1]	12.94	5.22	0.69	4.32	.....	17.43	trace	4.62	34.10	21.37
17544	14.13	.....	0.66	4.11	.....	.....	4.39		.....	23.35
15317[1]	17.16	5.69	0.71	4.45	.....	16.98	1.58	2.22	32.61	19.31
15260[1]	17.85	4.09	3.68	23.00	.....	27.12	1.29	1.20	25.22	0.23
17557	23.62	.....	0.61	3.84	.....	.....	3.38		.....	14.33
15256[1]	29.08	5.37	0.59	3.66	.....	18.23	1.61	2.10	27.02	12.93
15314[1]	15.91	5.71	0.86	5.38	.....	16.80	1.07	2.57	23.82	28.74
17549	15.96	.....	0.53	3.32	.....	.....	4.25		.....	27.66
15318[1]	14.22	6.66	0.64	4.01	.....	14.97	1.69	2.43	31.39	24.63
16676	7.04	0.60	2.38	14.88	.....	0.38	70.46	.....	6.64	0.37
16385	88.69	0.58	0.03	0.18	.....	0.47	5.75		3.72	0.61
16394	91.80	0.29	0.11	0.67	.....	1.76	2.57		2.41	0.50
16388	90.39	0.34	0.08	0.50	.....	0.13	5.14		3.36	0.14
16387	91.26	0.45	0.11	0.71	.....	0.18	3.79		3.47	0.14
16395	93.38	0.31	0.08	0.47	.....	0.38	2.88		2.52	0.06
16397	93.57	0.17	0.05	0.28	.....	0.62	2.54		2.72	0.10
16392	88.34	0.47	0.14	0.88	.....	2.67	3.00		3.96	0.68
16389	93.58	0.32	0.09	0.57	.....	0.82	1.95		2.40	0.36
16393	96.20	0.27	0.13	0.83	.....	0.99	1.15		0.51	0.05
16391	94.43	1.36[3]	0.11	1.04	.....	0.88	1.43		0.80	0.06

[3] 1.04 per cent salt (NaCl calc. from chlorine).

TABLE III. ANALYSES OF DIABETIC,

No.	Manufacturer and Product
	FRUITS AND VEGETABLES, CANNED—*Concluded*
16390	Peas, Green
16386	Rhubarb
16396	Spinach
16384	Tomatoes
	SPECIAL PREPARATIONS.
	La Societe L'Aliment "Essentiel," Nanterre, France
16255	Lacteous Flour
16265	"Essential" Flour
16268	"Roburol" with Cacao
16269	"Essential" Food, Cacao Flavor
16279	Cacao and Oat Cakes
16270	"Regimette" Dessert Cake
16278	Vegetable Broth
	MISCELLANEOUS.
16485	India Peas, dried
18640	Dahlia Tubers, dried
17545	Whiskey
17546	Vermouth

sample **17612** however does not agree with the one which is given on the package which states protein 72 per cent., fat 0.8 per cent. and carbohydrate plus starch 20 per cent. We find considerably less protein and more fat. Two samples of Aleurone bread, **16252** and **17610**, are not in so close agreement between themselves and the guaranty of the last named, protein 61.7, fat 1.6 and carbohydrate 10.5, is not in accord with our findings as regards carbohydrate and fat. It is not entirely clear to us what is referred to as carbohydrate in the guaranty but we interpret it to be comparable with total nitrogen-free extract. Special Diabetic breads, samples **16251** and **17611** are stated to contain protein 62 per cent., fat 0.5 per cent. and carbohydrate plus starch 30 per cent. Our analyses confirm the protein guaranty in one case, the carbohydrate guaranty in the other and the fat guaranty in neither case. As regards fat, however, it should be said that when determined by the usual continuous extraction methods figures reasonably approximating the guaranties in each case were obtained, but by

SPECIAL AND MISCELLANEOUS FOODS—(*Concluded*).

No.	Moisture	Ash	Nitrogen	Protein		Fiber	Nitrogen-free Extract			Ether Extract
				N x 6.25	N x 5.70		Starch	Sugar as Dextrose	Other N-free Extract	
	%	%	%	%	%	%	%	%	%	%
16390	88.74	0.37	0.51	3.19	.....	1.27	3.92		2.15	0.36
16386	96.35	0.51	0.07	0.41	.....	0.54	0.27		1.88	0.04
16396	91.46	2.39[4]	0.49	3.08	.....	0.93	0.56		0.98	0.60
16384	95.07	0.53	0.17	1.04	.....	0.32	1.48		1.34	0.22
16255	4.80	2.02	1.38	8.63	.....	0.32	31.22	40.96	8.48	3.57
16265	7.89	1.58	3.14	19.63	.....	0.27	49.13	9.30	9.24	2.96
16268	4.70	3.16	3.26	20.38	.....	0.75	19.76	26.80	20.34	4.11
16269	4.62	1.48	1.47	9.19	.....	0.78	27.83	35.47	16.21	4.42
16279	6.90	2.81	2.25	14.06	.....	1.98	37.03	7.23	17.72	12.27
16270	3.68	1.27	1.10	6.88	.....	0.37	47.00	20.90	8.35	11.55
16278	8.40	3.17	2.10	13.13	.....	3.41	37.52	14.68	18.51	1.18
16485	9.00	3.18	4.00	25.00	.....	4.15	37.91	6.76	12.93	1.07
18640	2.13	7.97	3.12	19.50	.....	8.55		60.50[5]		1.35
17545	.....	.....	.....	.....	.....	.....	.....	trace	.....	.....
17546	.....	.....	.....	.....	.....	.....	.....	4.02[6]	.....	.....

[4] 1.00 per cent salt (NaCl calc. from chlorine).
[5] For distribution of this group of constituents see page 245.
[6] Grams per 100cc.

the more approved method[1] for baked products much higher results were secured. It would appear from the guaranties of Aleurone, "Essentiel" gluten and Special Diabetic breads that they are designed to represent three classes of carbohydrate tolerance viz. 10, 20 and 30 per cent. in the order named. Our results in the main justify such classification except that Aleurone bread contained 15 to 20 per cent carbohydrate instead of 10 per cent. Samples **16253**, Rolls with gluten and **16254**, Rusks of gluten, both contain over 65 per cent. of available carbohydrate and are no more suitable for the diabetic than ordinary wheat bread. Surazotized Gluten flour, **16266** and Gluten flour with cacao, **16267**, contain from 20 to 25 per cent. total carbohydrate with about one half of that amount probably available.

The products of the Woman's Baking Company are prepared from washed bran or cellu-flour as the basic constituent. These

[1] Conn. Exp. Sta. Bull. 220, p. 273.

products were examined in this laboratory last year[1] and the further examination of them this year has been chiefly to determine the nature of the fat or oil present. The Cellu Products Company has suggested a number of recipes for making non-nutritive "foods" in which the fatty constituent is mineral oil and the Woman's Baking Company, adopting this idea or conceiving a similar one, has used a non-nutritive oil in its products. The nature of the ether extract was not determined in our previous analyses but the low or negligible saponification values of the ether extracts obtained in our recent examinations indicate that only a small amount of saponifiable oil is present, derived probably from the bran, spices, etc. The saponification numbers of the cellu products examined ranged from 3.2 to 10.5 and the bran products from 8.0 to 12.8. The ether extracts from bran muffins gave a value of 90.1 while that of washed bran itself had a value of 152.7. Mineral oil is not saponifiable, or, in other words, it has a saponification value of zero.

In our previous discussion[2] of these products attention was called to the difficulties of estimating their caloric values due chiefly to the uncertainty regarding the availability of the carbohydrates present. The conventional method of calculating caloric yield was finally followed with the reservation noted. It is now evident that the ether extract should be practically disregarded as a source of available energy in most of these products. Probably as close an approximation of energy yield as can be made will be obtained by including in the formula for calculating calories the nitrogen expressed as protein, carbohydrates represented by starch and soluble reducing sugars and not over 10 per cent. of the fat, except in case of bran muffins where 60 per cent. might be included. Calculated in this way the energy values range approximately from 50 to 100 calories per 100 grams. Including all the nitrogen-free extract in the calculation in the conventional way these values are increased by 100 to 150 calories.

Passover bread, **16676**, was said to be made from Duggan gluten flour but no further information regarding the flour could be obtained. The bread, which was in the form of a hard bread or cracker, contained as much starch as ordinary wheat bread.

Products of the Diaprotein Company, canned fruit and vegetables, were submitted by them at our request. These goods are specially selected by the packers and prepared without added sugar or salt, for clinical purposes. Partial analyses of the various products were submitted by the company which our analytical results substantially confirm. The claims as regards added sugar appear to be substantiated and mineral matter is less than 1 per cent. except in Refugee beans and spinach where the

[1] Conn. Exp. Sta. Bull. 227, p. 231.
[2] Conn. Exp. Sta., Bull. 227, p. 232.

normal ash appears to be enhanced by 1.04 per cent. and 1.00 per cent, respectively, of salt calculated from the chlorine content of the ash. Variations in composition of fruits and vegetables due to seasonal conditions, degree of ripeness, etc., are, of course, recognized.

The special Heudebert products are indicated for the feeding of infants, invalids or convalescents and recommended, in some instances, as of particular value in specific disorders. None of them are suggested for the use of diabetics and they do not belong in the category of diabetic foods. The claims made, however, are very extravagant. Thus, for example, Ruborol "is especially recommended for troubles of the stomach and the intestines, anaemia, convalescence of infectious sickness, tuberculosis, neurasthenia, and intellectual overwork." "Essential" Food, "is much more digestive than chocolate and kindred products; . . . It is also good for Bright's disease owing to the theobromine it contains and for persons in good health." The physician and the critical dietitian will require convincing evidence on these points before accepting these conclusions.

The sample of India peas closely resembles our common garden peas in composition. They contain about 58 per cent. of nitrogen-free extract about 3/5 of which is in the form of starch and soluble carbohydrate.

An analysis of dahlia tuber **18640** was made after the tuber had been washed free from adhering dirt, sliced thin, and air dried. The proximate analysis is given in Table III. A further distribution of the nitrogen-free extract was made as follows:

Soluble in hot water, before hydrolysis, as levulose	1.68 per cent.
after hydrolysis, as inulin[1]	49.18
Direct acid hydrolysis of water-insoluble residue, as dextrose	4.92
Total nitrogen-free extract (Table III.)	60.50
Undetermined nitrogen-free extract	4.72

[1] Calculated from levulose assuming the factor 0.9.

Thus inulin constitutes about 80 per cent. of the total nitrogen-free extract. The reducing power of the water solution before hydrolysis may be due to performed reducing substances or to levulose derived from partial hydrolysis of inulin by hot water.

Inulin occurs as a reserve carbohydrate in the underground parts of plants, particularly dahlia, artichoke, elecampane, burdock and similar plants. Unlike starch, it is somewhat soluble in water, readily soluble in hot water, gives no blue color with iodine, is not attacked by animal or vegetable amylases and hydrolyzes with dilute acid to levulose instead of dextrose. Plants which store up reserve material in the form of inulin have the mechanism (inulase), for its conversion to utilizable form, as do also certain

fungi, but there are no enzymes in the several digestive juices of the body capable of converting inulin into sugar. Human fecal extracts have been shown to contain an enzyme which attacks inulin with the formation of reducing sugars.[1] The acidity of the gastric juice is sufficient to hydrolyze inulin but the extent to which this proceeds will depend upon the conditions in the stomach. In the length of time which food ordinarily remains in the stomach, i.e., 2 to 3 hours, extensive hydrolysis does not take place.

Early observations that inulin fed to diabetics resulted in no conspicuous elimination of inulin, as such, in the feces and no glucose output in the urine led to the conclusion that it was utilized in the organism. The studies of Neubauer,[2] Lewis,[3] Frankel[4] and others indicate, however, that the failure of sugar to appear in the urine is due to the fact that no sugar is formed to be excreted; and the failure to recover inulin, as such, in conspicuous amounts in the feces is due to the decomposition of inulin by intestinal bacteria. The mechanism of inulin transformation in the intestine is obscure, but it does not result in recoverable sugar. The presence of inulase in the intestinal contents and excessive gas production which is observed after inulin feeding suggest that sugar may be an intermediate product in the transformation and that the sugar thus formed is immediately destroyed by fermentation. Whether or not inulin is excreted in the feces will therefore depend upon the length of time it remains in the intestine and the opportunity bacteria have had to act upon it; under some conditions a considerable amount may be eliminated unchanged.

The apparent utilization and tolerance of inulin in the body has led to its use to some extent in the diet of diabetics. Thus Teyxeira[5] suggested adding inulin to gluten of wheat. White[6] recommended that dahlia tubers be cooked and eaten as a vegetable by diabetics. Persia[7] reported favorable results from the use of inulin in diabetic treatment and remarks that the inulin was "well digested and assimilated." Strauss[8] likewise reports favorably on its use.

The assumption that levulose is better tolerated than other sugars has, perhaps, been based upon these earlier experiences with inulin when it was supposed that levulose resulted from it in metabolism. The facts appear to be, however, that inulin has little, if any, nutritive value and that from it no significant amounts of levulose are derived. Whatever levulose may arise from the action of the

[1] Okey, J. Biol. **39**, 149, (1919)
[2] München. med. Wchnschr., p. 1525, 1905.
[3] Jour. Am. Med. Assoc., **58**, 1176, 1912.
[4] Jour. Biol. Chem., **17**, 365, 1914.
[5] Boll. Chim. Farm., **43**, 605-6; Jahresb. Tierchem., **35**, 822, 1905.
[6] Allbutt and Rolleston; System of Medicine, III, 204.
[7] Jahresb. Tierchem., **25**, 822, 1905.
[8] Therapie der Gegenwart, **52**, 337, 1911.

acid gastric juice upon inulin will behave in diabetic metabolism just as does levulose from any other source.

FATS AND OILS.

Olive Oil.

An unofficial sample of pure Spanish olive oil, **17918**, was submitted by the Dairy and Food Commissioner. The sample had been referred to his department by the H. J. Heinz Co. who remarked that the oil responded to the tests for sesame oil as generally applied. Our examination showed that the oil responded positively to the Baudouin and Villavecchia tests, the red color darkening in a short time, finally becoming almost black. These tests when applied to the liquid fatty acids, however, gave only very faint pink colors which should he regarded as negative. This experience indicates the necessity of checking positive tests for sesame obtained in the regular way by tests made upon the liquid fatty acids.

Cooking Fats.

Seven samples of shortening materials were examined for the Dairy and Food Commissioner. They were **18112**, Flake White; **18113**, Peerless Puff Paste; **18121**, Selex; **18122** Cottolene; **18123** Snowdrift; **18124**, Puff Paste.

The samples were examined chiefly with reference to the presence of beef stearin by Belfield's test, samples of hardened cottonseed oil and known mixtures of cottonseed oil and beef stearin being examined as controls. Evidence of beef stearin seemed positive in cases of **18113** and **18124** but negative or inconclusive in the other samples. Positive tests were obtained for cottonseed oil in all cases except in **18121**, but it is recognized that heated or hydrogenated cottonseed oil does not respond to the Halphen test.

Butter.

Ten samples sold for butter were submitted by the Dairy and Food Commissioner and five were examined for purchasers. One sample, D. C. No. **19184**, sold by Morris Gold, New Haven, was found to be renovated butter.

Of five samples submitted by purchasers one, **16468**, was so-called "wavy" or "mottled" butter, the effect being due probably to unequal distribution of water and brine or to incomplete removal of buttermilk or both.[1]

[1] Jour. Dairy Science, **3**, 2, p. 27.

TABLE IV. INSPECTION OF ICE CREAM.

Town	No. of Samples	Fat Content		
		Range		Average
		%	%	%
Ansonia	6	9.2	11.2	9.7
Beacon Falls	1	....	....	9.6
Branford	2	9.4	13.0	11.2
Bridgeport	20	6.4	15.0	10.4
Bristol	7	7.2	15.2	12.8
Brookfield	2	7.6	8.2	7.9
Centerbrook	1	....	....	7.6
Compounce	1	....	....	11.8
Danbury	12	8.4	15.6	10.2
Danielson	5	5.6	11.0	8.1
Dayville	1	....	....	10.6
Deep River	1	....	....	13.3
Derby	1	....	....	4.8
Devon	1	....	....	7.1
East Haven	1	....	....	9.2
Forestville	7	8.0	14 0	10.8
Greenwich	9	5.6	17.2	10.1
Guilford	1	....	....	13.2
Hartford	12	7.6	17.6	11.6
Hazardville	1	....	....	10.1
Jewett City	4	4.5	14.0	9.6
Meriden	6	12.2	15.6	14.3
Mianus	2	8.2	9.6	8.9
Middletown	8	11.4	23.2	15.5
Milldale	1	....	....	8.0
Moosup	2	10.0	11.2	10.6
Naugatuck	8	8.0	13.2	10.8
New Britain	9	8.2	15.0	12.3
New Haven	31	6.0	17.0	10.7
New London	18	8.8	19.8	13.8
New Milford	10	7.1	20.0	12.2
North Haven	1	....	....	10.0
Norwalk	6	9.0	14.4	11.5
Norwich	10	8.4	18.6	11.8
Old Lyme	1	....	....	9.4
Plainfield	4	9.2	18.2	13.5
Plantsville	3	8.8	9.8	9.3
Pomfret	1	....	....	23.0
Portland	1	....	....	15.2
Putnam	6	8.4	19.2	12.4
Ridgefield	2	7.2	9.4	8.3
Rockville	4	3.6	15.4	8.7
Saybrook	3	8.0	15.8	11.1
Somerville	1	....	....	11.2
South Manchester	7	7.6	16.0	10.2
South Norwalk	3	13.2	16.0	14.4
Southington	4	8.0	13.0	10.8
Stafford Springs	4	9.0	15.6	12.4
Stamford	10	9.0	13.0	11.0
Stratford	4	7.8	9.6	8.7
Suffield	2	8.0	10.6	9.3
Terryville	1	....	....	9.2

TABLE IV. INSPECTION OF ICE CREAM—(*Concluded.*)

Town	No. of Samples	Fat Content		
		Range		Average
		%	%	%
Thomaston	3	14.0	14.8	14.5
Thompsonville	3	8.6	12.2	10.1
Torrington	8	8.0	15.6	11.7
Unionville	4	7.6	10.4	8.3
Wallingford	6	8.8	15.4	11.6
Wauregan	2	6.4	7.6	7.0
Waterbury	14	8.0	20.0	11.4
Westbrook	1	....	....	9.4
West Haven	1	....	....	6.8
Willimantic	4	13.6	17.0	15.8
Windsor Locks	5	2.3	10.8	6.5
Winsted	7	5.8	10.2	8.3
Not Given	1	....	....	13.2
Not Given	1	....	....	13.6

OLEOMARGARINE.

Five samples were examined, one being submitted by the Dairy and Food Commissioner and four by the Connecticut School for Boys. Analyses of the four last named are as follows:

No.	16125	16126	16127	16128
	%	%	%	%
Moisture	9.66	7.86	9.33	10.94
Fat	85.01	89.30	84.25	83.54
Salt, curd, etc.	5.33	2.84	6.42	5.52
Refraction of fat, butyro-refract. at 25° C.	59.2	58.2	56.48	56.25
Reichert-Meissel No.	2.02	4.21	4.90	7.37

On the basis of the Reichert Meissel number sample **16128** contains the greatest amount of butter or milk fat. From the standpoint of caloric value there is no great difference among the several products but milk fat enhances the food value by reason of the peculiar diet factors which it contains.

ICE CREAM.

During the past summer an extensive inspection of ice cream has been conducted by the Dairy and Food Commissioner. The samples submitted to us do not adequately represent the scope of the work since some of the samples collected were tested by inspectors of his department who are licensed milk testers and who have followed methods approved by this laboratory. All doubtful cases have been resampled and referred to us for final judgment.

Three hundred and twenty-nine samples have been tested here. The distribution of these by towns, the range in fat content and the average are given in Table IV.

TABLE V. ICE CREAM BELOW STANDARD.

No.	Dealer	Manufacturer	Flavor	Fat.
	BRIDGEPORT			%
20268	Frank Cuneo	Own make	Vanilla	7.3
20266	G. Monaco	Own make	Vanilla	7.7
	BROOKFIELD			
18189	Mrs. E. Calkins	Int'l Ice Cream Co.	Vanilla	7.6
	DANIELSON			
20293	Mary E. Salotti	Own make	Chocolate	5.6
	DERBY			
20596	Debarbiere & Musante	Own make	Vanilla	4.8
	DEVON			
20276	Ideal Confectionery Co	R. Kostopoulas	Vanilla	7.1
	GREENWICH			
20072	A. B. Libano & Co	Own make	Strawberry	5.6
	HARTFORD			
20006	Soda Shop	New Haven Dairy	Coffee	7.6
	JEWETT CITY			
20793	Dennis Sullivan	Own make	Chocolate	6.8
20792	Dennis Sullivan	Own make	Maple Walnut	4.5
	NEW HAVEN			
20025	Sweetland Bros	Own make	Chocolate	7.6
20563	Union Confectionery Co	Own make	Lemon	7.6
20783	J. Basil	Own make	Chocolate	7.6
	NEW MILFORD			
18200	Noble, Lynch & Noble	Int'l Ice Cream Co.	Vanilla	7.2
18193	Hipp's Ice Cream Co	Own make	Chocolate	7.1
	ROCKVILLE			
19958	John E. Gawtrey	Own make	Vanilla	3.6
19959	John E. Gawtrey	Own make	Coffee	3.7
	SOUTH MANCHESTER			
19956	Manchester Dairy Ice Cream Co.	Own make	Chocolate	7.8
19954	Joseph Sardella	Own make	Vanilla	7.6
	UNIONVILLE			
20000	Chas. Hackney		Vanilla	7.6
	WAUREGAN			
20295	H. J. Fournin	Own make	Vanilla	7.6
	WINDSOR LOCKS			
19192	Vito Colapietro	Own make	Vanilla	2.3
19195	Leon Colapietro	Own make	Vanilla	2.6
19183	Louis Molinari	Peter Fossa	Chocolate	7.0
	WINSTED			
20634	John Nubarek	Int'l Ice Cream Co.	Vanilla	7.8
20639	Manchester Dairy Co	Own make	Vanilla	7.6
20640	T. Lentin	Manchester Dairy Co	Strawberry	5.8

Samples found below standard, viz., 8 per cent. for plain cream and 6 per cent. for fruit and nut creams, are reported in more detail in Table V.

It is of interest to classify the samples on the basis of milk fat as we have done in other years. Such a comparison is given in Table VI.

TABLE VI. CLASSIFICATION OF ICE CREAM ON THE BASIS OF FAT CONTENT.

	1919		1920		1921	
Range of Fat, per cent.	Samples	Per cent.	Samples	Per cent.	Samples	Per cent.
8.0 to 9.9	25	30.5	134	33.5	94	28.5
10.0 to 11.9	26	31.7	83	20.8	71	21.6
12.0 and above	28	34.1	125	31.2	123	37.4
Below 8	3	3.7	58[1]	14.5	41[2]	12.5
Total	82	100.0	400	100.0	329	100 0

[1] Includes 11 fruit ice creams of legal standard viz., 6 per cent.
[2] Includes 14 fruit ice creams of legal standard viz., 6 per cent.

As noted in our report last year[1] the true average quality of the market product of the state is not shown by these figures since we have no knowledge of the gross production of the several grades. It is quite probable that the production of ice cream testing between 8 and 10 per cent. exceeds that of grades testing higher. It is evident however that our statute legalizing 8 per cent. ice cream has not caused grades richer in fat to disappear.

Fifteen samples were examined for individuals. Of these only three, **17668, 17669** and **17670,** require notice. These were the top, middle and bottom portions of a gallon can of vanilla cream submitted by the Semon Ice Cream Company of New Haven for study of uniformity of fat distribution. The can was heated gently to permit removal of the contents as a whole and cross sections were taken at the top, middle and bottom. Each of the three sections tested 10 per cent. fat showing a very even fat distribution.

Three similar experiments made in this laboratory on another occasion[2] showed satisfactory uniformity in two of the trials but in the third case the product had evidently stratified either by reason of imperfect mixing originally or, more probably, because of partial melting or "weakening" subsequently.

MILK AND MILK PRODUCTS.

CRYOSCOPY OF MILK.[3]

Methods for the detection of adulteration in milk have been greatly improved in recent years. Twenty-years ago the analyst was obliged to base his judgment of milk samples submitted for

[1] Conn. Exp. Sta. Bull. 227, p. 249.
[2] Conn. Exp. Sta. Bull. 219, pp. 215-216.
[3] The data and much of the discussion on this subject is taken from the report of the writer as associate referee to the Association of Official Agricultural Chemists at the meeting at Washington in October, 1921.

examination entirely upon the analysis of the sample. If the specific gravity, fat and non-fatty solids were low, added water was suspected; if the specific gravity and non-fatty solids were high and the fat low, skimming was indicated. In either case it was obviously difficult to pass certain judgment unless the samples were well outside the limits of reasonable composition, and a combination of both of the forms of sophistication mentioned further complicated the task of diagnosis. As a result of careful study of analyses of whole milk certain relationships between its several proximate constituents have been postulated and it is largely upon such ratios that the identification of skimmed milk still depends. The introduction of the immersion refractometer facilitated the solution of a number of analytical problems, not the least of which was that of the more certain detection of watered milk. Exhaustive observations upon the sera of authentic milks from cows in various periods of lactation, upon varied rations and in different seasons of the year, etc., showed that the refraction of the serum is a factor which varies within comparatively narrow limits and that it is possible to choose, from the large amount of data collected, a figure below which milk will not refract provided it is undiluted with water. Thus, for the copper method of preparing the serum, a refraction of 36 is the lowest recorded value for milk of known purity and a reading of less than this figure is regarded as indicative of added water. It is recognized that this method has its limitations and that 10 per cent. dilution, or even in some cases considerably more, may escape detection, but taken in conjunction with deductions drawn from the chemical analysis it is still an invaluable aid in deciding the presence of added water.

More recently a method has been devised whereby milk containing extraneous water can be detected and the amount thereof estimated with a degree of delicacy not heretofore possible. The method is based upon the freezing point of milk which is a physiological constant varying within very narrow limits, viz., -0.530° C. to -0.566° C. according to the studies herein reported which is the best information available at this time. Obviously as milk is diluted with water its freezing point approaches that of water and depressions less than -0.530° will be observed. By comparing the freezing point depression of milk which has been diluted with water with the minimum or the accepted average depression observed for whole milk of known purity the percentage of water added can be very closely approximated.

The theory and practice of freezing point determinations as applied to milk together with a critical review of the literature dealing with cryosocopic investigations of blood serum, bile, gastric juice, etc. have been very adequately set forth in a paper by Hortvet[1]

[1] Jour. Ind. Eng. Chem., 13, 3, p. 198, 1921.

who has outlined a carefully standardized method of procedure for the determination of freezing points. The practical application of this method to the detection and estimation of added water in milk is necessarily based upon a knowledge of the range in freezing point depressions which may be shown by normal milk and this further necessitates a study of milk obtained in different localities from normal individual cows and herds and from animals under varying conditions of daily routine and general health. Dr. Hortvet, as referee on dairy products for the Association of Official Agricultural Chemists, has continued the study of this subject during the past year and the writer, as associate referee for the same Association, has collaborated with him with special reference to the definition of the freezing point range for normal milk and the depressions which may be observed in milk from cows under abnormal conditions. We discuss here only that part of the work which comes within the scope of the writer's part in the program.

Collaboration.

Generous coöperation was received from the Libby, McNeill and Libby Laboratories, Morrison, Ill. through Dr. G. A. Menge who has reported results credit for which is due to Messrs. R. T. Beardsley and W. H. Tucker. Further data were supplied from the State Dairy and Food Department, St. Paul, Minn., through the collaboration of Messrs. Henry Hoffman, Otto Kneffner and C. S. Carl. Credit for data submitted from this Station is due to Mr. R. E. Andrew, collaborator, assisted by Mr. R. T. Merwin. Samples examined here were taken under the supervision of Mr. G. T. Fowler of the Dairy and Food Commissioner's Department and Mr. C. E. Shepard of this laboratory.

Classification of Results.

Two hundred and sixteen samples are represented in the combined reports of collaborators. Partial or complete analyses with freezing point determinations, the latter largely in duplicate, have been made and these data have been classified in appropriate groups and are discussed under titles as follows:

I. Freezing Point Depressions of Authentic Milk From Normal Individual Cows.

II. Freezing Point Depressions of Authentic Milk From Normal Herds.

III. Freezing Point Depressions of Authentic Milk From Healthy Cows but Under Abnormal Conditions of Daily Routine or Environment.

IV. Freezing Point Depressions of Authentic Milk From Cows which are Diseased or Otherwise Abnormal Physically.

TABLE VII. ANALYSES AND FREEZING POINT DEPRESSIONS OF AUTHENTIC MILK, NORMAL INDIVIDUAL COWS.

Herd	Indiv. Cow No. Sample No.	Breed	Date 1921	Sp. Gr. 15.6° C.	Fat	S-N-F.	Lactose	Ash	Acidity	Freezing Point —0° C.	
			(Collaborator, Libby, McNeill and Libby)								
H. T.	5 B	Holstein	9/14 P.M.	1.0306	3.3	8.30	4.64	0.639	0.145	0.532	0.531
H. A.	4 B	Holstein	9/14 P.M.	1.0310	3.6	8.47	3.71	0.799	0.147	0.551	0.551
H. A.	7 B	Holstein	9/14 P.M.	1.0380	3.8	10.26	3.65	0.805	0.155	0.566	0.566
B. J. F.	6 B	Holstein	9/14 P.M.	1.0300	3.3	8.15	4.39	0.660	0.140	0.533	0.533
	1	Holstein, Gr'd	9/18 P.M.	1.0260	6.3	7.76	3.41	0.664	0.120	0.548	0.549
	7	Holstein, Gr'd	9/18 P.M.	1.0303	4.9	8.55	4.45	0.697	0.170	0.548	0.546
	8	Holstein, Gr'd	9/18 P.M.	1.0264	3.0	7.20	4.29	0.770	0.103	0.548	0.548
	9	Holstein, Gr'd	9/18 P.M.	1.0303	3.8	8.34	4.37	0.678	0.165	0.538	0.537
	11	Holstein, Gr'd	9/18 P.M.	1.0288	4.7	8.14	4.16	0.728	0.153	0.549	0.548
B. J. F.	....	Holstein, Pure	9/14 P.M.	1.0300	2.2	7.90	4.38	0.693	0.140	0.535	0.535
B. V.	....	Holstein, Gr'd	9/16 P.M.	1.0287	0.9[1]	7.36	4.15	0.719	0.100	0.538	0.537
A. H.	....	Holstein, Gr'd	9/21 P.M.	1.0357	3.3	10.01	4.17	0.784	0.190	0.548	0.548
J. N.	....	Holstein, Gr'd	9/21 P.M.	1.0316	3.7	8.63	4.34	0.707	0.153	0.551	0 550
B. F. H.	....	Holstein, Gr'd	9/21 P.M.	1.0338	4.1	9.26	4.15	0.770	0.165	0.549	0.548
E. K.	....	Jersey, Gr'd	9/21 P.M.	1.0328	4.3	9.05	4.68	0.730	0.165	0.542	0.540
J. H.	....	Jersey, Gr'd	9/26 A.M.	1.0326	3.1	8.77	5.03	0.628	0.115	0.560	0.560
			9.26 P.M.	1.0320	2.8	8.57	4.78	0.622	0.118	0.546	0.545
.....	5	Br. Swiss	9/18 P.M.	1.0256	5.3	7.46	3.65	0.647	0.145	0.549	0.548
A. M.	....	Durham	9/16 P.M.	1.0310	3.5	8.44	4.55	0.661	0.145	0.533	0.533
A. S.	....	Durham, Gr'd	9/16 P.M.	1.0328	4.0	8.99	4.61	0.676	0.160	0.545	0.547
G. T.	....	Durham, Gr'd	9/26 A.M.	1.0318	4.0	8.74	3.75	0.782	0.110	0.548	0.549
			9/26 P.M.	1.0310	4.3	8.60	3.56	0.797	0.120	0.541	0.540
A. D.	....	Dur.-S. Horn	9/26 A.M.	1.0340	4.9	9.48	4.63	0.829	0.135	0.550	0.550
			9/26 P.M.	1.0340	4.4	9.37	4.52	0.832	0.123	0.548	0.547
O. R....	....	S. Horn-Hol.	9/26 A.M.	1.0325	4.6	9.05	3.63	0.636	0.083	0.540	0.539
			9/26 P.M.	1.0326	4.2	8.96	3.43	0.661	0.080	0.540	0.540
F. F.	....	Red Pole	9/23 A.M.	1.0304	5.5	8.94	4.53	0.695	0.138	0.551	0.551

[1] A.M. sample following day tested 1.6% fat.

TABLE VII. ANALYSES AND FREEZING POINT DEPRESSIONS OF AUTHENTIC MILK, NORMAL INDIVIDUAL COWS—(*Continued*).

Herd	Indiv. Cow No. Sample No.	Breed	Date 1921	Sp. Gr. 15.6° C.	Fat %	S-N-F. %	Lactose %	Ash %	Acidity %	Freezing Point —0° C.	
			(Collaborator, State Dairy & Food Dept., St. Paul, Minn.)								
.....	1 H.	Holstein, Reg.	5/9	1.0295	4.7	8.47	....	.....	.....	0.560	.....
.....	2 H.	Holstein, Reg.	5/9	1.0281	4.2	8.02	....	.....	.....	0.554	.....
.....	3 H.	Holstein, Reg.	5/9	1.0312	3.4	8.63	....	.....	.....	0.550	.....
.....	4 H.	Holstein, Reg.	5/9	1.0313	2.9	8.54	....	.....	.....	0.542	.....
.....	5 H.	Holstein, Reg.	5/9	1.0310	2.3	8.34	....	.....	.....	0.540	.....
.....	6230	Holstein	5/14	1.0305	3.3	8.57	....	.....	.....	0.544	.....
.....	6231	Holstein	5/14	1.0310	2.6	8.24	....	.....	.....	0.541	.....
.....	6232	Holstein	5/14	1.0310	2.8	8.48	....	.....	.....	0.543	.....
.....	6233	Holstein	5/14	1.0320	2.4	8.60	....	.....	.....	0.540	.....
.....	6234	Holstein	5/14	1.0330	2.8	8.95	....	.....	.....	0.554	.....
.....	6235	Holstein	5/14	1.0310	2.6	8.43	....	.....	.....	0.556	.....
.....	6236	Holstein	5/14	1.0315	4.9	9.07	....	.....	.....	0.552	.....
.....	6237	Holstein	5/14	1.0330	3.3	9.05	....	.....	.....	0.540	.....
.....	6238	Holstein	5/14	1.0310	4.4	8.78	....	.....	.....	0.545	.....
.....	6250	Holstein	5/17	1.0290	3.7	9.25	....	.....	.....	0.546	.....
.....	7022	Durham	9/7	1.0323	4.4	9.10	....	.....	.....	0.554	.....
St. L. P.	....	.....	8/25	1.0315	3.8	8.80	....	.....	.....	0.551	.....
			(Collaborator, Agricultural Experiment Station, New Haven, Conn.)								
Y	1	Holstein	4/5 A.M.	1.0323	3.6	8.80	....	.....	0.17	0.573	0.574[2]
			4/13 A.M.	1.0317	3.2	8.58	....	.....	0.15	0.558	0.559
			4/15 A.M.	1.0330	3.3	8.92	....	.....	0.16	0.565	0 566
			4/15 A.M.	1.0330	3.3	8.92	....	.....	0.15	0.565	0.565
			4/16 A.M.	1.0322	3.4	8.74	....	.....	0.16	0.565	0 565
			4/20 A.M.	1.0315	3.3	8.55	....	.....	0.15	0.562	0.562
			4/20 P.M.	1.0305	3.3	8.30	....	.....	0.14	0.542	0.542
			5/20 P.M.	1.0299	3.4	8.17	....	.....	0.14	0.536	0.537
	2	Holstein	4/6 A.M.	1.0320	4.3	8.88	....	.....	0.14	0.572	0.572[2]

[2] See discussion.

TABLE VII. ANALYSES AND FREEZING POINT DEPRESSIONS OF AUTHENTIC MILK, NORMAL INDIVIDUAL COWS—(*Continued*).

Herd	Indiv. Cow No. Sample No.	Breed	Date 1921	Sp. Gr. 15.6° C.	Fat %	S-N-F. %	Lactose %	Ash %	Acidity %	Freezing Point —0° C.	
(Collaborator, Agricultural Experiment Station, New Haven, Conn.—Continued)											
Y	2	Holstein	4/13 A.M.	1.0311	3.4	8.46	....	.....	0.15	0.544	0.544
			4/16 A.M.	1.0317	4.1	8.76	....	.....	0.14	0.562	0.562
			4/20 A.M.	1.0317	3.6	8.67	....	.....	0.13	0.553	0.554
			4/26 P.M.	1.0307	3.8	8.46	....	.....	0.15	0.547	0.546
			5/18 P.M.	1.0309	4.3	8.60	....	.....	0.13	0.551	0.552
	3	Holstein	4/7 A.M.	1.0337	5.4	9.54	....	.....	0.15	0.572	0.572[2]
			4/13 A.M.	1.0321	4.7	8.98	....	.....	0.15	0.557	0.557
			4/20 A.M.	1.0330	5.1	9.29	....	.....	0.15	0.562	0.563
			4/26 P.M.	1.0325	5.0	9.14	....	.....	0.14	0.547	0.547
			5/20 P.M.	1.0332	5.0	9.31	....	.....	0.15	0.549	0.550
	4	Holstein	4/9 A.M.	1.0308	4.4	8.60	....	.....	0.12	0.560	0.560
			4/20 A.M.	1.0320	3.6	8.73	....	.....	0.14	0.562	0.562
			4/9 P.M.	1.0299	4.4	8.37	....	.....	0.12	0.552	0.550
			4/26 P.M.	1.0308	3.1	8.34	....	.....	0.15	0.543	0.543
			5/26 P.M.	1.0315	3.3	8.85	....	.....	0.13	0.543	0.543
	5	Holstein	4/8 A.M.	1.0333	3.7	9.07	....	.....	0.15	0.552	0.552
	6	Holstein	4/16 A.M.	1.0326	3.3	8.82	....	.....	0.12	0.571	0.571[2]
			4/22 A.M.	1.0313	3.5	8.52	....	.....	0.11	0.571	0.571[2]
			4/26 P.M.	1.0309	3.7	8.48	....	.....	0.10	0.544	0.545
			4/25 P.M.	1.0301	3.1	8.15	....	.....	0.11	0.533	0.534
	7	Holstein	4/22 A.M.	1.0322	4.0	8.85	....	.....	0.12	0.571	0.571[2]
			4/25 P.M.	1.0312	4.0	8.60	....	.....	0.11	0.545	0.546
			5/26 P.M.	1.0326	4.3	9.03	....	.....	0.12	0.553	0.553
	8	Holstein	4/22 A.M.	1.0342	4.6	9.48	....	.....	0.13	0.580	0.580[2]
			4/25 P.M.	1.0333	4.0	9.13	....	.....	0.12	0.542	0.542
			5/18 P.M.	1.0343	5.0	9.58	....	.....	0.11	0.552	0.553
	9	Holstein	4/22 A.M.	1.0340	3.8	9.28	....	.....	0.15	0.571	0.571[2]
			4/25 P.M.	1.0317	4.7	8.90	....	.....	0.12	0.543	0.544
			5/18 P.M.	1.0318	4.6	8.94	....	.....	0.12	0.551	0.552

TABLE VII. ANALYSES AND FREEZING POINT DEPRESSIONS OF AUTHENTIC MILK, NORMAL INDIVIDUAL COWS—(*Continued*).

Herd	Indiv. Cow No. Sample No.	Breed	Date 1921	Sp. Gr. 15.6° C.	Fat %	S-N-F. %	Lactose %	Ash %	Acidity %	Freezing Point —0° C.	
(Collaborator, Agricultural Experiment Station, New Haven, Conn.—Continued)											
Y	10	Holstein	4/22 A.M.	1.0320	4.1	8.83	....	.....	0.15	0.572	0.572[2]
			5/18 P.M.	1.0301	4.0	8.33	....	.....	0.12	0.542	0.542
	11	Holstein	4/22 A.M.	1.0320	3.7	8.75	....	.....	0.15	0.562	0.562
			5/18 P.M.	1.0303	3.9	8.35	....	.....	0.15	.....	0.543
	12	Holstein	4/23 A.M.	1.0301	6.8	8.88	....	.....	0.16	0.572	0.572[2]
			5/18 P.M.	1.0327	6.5	9.47	....	.....	0.15	0.551	.....
	13	Holstein	4/23 A.M.	1.0304	3.8	8.37	....	.....	0.12	0.540	0.540
			5/26 P.M.	1.0316	4.6	8.84	....	.....	0.12	.....	0.542
	14	Holstein	4/23 A.M.	1.0319	3.8	8.75	....	.....	0.16	0.549	0.549
			5/20 P.M.	1.0320	4.0	8.81	....	.....	0.16	0.539	0.538
	15	Holstein	4/27 A.M.	1.0317	3.5	8.65	....	.....	0.11	0.561	0.561
			4/25 P.M.	1.0298	3.0	8.76	....	.....	0.13	0.523	0.523[2]
			4/26 P.M.	1.0305	3.3	8.30	....	.....	0.14	0.532	0.532
			4/27 P.M.	1.0301	3.2	8.17	....	.....	0.13	0.536	0.537
			5/20 P.M.	1.0312	3.4	8.48	....	.....	0.13	0.544	0.545
	16	Holstein	4/26 P.M.	1.0302	4.5	8.45	....	.....	0.16	0.540	0.541
			5/20 P.M.	1.0317	4.6	8.87	....	.....	0.16	.....	0.542
	17	Holstein	4/26 P.M.	1.0294	3.5	8.06	....	.....	0.13	0.541	0.541
			5/20 P.M.	1.0291	3.5	7.98	....	.....	0.12	.....	0.542
F	1	Holstein	4/16 A.M.	1.0310	3.2	8.40	....	.....	0.14	0.542	0.542
			5/6 P.M.	1.0304	3.1	8.23	....	.....	0.14	0.541	0.541
	2	Holstein	4/18 A.M.	1.0313	2.8	8.38	....	.....	0.15	0.542	0.542
			5/5 P.M.	1.0295	...	....	....	.....	0.14	0.543	0.544
	3	Holstein	4/18 A.M.	1.0329	...	....	....	.....	0.14	0.550	0.551
			5/5 P.M.	1.0296	3.2	8.05	....	.....	0.14	0.532	0.533
	4	Holstein	4/18 A.M.	1.0308	3.1	8.34	....	.....	0.15	0.542	0.543
			5/5 P.M.	1.0301	3.2	8.17	....	.....	0.15	0.529	0.530
	5	Holstein	4/18 A.M.	1.0318	3.4	8.64	....	.....	0.16	0.543	0.543
			5/5 P.M.	1.0317	3.5	8.64	....	.....	0.16	0.542	0.540

TABLE VII. ANALYSES AND FREEZING POINT DEPRESSIONS OF AUTHENTIC MILK, NORMAL INDIVIDUAL COWS—(*Concluded*).

Herd	Indiv. Cow No. Sample No.	Breed	Date 1921	Sp. Gr. 15.6° C.	Fat %	S-N-F. %	Lactose %	Ash %	Acidity %	Freezing Point —0° C.
(Collaborator, Agricultural Experiment Station, New Haven, Conn.—Concluded)										
F	6	Holstein	4/19 A.M.	1.0280	4.0	7.81	....	.....	0.11	0.545
			5/5 P.M.	1.0307	4.0	8.50	....	.....	0.13	0.541
	7	Holstein	4/19 A.M.	1.0325	4.1	8.90	....	.....	0.14	0.552
			5/6 P.M.	.....	3.5	....	....	.....	0.11	0.542
	8	Holstein	4/19 A.M.	1.0335	4.8	9.35	....	.....	0.14	0.548
			5/6 P.M.	1.0310	2.9	8.33	....	.....	0.16	0.536
	9	Holstein	4/19 A.M.	1.0298	3.8	8.23	....	.....	0.15	0.542
			5/6 P.M.	1.0305	3.8	8.40	....	.....	0.14	0.534
	10	Holstein	4/19 A.M.	1.0309	3.8	8.50	....	.....	0.13	0.547
			5/6 P.M.	1.0310	5.1	8.79	....	.....	0.12	0.543
	11	Holstein	4/19 A.M.	1.0301	3.5	8.23	....	.....	0.16	0.542
			5/6 P.M.	1.0303	2.7	8.10	....	.....	0.17	0.535
S	1	Jersey	4/29 A.M.	1.0336	6.0	9.63	....	.....	0.17	0.542
	2	Ayrshire	4/29 A.M.	1.0309	4.1	8.56	....	.....	0.18	0.531
	3	Guernsey	4/29 A.M.	1.0309	5.1	8.77	....	.....	0.20	0.549
P	5	.....	5/11 P.M.	1.0320	3.7	8.75	....	.....	0.16	0.532
			7/6 P.M.	1.0303	4.7	8.53	....	.....	0.14	0.535
	6	.....	5/11 P.M.	1.0309	...	....	....	.....	0.09	0.542
			7/6 P.M.	1.0271	3.8	7.55	....	.....	0.09	0.535

FREEZING POINT DEPRESSIONS OF AUTHENTIC MILK FROM I, NORMAL INDIVIDUAL COWS AND II, NORMAL HERDS.

The data obtained upon normal individual cows and normal herds are given in Tables VII and VIII respectively.

The term "normal" as applied to an individual cow or herd is used in this report to refer to animals which in the judgment of the ordinary observer or dairyman would be classed as healthy and which are fed and kept with ordinary care. It does not refer to animals which have been subjected to clinical tests and pronounced sound by expert authority. The milk from animals which conform to this interpretation of the term is presumed to be normal milk. While from a purely scientific standpoint it would be of interest to define the limits of freezing point depression for the milk of only such individuals as had been judged healthy by expert examination and clinical tests, yet that would be beside the immediate purpose of this study which is to define such limits as will serve for safely judging the substance and quality of market milk.

UNCORROBORATED RESULTS.

Before taking up the discussion of freezing point range as shown by the combined data, attention is called to certain extreme results which lie outside the experience of the collaborators as a whole. This refers to results below -0.570° C. found for a number of morning samples and to one extremely high figure, -0.523° C. observed in one case of evening milk.

These results are summarized from Table VII as follows:

TABLE VII, A. RESULTS REQUIRING FURTHER CORROBORATION.

Herd	Cow No.	Breed.	Date.	Freezing Point—0°C.	
Y	1	Holstein	4/5 A. M.	0.573	0.574
	2	Holstein	4/6 A. M.	0.572	0.572
	3	Holstein	4/7 A. M.	0.572	0.572
	6	Holstein	4/16 A. M.	0.571	0.571
			4/22 A. M.	0.571	0.571
	7	Holstein	4/22 A. M.	0.571	0.571
	8	Holstein	4/22 A. M.	0.580	0.580
	9	Holstein	4/22 A. M.	0.571	0.571
	10	Holstein	4/22 A. M.	0.572	0.572
	12	Holstein	4/23 A. M.	0.572	0.572
	15	Holstein	4/25 P. M.	0.523	0.523

All these results were obtained in the laboratory of the writer who can vouch for the care with which the freezing point observations were made and who can obtain no information of any abnormal conditions prevailing in this herd at the time the samples were taken. So far as this herd is concerned the low figures seem

TABLE VIII. ANALYSES AND FREEZING POINT DEPRESSIONS OF AUTHENTIC MILK, NORMAL HERDS.

Herd	No. of Cows	Breed	Date 1921	Sp. Gr. 15.6° C.	Fat	S-N-F.	Lactose	Ash	Acidity	Freezing Point —0° C.	
			(Collaborator, Libby, McNeill & Libby.)								
E. M.	4	Holstein, Gr'd	4/1 P.M.	1.0314	3.6	8.56	....	.....	0.145	0.535	0.534
W. T.	12	Holstein, Gr'd	4/1 P.M.	1.0305	2.8	8.17	....	.....	0.145	0.530	0.531
	13	Holstein, Gr'd	6/22 P.M.	1.0300	3.1	8.13	4.46	.....	0.140	0.541	0.541
	15	Holstein, Gr'd	7/14 P.M.	1.0304	3.3	8.26	....	.....	0.135	0.538	0.538
G. H.	13	Holstein, Gr'd	3/29 P.M.	1.0290	3.6	7.98	....	.....	0.135	0.532	0.532
			7/14 P.M.	1.0295	3.3	8.03	4.58	.....	0.135	0.541	0.541
W. B.	6	Holstein, Gr'd	4/1 P.M.	1.0324	2.7	8.63	....	.....	0.150	0.529	0.530
	13	Holstein, Gr'd and Pure	6/22 P.M.	1.0310	3.0	8.36	4.72	.....	0.135	0.539	0.537
			7/14 P.M.	1.0295	3.2	8.01	....	.....	0.130	0.533	0.532
A. G.	15	Holstein, Pure	8/2 P.M.	1.0294	3.4	8.02	....	.....	0.135	0.538	0.537
M. B.	16	Holstein, Gr'd	9/16 P.M.	1.0313	3.5	8.53	4.44	0.722	0.150	0.547	0.548
H. W.	11	Holstein, Gr'd	9/21 P.M.	1.0323	3.2	8.72	4.18	0.734	0.143	0.552	0.552
O. R.	10	Holstein, Gr'd	9/26 A.M.	1.0292	4.3	8.16	4.29	0.678	0.123	0.534	0.532
			9/26 P.M.	1.0285	4.3	7.98	3.69	0.710	0.110	0.532	0.533
G. P.	6	Holstein, Gr'd	9/21 P.M.	1.0313	3.5	8.53	4.23	0.696	0.133	0.551	0.551
D. F. M. 1 B.	3	Holstein, Pure	9/14 P.M.	1.0336	3.4	9.08	4.53	0.693	0.145	0.550	0.550
B. J. F. 3 B.	2	Holstein, Pure	9/14 P.M.	1.0300	2.7	8.05	4.39	0.676	0.145	0.535	0.535
S. W.	2	Hol.-Jersey	9/16 P.M.	1.0313	3.7	8.57	4.61	0.684	0.155	0.549	0.548
B. V.	11	Hol. 10, Jersey 1	9/16 P.M.	1.0301	3.1	8.15	4.47	0.686	0.145	0.550	0.549
A. P. T.	10	Hol. 4, Jersey 1, Bk. Pole 1, Dur. 2, Hereford 1, Guernsey 1	9/21 P.M.	1.0319	3.5	8.68	4.42	0.710	0.140	0.546	0.545
E. K.	12	Holstein 2, Jer. 10	9/21 P.M.	1.0320	3.8	8.76	4.52	0.704	0.148	0.543	0.542

TABLE VIII. ANALYSES AND FREEZING POINT DEPRESSIONS OF AUTHENTIC MILK, NORMAL HERDS—(*Concluded*).

Herd	No. of Cows	Breed	Date 1921	Sp. Gr. 15.6° C.	Fat %	S-N-F. %	Lactose %	Ash %	Acidity %	Freezing Point -0° C.	
			(Collaborator, Libby, McNeill & Libby.—*Concluded.*)								
F. F.	9	Holstein 7, Red Pole 1, Jersey 1	9/23 A.M.	1.0309	4.2	8.56	4.59	0.666	0.148	0.547	0.545
D. L.	2	Jersey, Gr'd	6/22 P.M.	1.0329	5.4	9.30	4.92	.....	0.142	0.550	0.549
J. J. R.	2	Jersey, Gr'd	8/1 P.M.	1.0316	3.3	8.56	4.82	.....	0.130	0.551	0.551
R. N.	6	Jersey 1, S. Horn 5	9/21 P.M.	1.0316	3.8	8.66	4.67	0.672	0.150	0.550	0.550
B	10	Durham, Gr'd	3/29 P.M.	1.0321	3.8	8.77	....	.....	0.143	0.542	0.541
A. D.	6	Dur.-S. Horn	9/26 A.M.	1.0325	4.6	9.05	4.52	0.687	0.105	0.540	0.539
			9/26 P.M.	1.0325	4.2	8.96	4.50	0.700	0.123	0.540	0.540
P. W.	7	Reds, Gr'd	6/20 P.M.	1.0322	3.9	8.83	4.68	.....	0.157	0.531	0.531
			7/14 P.M.	1.0324	3.7	8.84	....	.....	0.130	0.534	0.533
B. L.	4	S. Horn, Gr'd	9/23 A.M.	1.0314	3.6	8.57	4.48	0.706	0.150	0.557	0.556
B. W.	16	Mixed, Gr'd	6/20 P.M.	1.0326	3.7	8.98	4.45	.....	0.152	0.536	0.537
J. H.	11	Mixed, Gr'd	9/26 A.M.	1.0318	4.0	8.74	4.68	0.696	0.118	0.548	0.549
			9/26 P.M.	1.0310	4.3	8.60	4.55	0.698	0.120	0.541	0.540
G. T.	5	Mixed, Gr'd	9/26 A.M.	1.0313	4.5	8.73	4.29	0.719	0.128	0.552	0.553
			9/26 P.M.	1.0313	4.1	8.65	4.14	0.750	0.125	0.552	0.553
Factory Sample	2300	Mixed	9/23 A.M. & P.M.	1.0310	3.7	8.49	4.45	0.704	0.145	0.541	0.540
			(Collaborator, Agricultural Experiment Station, New Haven, Conn.)								
Y	17	Holstein	4/27 A.M.	1.0317	4.1	8.77	....	.....	0.13	0.553	0.553
			4/27 P.M.	1.0309	3.5	8.44	....	.....	0.14	0.539	0.540
F	11	Holstein	5/2 A.M.	1.0312	3.3	8.46	....	.....	0.16	0.559	0.560
			4/13 P.M.	1.0313	3.7	8.56	....	.....	0.15	0.535	0.535
			4/18 P.M.	1.0309	3.7	8.48	....	.....	0.16	0.539	0.540
			4/19 P.M.	1.0310	3.4	8.44	....	.....	0.15	0.540	0.540
			5/2 P.M.	1.0305	3.7	8.38	....	.....	0.14	0.540	0.540
S	7	Holstein	4/18	.....	3.4	....	....	.....	0.13	0.542	0.542
B	7	Holstein	4/18	.....	3.5	....	....	.....	0.13	0.550	0.550

to be substantiated by their occurrence in so many different individuals, at intervals of from one to eighteen days, and in one case recurrence in the same individual after an interval of six days, nevertheless, except in the instance just mentioned, they were not duplicated or very closely approximated in any other samples from the same cows. Similarly, the very high figure obtained in sample from No. 15 was not again observed although three other samples were examined. There is no information upon which these samples can be declared abnormal in the sense of the term herein defined yet for the reason that the figures have all been obtained from one herd, and because they have not been duplicated by the experience of any other collaborator nor satisfactorily substantiated in the laboratory where they were obtained they are recorded here with the provision that they require further corroboration and are classed accordingly.

VARIATIONS BETWEEN MORNING AND EVENING MILK WITH REFERENCE TO THE FREEZING POINT DEPRESSION.

A considerable amount of data have been obtained to show the relation between morning and evening milk both of individual cows and of herds as regards freezing point depressions. The data have been submitted chiefly by one collaborator so that no adequate comparison upon this point can be made of the experiences of collaborators as a whole. The results reported from this station show quite consistently greater depressions in the case of morning samples, whether from individuals or herds.

The results reported from the laboratory of Libby, McNeill and Libby do not confirm this experience but the data are not complete enough to successfully contradict it.

The comparisons are shown in the following summary based upon Tables VII and VIII.

The extreme figures which were discussed and disposed of in the preceding table are included in this tabulation merely to show that the differences, without reference to their magnitude, are in the same general direction as the majority of other differences.

The last four observations in each group are from the Libby, McNeill and Libby laboratories. In the case of individual cows their data harmonize with those reported from this station but in the case of herds they do not. However taking the six observations as they stand the average freezing point depression is 0.007° greater in the morning milk which is a magnitude well beyond the limit of experimental error and may therefore be regarded as a real value.

TABLE VII-VIII, A. VARIATION IN FREEZING POINT DEPRESSIONS OF MORNING AND EVENING MILK.

INDIVIDUAL COWS.

Herd and Cow No.	No. of Samples A. M.	No. of Samples P. M.	A. M. Freezing Pt. Average — 0°C.	P. M. Freezing Pt. Average — 0°C.	A. M. Freezing Pt. lower (+) or higher (—) than P. M. — 0°C.
Y 1	5	2	0.563	0.539	+ 0.024
2	3	2	0.553	0.549	+ 0.004
3	2	2	0.560	0.548	+ 0.012
4	2	3	0.561	0.546	+ 0.015
6	2	2	0.571	0.539	.....
7	1	2	0.571	0.550	.....
8	1	2	0.580	0.547	.....
9	1	2	0.571	0.548	.....
10	1	1	0.572	0.542	.....
11	1	1	0.562	0.543	+ 0.019
12	1	1	0.572	0.551	.....
13	1	1	0.540	0.542	— 0.002
14	1	1	0.549	0.538	+ 0.011
15	1	3	0.561	0.538	+ 0.023
F 1	1	1	0.542	0.541	+ 0.001
2	1	1	0.542	0.544	— 0.002
3	1	1	0.551	0.533	+ 0.018
4	1	1	0.543	0.530	+ 0.013
5	1	1	0.543	0.541	+ 0.002
6	1	1	0.546	0.542	+ 0.004
7	1	1	0.552	0.542	+ 0.010
8	1	1	0.549	0.536	+ 0.013
9	1	1	0.542	0.534	+ 0.008
10	1	1	0.547	0.543	+ 0.004
11	1	1	0.542	0.535	+ 0.007
J. H.	1	1	0.560	0.546	+ 0.014
G. T.	1	1	0.549	0.541	+ 0.008
A. D.	1	1	0.550	0.548	+ 0.002
O. R.	1	1	0.540	0.540	± 0.000
HERDS.					
Y	1	1	0.553	0.540	+ 0.013
F	1	4	0.560	0.539	+ 0.021
J. H.	1	1	0.549	0.541	+ 0.008
G. T.	1	1	0.553	0.553	± 0.000
A. D.	1	1	0.540	0.540	± 0.000
O. R.	1	1	0.533	0.533	± 0.000

VARIATION IN FREEZING POINT DEPRESSIONS OBSERVED IN MILK FROM THE SAME INDIVIDUAL COW OR THE SAME HERD AT DIFFERENT INTERVALS.

In a few instances a sufficient number of samples have been taken from the same cow or herd to indicate what the variation in freezing point depression may be from day to day. While the data are not extensive enough to be conclusive they indicate that the

variation between the morning and evening milk is greater than the variation between morning samples or evening samples from day to day.

The following summary illustrates this point:

TABLE VII-VIII, B. VARIATION IN FREEZING POINT DEPRESSIONS OF MILK FROM THE SAME COW OR HERD.

Herd and Cow No.	No. of Samples. A. M.	No. of Samples. P. M.	Freezing Point Variation A. M. —o°C.	Freezing Point Variation P. M. —o°C.	Extreme Range A. M. and P. M. —o°C.
			INDIVIDUAL COWS.		
Y 1	5	2	0.007	0.006	0.029
2	3	2	0.018	0.005	0.018
3	2	2	0.006	0.003	0.016
4	2	3	0.002	0.008	0.019
6	2	2	0.000	0.011	.....
7	1	2	.....	0.007	.....
8	1	2	.....	0.011	.....
9	1	2	.....	0.008	.....
15	1	3	.....	0.013	0.029
			HERDS.		
F	1	4	.....	0.005	0.025

THE RANGE IN FREEZING POINT DEPRESSIONS OBSERVED IN MILK FROM NORMAL COWS.

Hortvet has reported[1] summaries covering his experience with reference to the range in freezing point depressions for milk from 60 normal individual cows and from 15 normal herds. It is of interest and, indeed the chief purpose of this study, to compare his data with that obtained from the wider observations of the several collaborators this year, and our combined experience is shown in condensed form in the following summary, Table VII-VIII, C.

From this condensed summary it appears that the tentative limits suggested by Hortvet are not substantially changed by the further observations made in collaborative study. For individual cows the minimum depression of -0.530° and maximum depression -0.566° are recorded as compared with -0.534° and -0.562° reported a year ago. For herd milk the new high figure of -0.530° has been found but no new low figure established. The average for individual cows as reported last year (-0.547°), remains practically unchanged, -0.545°, while the average for herd milk is raised from -0.551° to -0.544°. The minimum depression observed for normal individual cows is -0.530° and the same figure obtains also for herd milk.

[1] Report of Minnesota State Dairy and Food Commissioner, 1920, p. 111.

TABLE VII-VIII, C. RANGE IN FREEZING POINT DEPRESSIONS IN NORMAL MILK.

	Sp. Gr.	Fat. %	S-N-F. %	Freezing Point —o°C.
		INDIVIDUAL COWS.		
State Dairy and Food Dept., St. Paul, Minn.—1919-1920 (60 samples).				
Maximum	1.0350	7.30	10.15	0.562
Minimum	1.0262	2.20	7.37	0.534
Average	1.0319	3.94	8.90	0.547
			—*1921 (17 samples).*	
Maximum	1.0330	4.9	9.25	0.560
Minimum	1.0281	2.4	8.02	0.540
Average	1.0311	3.4	8.67	0.547
Libby, McNeill and Libby.—1921 (27 samples).				
Maximum	1.0380	6.3	10.26	0.563
Minimum	1.0256	0.9	7.20	0.532
Average	1.0313	3.9	6.2	0.546
Agricultural Experiment Station, New Haven, Conn.—1921 (75 samples).				
Maximum	1.0343	6.8	9.63	0.566
Minimum	1.0271	2.7	8.17	0.530
Average	1.0313	4.0	8.64	0.543
		HERDS.		
State Dairy and Food Dept., St. Paul, Minn.—1919-1920 (15 samples).				
Maximum	1.0330	5.50	9.27	0.562
Minimum	1.0305	3.10	8.48	0.545
Average	1.0319	4.15	8.95	0.551
Libby, McNeill and Libby—1921 (37 samples).				
Maximum	1.0336	5.4	9.30	0.553
Minimum	1.0285	2.7	7.98	0.530
Average	1.0312	3.7	8.45	0.542
Agricultural Experiment Station, New Haven, Conn.—1921 (9 samples).				
Maximum	1.0317	4.1	8.77	0.560
Minimum	1.0305	3.3	8.38	0.535
Average	1.0311	3.6	8.50	0.544
Combined results of all collaborators.				
		INDIVIDUAL COWS (179 SAMPLES)		
Maximum	1.0380	7.3	10.26	0.566
Minimum	1.0256	0.9	7.20	0.530
Average	1.0315	3.8	8.71	0.545
		HERDS (61 SAMPLES).		
Maximum	1.0336	5.5	9.30	0.562
Minimum	1.0285	2.7	7.98	0.530
Average	1.0313	3.8	8.58	0.544

TABLE IX. ANALYSES AND FREEZING POINT DEPRESSIONS OF AUTHENTIC MILK.
Healthy Cows Under Abnormal Conditions of Daily Routine or Environment.

Herd	Date of milking, 1921	Description	Sp. Gr. 15.6° C.	Fat %	S-N-F. %	Lactose %	Ash %	Acidity %	Freezing Point —0° C.	
		(Collaborator, Libby, McNeill & Libby)								
		INDIVIDUAL COWS.								
A. M. 2A.	8/30 P.M.	Pure Jersey, driven 4 blocks to Fair, milking delayed 1 hour	1.0327	7.6	9.69	4.29	0.817	(1)	0.563	0.563
2B.	9/14 P.M.	Same cow, normal conditions	1.0398	7.0	11.34	1.80	0.874	0.160	0.562	0.563
H. T. 4A.	8/30 P.M.	Pure Holstein, driven 6 miles to Fair, milking delayed 3½ hours	1.0294	4.1	8.18	4.52	0.666	(1)	0.547	0.546
4B.	9/14 P.M.	Same cow, normal conditions	1.0306	3.3	8.30	4.64	0.639	0.145	0.532	0.531
H. A. 5A.	8/31 P.M.	Pure Holstein, milking delayed 10½ hours	1.0322	3.9	8.84	4.00	0.815	(1)	0.578	0.577
5B.	9/14 P.M.	Same cow, normal conditions	1.0310	3.6	8.47	3.71	0.799	0.147	0.551	0.551
H. A. 6A.	8/31 P.M.	Pure Holstein, milking delayed 10½ hours	1.0358	5.5	10.05	4.25	0.808	(1)	0.563	0.562
6B.	9/14 P.M.	Same cow, normal conditions	1.0380	3.8	10.26	3.65	0.805	0.155	0.566	0.566
J. F. 7A.	8/31 P.M.	Pure Holstein, milking delayed 9½ hours	1.0270	3.8	7.51	3.67	0.732	(1)	0.537	0.537
7B.	9/14 P.M.	Same cow, normal conditions	1.0300	3.3	8.15	4.39	0.660	0.140	0.533	0.533
		HERDS.								
F. M. 1A.	8/30 P.M.	Three pure Holsteins, driven 6 miles to Fair arriving 7.30 A.M. Sample taken from evening milk	1.0318	5.48	9.95	4.59	0.762	(1)	0.571	0.571
1B.	9/14 P.M.	Same herd, normal conditions	1.0336	3.40	9.08	4.53	0.693	0.145	0.550	0.550
J. F. 3A.	8/30 P.M.	Two pure Holsteins, driven 5 miles to Fair arriving 7.30 A.M. Sample taken from evening milk	1.0316	3.3	8.55	4.59	0.700	(1)	0.561	0.560
3B.	9/14 P.M.	Same herd, normal conditions	1.0300	2.7	8.05	4.39	0.676	0.145	0.535	0.535

[1] Freezing point observed same evening that samples were taken.

III. FREEZING POINT DEPRESSIONS OF AUTHENTIC MILK FROM HEALTHY COWS UNDER ABNORMAL CONDITIONS OF DAILY ROUTINE OR ENVIRONMENT.

An interesting group of data was submitted by one of the collaborators showing the effect upon the freezing point of milk when the animals had been subjected to slight exercise, severe exercise or strain, or to delayed milkings.

The data appear in Table IX.

Apparently long delayed milking may or may not influence the freezing point depression. Of three cases where milkings were delayed from 9½ to 10½ hours, in one there was a conspicuous increase in depression but in the other two the changes were very slight, one of them being a decreased depression. There appears to be no evidence that moderately delayed milking e.g., 1 to 3 hours, produces any effect upon the freezing point.

Moderate exercise, such as a walk of four blocks, was without effect. In cases of severe exercise, strain or fatigue, such as walks of 5 or 6 miles, the freezing point was very materially lowered both for individuals and herds, the variations from normal being from 0.015° to 0.026°. The comparisons between the normal and abnormal are true since the observations were made on the evening milk in both cases. In point of magnitude certain of these abnormal figures e.g., -0.571 and -0.578, are at first glance suggestively coincident with the extremely low depressions observed in a number of morning samples discussed elsewhere in this report, but they offer no valid explanation of them first, because a delay of 10½ hours in milking does not occur in ordinary practice and second, morning milk is drawn after a period of rest.

IV. FREEZING POINT DEPRESSIONS OF AUTHENTIC MILK FROM COWS WHICH ARE DISEASED OR OTHERWISE ABNORMAL PHYSICALLY.

The observation that cows which to all outward appearances are sound and healthy may yet prove to be tubercular as judged by the tuberculin test is not uncommon. This suggested the desirability of studying the freezing point depressions of milk obtained from tubercular reactors and animals otherwise physically abnormal, and the data obtained in this investigation are given in Table X. Over 80% of the results reported by collaborators were within the limits observed for normal individuals and herds, but in 5 cases out of 33 unusually high freezing points were obtained which ranged from -0.520° to -0.523°. The evidence in 3 of these 5 cases is, however, somewhat contradictory for the reason that samples drawn from the same cows after an interval of 2 months gave

TABLE X. ANALYSES AND FREEZING POINT DEPRESSIONS OF AUTHENTIC MILK.
Cows Diseased or Otherwise Abnormal Physically.

Herd or No.	Date of milking, 1921	Description	Sp. Gr. 15.6° C.	Fat %	S-N-F. %	Lactose %	Ash %	Acidity %	Freezing Point —0° C.	
		(Collaborator, Libby, McNeill & Libby)								
		INDIVIDUAL COWS.								
2	9/18 P.M.	Pure Holstein, tubercular reactor	1.0263	4.0	7.38	3.10	0.763	0.137	0.550	0.549
3	9/19 A.M.	Grade Holstein, tubercular reactor, not milked evening of previous day	1.0265	3.3	7.28	2.41	0.790	0.100	0.555	0.556
6	9/18 P.M.	Grade Holstein, tubercular reactor	1.0298	3.4	8.13	2.41	0.731	0.130	0.560	0.560
12	9/18 P.M.	Grade Holstein, tubercular reactor	1.0286	4.5	8.05	4.04	0.698	0.170	0.544	0.543
13	9/18 P.M.	Pure Holstein, tubercular reactor	1.0280	4.6	7.92	4.17	0.661	0.155	0.550	0.550
14	9/18 P.M.	Pure Holstein, tubercular reactor	1.0240	3.2	6.64	3.12	0.697	0.090	0.536	0.535
15	9/19 A.M.	Pure Holstein, tubercular reactor	1.0364	3.7	7.34	2.80	0.782	0.100	0.551	0.549
4	9/18 P.M.	Guernsey-Holstein, tubercular reactor	1.0299	4.7	8.42	2.67	0.714	0.145	0.550	0.552
10	9/18 P.M.	Grade Guernsey, tubercular reactor	1.0270	4.6	7.67	2.96	0.767	0.136	0.542	0.543
SC	7/13 A.M.	Grade Jersey, poor physical condition	1.0286	3.6	7.91	....	.....	0.123	0.522	0.523
	7/14 A.M.	Symptoms of tuberculosis	.....	...	....	....	.....	0.132	0.523	0.523
A. M. 2B.	9/14 P.M.	Jersey, colostrum milk	1.0398	7.0	11.34	1.80	0.874	0.160	0.562	0.563
		HERDS.								
	9/18 P.M.	14 cows, mixed breeds, 8 tubercular	1.0272	4.2	7.64	3.65	0.716	0.133	0.548	0.548
		(Collaborator, Agricultural Experiment Station, New Haven, Conn.)								
P 1	5/11 P.M.	Holstein, tubercular	1.0300	3.7	8.25	....	.....	0.14	0.522	0.522
	7/6 P.M.		1.0272	4.4	7.69	....	.....	0.12	0.537	0.538
P 2	5/11 P.M.	Holstein, tubercular	1.0304	2.0	8.00	....	.....	0.14	0.519	0.520
	7/6 P.M.		1.0215	9.5	7.38	....	.....	0.13	0.534	0.535
P 3	5/11 P.M.	Holstein, tubercular	1.0287	...	....	....	.....	0.12	0.522	0.522
	7/6 P.M.		1.0286	4.0	7.96	....	.....	0.18	0.550	0.552
P 4	5/11 P.M.	Holstein, tubercular	1.0304	4.0	8.41	....	.....	0.15	0.537	0.538
	7/6 P.M.		1.1277	4.2	7.78	....	.....	0.13	0.541	0.541

TABLE X. ANALYSES AND FREEZING POINT DEPRESSIONS OF AUTHENTIC MILK.—(*Concluded*).
Cows Diseased or Otherwise Abnormal Physically.

Herd or No.	Date of milking, 1921	Description	Sp. Gr. 15.6° C.	Fat %	S-N-F. %	Lactose %	Ash %	Acidity %	Freezing Point —0° C.	
		(Collaborator, State Dairy & Food Department, St. Paul, Minn.)								
517	9/22	Heifer, 2 years old, in heat, tubercular reactor	1.0301	3.4	8.35	....	.....	.....	0.551	.....
518	9/22	Tubercular reactor, 10 years old	1.0285	2.9	7.84	....	.....	.....	0.541	.....
519	9/22	Heifer, 3 years old, tubercular reactor	1.0284	3.8	8.00	....	.....	.....	0.548	.....
520	9/22	Tubercular reactor	1.0295	3.6	8.23	....	.....	.....	0.544	.....
521	9/22	Tubercular reactor, wild cow, one eye blind	1.0328	3.6	9.05	....	.....	.....	0.547	.....
522	9/22	Tubercular reactor, produced 30 lbs. 80% butter in 7 consecutive days	1.0293	3.1	8.08	....	.....	.....	0.543	.....
523	9/22	Tubercular reactor	1.0303	4.4	8.60	....	.....	.....	0.543	.....
524	9/22	Tubercular reactor	1.0328	3.3	9.00	....	.....	.....	0.534	.....
525	9/22	Tubercular cow with infected udder	1.0254	0.5	6.59	....	.....	.....	0.586	.....
526	9/22	Tubercular reactor	1.0290	3.7	8.23	....	.....	.....	0.540	.....
513	9/17	Holstein, calved 7 days previous to sampling, infected, still discharges pus	1.0294	4.5	8.40	....	.....	.....	0.554	.....
514	9/17	Guernsey, abortion 11 days previous to sampling	1.0341	4.3	9.53	....	.....	.....	0.538	.....

freezing points within the limits for normal milk. On the basis of these data therefore it would appear that while in many cases tuberculosis and other pathological conditions may not necessarily be reflected in the freezing point depression of the milk, nevertheless, a few exceptionally high freezing points have been observed which should be borne in mind when deciding the significance of depressions less than -0.530° in the case of milk from individual cows.

It has not been possible to include in this report any adequate review of the literature dealing with the effect of pathological conditions upon the freezing points of secretions. Tieken[1] has shown comparisons between the freezing point of the blood and of various body fluids for a number of diseases in man. In the several cases of tuberculosis reported the freezing point of the blood remained normal, (-0.56° C.), with the other fluids under observation closely corresponding. When conspicuous departures from normal were observed in the blood e.g., in uremic coma, they were in the direction of *increased* depressions (-0.58° to -0.68°). Marked increase in depression in freezing point of the blood has been observed by some investigators in carcinoma, excessive amounts of protein decomposition products being regarded as the cause, but this experience has been questioned by others who found no such increase.[2] Koestler[3] has investigated the detection of milk altered by secretion disturbances and finds that pathological disturbances increase the serum nitrogen, chlorine and sodium and decrease the lactose, potassium and phosphorus. It is said that the altered milk showed normal lowering of freezing point; and that this determination is a valuable check in cases where the general analytical results indicate added water. Further examination of this and other literature on the subject must be reserved for future study.

Conclusions.

The complete data now represent the examination of 291 samples distributed as follows:

Normal individual cows	179
Normal herds	61
Diseased or otherwise abnormal:	
individual cows	37
herds	3
Unclassified, requiring further corroboration	11
Total	291

The results indicate:

[1] Wells, Chem. Pathol. p. 324.
[2] Wells, Chem. Pathol. p. 461.
[3] Chem. Abs. **15**, 10, 1581.

(1). That there is an appreciable, and may be a conspicuous, difference in freezing point depression between morning and evening milk. This morning-evening variation is greater than that observed between morning samples or evening samples from day to day.

(2). The minimum freezing point depression of -0.530° and maximum of -0.566° for milk from normal individual cows and the minimum of -0.530° and maximum of -0.562° for milk from normal herds is reasonably substantiated by the experience of all collaborators.

(3). According to the data here reported moderate exercise or moderately delayed milkings are not reflected in the freezing point depressions of the milk. Long delayed milkings, 9½ to 10½ hours, may or may not be followed by depressions varying from normal. Severe exercise, strain or fatigue are followed by materially increased depressions.

(4). The milk from tubercular cows or those otherwise in poor or abnormal physical condition has generally fallen within the limits for normal milk as regards freezing point. The few exceptions noted have been in the direction of decreased depressions.

(5). Extremely low freezing points observed in certain samples of morning milk suggest a fuller investigation of this point. The study also of the effect of pathological conditions upon the freezing point may well be continued. The effect of increased acidity upon the freezing point depression with a view to corroborating or modifying the correction factor suggested by Kiester[1] should be studied.

Market Milk.

Nine hundred and sixty-seven samples of market milk have been submitted by the Dairy and Food Commissioner classified as follows:

Not found adulterated	593	61.3%
Adulterated by dilution with water	78	8.0
Adulterated by skimming	30	3.1
Adulterated by skimming and dilution with water	1	0.1
Adulterated by reason of being:		
below standard in solids and solids-not-fat	139	14.4
below standard in solids and fat	21	2.2
below standard in solids, fat and solids-not-fat	105	10.9
Total	967	100.0

There is reason to believe that the general quality of market milk available in this state is better than the data just given would indicate since, as we have stated in previous reports on this subject, the majority of samples received by us are submitted upon the suspicion of inferiority or adulteration. Many samples are tested

[1] Jour. Ind. Eng. Chem., **9**, p. 862.

TABLE XI. ADULTERATED MILK.

No.	Dealer	Solids	Fat
	Containing Added Water.		
	AVON.		
21102	Wm. Thompson & T. B. Edgerly	10.93	3.8
21103	Wm. Thompson & T. B. Edgerly	7.98	2.8
	BARKHAMSTED.		
20719	Ralph Bradley	10.81	3.3
20713	Chas. H. Segeyt	11.55	3.7
20720	John J. Wright	9.88	2.9
	BECKLEY.		
19156	Thomas Boncek	4.19	1.1
19157	Thomas Bodcek	5.17	0.7
19159	Alex. Kokoski	7.56	2.8
	BERLIN.		
19160	James Balfye	10.90	3.5
17389	Alexander Bruce	11.35	3.7
17390	Alexander Bruce	9.99	3.1
17391	Alexander Bruce	10.41	3.2
	BETHANY.		
20532	Kasloski & Nero	10.64	3.6
	BETHEL.		
19388	E. H. Converse	10.94	3.7
	BLOOMFIELD.		
20916	T. Ballai	10.63	3.2
20393	Thomas Seathem	11.48	4.2
20394	Thomas Seathem	11.16	3.9
	BRANFORD.		
21320	Nick. Dubiago	10.86	3.7
19594	Angello Mongello	11.15	3.5
	BRIDGEPORT.		
20442	Beebe Dairy	9.51	2.9
20523	Beebe Dairy	10.38	2.9
	BRISTOL.		
20801	A. Alklis	10.73	3.3
	CANTON.		
20943	M. Basha	10.89	3.5
18328	Mike Mishi	11.89	4.1
	Containing Added Water —continued		
	COLLINSVILLE.		
20939	W. J. Humphrey	10.97	3.5
	DANBURY.		
19378	Geo. Waltz	9.76	2.3
19379	Geo. Waltz	10.47	3.1
	FORESTVILLE.		
21105	Weintz Zwarville	10.95	3.4
	GUILFORD.		
19558	Wm. Hinnes	10.30	3.0
19555	C. Woruncke	11.20	3.6
19556	C. Woruncke	12.19	4.9
	HAWLEYVILLE.		
19368	S. Bonderank	8.62	2.7
19369	S. Bonderank	9.12	2.5
18543	John Oshavett	10.12	3.1
	KENSINGTON.		
20747	Walter Rudnick	10.42	3.4
	MERIDEN.		
21006	Belmont Lunch, T. Chamis	9.69	2.7
17382	D. Marcellino	10.86	3.2
17395	D. Marcellino	10.58	3.3
	MILFORD.		
19410	Chris. Anderson	9.79	2.6
19411	Chris. Anderson	9.93	2.8
	NEW MILFORD.		
19331	John Anderson	10.46	3.3
19308	J. Prucknik	10.73	3.3
	NORWALK.		
18537	Peter O'Haro	11.63	4.1
18353	M. Roberts	8.18	2.9
18354	M. Roberts	8.15	2.6
	NORWICH.		
21190	George Anderson	10.92	3.6
	RIDGEFIELD.		
18563	Jacob Baker	12.29	4.4

TABLE XI. ADULTERATED MILK—(*Continued*).

No.	Dealer	Solids	Fat
	Containing Added Water —continued		
	ROCKY HILL.		
20362	J. Anulewicz	10.34	3.1
20363	J. Anulewicz	11.35	3.6
20364	J. Anulewicz	10.90	3.2
20365	J. Anulewicz	11.04	3.6
20366	J. Anulewicz	10.82	3.5
20367	J. Anulewicz	11.14	3.6
20374	Toney Russell	10.97	3.5
	SHELTON.		
20426	Joseph Carson	10.83	3.3
20427	Joseph Carson	11.09	3.5
20428	James Facendo	11.07	3.4
	STEPNEY DEPOT.		
19415	Mnozinski	11.04	3.7
19416	Mnozinski	10.38	3.3
19417	Mnozinski	10.07	3.2
	UNIONVILLE.		
21101	Edward Sailing	11.20	3.6
	WATERBURY.		
20805	Exchange Lunch	10.91	3.3
20807	Puritan Ice Cream Parlor	10.24	2.7
	WATERFORD.		
19265	Joe Verito	10.46	3.2
	WETHERSFIELD.		
20378	Gerrent Bros.	11.11	3.4
20395	H. W. Wells	10.08	3.4
20396	H. W. Wells	10.85	3.5
20397	H. W. Wells	10.10	3.0
20398	H. W. Wells	9.62	3.0
	WEST HARTFORD.		
18304	A. J. Back	11.71	4.0
18305	A. J. Back	10.62	3.0
18306	A. J. Back	10.32	3.2
18307	A. J. Back	11.11	3.5
20985	C. F. Crosson	6.72	1.6
	WILLIMANTIC.		
21017	Walo Andryshawki	11.32	3.7
	WOODBRIDGE.		
20534	I. Setlow	10.27	2.5
20538	I. Setlow	10.15	2.5
	Containing Added Water —concluded		
	WOODBURY.		
20353	F. H. Shaw	10.78	3.4
20356	F. H. Shaw	10.59	3.2
	Skimmed Milk.		
	BRIDGEPORT.		
20436	Beebe Dairy	10.91	2.0
	BRISTOL.		
21104	Presto Lunch, Peter Blanos	11.19	2.4
	DANIELSON.		
21150	Harry Evergates	10.99	2.6
21088	J. W. Gallup	11.47	2.8
	EAST GRANBY.		
20902	M. C. Griffin	11.14	2.6
20903	M. C. Griffin	11.16	2.6
	GOSHEN.		
19080	S. Oviatt	11.34	2.7
	HARTFORD.		
20687	Vermont Lunch	10.50	2.0
	KENSINGTON.		
20743	Louis Prey	12.04	2.9
	MERIDEN.		
21003	Jack Barkowitz	11.31	2.5
21005	Frank E. Packard	10.82	2.2
	NEW BRITAIN.		
20731	James Chimoridis	9.90	1.6
20735	Hudson Lunch	12.04	2.9
20739	Welgner Bros., Hotel Beloin	11.01	2.4
	NEW LONDON.		
18825	Far East Lunch	11.07	2.4
	ROCKY HILL.		
20373	Toney Russell	10.71	2.3
20360	Fred Suppe	10.97	2.6
	STAFFORD SPRINGS.		
21275	Rand Bros.	11.26	2.5
	SUFFIELD.		
20961	A. G. Bissell	11.34	2.5

TABLE XI. ADULTERATED MILK—(*Concluded*).

No.	Dealer	Solids	Fat	No.	Dealer	Solids	Fat
	Skimmed Milk—continued				*Skimmed Milk—concluded*		
	THOMPSONVILLE.				WINDSOR LOCKS.		
20975	Geo. Thomas	10.89	2.3	20956	Gregory Apostol	10.99	2.3
20969	Peter Tenerowicz	10.59	2.2	21125	Bridgeview Rest., Thos. Zaccheo	12.10	3.1
	WATERFORD.						
19277	John W. Worral	10.95	1.9		WOODBURY.		
	WEST HARTFORD.			18585	Joe Baltz	12.32	2.7
20989	E. W. Downs	10.39	1.3	21010	Unknown	11.25	2.6
20996	W. E. Johnson	11.19	2.4				
20990	R. B. White	10.90	2.2		*Watered and Skimmed.*		
	WINDSOR.				SHELTON.		
20979	I. W. Hemphill	11.28	2.1	20544	Alex. Emory	9.54	2.1

by inspectors attached to the Dairy and Food Commissioner's Department who have qualified for licenses to test milk and cream. In this way we are often saved the necessity of testing milk of good quality.

Samples found adulterated by reason of watering or skimming or both are summarized in Table XI.

Ninety-eight samples have been submitted by purchasers or producers of which number three were found to be watered.

CREAM.

Twenty-two samples of cream have been examined for purchasers or producers and four to check candidates for tester's license.

CONDENSED MILK AND OTHER MILK PRODUCTS.

Eight samples of various milk products have been examined.

Three samples of condensed milk were found to be of average composition and require no comment.

Two samples of condensed skimmed milk D. C. Nos. **20160** and **20204** were mouldy and unfit for food.

A sample of malted milk, **15976**, submitted by Crary Brokerage Co., Waukesha, Wis. was examined as follows:

Moisture 1.90 per cent.; ash 3.78 per cent.; nitrogen 1.42 per cent.; fat 7.60 per cent.; acidity as lactic acid 0.86 per cent.

A sample of milk powder, **16272**, contained moisture 4.34 per cent. and fat 3.45 per cent.

Protein milk, **17957**, and Modified Buttermilk, **17958**, both made by the Beebe Laboratories Inc., St. Paul, Minn. were examined as follows:

No.	17957	17958
Water	86.39%	90.02%
Ash	0.99	0.93
Protein (N x 6.38)	6.20	3.40
Fat	2.78	0.43
Carbohydrates (by diff.)	2.92	4.62[1]
Acidity, calc. as lactic acid	0.72	0.60

[1] Starch conversion products present.

Protein Milk, **17957**, is stated to be prepared by the formula of Finkelstein and Meyer and to be relatively low in carbohydrate and mineral matter and comparatively high in protein. It is directed to make the contents of the can, 20 ozs., up to 1 quart, hence the composition of the diluted material will be approximately, solids 8.5 per cent., protein 3.9 per cent., fat 1.7 per cent., carbohydrate 1.8 per cent., ash 0.6 per cent. and lactic acid 0.5 per cent. This shows rather more protein and less fat than the diluted material is stated to contain but agrees with the statement as regards lactic acid and carbohydrates. As compared with average whole milk the product is higher in protein and much lower in sugar, as claimed. Mineral matter (ash), is higher than in average whole milk.

Modified Buttermilk, **17958**, is stated to be freshly prepared buttermilk combined with carbohydrates consisting of starch and resultant dextrins. This preparation as well as Protein Milk are intended for infant and invalid feeding and both the quantity to be fed and the frequency of feeding are left to the discretion of the physician.

HUMAN MILK.

Thirty samples of human milk have been examined for physicians or for the Visiting Nurse Association. Nurses should bear in mind the necessity of obtaining a representative sample for examination because the fractional parts of the secretion vary in composition. The variation is chiefly with respect to fat so that no adequate idea of the "richness" of breast milk will be obtained unless the entire supply is drawn and well mixed.[1]

The composition of milk varies with the species, with individuals of the same species and with the same individual under varied conditions. The average composition of cow's milk can be stated with rather more accuracy than that of human milk on account of the difficulties, in many cases, of obtaining adequate and repre-

[1] Conn. Exp. Sta. Bull. 227, p. 255.

sentative samples of the last named. Authorities will differ as to the exact figures which should be chosen to represent the average composition of the milk of these two species but the following comparison may be taken as illustrating their essential differences.

TABLE XII. AVERAGE COMPOSITION OF COW'S MILK AND HUMAN MILK.

	No. of analyses	Water	Solids	Protein	Fat	Sugar	Ash
		%	%	%	%	%	%
Cow's milk[1]	...	87.4	12.6	3.8	3.6	4.5	0.7
Human milk	200[2]	87.4	12.6	2.3	3.8	6.2	0.3
	94[3]	88.2	11.8	1.5	3.3	6.8	0.2

[1] As stated by S. M. Babcock.
[2] From König's Chemie der mens. Nahr. u. Genuss., Leach 2d Ed., p. 127.
[3] From Richmond, Dairy Chem., London, Leach 4th Ed., p. 113.

It is evident that cow's milk contains more tissue building material, protein and mineral matter, than human milk which is in harmony with the peculiar needs of the first named species, the young of which are born in a relatively more advanced stage of development than is the human being.

Analyses of the samples submitted during the past year are given in Table XIII.

OYSTERS.

Three samples were examined for the Dairy and Food Commissioner. Two of these, **18545** and **18546**, were taken from the Thomas Oyster Co. and one, **18547**, from the J. P. McNeil Estate, both of New Haven. Sample **18545** had been aerated by means of a mechanical blower, evidently in water of less salt content than that of the original oyster liquor. Samples **18546** and **18547** were shucked oysters not so treated. It is illegal in this state to "sell oysters or other shell-fish which have been subjected to 'floating' or 'drinking' in brackish water, or water containing less salt than that in which they are grown."[1]

Analyses are given in Table XIV.

Solids, ash and salt in the drained oysters are distinctly less in **18545** than in the others and the salt content of the liquor is only a small fraction of that found in the original liquor.

TEA.

DETERMINATION OF CAFFEINE.

According to the plan indicated in our report[2] last year a method for the determination of caffeine in tea, which was devised in this

[1] Conn. Regulation 14.
[2] Conn. Exp. Sta. Bull. 227, p. 256.

TABLE XIII. ANALYSES OF HUMAN MILK.

No.	Solids %	Protein %	Fat %	Sugar %	Ash %
15843	10.50	1.37	1.20	7.69	0.24
15872	12.76	1.28	3.40	7.84	0.24
15937	.....	....	3.00	....	....
16301	.....	1.46	1.50	....	....
16304	.....	1.40	3.60	....	....
16379	.....	1.50	2.20	....	....
16807	.....	....	2.80	....	....
16854	9.48	....	1.00	....	0.17
16876	.....	1.21	2.60	....	....
16916	14.17	1.60	5.50	6.83	0.24
16917	.....	1.72	4.60	....	....
16990	.....	1.28	3.40	....	....
17038	14.10	1.28	6.20	6.38	0.24
17039	15.14	1.28	7.40	6.31	0.15
17055	10.43	1.08	2.60	6.61	0.14
17093	.....	1.28	3.40	....	....
17124	9.60	1.25	1.20	6.95	0.20
17514	11.36	0.92	2.80	7.64	0.15
17542	12.60	1.31	3.80	7.28	0.21
17607	12.28	1.32	3.20	7.54	0.22
17614	11.91	1.03	3.40	7.26	0.22
17623	15.60	1.33	5.30	....	....
17644	13.42	....	4.20	8.97[1]	0.25
17627	13.95	....	4.80	8.82[1]	0.33
17650	11.71	1.34	2.20	7.95	0.22
17732	12.15	1.46	5.00	5.43	0.26
17758	11.45	1.79	2.20	7.19	0.27
17767	11.95	....	2.66	9.16[1]	0.13
17920	.....	1.27	3.80	....	....
17922	11.06	1.28	2.20	7.31	0.27

[1] Protein included.

TABLE XIV. ANALYSES OF OYSTERS.

D. C. No.	18545	18546	18547
Net weight of sample, grams	463.8	474.4	478.0
Weight of liquor, grams	34.7	128.7	110.5
Weight of drained oysters, grams	429.1	345.7	367.5
Loss on boiling drained oysters, per cent	49.79	40.93	43.30
Solids in drained oysters, per cent	16.10	22.13	20.65
Ash in drained oysters, per cent	1.06	2.41	2.24
Solids in liquor, per cent	4.15	5.22	5.16
Ash in liquor, per cent	0.60	2.48	2.32
Salt (NaCl) in oysters, per cent	0.05	0.68	0.73
Salt (NaCl) in liquor, per cent	0.24	1.92	1.81

laboratory, has been studied collaboratively and the results have been summarized elsewhere by Mr. Andrew.[1] An abstract of his report is given here.

[1] Report of R. E. Andrew, Referee on Tea, Assoc. Official Agricultural Chemists, Washington, Oct., 1921.

COLLABORATION.

Samples were sent to ten different chemists who expressed their willingness to coöperate. Reports were received from Mr. Henry Lepper, Bureau of Chemistry; Mr. W. S. Hubbard, who reported analyses by Mr. Charles A. Herrmann, Bureau of Chemistry, New York Station; Dr. I. K. Phelps, Food Control Laboratory, Bureau of Chemistry, who reported analyses by Miss Dorothy B. Scott, Miss Lillian Offutt and Mr. J. I. Palmore; Mr. L. E. Walter, Laramie, Wyoming, who reported results obtained by Mr. Harold R. Baker, Asst. State Chemist.

INSTRUCTIONS TO COLLABORATORS.

Three samples were used, viz., I Green Tea, II Black Tea, III Mixture of Green and Black Teas. Each sample was finely ground and well mixed. Sub-samples were sent to each collaborator with the following instructions:

Determine caffeine in each of the samples by the following methods:—

MODIFIED STAHLSCHMIDT METHOD.

Weigh 3.125 grams of the finely powdered sample into a 500 cc. flask, add 225 cc. of water (this volume will be reduced to about 200 cc. by boiling), attach a reflux condenser and boil for 2 hours. Add 2 grams of dry basic lead acetate and boil 10 minutes. Cool, transfer to a 250 cc. graduated flask, fill to the mark, filter through a dry filter, measure 200 cc. of the filtrate into a 250 cc. graduated flask and pass hydrogen sulphid through to remove the excess of lead. Make the solution up to the mark and filter through a dry filter. Measure 200 cc. of this filtrate into an evaporating dish and concentrate to about 40 cc. Wash the concentrated solution with as little water as possible into a small separatory funnel and shake out six times with chloroform, using 25, 20, 15, 10, 10, 10 cc., respectively, combining the several extracts in a second separatory funnel. Treat the combined extracts with 5 cc. of 1 per cent. potassium hydroxide, allow the liquids to separate and draw off the chloroform. Wash the aqueous solution in the separatory with chloroform, in two portions of 10 cc. each adding these washings to the main extract. Distill off most of the solvent, transfer to a small tared flask, evaporate, dry at 100° C. and weigh. Test the purity of the residue by determining nitrogen therein and calculate caffeine by the factor 3.464.

POWER-CHESNUT METHOD.

Extract 10 grams of material for 8 hours in a Soxhlet apparatus with hot 95 per cent. alcohol. Add the alcoholic extract to a suspension of 10 grams of heavy magnesium oxide in 100 cc. of water, rinse the flask with a little hot water and add rinsings to the mixture. Allow the mixture to evaporate slowly on a boiling water bath, with frequent stirring, until the alcohol is removed and a nearly dry, powdery mass is obtained. Transfer the mass to a smooth filter by means of a sufficient amount of hot water, cleaning the container thoroughly. Wash the material on the filter with

successive portions of hot water until the filtrate measures 250 cc. Add 10 cc. of 10 per cent. sulphuric acid to the filtrate contained in a flask of suitable size, place a funnel in the neck of the flask, boil cautiously until danger of frothing is passed and continue active boiling for one half hour. Allow the solution to cool and filter into a separatory funnel through a double moistened filter and wash the flask and filter with small portions of 0.5 per cent. sulphuric acid. Shake the clear acid filtrate with 6 successive 25 cc. portions of chloroform, collecting the several extracts in a second separatory funnel. Treat the combined chloroform extracts with 5 cc. of 1 per cent. solution of potassium hydroxide and allow the chloroform to completely subside. Draw off the chloroform into a suitable flask, filtering through a dry paper or pledget of cotton inserted in the stem of the separatory funnel. Wash the alkaline liquid remaining in the separatory with two portions of chloroform, also washing the filter if used, and unite the washings with the main bulk of chloroform solution. Distill the solvent to small volume, transfer to a tared beaker, evaporate to dryness, further dry for one hour at 100° C., cool and weigh.

To test the purity of the residue determine nitrogen therein and calculate caffeine by the factor 3.464.

PROPOSED METHOD.

To 5 grams of material in a 500 cc. graduated flask add 10 grams of heavy magnesium oxide and 200 cc. of distilled water. Boil gently over a low flame for two hours using a small bore glass tube 30 inches long as a condenser. Cool, dilute to volume and filter through a dry paper. Take an aliquot of 300 cc., equivalent to 3 grams of original material, in an Erlenmeyer flask of 1000 cc. capacity, add 10 cc. of 10 per cent. solution of sulphuric acid and boil until the volume is reduced to about 100 cc. Filter into a separatory funnel, washing the flask with small portions of 1 per cent. sulphuric acid and shake out six times with chloroform using 25, 20, 15, 10, 10, 10 cc. portions. Treat the combined extracts with 5 cc. of a 1 per cent. solution of potassium hydroxide. When the liquids have completely separated draw off the chloroform layer into a suitable flask or beaker. Wash the alkaline solution in the separatory with two portions of chloroform of 10 cc. each and unite the washings with the main bulk, transfer to a tared flask, evaporate to dryness and further dry in a water oven at 100° C. to constant weight.

If desired, transfer the residue thus obtained to a digestion flask with successive small portions of sulphuric acid and determine nitrogen by the Kjeldahl method. Calculate caffeine from nitrogen by the factor 3.464.

NOTES ON METHODS.

Results for caffeine *by weight* and *from nitrogen* are desired.

In the Power-Chesnut method extraction should be continued until the extract is colorless. The heavy magnesium oxide used should meet the United States Pharmacopoeia requirements.

Evaporation of the last portion of solvent from the caffeine should be done carefully to prevent loss by spattering.

If the results by all methods outlined cannot be obtained those by the Modified Stahlschmidt and proposed methods are particularly desired.

RESULTS OF COLLABORATIVE WORK.

The results obtained by the various collaborators are given in Table XV.

TABLE XV. CAFFEINE IN TEA.

Sample I.

Analyst	Modified Stahlschmidt Method. Caffeine by weight.	from N.	Power-Chesnut Method. Caffeine by weight.	from N.	Proposed Method. Caffeine by weight.	from N.
Henry A. Lepper,	1.97	1.97	2.09	1.98	2.10	1.92
Bureau of Chemistry	....	....	2.05	1.99	2.11	1.92
Dorothy Scott,						
Food Control Laboratory,	2.30	1.60	2.09	1.93	2.38	2.05
Bureau of Chemistry.	2.02	1.65	1.85R	1.79	2.14	1.96
Lillian Offutt,						
Food Control Laboratory,	2.10	1.63	2.36	2.09	2.08	1.65
Bureau of Chemistry.	2.00	1.55	2.34K	2.15	2.00	1.85
J. I. Palmore,						
Food Control Laboratory,	2.33	1.94	2.15	....	2.20	2.02
Bureau of Chemistry.	2.19	1.81	2.16S	....	2.29	2.02
Harold R. Baker,	2.63	1.73	....	....	1.96	1.63
Asst. State Chemist,	2.32	1.73	....	....	2.15	1.68
Laramie, Wyoming.	2.17	1.82	....	....	2.33	1.73
Charles A. Herrmann, Bureau of Chemistry, New York Station.	2.23	2.25	....	....	2.34	2.25
R. E. Andrew,	2.18	2.08	2.33	2.25	2.20	2.16
Agricultural Exp. Station,	2.19	2.08	2.34	2.26	2.25	2.17
New Haven, Conn.	....	....	....	....	2.20	2.15
	....	....	....	....	2.20	2.15

Sample II.

Henry A. Lepper,	2.25	2.16	2.15	2.06	2.29	2.10
Bureau of Chemistry.	....	....	2.24	2.17	2.31	2.16
Dorothy Scott,						
Food Control Laboratory,	2.17	1.65	2.49R	2.32	2.35	2.14
Bureau of Chemistry.	2.03	1.75	....	....	2.19	2.15
Lillian Offutt,						
Food Control Laboratory,	2.16	1.75	2.55	....	....	....
Bureau of Chemistry.	2.10	1.58	2.37K	2.21	2.20	2.13
J. I. Palmore,	2.56	1.99	2.32	2.20	2.37	2.22
Food Control Laboratory,	2.39	2.02	2.33S	2.21	2.28	2.12
Bureau of Chemistry.	....	....	2.38	2.21	2.22	2.05
	....	....	2.35R	2.20	2.50	2.23
Harold R. Baker,	2.28	1.78	....	....	2.36	1.97
Asst. State Chemist,	2.29	1.68	....	....	2.39	....
Laramie, Wyoming.	2.28	1.92	....	....	2.40	1.97
R. E. Andrew,	2.28	2.25	2.52	2.42	2.38	....
Agricultural Exp. Station,	2.29	2.22	2.46	2.37	2.40	2.30
New Haven, Conn.	....	....	....	....	2.39	2.33
	....	....	....	....	2.40	2.33

TABLE XV. CAFFEINE IN TEA.--(*Concluded*).

Sample III.

Analyst	Modified Stahlschmidt Method. Caffeine by weight.	from N.	Power-Chesnut Method. Caffeine by weight.	from N.	Proposed Method. Caffeine by weight.	from N.
Charles A. Herrmann, Bureau of Chemistry, New York Station.	2.45	2.42	....	....	2.56	2.54
R. E. Andrew,						
Agricultural Exp. Station,	2.43	2.37	2.49	2.44	2.53	2.51
New Haven, Conn.	2.43	2.39	2.39	2.32	2.53	2.52

K Modified Knorr Extractor used.
R Rask Extractor used.
S Soxhlet Extractor used.

DISCUSSION OF RESULTS.

The experience with these three methods was summarized by the referee[1] last year as follows:

"The results obtained by the proposed method are in close agreement with those obtained by the other two methods and the caffeine residues are of an equal degree of purity. The time required is very much less than in either of the other procedures." The average difference between results for caffeine by weight and from nitrogen was considerably under 0.1 per cent. and practically the same in all methods.

The results this year show satisfactory agreement as regards results for caffeine by weight but too wide discrepancies between these figures and the corresponding results estimated from nitrogen. The trouble quite evidently lies in the determination of caffeine nitrogen, but why this should be at all troublesome, or why it should be more so in case of the Stahlschmidt method than in the other methods, is difficult to understand. An allowance of 0.1 per cent. for experimental error in determining nitrogen (equivalent to 0.35 per cent. caffeine), is a very liberal tolerance and about twice as great as is generally necessary; nevertheless, excluding only those figures for caffeine from nitrogen which vary from caffeine by weight by more than 0.35 per cent. the averages for the three samples become as follows:

[1] Report of the Referee on Tea to the A. O. A. C., 1920.

TABLE XVI. SUMMARY OF CAFFEINE DETERMINATIONS IN TEA.

Sample No.	Modified Stahlschmidt Method.		Power-Chesnut Method.		Proposed Method.	
	Caffeine by weight.	from N.	Caffeine by weight.	from N.	Caffeine by weight	from N.
	%	%	%	%	%	%
I	2.20	2.04	2.18	2.06	2.18	2.02
II	2.26	2.10	2.38	2.24	2.34	2.19
III	2.44	2.39	2.44	2.38	2.54	2.53

In computing this summary no figures reported by the Power-Chesnut method have been excluded. Of results reported by the proposed procedure only five have been excluded. It was necessary to exclude sixteen of the 28 results reported by collaborators by the Stahlschmidt method, as it is manifestly unfair in this case to recognize results which vary from the results by weight to the extent of from 0.5 to nearly 1 per cent. since it is evident that the results by weight are in satisfactory accord with the other two methods and there are ample data to show that the method will yield a caffeine residue of equal purity. The summary given is reasonably fair to all methods although it will be noted that the Power-Chesnut method gains by the fact that reports are less complete by that method than by the other two. If all figures reported had been included in the averages reported in the summary the only conspicuous change would occur in the results for caffeine from nitrogen in samples I and II by the Stahlschmidt method.

The accumulated data of the past two years show that the proposed method compares satisfactorily with the other two methods both as regards the gross amount of caffeine obtained and the degree of purity of the caffeine residues. In the opinion of all collaborators it is simpler to manipulate, requires less time than the Stahlschmidt method, and in the opinion of some it is superior to the Power-Chesnut method. The referee, however, made the second recommendation that the Power-Chesnut method as herein described, except that in line 10 the wording be changed to read 20 cc. of 10 per cent. sulphuric acid instead of 10 cc. of 10 per cent. sulphuric acid, be made official for the determination of caffeine in tea; and made a first recommendation that the proposed method for the same determination also be made official. Both recommendations were adopted.

VINEGAR.

Thirteen samples were submitted by the Dairy and Food Commissioner, four of which failed to meet the legal requirements. Three samples, **20777, 20778** and **20778A,** were sent for examination in connection with a peculiar growth which formed on the top of pickles in which this vinegar had been used. The growth was referred to the Department of Botany of this station and found to be a dense growth of bacteria zoogloea. The infection is thought to have come from the pickles but experimental inoculations of this and other vinegars indicated that this particular vinegar offered especially favorable conditions for growth, the exact cause of which has not been determined.

Of eight samples sent by individuals three were found to be below the standard required in this state.

MISCELLANEOUS MATERIALS.

FOODS, ETC.

Twenty samples of this class have been examined for individuals and for the Dairy and Food Commissioner. They require no particular comment.

D. C. No. 20161. *Baked Beans, Diamond Brand,* were found wholesome and fit for food as far as organoleptic tests could discover.

17473. *Blackberry Preserves,* showed gas formation, had a sour taste and were judged unwholesome.

16313. *Cherries, Maraschino,* were analyzed as follows:

Solids 52.63 per cent.; invert sugar 11.48 per cent.; sucrose 38.22 per cent.; ash 0.17 per cent.; undetermined 2.67 per cent.

The liquor and drained cherries were analyzed separately and the above composite analysis calculated. The cherries were colored with a permitted dye, erythrosin, and no alcohol, saccharin, salicylic or benzoic acids or sulphites were found.

16294. *Crullers,* sugared, were analyzed as follows:

Moisture 21.80 per cent.; ash 1.42 per cent.; protein (N x 6.25) 5.88 per cent.; fat 21.23 per cent.; carbohydrates, by difference, 49.67 per cent.

16757. *Les Fruits.* This is a fruit paste to be used as a laxative food. It contained:

Moisture 31.41 per cent.; ash 3.11 per cent.; protein (N x 6.25) 3.12 per cent.; ether extract (crude fat) 2.26 per cent.; total sugars, as invert sugar 48.40 per cent.; undetermined nitrogen-free extract 6.99 per cent. Emodin-bearing drugs present.

D. C. No. 20205. *Peaches,* canned, were found to be wholesome and fit for food. Another sample **17470,** V-W Brand, was fermented and the can sprung by gas pressure.

16302. *Purslain,* canned, prepared by Mrs. John Haberle, New Haven was examined as follows:

Moisture 91.68 per cent.; ash 1.76 per cent.; protein (N x 6.25) 1.12 per cent.; fiber 1.19 per cent.; ether extract 0.35 per cent.; nitrogen-free extract, by difference 3.90 per cent.

Chemical analysis alone is not very illuminating. The product is said to possess antiscorbutic properties, which, of course, no chemical analysis can demonstrate.

Other samples include sugar, flour, canned spinach, canned peas, wine, beer, whiskey and water and require no particular comment.

Materials Examined for Poisons, etc.

Thirty-one samples were examined for poisonous, injurious or illegal substances as follows:

No. of samples.	Kind of Material.	Remarks.
1	Bread.	Moulds present.
8	Candy.	No poisons detected. Alcohol 0.4 per cent. in one sample.
1	Canning compound.	Borax present.
4	Chicks, viscera of	No poison detected.
1	Corn.	No poison detected.
1	Coffee.	No poison detected.
1	Deposit in engine.	Aluminum powder.
1	Ginger extract.	Capsicum present.
1	Goose, viscera of	Pins, nails, staple, bits of brass in gizzard.
1	Lumps in flour.	Not identified.
2	Soils.	No poison detected.
5	Stomach contents.	No poison detected.
3	Urine, for lead.	No lead detected.
1	Wine.	Traces of tin and zinc.

II. DRUGS.

PROPRIETARY REMEDIES, ETC.

Five preparations of this class have been examined.

15668. *Dr. True's Elixer,* a family laxative and worm expeller, made by Dr. J. F. True & Co., Auburn, Me. and Knowlton, Que.

Examination and analysis showed the following composition:

Alcohol 7.90 per cent. by volume; solids 45.0 grams per 100 cc.; flavor wintergreen; santonin none; spigelia indicated; emodin-bearing drugs present, aloes identified.

This is a syrup containing vegetable laxatives. A previous examination[1] of this remedy showed the presence of santonin which has apparently been replaced by spigelia.

15670. *Russell Emulsion,* made by the Standard Emulsion Co., New York. This preparation is said to be made of equal parts of

[1] Conn. Exp. Sta. Report 1914, p. 254.

beef suet, cocoanut, peanut and cottonseed oils with clove oil to flavor and less than ¾ of 1 per cent. of sodium borate as a preservative.

Examination and analysis showed the following composition:

Solids 47.45 per cent.; ash 1.74 per cent.; fats 39.11 per cent.; constants of fat, refractive index 1.4613, Riechert-Meissel No. 9.4; cottonseed oil present; boric acid 0.32 per cent.; oil of cloves present.

The declared composition is practically substantiated by the analysis. No test was made for peanut oil but cottonseed and cocoanut oils are indicated. Sodium borate is illegal when used as a preservative in foods[1] but its use in drugs is probably within the law.

15669. *Milks Emulsion,* made by the Milks Emulsion Co., Terre Haute, Ind.

Examination and analysis showed the following composition:

Solids 95-43 per cent.; fat, unsaponifiable, 94.00 per cent.; glycerin, small amount indicated; wild cherry not identified; oil of wintergreen present.

This analysis essentially confirms advertising literature which states that the product is composed of about 95 per cent. of petroleum oil with vegetable oils, glycerin and wild cherry syrup.

D. C. No. 18396. *Medicine* submitted by the Dairy and Food Commissioner. It is not sold as a proprietary remedy and there is no advertising literature available. The medicine was purchased as a cure for tuberculosis and the purchaser claims that a cure was effected. The preparation was a syrup containing alcohol, chloroform and unidentified vegetable extractives. Opium alkaloids and emodin-bearing drugs were not detected. The label bore no claim of curative properties.

D. C. No. 16330. Phosphorated Iron, distributed by the Iron Remedy Co., Fort Wayne, Ind. These were sugar-coated pills in which iron and phosphates were the only medicaments detected.

UNITED STATES PHARMACOPOEIA OR NATIONAL FORMULARY PREPARATIONS.

All samples discussed in this section were submitted by the Dairy and Food Commissioner unless otherwise stated.

Bay Rum.

Bay Rum, or Spirit of Myrcia, was formerly an official preparation of the United States Pharmacopoeia. These names are used synonymously in the 3d edition of the National Formulary but in the 4th edition the title Compound Spirit of Myrcia appears and the name Bay Rum has been dropped. The formula, however,

[1] Regulation 7.

remains substantially the same, the finished product containing about 58 per cent. of alcohol by volume. The preparation is held to be fit for beverage purposes under Federal Prohibition Regulations[1] and for this reason we find many samples marked to indicate that they have been medicated with tarter emetic or otherwise to make them non-drinkable.

Twenty-four samples were examined. The inspection was made primarily with reference to the possible presence of wood alcohol but that substance was not found in any case. A large proportion of the samples were deficient in grain alcohol, nineteen falling short of the standard or declared alcohol content by more than 10 per cent.

Tincture of Belladonna Leaves.

This preparation should contain in 100 mils not less than 0.027 gram nor more than 0.033 gram of the total alkaloids of belladonna leaves.[2]

Nine samples were examined. All were found to be of standard strength or within reasonable limits thereof.

Table XVII. Assays of Tincture of Belladonna.

D. C. No.	City or Town	Dealer	Alkaloids of belladonna, gm. per 100 cc.
19428	*Derby*	Prudy Drug Co.	0.025
20134	*Hartford*	Sisson Drug Co.	0.027
20126	*Middletown*	Hartman Drug Co.	0.029
19700	*New Britain*	L. K. Liggett Co.	0.027
20210	*New Haven*	Est. of J. A. Hodgson	0.025
19715	*Thompsonville*	Geo. R. Steele, Est	0.026
20185	*Unionville*	Paul Flynn	0.025
20170	*Waterbury*	Apothecaries Hall Co.	0.035
20111	*Willimantic*	Cartier, The Druggist	0.032

Belladonna Leaves (Powder).

Belladonna leaves should yield not less than 0.3 per cent. of total alkaloids and not over 20 per cent. of ash.[3]

One sample, **19641,** was examined which was not excessive in ash but was deficient in alkaloids, containing only 0.17 per cent. or 56.6 per cent. of the required amount.

Milk of Bismuth.

The official preparation of Bismuth Magma contains not less than 5.6 per cent. nor more than 6.2 per cent. of bismuth trioxide, Bi_2O_3.[1]

Ten samples were submitted which assayed as shown in Table XVIII.

[1] Bureau of Int. Rev., Regulations 60, p. 36.
[2] U.S.P. IX, p. 448.
[3] U.S.P. IX, p. 72.

Table XVIII. Assays of Milk of Bismuth.

D. C. No.	City or Town	Dealer or Manufacturer	Per cent. Bi_2O_3, min. required or declared	Bi_2O_3, found
20179	*Meriden*	Louis Liggett (Park Davis)	5.6	6.6
19421	*Naugatuck*	Carl G. Olson (Park Davis)	5.6	6.8
19702	*New Britain*	L. K. Liggett Co. (Park Davis)	5.6	6.8
20494	*New London*	James' Drug Store	5.6	6.4
19432	*Shelton*	E. J. Barden (Lilly)	5.6	3.7
19621	*So. Manchester*	J. H. Quinn & Co. (Lilly)	3.35	3.8
19631	*Stafford Springs*	D. H. McCormick (Park Davis)	5.6	6.9
19717	*Thompsonville*	Geo. R. Steele, Est. (Lilly)	3.35	3.8
20188	*Unionville*	Albert C. Roby (Lilly)	5.6	3.7
20106	*Willimantic*	Bay State Drug Co. (Park Davis)	5.6	6.0

The products examined are not of the druggists' own manufacture except possibly in one case, and the amount of bismuth present is somewhat in excess of the maximum amount named in the official specifications in most cases. Two of the Lilly products are stated to contain 3.35 per cent. bismuth trioxide and it is probable that the other samples of this make are intended to be of the same strength, but the samples as sold have no declaration of the fact and were therefore presumed to be of standard quality, hence arises what is probably only an apparent deficiency.

Solution of Calcium Hydroxide (Lime Water).

This preparation is a solution containing not less than 0.14 per cent. of calcium hydroxide, $Ca(OH)_2$, at 25° C.[2]

Sixty-nine samples were examined and twelve were found to be deficient by substantial amounts. Assays are given in Table XIX.

Tincture of Colchicum Seed.

One hundred mils of this tincture are required to contain not less than 0.036 gram nor more than 0.044 gram of colchicine.[3]

Two samples, **19438,** from Goulden's Pharmacy, Stamford, and **19430,** from F. G. Stanford, Shelton, contained 0.03 gram and 0.04 gram of colchicine respectively.

[1] U.S.P. IX, p. 260.
[2] U.S.P. IX, p. 239.
[3] U.S.P. IX, p. 453.

TABLE XIX. ASSAYS OF LIME WATER.

D.C.No.	City or Town	Dealer	Calcium Hydroxide per cent.
20479	*Bethel*	English's Drug Store	0.06
20218	*Branford*	Branford Pharmacy	0.13
20215		Spalding Co.	0.03
20412	*Bridgeport*	Kaesmann Drug Store	0.16
19743	*Bristol*	Madden Drug Store	0.15
19745		Rickman's Economy Drug Store	0.15
19740		Leroy P. Tucker	0.17
20323	*Central Village*	H. Elmer Lewis	0.16
20128	*Cromwell*	Geo. F. Chapin Est.	0.16
20464	*Danbury*	Burns' Drug Store	0.16
20474		Doran's Drug Store	0.16
20468		Kenner & Benjamin	0.12
20319	*Danielson*	Burrough's Drug Store	0.17
20316	*Dayville*	Wm. E. LaBelle	0.14
19734	*East Hartford*	O'Connell Drug Co.	0.17
20483	*Fairfield*	The Boyle Pharmacy	0.10
20486		Randall's Pharmacy	0.17
20158	*Hartford*	Frank L. Palmer	0.17
20140		Sisson Drug Co.	0.15
20184	*Meriden*	M. P. Forcier	0.15
20176		Louis Liggett	0.16
20182		Pinks Pharmacy	0.13
20122	*Middletown*	Lincoln's Drug Store	0.16
20239	*Milford*	J. H. Barnes	0.05
20240		John Howes	0.14
20305	*Mystic*	Mystic Pharmacy	0.17
20487	*New Haven*	Coburn's Drug Store	0.16
20195		T. P. Gillespie & Co.	0.05
20203		Horowich & Son	0.21
20222		Deegan-Hope Drug Co.	0.17
20199		Spalding Drug Co.	0.14
20207		Taft Pharmacy	0.16
20225		Visel & Kennedy	0.16
20219		Wood's Drug Store	0.04
20496	*New London*	L. P. Desmarais	0.16
20491		Starr Bros.	0.01
20235	*New Milford*	Albert Evitts	0.03
20232		W. N. Noble	0.17
20300	*Noank*	Wm. M. Hill, M.D.	0.05
20480	*Norwalk*	Devine & Hardwick Co., Inc.	0.16
20482		H. Glendening & Co.	0.16
20332	*Norwich*	Smith Pharmacy	0.15
20325	*Plainfield*	Edmond Mercier	0.16
20102	*Plainville*	Geo. R. Byington	0.15
20119	*Portland*	C. E. Blodgett	0.16
20310	*Putnam*	Edward H. Burt	0.17
20313		James F. Donahue	0.12
20311		Geo. E. Dresser	0.13
19644	*Rockville*	Thomas' Pharmacy	0.14
19747	*Southington*	Chafee's Drug Store	0.16
20462	*South Norwalk*	L. K. Liggett Co.	0.13
20458		H. A. Mead	0.16
20301	*Stonington*	Burch's Drug Store	0.15
20247	*Stratford*	F. B. Brill	0.16
20243		Wm. H. St. John & Co.	0.14
20155	*Thomaston*	Pickett Drug Co.	0.16
20148	*Torrington*	Claxton's Pharmacy	0.16
20150		Collins & Collins	0.15
20187	*Unionville*	Paul Flynn	0.09

TABLE XIX. ASSAYS OF LIME WATER—(*Concluded*).

D.C.No.	City or Town	Dealer	Calcium Hydroxide, per cent.
19726	*Wallingford*	Wallingford Drug Co., Inc.	0.16
20169	*Waterbury*	Apothecaries Hall Co.	0.04
20162		H. W. Lake Drug Co.	0.15
20191	*West Hartford*	Allen B. Judd Co.	0.13
20418	*West Haven*	Home Drug Store	0.16
19441	*Westport*	Westport Drug Co.	0.19
20131	*Wethersfield*	W. T. Eagan	0.16
20117	*Willimantic*	Wilson Drug Co.	0.01
20115		Chas. de Villers	0.17
20142	*Winsted*	John A. Williams	0.16

TINCTURE OF FERRIC CHLORIDE.

This preparation is required to contain not less than 4.48 per cent. of iron (Fe).[1]

Eighteen samples were submitted and all were found to be of standard quality or within reasonable limits thereof.

TABLE XX. ASSAYS OF TINCTURE OF FERRIC CHLORIDE.

D. C. No.	City or Town	Dealer	Iron (Fe), per cent.
20216	*Branford*	Spalding Co.	4.65
19444	*Bridgeport*	Hindle's Drug Store	4.38
20402	*Clinton*	Chas. B. Hull	4.78
20467	*Danbury*	Kenner & Benjamin	4.75
20308	*Groton*	C. S. Woodhull Davis	5.11
20489	*New Haven*	Coburn's Drug Store	4.76
20211		Est. J. A. Hodgson	6.52
20209		Taft Pharmacy	4.42
20221		Visel & Kennedy	4.35
20498	*New London*	Nichols & Harris Co.	4.76
20230	*New Milford*	Park Pharmacy	4.54
20236		Albert Evitts	4.76
20334	*Norwich*	James C. Mara	4.26
20461	*South Norwalk*	L. K. Liggett	4.32
20450		Plaisted Drug Store	5.45
20248	*Stratford*	F. B. Brill	4.53
20244		H. H. St. John & Co.	4.32
20302	*Stonington*	C. T. Brayton & Co.	4.90

SYRUP OF FERROUS IODIDE.

The official preparation is a syrupy liquid containing not less than 4.75 per cent. nor more than 5.25 per cent. of ferrous iodide (FeI_2).[2]

Six samples were examined two of which were somewhat less than the minimum strength required but the deficiency was less than 10 per cent.

[1] U.S.P. IX, p. 454.
[2] U.S.P. IX, p. 429.

TABLE XXI. ASSAYS OF FERROUS IODIDE.

D. C. No.	City or Town	Dealer	FeI_2, per cent.
19443	*Bridgeport*	John Clampet Drug Store	5.30
20409		Laity Bros.	4.41
20208	*New Haven*	Taft Pharmacy	4.38
20229	*New Milford*	Park Pharmacy	4.79
20338	*Norwich*	Lee & Osgood	5.19
20452	*South Norwalk*	Plaisted Drug Store	4.84

SYRUP OF HYDRIODIC ACID.

One hundred mils of this preparation are required to contain not less than 1.3 grams nor more than 1.45 grams hydriodic acid (HI).[1] The solution when fresh is colorless or straw-colored; solutions which are orange colored or darker have deteriorated.

Sixteen samples have been examined. Three were deficient, one conspicuously so being only 59.2 per cent. of the minimum requirement, while the other two were 91 per cent. and 86 per cent. of minimum standard strength.

TABLE XXII. ASSAYS OF SYRUP OF HYDRIODIC ACID.

D. C. No.	City or Town	Dealer	HI, gram per 100 cc.
19426	*Ansonia*	E. B. Schoonmaker	1.43
20473	*Danbury*	Doran's Drug Store	1.52
20157	*Hartford*	Frank L. Palmer	1.18
20124	*Middletown*	Hartmann Drug Co.	1.28
19649	*New Britain*	L. K. Liggett Co.	1.50
20223	*New Haven*	Deegan-Hope Drug Co.	1.12
20206		Taft Pharmacy	1.43
20495	*New London*	James' Drug Store	1.50
20226	*New Milford*	Park Pharmacy	1.52
19642	*Rockville*	Thomas' Pharmacy	1.47
19622	*So. Manchester*	J. H. Quinn & Co.	1.49
19630	*Stafford Springs*	D. H. McCormick	1.47
19635		Ethel H. Wikes	1.41
19435	*Stamford*	Sherwood Drug Store	1.47
19716	*Thompsonville*	Geo. R. Steele Est	1.48
19721	*Wallingford*	Wallingford Drug Co., Inc.	0.77

TINCTURE OF IODINE.

The official tincture contains in 100 mils not less than 6.5 grams nor more than 7.5 grams of iodine and not less than 4.5 grams nor more than 5.5 grams of potassium iodide.[2]

Thirty-five samples were examined and all were satisfactory except one sample, **20407**, which was about 14 per cent. too low in iodine and contained 18 per cent. too much potassium iodide indicating careless preparation.

[1] U.S.P. IX, p. 427.
[2] U.S.P. IX, p. 457.

TABLE XXIII. ASSAYS OF TINCTURE OF IODINE.

D. C. No.	City or Town	Dealer	Grams per 100 cc. I	KI
20213	*Branford*	T. D. Williams	7.0	5.0
20413	*Bridgeport*	European Pharmacy	6.7	5.1
20407		H. A. Scalton	5.6	6.5
20410		Wolf-Heiman	6.8	4.9
19746	*Bristol*	Rickman's Economy Drug Store	6.9	5.3
19739		Leroy P. Tucker	6.6	4.8
20471	*Danbury*	Northrop's Drug Store	7.1	5.1
20322	*Danielson*	Woodward's Drug Store	7.5	5.3
19736	*East Hartford*	W. B. Noble	6 8	4.5
19733		O'Connell Drug Co.	7.2	5.1
19729	*Glastonbury*	People's Pharmacy	6.9	4.8
20159	*Hartford*	Frank L. Palmer	6.5	4.6
20138		Sisson Drug Co.	6.9	5.4
20327	*Jewett City*	Chas. R. Carey	7.3	5.3
20328		J. P. Gorman	7.3	5.3
20121	*Middletown*	Lincoln's Drug Store	6.8	5.4
20488	*New Haven*	Coburn's Drug Store	7.4	5.1
20201		Spalding Drug Co.	6.9	5.0
20492	*New London*	United Chemists	7.2	5.3
20237	*New Milford*	Albert Evitts	6.9	5.0
20233		W. N. Noble	6.8	5.1
20329	*Norwich*	G. G. Engler	7.5	5.6
20455	*South Norwalk*	Harold A. Mead	6.6	4.7
20245	*Stratford*	Wm. H. St. John & Co.	7.4	5.2
20154	*Thomaston*	Pickett Drug Store	7.8	4.6
20189	*Unionville*	Albert Roby, Druggist	7.1	5.1
19725	*Wallingford*	Wallingford Drug Co.	7.3	5.5
20164	*Waterbury*	H. W. Lake Drug Co.	7.4	4.2
20401	*Westbrook*	J. W. Neidlinger	7.1	5.2
20417	*West Haven*	Silver Drug Corp.	6.6	4.5
19440	*Westport*	Bridge Pharmacy	7.0	5.1
20109	*Willimantic*	Bay State Drug Co.	6.9	6.6
20113		Cartier, The Druggist	7.2	5.5
20144	*Winsted*	Bannon's Drug Store	6.8	4.0
20143		John A. Williams	6.8	5.1

IPECAC.

The official dried root contains not less than 1.75 per cent. of the ether-soluble alkaloids of ipecac.[1]

Four samples were examined and found to conform substantially to the required standard.

TABLE XXIV. ASSAYS OF IPECAC.

D. C. No.	City or Town	Dealer	Ether-soluble alkaloids, per cent.
19429	*Derby*	Alfonso Indocci	1.63
19640	*Rockville*	Thomas' Pharmacy	1.92
19623	*So. Manchester*	J. H. Quinn & Co.	2.07
19632	*Stafford Springs*	D. H. McCormick	1.73

[1] U. S. P. IX, p. 229.

Chlorinated Lime.
(Chloride of Lime).

This product is made by treating calcium hydroxide with chlorine and should contain not less than 30 per cent. of available chlorine.[1] It is directed to be preserved in air-tight containers and kept in a cool, dry place.

Eight samples were examined representing, however, but three brands. None were found to be of standard strength. Four were approximately one-half strength, two were about two-thirds strength and two were three-fourths strength. It is probable that, as first packed, the products contained the full amount of available chlorine but it is well known that they will deteriorate with access of air. The samples were obtained in original containers none of which could be said to be air-tight, but sealed by means of circular covers fitted into the cans by pressure. The general use of this material as a disinfectant makes it the more important that it should be used as fresh as possible and the purchaser should understand that, once opened, the contents does not remain efficient indefinitely.

The samples were assayed by the method as described in the Pharmacopoeia. To gain some idea of the rate of deterioration duplicate assays were made about 7 weeks subsequent to the first examination with the results shown in Table XXV.

Table XXV. Assays of Chlorinated Lime.

D. C. No.	City or Town	Dealer	Brand	Available Chlorine per cent. First assay	Second assay (7 weeks later)
19425	*Ansonia*	Bristol Drug Co	Acme	13.9	11.0
20190	*Farmington*	S. J. Adgate	Acme	23.2	21.8
19645	*New Britain*	L. K. Liggett Co	Hudson	14.5	14.1
19616	*So. Manchester*	J. H. Quinn & Co	Acme	15.8	13.4
19627	*Stafford Spgs*	D. H. McCormick	Acme	15.1	13.8
19711	*Thompsonville*	Geo. R. Steele Est	Acme	21.0	19.5
19707		Thompsonville Drug Co.	Wander's.	19.2	17.6
20104	*Willimantic*	Bay State Drug Co	Wander's.	23.1	20.8

Linseed Oil.

The official oil of the Pharmacopoeia is raw oil, i.e., not boiled.[2] Among other specifications, the specific gravity should be between 0.925 and 0.935 at 25° C. and the oil should be free from mineral and rosin oils. The refractive index[3] at 25° C. is between 1.4790 and 1.4805.

[1] U. S. P. IX, p. 96.
[2] U. S. P. IX, p. 295.
[3] Canada Inland Rev. Bull. 430, 1919.

Fifteen samples were examined and all found to conform essentially to the requirements of the Pharmacopoeia for raw oil and no adulterants were detected.

One sample, **17628**, submitted by the Department of Entomology of this station, conformed also to the usual requirements.

Milk of Magnesia.

Magnesia Magma yields not less than 6.5 per cent nor more than 7.5 per cent. of magnesium hydroxide, $Mg(OH)_2$.[1]

One sample, **20100**, contained 7.4 per cent. of magnesium hydroxide and was of standard quality.

Mercurial Ointment.

The official ointment will contain about 50.5 per cent. mercury on the basis of the formula given in the Pharmacopoeia. It should assay not less than 49 per cent. nor more than 51 per cent. of mercury.[2]

Diluted mercurial ointment, otherwise known as blue ointment, contains 60 per cent. of mercurial ointment of official strength and should assay from 29 per cent. to 31 per cent. of mercury.[3]

Only one sample, **20133**, of the full strength preparation was examined. It was said to be made by Powers and Weightman and was sold by the Sisson Drug Co., Hartford. It contained 45.9 per cent. of mercury which is about 94 per cent. of official strength.

Fifteen samples of diluted ointment were examined. Three of these, **19434**, **19442**, and **19713**, were not so marked and would therefore be presumed to be of full strength while **20153**, marked dilute, contained an excess of mercury for the dilute article. The assays are given in Table XXVI.

Tincture of Nux Vomica.

One hundred mils of this preparation yields not less than 0.237 gram nor more than 0.263 gram of the alkaloids of nux vomica.[4]

The single sample, **19643**, assayed was purchased at Thomas' Pharmacy, Rockville and contained 0.291 gram of the alkaloid which is about 10 per cent. in excess of the maximum limit.

[1] U. S. P. IX, p. 261.
[2] U. S. P. IX, p. 479.
[3] U. S. P. IX, p. 480.
[4] U. S. P. IX, p. 461.

TABLE XXVI. ASSAYS OF DILUTED MERCURIAL OINTMENT.

D. C. No.	City or Town	Dealer and Manfr. (if known)	Mercury, per cent.
19447	*Essex*	W. H. Pond (Powers & Weightman)	28.4
19434	*Greenwich*	Greenwich Drug Store	28.4
20405	*Guilford*	J. H. Monroe	27.3
20174	*Meriden*	W. Mosher (Powers & Weightman)	26.4
19419	*Naugatuck*	Vrehoe & Leary	31.1
19701	*New Britain*	L. K. Liggett Co (United Drug Co.)	30.6
19639	*Rockville*	Thomas' Pharmacy	30.2
19442	*Southport*	L. R. Switzer Drug Store (Eimer & Amend)	26.9
20249	*Stratford*	F. B. Brill (Park, Davis & Co.)	26.6
19713	*Thompsonville*	Geo. R. Steele Est. (United Drug Co.)	30.3
19708		Thompsonville Drug Co. (Norwich Phar. Co.)	29.4
20149	*Torrington*	Claxton's Pharmacy (Mallinkrodt)	30.7
20153		Donahue's Pharmacy	36.6
19722	*Wallingford*	Wallingford Drug Co., Inc. (Merck & Co.)	29.6
20114	*Willimantic*	Chas. de Villers (Park, Davis & Co.)	26.4

SPIRIT OF PEPPERMINT.

(ESSENCE OF PEPPERMINT.)

The official preparation should contain 10 per cent. by volume of peppermint oil[1] but no method is described in the Pharmacopoeia for the determination of oil. Mitchell's precipitation method,[2] in our experience, gives low results until the solution contains about 8 per cent. of oil when they are substantially correct. Howard's modification[2] is more satisfactory but is subject to some inaccuracies due to difficulties of technique. The tentative method[3] gives results which accord with Mitchell's method, at least on solutions containing 8 to 10 per cent. of oil. In preparations containing only small amounts (less than 5 per cent.), of oil we have used an abbreviated form of the tentative method centrifuging directly after the addition of saturated salt solution.

Fifty-eight samples have been examined. Six were very low in oil and five others were deficient by amounts ranging from 12 per cent. to 20 per cent. of the standard. The results are given in Table XXVII.

OIL OF TURPENTINE.

("SPIRITS OF TURPENTINE.")

Among other specifications official oil of turpentine should have a specific gravity of from 0.860 to 0.870 at 25 °C.; 5 mils should leave not more than 0.1 gram of residue on evaporation;

[1] U. S. P. IX, p. 409.
[2] Leach, 4th. Ed., p. 431.
[3] Methods of Analysis, A. O. A. C., p. 206.

TABLE XXVII. ASSAYS OF ESSENCE OF PEPPERMINT.

D. C. No.	City or Town	Dealer	Peppermint oil, per cent.
19418	*Ansonia*	Everett McQuade	10.0
20478	*Bethel*	English's Drug Store	10.8
20214	*Branford*	Spalding Drug Co.	9.6
20217		Branford Pharmacy	10.2
20408	*Bridgeport*	A. Parsdine	9.6
20414		Frank E. Fickett	9.2
19737	*Bristol*	Leroy Tucker	9.4
19742		Madden Drug Store	5.0
19744		Rickman's Economy Drug Store	10.0
20466	*Danbury*	Simons Pharmacy	4.6
20469		Kenner & Benjamin	6.1
20472		Northrop's Drug Store	14.8
20475		Doran's Drug Store	1.9
20476		Ideal Pharmacy	9.6
20321	*Danielson*	Woodward's Drug Store	11.2
19427	*Derby*	Clarence Hotchkiss	10.0
20484	*Fairfield*	The Boyle Pharmacy	1.7
20485		Randall's Pharmacy	9.2
20307	*Groton*	C. S. Woodhull Davis	9.2
20404	*Guilford*	F. F. Donden	10.0
20137	*Hartford*	The Sisson Drug Co.	2.5
20156		F. L. Palmer, Park Drug Store	10.4
20181	*Meriden*	Pinks Pharmacy	9.2
20120	*Middletown*	Lincoln's Drug Store	8.8
20238	*Milford*	J. H. Barnes	8.6
20324	*Moosup*	Frank La Rose & Co.	9.6
20303	*Mystic*	Mystic Pharmacy	8.6
19422	*Naugatuck*	C. G. Olson	9.8
19703	*New Britain*	L. K. Liggett Co.	10.2
20194	*New Haven*	T. P. Gillespie & Co.	9.9
20202		Horowich & Son	13.6
20220		Wood's Drug Store	9.6
20224		Visel & Kennedy	10.0
20490	*New London*	Starr Bros.	10.0
20499		Nichols & Harris Co.	9.2
20231	*New Milford*	W. N. Noble	9.0
20234		Albert Evitts	9.8
20481	*Norwalk*	H. Glendening & Co.	9.8
20330	*Norwich*	G. G. Engler	11.0
20333		James C. Mara	9.8
20337		Lee & Osgood	10.2
20309	*Putnam*	Edward H. Burt	9.0
20312		James F. Donahue	9.6
19748	*Southington*	Chafee's Drug Store	8.6
19626	*So. Manchester*	J. H. Quinn & Co.	9.6
20451	*South Norwalk*	Plaisted Drug Store	9.0
20454		Harold A. Mead	16.8
19437	*Stamford*	Borg Bros.	9.8
19719	*Thompsonville*	Geo. R. Steele Est.	9.0
20147	*Torrington*	Claxton's Pharmacy	9.6
19724	*Wallingford*	Wallingford Drug Co., Inc.	10.8
20163	*Waterbury*	H. W. Lake Drug Co.	9.2
20420	*West Haven*	W. J. Coughlan	8.0
20130	*Wethersfield*	W. T. Eagan	10.0
20107	*Willimantic*	Bay State Drug Co.	9.2
20116		Chas. de Villers	11.6
20241		John T. Howes	10.0
20141	*Winsted*	John A. Williams	8.0

unpolymerized oil should not exceed 1 per cent. and the refractive index of the unpolymerized portion should not be less than 1.5 at 20° C.[1]

Twenty samples were examined. One sample, **20186**, contained 5.6 per cent. of mineral oil. It was examined as follows:

Sp. Gr. 25° C. 0.858; unpolymerized oil 5.6 per cent.; refractive index at 20° C. of unpolymerized residue 1.4613; residue on evaporation 0.144 gram per 5 cc.

The sample was purchased of Paul Flynn, Unionville, and said to have been supplied by the Hoffman Wall Paper Co., New York.

The other samples were not found to be adulterated. In a few instances unpolymerized residues exceeded 1 per cent. but the constants thereof did not indicate mineral oil.

Witch Hazel Water

Hamamelis water or witch hazel water should contain not less than 14 per cent. of alcohol by volume and certain other specifications should obtain.[2]

Four samples were submitted and since the object of the examination was the detection of wood alcohol, only alcohol was determined. No wood alcohol was indicated in any case and there were no significant deficiencies of grain alcohol the percentages of which ranged from 13.20 per cent. to 14 per cent. Only two manufacturers were represented by the four samples, viz., the E. E. Dickenson Co., Essex, and Brewer & Co., Worcester, Mass.

Ointment of Zinc Oxide.

(Zinc Ointment.)

The official preparation contains 20 per cent. of zinc oxide (ZnO).[3] No method of assay is given but direct ignition of the ointment has been shown[4] to give reliable results and this method was followed.

Thirty-four samples were examined, nearly all of which were of standard or satisfactory quality. No deficiencies greater than 10 per cent. were found except sample **20200** which contained 88 per cent. of the required amount of zinc oxide. Assays are given in Table XXVIII.

[1] U. S. P. IX, p. 302; also Bureau of Chemistry, Bull. 135, p. 31 et seq.
[2] U. S. P. IX, p. 58.
[3] U.S.P. IX, p. 483.
[4] Mass. State Board of Health, Food and Drug Report 1909, p. 53.

Table XXVIII. Assays of Zinc Ointment.

D. C. No.	City or Town	Dealer and Manufacturer	Zinc Oxide, per cent.
19738	*Bristol*	Leroy Tucker, (Meyers & Co.)	18.0
20129	*Cromwell*	Geo. F. Chapin Est., (Lilly)	20.0
20463	*Danbury*	Burn's Drug Store, (Lilly)	19.8
20318	*Danielson*	Burroughs' Drug Store	18.5
19735	*East Hartford*	W. B. Noble, (Norwich Pharmacal Co.)	20.9
19731		O'Connell Drug Co., (Sisson Drug Co.)	20.2
20132	*Hartford*	Sisson Drug Co	20.5
20183	*Meriden*	N. P. Forcier	19.5
20180		Louis Liggett, (United Drug Co.)	20.2
20175		W. Mosher, (Sharpe & Dohme)	21.3
20123	*Middletown*	The Hartman Drug Co., (Bristol & Myers)	21.0
20304	*Mystic*	Mystic Pharmacy	19.4
19420	*Naugatuck*	Pickett Drug Co	18.9
19647	*New Britain*	L. K. Liggett, (United Drug Co.)	20.0
20200	*New Haven*	Spalding Drug Co., (Apothecaries Hall Co.)	17.6
20227	*New Milford*	Park Pharmacy, (Park, Davis & Co.)	19.0
20339	*Norwich*	Lee & Osgood	19.3
20331		Smith's Pharmacy, Inc.	18.1
20118	*Portland*	C. E. Blodgett, (E. L. Patch)	20.4
19638	*Rockville*	Thomas' Pharmacy, (Crystal Chem. Co.)	21.2
20400	*Saybrook*	Saybrook Pharmacy	20.2
19618	*So. Manchester*	J. H. Quinn & Co., (The Upjohn Co.)	19.5
20460	*South Norwalk*	L. K. Liggett Co., (United Drug Co.)	19.7
20456		Harold A. Mead, (Norwich Pharmacal Co.)	20.0
19629	*Stafford Springs*	D. H. McCormick, (United Drug Co.)	19.8
19634		Ethel Wikes, (McKesson & Robbins)	20.3
19436	*Stamford*	Jones Drug Store. (Sharpe & Dohme)	20.6
19712	*Thompsonville*	Geo. R. Steele Est., (United Drug Co.)	19.7
19706		Thompsonville Drug Co., (Norwich Pharmacal Co.)	19.8
20152	*Torrington*	Donahue's Pharmacy, (Upjohn & Co.)	20.6
19720	*Wallingford*	Wallingford Drug Co., Inc., (Sharpe & Dohme)	19.1
20165	*Waterbury*	Apothecaries Hall Co.	19.8
20105	*Willimantic*	Bay State Drug Co., (Norwich Pharmacal Co.)	19.7
20110		Cartier, The Druggist, (Claflin)	19.8

Zinc Stearate.

This preparation is essentially a compound of zinc and stearic acid and should contain an amount of zinc corresponding to not

less than 13 per cent. nor more than 15.5 per cent. of zinc oxide (ZnO).[1]

All of the fourteen samples examined fell within the limits prescribed.

TABLE XXIX. ASSAYS OF ZINC STEARATE.

D. C. No.	City or Town	Dealer and Manufacturer	Zinc Oxide, per cent.
20465	*Danbury*	Simons Pharmacy, (Lilly)	14.2
19728	*Glastonbury*	Peoples' Pharmacy, (Mallinckrodt Chem. Co.)	14.2
20178	*Meriden*	Louis Liggett Co., (United Drug Co.)	14.3
19646	*New Britain*	L. K. Liggett Co., (Merck & Co.)	14.4
20228	*New Milford*	Park Pharmacy	13.5
19637	*Rockville*	Thomas' Pharmacy, (American Druggists Syn.)	14.7
19431	*Shelton*	F. G. Sanford	13.3
19617	*So. Manchester*	J. H. Quinn & Co., (Norwich Pharmacal Co.)	14.2
20459	*South Norwalk*	L. K. Liggett Co., (United Drug Co.)	14.2
20453		Plaisted Drug Store, (E. Fougera & Co.)	14.4
19628	*Stafford Springs*	D. H. McCormick, (Merck & Co.)	13.5
19633		Ethel H. Wikes, (McKesson & Robbins)	14.0
19650	*Thompsonville*	Thompsonville Drug Co., (Merck & Co.)	14.4
20166	*Waterbury*	Apothecaries Hall Co.	14.8

MISCELLANEOUS DRUGS, ETC.

Nine samples of this class have been examined, chiefly for health officers and physicians.

17658, 17659, 17660, 17661. Drugs distributed by the Direct Sales Co., Buffalo, N. Y., and submitted by Dr. S. B. Kleiner of New Haven.

Five grain *aspirin* tablets were found to contain 5.07 grains per tablet. Five grain *sodium bromide* tablets were found to contain 5.01 grains per tablet. One-fourth grain *mercury iodide* tablets were found to contain 0.223 grain of HgI. Blank tablets, examined for color only, were found to be colored with Naphthol yellow S, a harmless dye.

15891. *Unknown* powder submitted by the Department of Health, Bridgeport. The material had been seized by the local police and was found to consist of, or contain, cantharides.

16600. *Laxative* tablets submitted by Dr. A. B. Sturges, Wallingford. They were found to consist of, or contain, phenolphthalein, licorice and an unidentified bitter principle. Tests for alkaloids and emodin-bearing drugs were negative.

16599. *Eye* solution given to dilate the pupil of the eye instead

[1] U.S.P. IX, p. 493.

of which, it was claimed, contraction resulted. The prescription called for dionin and duboisine in water. It was thought that physostigmine had been substituted for one of the ingredients.

Tests for physostigmine were negative but dionin was identified and the solution further caused the pupil of a cat's eye to dilate markedly within 20 minutes.

15876 and **15877.** *Medicines,* sent by Dr. John T. Black of the State Board of Health for identification of any medicaments. Iodides were identified in both preparations and no further examination was made.

Fourteen other materials were examined which do not require extended comment. Among these were *roach powders* consisting essentially of borax, naphthalene, ammonium carbonate and probably Persian insect powder or variations of these ingredients; *tobacco dust* and various *arsenicals* for dusting purposes; *tobacco* and *sal ammoniac.* A sample of Mrs. Potter's Walnut Tint Hair Stain was made up of paraphenylene-diamine and hydrogen peroxide in separate containers; this combination has been commented upon in previous reports.[1]

[1] Conn. Exp. Sta. Bull. 227, p. 271; Report 1914, p. 289.

SUMMARY.

Materials	Sampled by, or at request of: Station Agent	Dairy and Food Commissioner	Individuals	Total	Adulterated, below standard or otherwise illegal
FOODS.					
Carbonated Beverages	....	153	....	153	21
Casein	6	....	....	6	....
Calcium Casein	5	....	....	5	....
Cider	....	4	....	4	3
Cocoa	....	3	2	5	....
Coffee	1	....	1	2	....
Diabetic Foods, etc.	39	....	25	64	....
Fats and Oils:					
Olive Oil	....	1	....	1	....
Cooking fats	....	7	....	7	....
Butter	....	10	5	15	1
Oleomargarine	....	1	4	5	....
Ice cream	....	329	15	344	27
Milk and Milk Products:					
Cryoscopic studies of milk	103	....	....	103	....
Market milk	....	967	98	1,065	377
Cream	....	4	22	26	....
Condensed milk, etc.	....	2	6	8	2
Human milk	....	....	30	30	....
Oysters	....	3	....	3	1
Tea	3	....	....	3	....
Vinegar	....	13	8	21	7
Miscellaneous Materials:					
Foods, etc.	....	3	18	21	3
Other materials	....	8	23	31	....
Total	157	1,508	257	1,922	442
DRUGS.					
Proprietary Remedies	3	2	....	5	....
U. S. P. Drugs:					
Bay Rum	....	24	....	24	19
Belladonna, Tincture of	....	9	....	9	....
Belladonna Leaves, Powder	....	1	....	1	1
Bismuth, Milk of	....	10	....	10	2
Calcium Hydroxide, Solution of	....	69	....	69	12
Colchicum Seed, Tincture of	....	2	....	2	....
Ferric Chloride, Tincture of	....	18	....	18	....
Ferrous Iodide, Syrup of	....	6	....	6	....
Hydriodic Acid, Syrup of	....	16	....	16	2
Iodine, Tincture of	....	35	....	35	1
Ipecac, Powdered	....	4	....	4	....
Lime, Chlorinated	....	8	....	8	8
Linseed Oil	....	15	1	16	....
Magnesia, Milk of	....	1	....	1	....
Mercurial Ointment	....	1	....	1	....
Mercurial Ointment, Dilute	....	15	....	15	4
Nux Vomica, Tincture of	....	1	....	1	....
Peppermint, Essence of	....	58	....	58	11
Turpentine	....	20	....	20	1
Witch Hazel	....	4	....	4	....
Zinc Ointment	....	34	....	34	1
Zinc Stearate	....	14	....	14	....
Miscellaneous Drugs, etc.	....	....	23	23	....
Total	3	367	24	394	62
Total for Foods and Drugs	160	1,875	281	2,316	504

Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

BULLETIN 237 FEBRUARY, 1922

Forestry Publication No. 13

Control of White Pine Blister Rust in Connecticut

1909-1921

By W. O. FILLEY, Forester and H. W. HICOCK, Assistant

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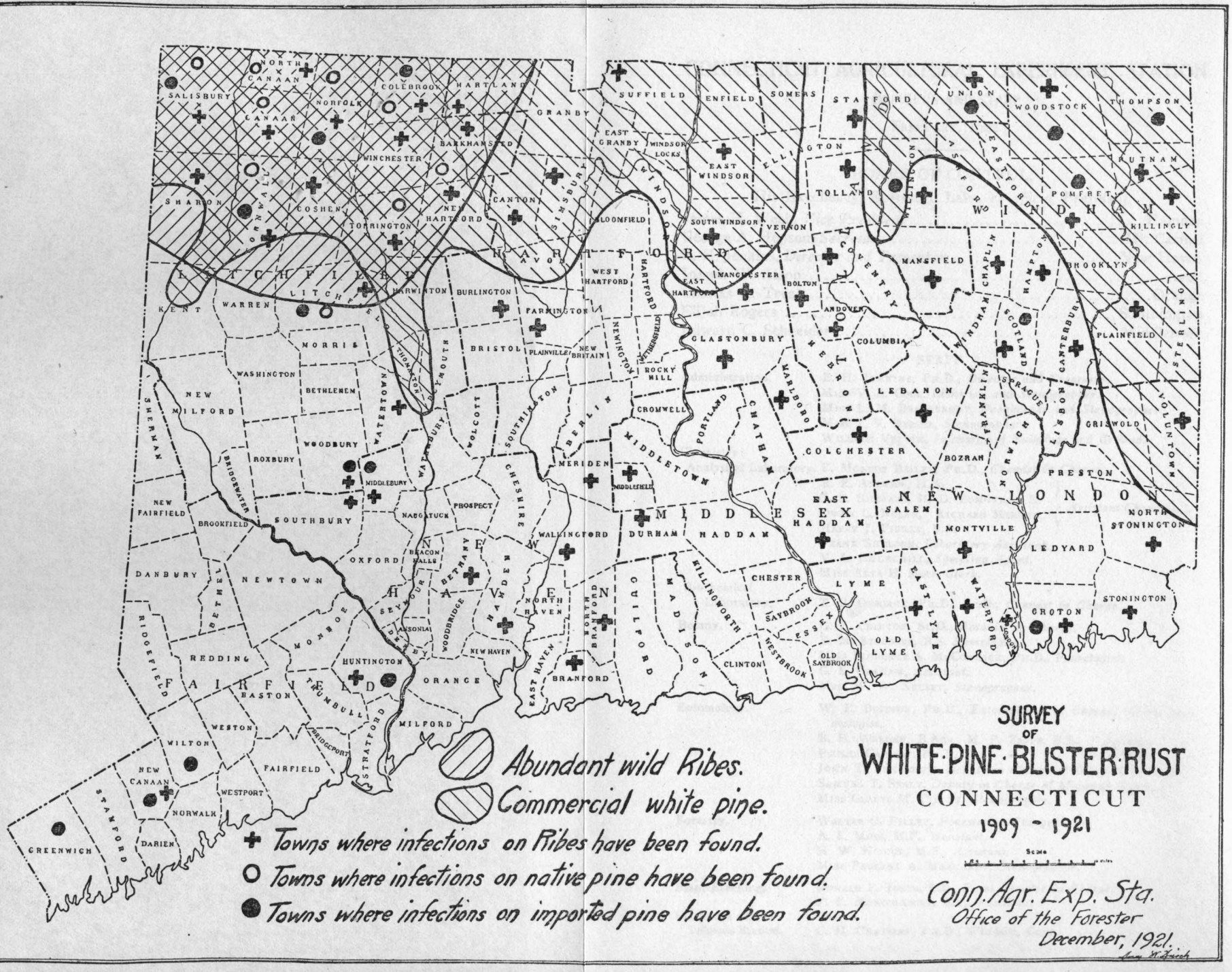

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Control of White Pine Blister Rust in Connecticut

For a number of years it has been evident that the future of the eastern white pine forests depends on the control of a fungous disease known as the white pine blister rust. The purpose of this bulletin is to furnish information regarding this disease, its prevalence in Connecticut, and the practicability of control methods. In order to emphasize the necessity of protecting white pine growth from a very serious menace, a report on the value of white pine timber in the state is included.

In 1916 the rust was found in all the New England States, New York, New Jersey, Pennsylvania, Wisconsin, Minnesota and Ontario, Canada. All these states have taken measures to study and control the disease, and the Connecticut General Assembly of 1917 passed the following legislation for that purpose.

"The director of the Connecticut Agricultural Experiment Station shall have authority to investigate and control the fungous disease known as white pine blister rust or currant rust. Said director may appoint a member or members of the experiment station staff to administer such work under his direction, and may employ other assistance when necessary. All white pine, currants or gooseberries infected with said rust may be uprooted and destroyed forthwith. Said director may designate districts within which currant or gooseberry bushes growing wild, abandoned or escaped from cultivation may be uprooted and destroyed under his direction, and in the performance of his duties, he or any person authorized by him, may at any time enter any public or private grounds, and any person wilfully hindering the performance of such duty shall be fined not less than ten nor more than fifty dollars for each offense. The sum of seven thousand five hundred dollars is appropriated annually for carrying out the provisions of this section." (General Statutes of 1918, Section 2117.)

The discovery of the rust in Connecticut in 1909 resulted in immediate study of its nature and occurrence. This was made by members of the Experiment Station staff, all needed equipment being furnished by the Station. In 1916 it became apparent that active measures for the control of the disease should be undertaken as soon as possible, in addition to a continuation of the studies already begun.

Under an agreement with the Bureau of Plant Industry, United States Department of Agriculture, federal funds for coöperative control work were received in 1916 and have been available each year since. The disease has thus been under observation for twelve years, and for the last six years considerable control work has been done in coöperation with the Federal Government. Under the agreement mentioned the amount of federal funds

expended to September 30, 1921 was $12,124.44, while the total amount expended by the State was $24,080.11.

The work of the Experiment Station on the disease has been carried on jointly by the forestry and botanical departments; the former having charge of the administration of funds and of the active control measures, the latter in charge of research and investigations.

The control work has been on an experimental basis for the past six years. The disease develops comparatively slowly and three or more years must elapse before the effects of control are fully apparent. It was necessary to test and compare various field methods to determine which would accomplish the desired results at a minimum cost. Much has been learned regarding the rust and its control. It can now be confidently stated that the eradication of currant and gooseberry bushes to a distance of 1,000 feet from white pine will, in most cases, adequately protect the pine from the disease. The eradication of Ribes is practicable, even in regions where the wild species are abundant, and the work can be done by land owners at a comparatively low cost.

A detailed report of studies by Doctors Clinton and McCormick of the botanical department on new points in the life history of the fungus appeared in Bulletin 214 of the Connecticut Agricultural Experiment Station, but in order that the present bulletin may be as complete as possible, a resumé of these studies is included.

The Importance of White Pine.

At the time of settlement of this country by Europeans, the northeastern United States from Maine to Minnesota and from southern Canada to West Virginia (even as far south as Georgia along the mountain tops) contained many virgin stands of eastern white pine (*Pinus strobus*), both pure and in mixture with hardwoods. The forests were valuable to the early settlers only for fuel and for building materials. Implements for working up logs into boards, shingles and framing pieces were comparatively crude, and only trees which could be worked up easily were selected. Chief among these was white pine. Evidence of this is to be found in the older New England houses today. Built almost entirely of white pine except for the frame, and many of them unpainted, these houses have withstood the elements for nearly three hundred years and are still habitable. White pine was therefore one of the first woods to enter into the domestic life of our forefathers and it played an important part in the early development of New England.

The demand for wood in various forms has increased many fold in the last three centuries. For a considerable number of

these uses white pine has been the first choice, as it always will be if obtainable. Many woods have been substituted for it but few have proved as satisfactory. Inroads on the white pine stands by lumbering and fire have been enormous, so that today the annual cut is far less than the demand and is diminishing each year.

From this brief description of the past and present status of white pine, let us glance into the future to see what part this valuable tree is to play in the forest production of northeastern United States, and more specifically of Connecticut.

A plentiful supply of low priced lumber is essential for the prosperity of any community. This is particularly true of an industrial state like Connecticut. The ideal condition would be for every community to produce all the lumber it needs, thus eliminating high freight rates and stimulating local industry. Since this is impracticable in many cases, the question arises as to what species will most fully satisfy the needs of the community and make it most nearly self-supporting.

The killing of the chestnut trees by the bark disease has left the state practically bereft of a good general purpose timber tree. Of the many other native hardwoods, some produce very valuable materials, but few of them can be grown profitably because of the length of time required to mature. It is generally conceded by foresters that while some hardwood lumber is essential and must be produced, the bulk of the lumber in the northeast must come from coniferous trees. Of these, ten species are found growing native within this state as follows: cedars, three species; spruce, one; balsam fir, one; larch, one; hemlock, one; and pines, three. Because of slow growth, restricted range, or other adverse habits all these species except red pine *(Pinus resinosa)* and white pine may be eliminated in considering the future.

These two trees are quite similar in growth and habits, although the wood of red pine is considered to be slightly inferior to that of white pine. Planting stock of both species is easily raised and set out. With regard to immunity to insects and fungi, red pine has a decided advantage and it is less susceptible to damage by fire. White pine is found throughout most of the northern third of the state and if the species is favored, its range may be greatly extended without excessive cost. The range of red pine, on the other hand, covers only portions of the most northerly towns. Its further extension, therefore, must be by planting until the species is more widely established in the state.

Dr. Haven Metcalf of the Bureau of Plant Industry has stated that the practise of forestry in New England and New York is "impossible" without white pine. Perhaps it would be better to say "very difficult." At any rate it is generally conceded that white pine, because of its excellent qualities and many and diversified uses, is our most valuable timber tree. Foresters claim that

it is one of the few trees that can be grown as a crop with profit under intensive management.

If the future of our local lumber supply depends so much on this one species surely it is worth protecting from fire, insects and fungi. Fire is always destructive to growing timber, and white pine is more susceptible than many other species. There are several insects which damage white pine to some extent, but these pests are either not very serious or can be controlled. Of the various fungi parasitic on the tree, the only one which seems to endanger the existence of the species is that with which this report is concerned.

History of the Disease.

This disease is caused by a parasitic fungus known to science as *Cronartium ribicola*. It is classified among fungi as a heteroecious rust because it develops distinct stages of its existence on different host plants, of which it requires two for its development and spread. They are:—

a. The several species of five needled pines.
b. The several species of currants and gooseberries.

During a complete life cycle this rust produces four different kinds of spores, two on the pine and two on the Ribes host. *Ribes* is the scientific generic name for the plants commonly known as currants and gooseberries, and in this report the term "Ribes" is used to designate them.

About 1856 Dietrich, a German botanist, reported the two stages of the fungus on Ribes and on pine in northwestern Russia. He evidently did not recognize that he had two forms of the same rust on different hosts. Klebahn of Germany in 1888 was the first to prove the relationship of the two forms when he inoculated leaves of Ribes from the spore stage which was found on five needled pines. The fungus has, therefore, been known in Europe by botanists for many years. The five needled pines of the old world are relatively of small commercial importance and it was probably the destruction of the North American five needled pines, introduced extensively for forest and ornamental planting, which really directed the attention of Europeans to the disease.

According to Spaulding's 1911 report,* the blister rust has been found on one or both hosts in Norway, Sweden, Denmark, Russia, Siberia, Austro-Hungary, Italy, Switzerland, Germany, France, Belgium, Holland, England, Scotland and Japan. Losses as high as 100 % have been reported from Europe.

Prof. Tubeuf of Munich wrote a paper in 1905 on the ravages of the disease in Germany on American white pine, a tree which

* Bulletin 206, Bureau of Plant Industry.

has been used there for forest and ornamental purposes for two hundred years. He also cited the damage to nursery stock and young reproduction, and the fact that in some places the use of this species has been abandoned by nurserymen because of the rust.

Moir, after studying the disease in western Europe in 1920, reported* that in Norway, Sweden, Denmark and Belgium the use of white pine in the regeneration of forests had been practically given up because of the rust. Although the necessary control methods are well known there, the cultivated black currant (because its fruit is so highly prized for jam) is considered of more value than the exotic white pine. Moir also studied the effects of the disease on sugar pine (*Pinus lambertiana*), western white pine (*Pinus monticola*) and limber pine (*Pinus flexilis*) planted in western Europe and found all to be as severely damaged as eastern white pine.

It is very difficult to say just when the disease was first introduced into America. Stewart was the first to identify and definitely report it in this country. In 1906 he found a serious infection on various species of Ribes at Geneva, N. Y., although it was not until 1912 that it was discovered on white pine in that region. The rust was first reported on white pine in 1909 in several of the eastern states where seedlings imported from Europe had been planted. It is very probable that it had been brought into this country in small quantities for many years previous to 1909 when, as is now known, it was introduced in considerable quantities on forest planting stock, chiefly from Heins Nursery in Germany.

In 1908 and 1909 about 750,000 white pine transplants were imported from Germany for forest planting in Connecticut. After planting it was discovered that some of these trees were breaking out with the yellow blisters, or aecial stage of the rust. It was first discovered in April, 1909 by Mr. C. A. Metzger on trees which he was planting in Wilton, specimens being sent by him to this Station for identification.

From more recent investigations, there are indications that infected pines may have been introduced in at least one place in the state before the general introduction of the rust in 1908 and 1909. At the Bowditch nursery in Pomfret, there is a small forest planting about thirty years old which has developed the disease for a number of years. The trees are known to be of European origin and some of them appear to have been infected prior to 1908.

Life Cycle.

As previously stated, the disease is a rust which requires two hosts (one of the five needled pines and some species of Ribes) for

* Bulletin 6, American Plant Pest Committee.

the completion of its life cycle. In describing this cycle, let us assume that we start with a pine which has become infected and is producing spores. These spores (aeciospores) are blown to Ribes leaves in the spring, from early in April until June depending on the season. With proper atmospheric conditions the parasite develops in the leaf and shows on the under side in about two weeks as minute orange-yellow pustules, which mature and break, giving off an orange-colored powdery mass of spores (uredospores). This is the first spore stage on Ribes. These uredospores are capable only of infecting Ribes and during the early part of the summer spread the disease from one bush to another. From midsummer until the leaves fall the second spore stage on Ribes is produced. This takes the form of minute rusty brown hairs (telia) on the lower surface of the leaf. These hairs are made up of single-celled spores (teliospores) which adhere permanently together. Often uredospores and teliospores are both found on the same leaf. The latter upon germination produce minute temporary spores (sporidia) which cannot infect Ribes, but if carried to pine needles may cause infection.

Pines become infected, therefore, only after telia appear on Ribes. Doctors Clinton and McCormick have conclusively demonstrated that the rust enters the pine host through the stomata or breathing pores of the needles and works back into the bark and twig tissues. Needles of the current season are probably more susceptible to infection than older ones.

Once the disease has entered the tree it proceeds to develop parasitic threads (the mycelium) in the tissues of the host. The first outward sign of the work of the parasite is a discoloration of the bark to a yellow or orange-greenish hue accompanied by swelling. In one to several years after infection of its needles the swollen portion of the pine develops what are known as pycnia. These exude on the bark as drops of a sticky fluid containing spores (pycniospores) whose nature in this and other rusts has never been fully determined, but which are considered by some to be spores that have lost their function. When these drops dry out there remain on the bark yellowish spots of varying shape, which later turn a deep reddish brown. They are known as pycnial scars.

Usually during the spring after pycnia are borne the fungus develops the fruiting bodies known as aecia. These never appear until the third year after infection of the pine needles and their development may be delayed until the fourth year, or even longer under adverse conditions. Very small pines are often killed before aecia appear at all. The aecia are the orange spore cases, or blisters, which push through the bark as flattened pustules about one fourth of an inch high. They soon burst and send out a mass of aeciospores which, if carried to Ribes, cause the infection on the leaves mentioned at the beginning of the life cycle. After fruiting, the bark through which the pustules have protruded becomes much seamed and cracked, often exuding pitch and frequently attacked by secondary fungi and insects. Older infections sometimes show constriction with swelling above.

Not infrequently a tree which has been diseased for several years will show a number of distinct zones as follows:—

a. Dead, cracked bark where the disease has fruited in previous years.
b. Fruiting pustules, or remnants of pustules, that have fruited during the current season.
c. Zone of pycnial scars and pycnial drops.
d. A discolored area usually surrounding all other stages and moving forward slowly into new tissues with each year's growth.

Some important points to be noted are:—

1. Two spore stages are borne on each host during the life cycle of this rust.
2. Two hosts must be present if the disease is to spread from pine to pine.
3. Spores from the stage on pine cannot directly infect other pines.
4. The rust is perennial on the pine but not on the Ribes host.
5. The fungus may grow within the pine host for a number of years without fruiting.

Experiments by members of the Bureau of Plant Industry and others show that all five needled pines are commonly infected by this rust. The botanical department of this Station has made extensive experiments with other pines and a summary of the results appears later in this report. Ribes vary considerably in their susceptibility to infection. Black currants are undoubtedly the most susceptible, followed closely by certain wild gooseberries, skunk currants and cultivated flowering currants. The thick leaved variety of cultivated red currant and certain cultivated gooseberries are probably the least susceptible in this state.

Moist, fairly cool weather is apparently the most favorable for the growth of the fungus and the production of spores. The aeciospores which develop on pine may travel long distances and over large barriers, such as mountain ranges, without losing their quality of infecting Ribes. The average longevity of the spores varies considerably according to their kind. The aeciospores which carry the disease from pine to Ribes may remain alive for several months. Dr. H. H. York has made tests showing that with a humidity of 90 and a temperature of 22-25 degrees C. (72°-77° Fahr.) the sporidia which carry the disease from Ribes to pine remain viable for less than ten minutes.

Legislation.

Under the Plant Quarantine Act of August 21, 1912, as amended March 4, 1917, the Secretary of Agriculture was given the power to "quarantine any state or territory or any district of the United States, or any portion thereof" to prevent "the spread of any plant disease or insect infestation." Under this Act the

Federal Horticultural Board established a quarantine against the shipment of five needled pines and black currants out of the New England States and New York, and against the shipment of these plants from the states east of and including Minnesota, Iowa, Missouri, Arkansas and Louisiana into territory further west. Congress also appropriated $300,000 for the investigation and control of the disease, part of which was to be used coöperatively to balance money appropriated by the states.

In 1917, the Connecticut legislature passed two laws, which in brief are as follows:—

a. A general plant pest law authorizing the Director of the Connecticut Agricultural Experiment Station to control insects or diseases which are, or may become, serious pests to economic plants. He is given the power to destroy infected plants, prohibit or regulate transportation of the same, and to establish quarantine in such areas and against such pests as he may deem necessary. (G. S. 1918, Section 2106.)

No quarantine against Blister Rust has ever been put into effect in this state.

b. A Blister Rust law authorizing the Director of the Connecticut Agricultural Experiment Station to control the White Pine Blister Rust. He is given the power to order white pines, and currant and gooseberry plants to be unrooted and destroyed. (G. S. 1918, Section 2117.)

This latter act authorizes an expenditure of $7,500 per year for the control of Blister Rust.

Control 1909-1915.

As was previously stated, 750,000 imported white pine trees were introduced into Connecticut in 1908-1909. Records of their distribution were available at the Experiment Station and soon after the infection on pine was discovered at Wilton by Mr. Metzger in April, 1909, most of the plantations originating from this stock were examined by members of the station staff, and by Drs. Spaulding and Graves representing the Bureau of Plant Industry. In addition to the infection in Wilton, five plantations were found to contain from one to several infections and five others had a few suspicious trees. The above eleven plantations and a number of others were inspected in 1910 and in subsequent years. As no further signs of the rust were found, it was concluded that all the infected trees were either destroyed or had died. The importation of foreign planting stock was discouraged by the forestry department of the Station after 1910. In 1912 one lot of stock received from Holland by a commercial nursery contained so many diseased trees that all were ordered destroyed by the state nursery inspector.

The rust was found on Ribes in Meriden in 1912 and again in 1916. In the summer and fall of 1915, the state nursery inspector

of Massachusetts reported many infections on Ribes in that state close to the Connecticut line, and one over the line in the town of North Canaan. Infections reported from other states indicated that the rust had become well established in this country and during the following winter (1915-1916) plans were made for coöperation between the Connecticut Agricultural Experiment Station and the Bureau of Plant Industry for more thorough scouting to determine how serious the infection might be.

Control 1916.

Under this coöperative agreement the salaries of extra men were paid by the Federal Government and their expenses paid by the State. The station forester, then ex-officio state forester, was placed in charge and other station employees were used on the work during all or part of the season. No state funds were available except the appropriation for the care of state forests, a part of which was used. Ten extra men were employed for varying periods from May 1 to September 30.

During May and June two crews inspected eighty plantations and sixteen nurseries where there was reason to think that the disease might exist. Infected trees were found in ten plantations in Wilton, Huntington, Groton, Middlebury, Woodbury, Cornwall, Litchfield (2) and Norfolk (2). Only in Norfolk was there any sign of the disease having spread from its point of introduction, but there numerous secondary infections on native pines were found and destroyed. Wild Ribes were very plentiful and on June 15 the first fruiting stage was found on this host. By July 1 it was too late to prevent the spread of the disease from pine and for the rest of the season, using the infected plantations as a center, a crew of six men worked on the eradication of Ribes. They removed and destroyed many thousand wild and escaped Ribes in an area of approximately three square miles.

In addition, cultivated Ribes were inspected over a large territory. It was thus determined that the infected area included about forty-five square miles inside a triangle with its apexes at Canaan Valley, North Colebrook and South Norfolk. Eradication was discontinued in September and several of the men were used to scout the state for Ribes infections. During the entire season scouting was done in 110 of the 168 towns. Infections were found in 65, of which only 20 were west of the Connecticut River. The infections in these 20 towns were widely scattered except in northern Litchfield County. In the 45 towns east of the river the infections were more numerous but could not be attributed to any known center of pine infection.

Control 1917.

From the work in 1916 it was apparent that the blister rust had become well established and that special funds would be needed to control the disease. Five thousand dollars was granted by the legislature for immediate use and ten thousand dollars for the two years ending September 30, 1919. The Director of the Experiment Station, being charged with the execution of the law, delegated the direct supervision to the forestry department. The botanical department took charge of the identification of specimens and investigational work.

The labor situation in the spring of 1917 was rather acute, but the early closing of the Connecticut Agricultural College to release students for agricultural work made available a number of men for blister rust control. In all thirty-two men were employed in this work but during the latter part of the summer many of the men left to enter some branch of military service, and for this reason the periods of service varied considerably. As in 1916 the Bureau of Plant Industry coöperated by paying the salaries of extra men employed. The plan of work was as follows:—

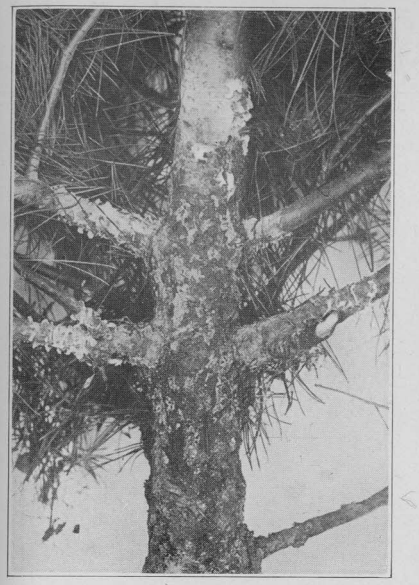
a. Inspection of pine plantations throughout the state.
b. Scouting for the disease on Ribes.
c. Eradication of Ribes at Norfolk.

In May and June two crews found infections in eighteen plantations, eight of which had been located in 1916, the remaining ten being found for the first time in 1917. Two plantations and one nursery in which infected pines were found in 1916 seemed to be clean the following year. No infected stock, either pine or Ribes, was found in any nursery in the state, although inspections were made both in the spring and in the fall.

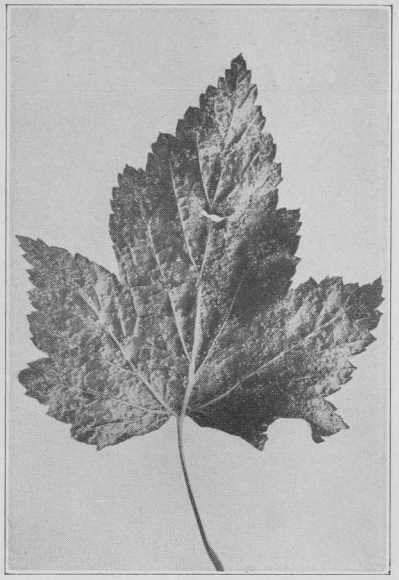
The most serious infection discovered outside of Norfolk was that on the Bowditch estate in Pomfret. Here the infected trees were over twenty years old and had evidently borne the rust for some time, but conditions were not favorable for its spread, as there is almost no native pine in this region and wild Ribes are very scarce.

To facilitate scouting for infection on Ribes, the state was divided into ten districts with a scout for each. These scouts inspected Ribes in yards and along roads in their respective districts once in two weeks and in this way kept track of any new infections that developed. A supervisor of scouts visited each district and spent a day with the scout about twice a month.

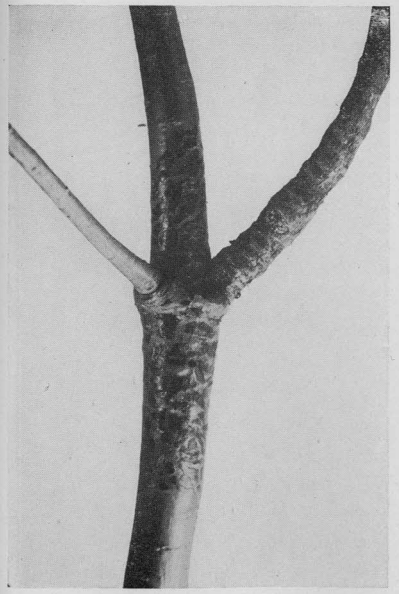
The most important result of this scouting was the finding of the pine infection center in Pomfret. Its presence was suspected from the early and general infection of Ribes reported by the scout in that vicinity. By a careful inspection of planted pine he



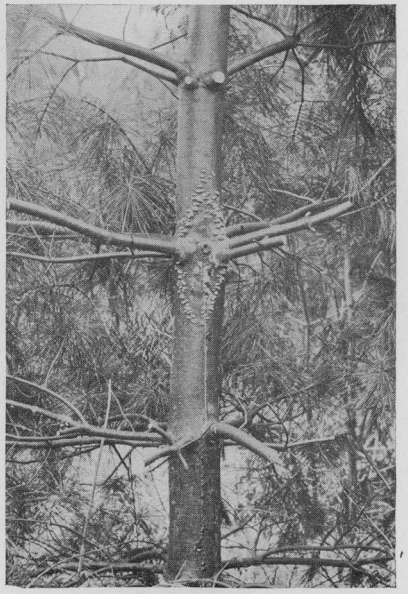
a. Primary infection on imported pine.



b. Telial stage on Ribes.



c. Pycnial stage on pine.



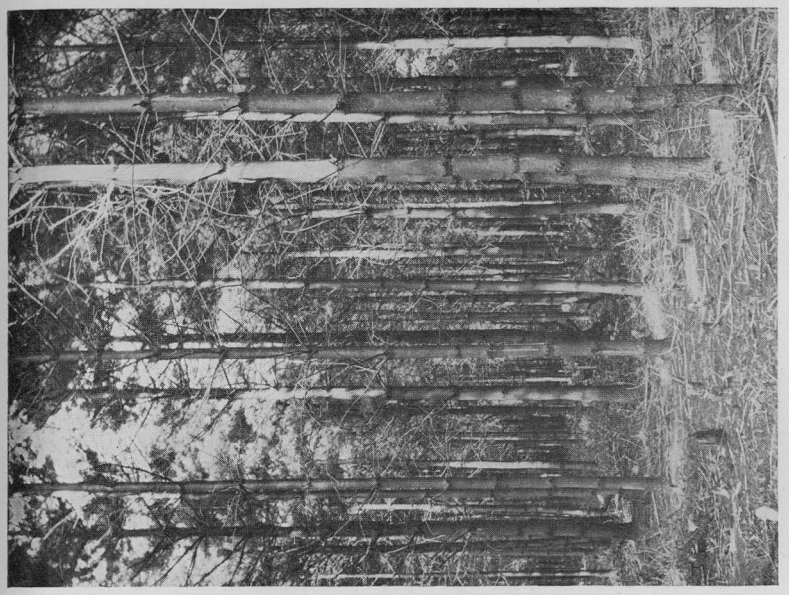
d. Aecial stage on pine.

WHITE PINE BLISTER RUST.

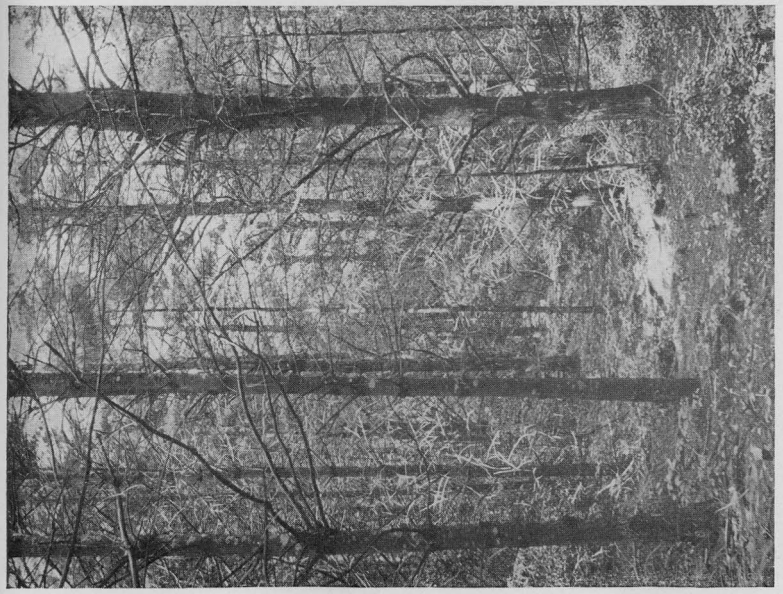
a. Natural reproduction in Cornwall.

b. Plantations in Middlebury.

FUTURE WHITE PINE FOREST.



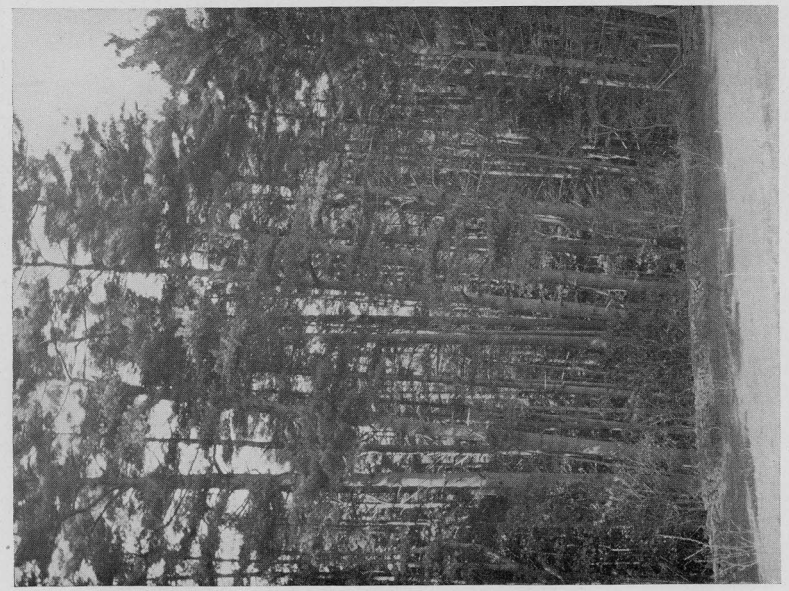
b. Natural stand thinned.



a. Natural stand unthinned.

YOUNG WHITE PINE FOREST IN UNION.

PLATE XXVI.



MATURE WHITE PINE FOREST IN CORNWALL.

150 years old; 140 feet tall; 67,000 bd. ft. per acre.

was able to locate a center of infection on the Bowditch estate. The Ribes infections in other parts of the state, with one exception, were too scattering to indicate infection centers close at hand. The exception was in the vicinity of Branford where there seemed reason to suspect the presence of pine infection, but a careful search failed to show any.

Control work was again confined to the Norfolk region, for nowhere else was there evidence that the disease had spread to pines outside the infection center. The control areas selected covered about ten square miles in the northern half of the town. Work with two crews was begun May 12th and another was organized in July. Early in the season an attempt was made to locate and remove pine infections on those areas from which Ribes was eradicated the previous year. Six hundred acres were covered in this way but the work was slow and expensive. The average cost of $1.80 per acre did not seem justified when compared with the much lower cost of removing Ribes the previous year. Moreover, it is never possible to detect with certainty all pine infections, since some of them may be so well hidden as to be overlooked, while others may not be sufficiently developed to be recognizable.

Systematic scouting for pine infection was therefore abandoned and during the rest of the season Ribes were eradicated from about three thousand acres at an average cost of 85 cents per acre. While no accurate count was kept of the Ribes removed, the number varied from many thousand per acre in some of the swamps to almost none on the hardwood ridges. The cost naturally varied with the character of the land and the abundance of Ribes. From 50% to 60% of all Ribes destroyed showed infection.

Infection on Ribes was found to be fairly general, not only in the control area but for some distance east and west in the towns of Colebrook and Canaan. The various species of Ribes found in the order of abundance were as follows:—*Cynosbati* var. *glabratum, oxyacanthoides, vulgare, prostratum, nigrum, odoratum, Cynosbati, rotundifolium, gracile, triste* var. *albinervium,* and *Americanum.*

Control 1918.

On account of war conditions which prevailed in 1918 practically no eradication work was attempted. Members of the Station staff inspected pine and Ribes in different parts of the state throughout the summer. Two extra men were employed in Norfolk to check over areas previously worked, with gratifying results. On one and one-half square miles of territory worked in 1917 only 386 Ribes were found, or about one for each two acres.

From May 1 to September 1 selected red and black currant bushes were sprayed at ten day intervals with 4-4-50 Bordeaux mixture to determine the possibility of controlling the disease on Ribes by spraying. Unsprayed bushes were used as checks. The results indicated that it might be possible to hold the disease in check on Ribes by frequent spraying, but that the frequency required would make the plan impracticable.

As previously mentioned, infections on cultivated Ribes found in the town of Branford in 1916 aroused the suspicion of a pine infection nearby. Infected Ribes were plentiful at three places and at two of these all bushes were destroyed soon after discovery. The black currant bushes at the remaining place were inspected at frequent intervals, as were the few pines in the neighborhood, but without result. The nearest known pine infection was at Middlebury, some thirty miles away. In September 1918 an intensive survey was made of all cultivated Ribes within three miles of the infected black currants. Of 201 places visited 73 had Ribes and infection was found at 13, but the infections were too widely scattered to indicate the presence of a pine infection center.

Nine plantations and one nursery were inspected in 1918. In six plantations fruiting infections were found, while in two others there were specimens apparently killed by the rust. One new infection was found in the town of Greenwich in a plantation which had not previously been inspected.

During the summer practically all the scattered Ribes infections located in 1917 were visited at least once. A decrease in the number of infections was evident as compared with the previous year. Considerable time was spent in July and August inspecting Ribes in the southwest corner of the state, but infections were not sufficiently abundant to indicate the presence of unknown pine infections.

Control 1919.

From inspections in previous years it was apparent that many of the plantations of imported pine were in no danger from the rust, and these were consequently eliminated from the inspection of 1919. Six plantations were inspected and the disease was found in five, but only in small amounts and with no indication that it was spreading.

Eradication of Ribes was resumed May 1 on areas in Norfolk and Colebrook adjoining those worked in 1917. During the summer a crew of five men covered about 2,500 acres and destroyed 30,000 wild Ribes bushes. The cost of eradication averaged 93 cents per acre, including wages, sustenance, supervision, transportation and depreciation of equipment.

Checks were made to determine the efficiency of the crew in

eradicating Ribes. Four tracts worked earlier in the season were selected and a portion of each reworked. The results showed that the crew removed an average of 90% of all Ribes during the first working of the ground.

During June scouting for infection on cultivated Ribes in 24 towns in Tolland, Windham and New London Counties showed infection in four towns, but only at places where it had been found in previous years. Later in the summer nine towns in Litchfield County were scouted in the same manner and Ribes infection was found to be quite general.

The survey of the Branford area which was made in 1918 (see page 316) was checked up in 1919. All but two places showing infection on Ribes in 1918 showed it in 1919, and one new infection was found. All white pines in the area were inspected for infections but none found.

In order to determine the spread of the disease in Pomfret, a survey covering about 30 square miles adjoining the Bowditch estate was made in July and August, 1919. All pine plantations and cultivated Ribes in the region were inspected and mapped. Eighteen separate infections on Ribes were found, but no pine infection except at the Bowditch estate. Here the scout eradicated a large number of escaped Ribes bushes in and near the pine grove. Wild Ribes are very scarce in this vicinity.

In coöperation with the Bureau of Plant Industry, a pine survey of the state was begun in December, 1919. Its purpose was to obtain information regarding the amount and value of white pine in the state and to demonstrate the importance of protecting it from the rust. One man was employed until June, 1920, mapping the pine lands of Windham, New London and eastern Tolland Counties, reporting on the age, area, percentage of pine in mixture, quantity in board feet and value of all stands containing pine.

Control 1920.

Labor suitable for this work was difficult to obtain until after the schools and colleges closed, when twelve men were secured and put in the field. The area selected for eradication consisted of about 2,000 acres in the town of Colebrook, east of that eradicated in 1919. Forty three thousand Ribes bushes were removed and destroyed. Checks run frequently, according to methods prescribed by the Bureau of Plant Industry, showed that the men were getting 90% to 97% of all Ribes during the first trip over the ground.

As in former years inspection of cultivated Ribes was carried out to determine the approximate limits of the disease. In 1920 this work was confined to Litchfield County where infection on Ribes was found to be quite general. No attempt was made to

check over either the Branford or the Pomfret areas during the season, nor was there any inspection of plantations.

Work on the pine survey, started in 1919, was resumed in November, 1920 and a new line of work, the scouting of native white pine for infection, undertaken. This seemed necessary because of the amount of Ribes infection found throughout the state for a number of years. The Bureau of Plant Industry furnished one man for the survey and two for the scouting. The two lines of work were carried on simultaneously, as this method was considered more efficient than to cover the ground twice for mapping and scouting. The cost of the survey was 2 cents per acre for the area actually mapped and about 3 mills per acre for the entire area covered. The men located infections on native pine in the towns of Cornwall, Barkhamsted, and North Canaan, as well as many new infections in Norfolk and Colebrook. (For results of the survey see page 321.)

Owing to the fact that infection had been found on Ribes in the vicinity of Branford for a number of years, this region was again scouted for infections on pine previous to the start of the regular scouting and survey work. All pines, both native and ornamental, in the neighborhood of known Ribes infections were carefully looked over, but not a single pine infection was found.

Control 1921.

Beginning on April 14 seven plantations and one nursery were inspected for pine infection. One plantation contained several fruiting specimens of the rust and in another two suspected trees were removed. In the remaining plantations and in the nursery, no sign of rust was found.

A crew of five men organized a camp in Norfolk on May 1 and carried on eradication, scouting and checking until September 15. Some 8,000 acres in the towns of Norfolk, Colebrook and North Canaan were covered and 39,000 Ribes bushes were removed and destroyed. Of this area, 4,000 acres was new territory which had not been previously worked. In addition the crew scouted forest and ornamental plantings of imported stock in Litchfield, Cornwall, Norfolk and Colebrook and found infections in all plantations thus inspected.

The effectiveness of Ribes eradication cannot be determined until sufficient time has elapsed to allow Ribes grown from seed, or from incompletely removed root crowns, to become large enough so that they can be readily seen. Furthermore, on pines which have become infected since the Ribes were removed, the disease would require at least two years to reach a stage which could be unmistakably recognized. In order, therefore, to check up the results of previous Ribes eradication in Norfolk, some 4,000 acres

which were worked in 1916, 1917 and 1919 were reworked in 1921 with the following results:

a. Some large Ribes missed in previous years were found, but these were so few in number per acre as to be of minor importance. Numerous small Ribes, originating either from seed or from improperly removed root crowns were found, but the small amount of leaf surface and the fact that these plants were usually growing under dense shade reduces the liability of their acting as transmitters of the disease for several years. Judged by the comparatively small number of Ribes found in reworking, the first eradication appears to have been fairly effective but the necessity for rescouting these areas after a few years, and reworking them if necessary, is indicated.

b. The number of pines showing infection which had occurred since eradication was almost negligible. In contrast with this, on an area from which Ribes had not been removed prior to 1921, twenty-seven pine infections were found, 70% of which took place in 1918 and 1919.

During the winter of 1920 and 1921 scouts had discovered new infections on native pine in several additional towns in Litchfield County. Prior to this time, the only known infection on native pine was in the Norfolk-Colebrook region. Careful investigation of these newly located infections indicated that control must be undertaken on a much larger scale. It was considered advisable, however, to secure further information as a basis for future work in the new areas. During the summer and fall, therefore, a preliminary survey of the towns of Cornwall, Canaan, Salisbury and a part of North Canaan was completed. The towns were subdivided into blocks for each of which observations were made on the prevalence of Ribes, amount and character of pine infection, and other factors bearing on control. Pine infection was found to be quite generally distributed over all the territory scouted and in some places it was very heavy. Ribes were plentiful but not as abundant as in the Norfolk region.

During November a scout covered practically all the towns along the Rhode Island line inspecting native pine but was unable to locate any infection.

The survey made in Pomfret in 1919 was checked up this year. Four fruiting infections on pine were found at the Bowditch estate and one new infection on ornamental pine about one-half mile to the south. The cultivated Ribes scouted in 1919 showed less infection in 1921 than in the former year.

On July 1, 1921 the federal allotment for blister rust control in Connecticut was cut from $5,000 to $2,000. Moreover the Secretary of Agriculture ruled that this allotment should be used for education, demonstration and supervision, but not for eradication as in previous years. The federal money has therefore been used

since July 1 to pay part of the salary of a member of the Experiment Station staff whose time is largely spent in supervising the control work. As a result of this reduction in the federal funds available, the amount of control work which can be done with the present state appropriation is greatly reduced. Moreover the disease has recently been found in alarming amounts in several new sections. To check its spread, prompt action is necessary, or much young pine will be killed before reaching merchantable size. It is imperative, therefore, that owners of pine coöperate in the control work, since state and federal funds are wholly inadequate to care for the present situation.

Future Control Work.

Blister rust control has been in the experimental stage during the past six years. Although its principles were well understood in European countries they had never been practiced extensively there, and many points in the life history of the disease were not thoroughly understood. Its characteristics and life history are now well known as a result of the exhaustive studies which have been made in this country by federal and state agents. There are still many scientific points not fully understood and investigational studies must be continued, but the practicability of control methods has been firmly established. The coöperative work with the Bureau of Plant Industry in the various states has demonstrated that the application of simple field methods at a moderate cost per acre will hold the disease absolutely in check.

These control methods should be carried out locally by pine owners themselves, since they are the ones directly benefited by the results secured. Public funds should be used for supervision, for education and for further experimental work, but not, as in the past, for actual field control on a large scale. Education of pine owners through state and federal agencies is essential, because many of them do not realize the value of their young pine or the necessity of protecting it from the rust.

On average quality forest soil which could not profitably be used for agriculture, white pine either self-sown or planted will, in 40 to 50 years, produce a gross revenue of over $200 per acre, as contrasted with $75 per acre if the land grows only hardwoods. Unless the blister rust is kept under control, however, it may and probably will, destroy the pine before it reaches merchantable size, as the greatest danger is to trees less than 15 feet high to which the disease is fatal in a very few years.

Assistance must be given pine owners in recognizing the disease, for its presence on pine is very deceptive. It can be identified at the end of the first year only with the aid of a microscope. After the second year a careful scrutiny will reveal its presence,

although to an untrained eye a tree already diseased beyond recovery may outwardly seem to be healthy.

Supervision of Ribes eradication by state or federal agents is of great importance. Unless the work is done with sufficient thoroughness to remove practically all the Ribes in the vicinity of pine stands, the protection secured will not be sufficient to warrant the expense incurred. A trained supervisor will be able to maintain the efficiency of the work and to reduce its cost by eliminating areas where Ribes are not sufficiently abundant to require eradication.

The National Situation.

The introduction of this disease into the United States and its subsequent spread has brought about a condition very different from that in Europe. Our eastern white pine, sugar pine, limber pine and western white pine were formerly used quite extensively in western Europe for forest and ornamental planting. On account of damage by the blister rust the use of these trees is now being discontinued because the cultivated black currant is more highly prized for its fruit than the American soft pines for their lumber. In this country the necessity for protecting the five needled pines at the expense of Ribes should be beyond question, because of the greater importance and value of pine lumber as compared with currants and gooseberries.

In the northeastern United States where the rust was generally introduced some twelve years ago the disease, on account of its deceptive character, became firmly established before the damage it might do was generally realized. In many parts of the range of the eastern white pine, 10% to 15% of all the trees of this species are infected and in some areas infection runs as high as 100%. This condition is very serious because much of the present crop of young pine will be killed before it is large enough to cut and because, if the rust is not controlled in the immediate future, it may become so prevalent as to render the use of white pine impossible in the regeneration of our forests.

In Connecticut the situation is not as bad as in other New England states, because the area in which blister rust can become serious is limited to about 500 square miles in northern Litchfield County. This is the only section of the state where wild Ribes are abundant. It is very probable that infection will occur at many other points because of the presence of cultivated Ribes, but it is believed that such infections will be quite local and easily controlled.

In the western states the danger from blister rust is one of the future rather than of the present. Agents of the Bureau of Plant Industry are constantly on the watch for its appearance and every

possible means of enforcing the quarantine against the shipment of Ribes and five needled pines into the west are being used. Very recently (November 1921) an infection on eastern white pine planted in southern British Columbia has been discovered, and since that time several infections on western white pine have been found over the line in the state of Washington. However, these infections have apparently been located before the disease has spread to any extent, and with sufficient funds it should be possible to control it. Nevertheless, the danger of its becoming established in the west is very great. A strict enforcement of the federal quarantine and continued vigilance on the part of federal scouts will be necessary to prevent its introduction and spread into a region where control may prove impossible.

The territory between British Columbia and Mexico includes the range of the western white pine and sugar pine which are very important timber trees. Several other five needled species found in this section, while valuable to some extent for lumber, are even more valuable as a covering for high mountain water-sheds. Moreover, there are more than 60 species of Ribes native to this region. This combination of several species of pine susceptible to the rust and an extraordinarily large number of Ribes species affords ideal conditions for the development and spread of the disease throughout the entire range of the western five needled pines.

NEW INVESTIGATIONS BY THE BOTANICAL DEPARTMENT.

Though the general life history of the blister rust had previously been worked out in Europe there were some lesser phases, unknown or in doubt, when the botanical investigations were first undertaken by Doctors Clinton and McCormick of this Station. The life history in general has been covered by their work, but special emphasis was laid upon the doubtful or unknown points. A part of these investigations have been published in Bulletin 214 (pp. 428-459) of this Station, and in papers read before the Blister Rust Conferences and the Botanical Society of America. Additional details will be given in a bulletin of the Station to be published during 1922.

The main new points brought out in their investigations were along two lines. First, as regards the point of entrance of the fungus in the pine, it was shown by artificial infections that this takes place through the leaves, and that a very definite method is followed. The germinating sporidia gain entry by a germ tube through the stomates, or breathing pores, into the interior of the leaf and immediately form an enlargement which may have several functions, such as a hold fast, storehouse for food, etc. From this swelling an infection thread proceeds through the stomatal cavity and comes in contact with the leaf cells. A tube is sent into the cell for food, and then a vigorous growth of threads results in the intercellular spaces, in time forming a sclerotial mass of fungous threads. This development kills the green coloring matter of the cells, with the result that a golden-yellow spot shows on the leaf near the spot where the fungus entered. In time the fungous threads come in contact with the food carrying ducts of the leaf, and then in an inconspicuous manner rapidly work lengthwise of the leaf, especially downward, until they reach the bark, where a vigorous development takes place resulting in the swelling already noted. These facts have all been confirmed by similar observations on infections taking place in nature. While natural infection of the leaves takes place in the fall, the external evidence, through the golden yellow spots on the leaves, is not conspicuous until the following spring or early summer.

The second point brought out was that not only the five needled pines but also seedlings of certain two and three needled pines could be artificially infected, some as readily and vigorously as the white pine. On some of these hosts the infection has proceeded as far as any that has taken place in infection work at this Station with white pine of the same age: namely, to where the infected stems produced the pycnial stage. Altogether some thirty different species of seedlings of the genus Pinus have been experimented with, and at least fifteen of these have become infected in the leaves. The varying vigor of the rust's development indicates difference in resistance of the species inoculated, so that no doubt with certain of them infection proceeds no further than invasion of the leaf, and so fails of true infection.

As regards infection of Ribes with the aeciopores from white pine, successful inoculations have been made with twenty-six species. Some species show much more resistance to infection than do others, cultivated black currants being one of the most susceptible.

A SURVEY OF WHITE PINE IN CONNECTICUT.

The pine survey for Connecticut, which was made during the winters of 1919-1920 and 1920-1921, has been briefly referred to in other parts of this report. The object of the work was to furnish data on the amount and location of white pine growing within the state. As such figures would manifestly not be accurate for any extended period, it was decided to accomplish the work at as low a cost as possible consistent with reasonable accuracy.

Since there is no considerable amount of white pine outside of Litchfield, Hartford, Tolland, Windham and New London Counties, the survey was limited to such portions of these counties as were known to contain pine.

The U. S. G. S. topographic sheets were used for the mapping. With the aid of a pocket compass and pacing, the boundaries of the various blocks of pine were sketched in. Three general types were plotted upon the map.

a. Pine reproduction; stands under 25 years of age with pine forming 60% or more of the mixture.

b. Pure pine; stands over 25 years of age with pine forming 60% or more of the mixture.

c. Pine-hardwoods; mixed stands with other species forming more than 40% of the mixture.

The country was divided into blocks with the highways as boundaries and further subdivided into the various types, for each of which notes were made showing:—

a. Age class.
b. Percentage of pine.
c. Area in acres.
d. Volume in board feet per acre.

Areas were obtained by scaling the map. Age was roughly determined by counting the whorls of branches. The estimates of percentage and value were, of necessity, made largely by eye but were checked by the frequent laying out of plots on which more careful estimates were made. In practically all cases supplemental notes regarding the character of the timber, reproduction, etc., were kept for each type.

From field data thus gathered it was possible to compile figures on area of reproduction, area of pure pine, area of pine in mixture with other species and the stand in board feet for each town surveyed. Figures of total forest area were taken from the Forest Survey of Connecticut, published in the annual report of this Station for 1915. Fifty-two towns were covered in whole or in part. A summary of the information for each county by towns follows.

HARTFORD COUNTY.

Town	Pure Pine Reproduction Acres	Pure Pine Acres	Pine-Hardwoods Acres	Forest Area Acres	Stand of Pine B. F.
Avon	686	445	110	7,400	1,260,000
Bloomfield	34	38	20	4,350	430,000
Canton	127	479	78	11,600	370,000
E. Granby	386	198	..	4,300	240,000
E. Hartford	35	123	..	2,100	800,000
E. Windsor	16	77	125	3,400	450,000
Enfield	832	765	424	7,000	6,760,000
Farmington	500	70	...	8,000	710,000
Granby	888	923	1,446	17,000	5,550,000
Hartland	108	9	613	15,700	350,000
Manchester	84	212	45	5,700	1,650,000
Simsbury	1,216	1,252	150	10,500	8,830,000
S. Windsor	12	92	145	4,800	990,000
Suffield	215	203	115	5,450	450,000
Windsor	30	455	352	7,300	4,210,000
Windsor Locks	685	271	...	2,550	890,000
Totals	5,854	5,612	3,623	117,150	33,940,000

LITCHFIELD COUNTY.

Town	Pure Pine Reproduction Acres	Pure Pine Acres	Pine-Hardwoods Acres	Forest Area Acres	Stand of Pine B. F.
Barkhamsted	1,129	336	3,141	15,300	5,480,000
Canaan	157	333	9,587	15,500	1,372,000
Colebrook	1,211	964	8,613	15,400	6,120,000
Cornwall	700	444	803	18,100	6,920,000
Goshen	20	133	192	15,100	2,040,000
Harwinton	75	36	150	11,700	340,000
Litchfield	35	67	73	16,000	780,000
Morris	28	6	40	3,550	130,000
New Hartford	781	257	1,092	13,000	2,250,000
Norfolk	835	1,437	10,394	22,300	12,100,000
North Canaan	768	889	3,928	5,850	1,980,000
Salisbury	496	1,424	6,581	17,800	10,420,000
Sharon	...	42	862	17,000	310,000
Thomaston	...	3	30	4,550	60,000
Torrington	46	154	55	16,200	680,000
Winchester	433	185	2,813	12,700	1,400,000
Totals	6,714	6,710	48,354	220,050	52,382,000

NEW LONDON COUNTY.

Town	Pure Pine Reproduction Acres	Pure Pine Acres	Pine-Hardwoods Acres	Forest A ea Acres	Stand of Pine B. F.
Griswold	25	5	725	9,450	40,000
Voluntown	250	437	8,812	22,500	4,910,000
Totals	275	442	9,537	31,950	4,950,000

TOLLAND COUNTY.

Town	Pure Pine Reproduction Acres	Pure Pine Acres	Pine-Hard-woods Acres	Forest Area Acres	Stand of Pine B. F.
Elllington	20	40	20	11,300	90,000
Mansfield	..	3	..	12,600	35,000
Somers	392	424	280	9,000	1,800,000
Stafford	38	447	5,341	28,800	2,980,000
Tolland	20	58	89	16,500	250,000
Union	1,000	1,594	9,831	15,000	15,920,000
Willington	73	32	145	15,900	250,000
Totals	1,543	2,598	15,706	109,100	21,325,000

WINDHAM COUNTY.

Town	Pure Pine Reproduction Acres	Pure Pine Acres	Pine-Hard-woods Acres	Forest Area Acres	Stand of Pine B. F.
Ashford	..	342	3,093	14,600	1,590,000
Brooklyn	75	69	1,770	7,500	320,000
Canterbury	..	87	932	12,800	400,000
Eastford	150	417	3,261	13,100	4,720,000
Killingly	200	274	11,556	19,100	1,020,000
Plainfield	50	36	1,873	13,000	160,000
Pomfret	100	42	2,775	12,500	440,000
Putnam	100	409	3,495	5,550	1,290,000
Sterling	50	30	4,210	13,600	300,000
Thompson	400	672	11,760	16,400	2,480,000
Woodstock	600	1,352	11,836	19,800	10,050,000
Totals	1,725	3,730	56,561	147,950	22,770,000

TOTALS BY COUNTIES.

County	Pure Pine Reproduction Acres	Pure Pine Acres	Pine-Hard-woods Acres	Forest Area Acres	Stand of Pine B. F.
Hartford	5,854	5,612	3,623	117,150	33,940,000
Litchfield	6,714	6,710	48,354	220,050	52,382,000
New London	275	442	9,537	31,950	4,950,000
Tolland	1,543	2,598	15,706	109,100	21,325,000
Windham	1,725	3,730	56,561	147,950	22,770,000
Totals	16,111	19,092	133,781	626,200	135,367,000

In the remaining 117 towns there are scattered plantations and native stands of white pine which should be included in totals for the state. The following figures are therefore thought to be conservative.

	Pure Pine Reproduction Acres	Pure Pine Acres	Pine-Hard-Woods. Acres	Forest Area Acres	Stand of Pine B. F.
State of Connecticut	20,000	20,000	150,000	1,483,300	150,000,000

Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

BULLETIN 238 FEBRUARY, 1922

BEING THE

Report on Commercial Feeding Stuffs

1921

By E. M. BAILEY

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The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

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February, 1922.

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Commercial Feeding Stuffs.

By E. M. BAILEY.*

PROVISIONS OF THE STATUTES RELATING TO FEEDING STUFFS.

Under the Connecticut statutes the term "concentrated commercial feeding stuffs" covers practically all feeds excepting hay and straw, whole seed, unmixed meal made directly from any of the cereals or from buckwheat, and feed ground from whole grain and sold directly from manufacturer to consumer.

Under the new fertilizer law cottonseed meal is classed as a commercial fertilizer and, as such, is subject to analysis fees and tonnage tax. Provision is made, however, to exempt meal sold exclusively for feeding purposes.[1]

Section 4775 requires that every lot or parcel of concentrated commercial feeding stuff shall bear a statement giving the name and address of the manufacturer or importer, the number of net pounds in the package, the name of the article, and the percentage of protein and fat contained in it. The law forbids the use of any metal in affixing tags.

No registration of feed or payment of analysis or license fees is required.

The penalty for violation of the statute is not more than $100 fine for the first offense and not more than $200 for each subsequent offense.

The law authorizes this station to take samples from any manufacturer or dealer, in a prescribed manner, and requires the station to analyze annually at least one sample of each brand which it has collected, and to publish these analyses "together with such additional information in relation to the character, composition and use thereof as may be of importance."

CLASSIFICATION OF SAMPLES.

The classification and summary of commercial feeding stuffs and other materials requiring fodder analysis which have been examined during the past year are as follows:

---

* Analyses are by Messrs. Nolan, Merwin and Fisher; inspection and sampling are by Mr. Churchill; and the compilation of results for publication is largely due to Miss Moss.

[1] Chapt. 204, Public Acts, 1919.

Official samples taken by the Station Agent	159
Samples submitted by individuals	57
Samples examined in connection with field experiments at Storrs	267
Samples examined in connection with field experiments at this station	52
Total	535

Only the results of the official inspection and samples submitted by individuals are included in this report. Other data are discussed elsewhere.

Official samples taken by this station are classified as follows:

Cottonseed Meal	14	Maize Products	17
Linseed Meal	6	Distillers' Products	2
Wheat Bran	19	Brewers' Products	2
Wheat Middlings	14	Dried Beet Pulp	7
Red Dog Flour	3	Dried Buttermilk	1
Wheat Mixed Feed	6	Proprietary Stock Feeds	51
Rye Products	2	Poultry Feeds	15
		Total	159

STANDARDS FOR WHEAT MILL FEEDS.

Tentative standards for wheat mill feeds, with or without screenings, have been adopted by the Association of Feed Control Officials. The figures which refer to crude fiber and represent the maximum in each case, are as follows:

Standard Middlings	9.5%
Flour Middlings	6.0
Red Dog Flour	4.0
Brown Shorts	6.5
Gray Shorts	5.5
White Shorts	3.5
Wheat Mixed Feed	8.5

SIGNIFICANCE OF THE NUTRIENT GROUPS.

The significance of the several nutrient groups as shown by the conventional proximate analysis has been discussed in previous bulletins.[1] Occasional inquiries continue to be received as to the distinction between the terms "nitrogen-free extract" and "carbohydrates" appearing upon commercial feed tags. The sense of the Association of Feed Control Officials upon this point is embodied in resolutions adopted by them as follows:

"Resolved that it is the sense of this Association that we understand the term 'Nitrogen-free Extract' to cover the product indicated by the percentage obtained by subtracting from 100 per cent. the sum of the percentages of ash, moisture, protein, fat and fiber.

"Resolved that the term 'Carbohydrates' be interpreted to cover the

[1] Conn. Exp. Sta. Bull. 206, 1918; Bull. 212, 1919.

product indicated by the percentage obtained by the addition of the percentages of crude fiber and nitrogen-free extract."

In practice tags often bear declarations of both "fiber" and "carbohydrates" and in such cases the term "carbohydrates" must be regarded in the sense of "nitrogen-free extract."

The Association has adopted further resolutions to the effect that the practice of packing feeds in bags containing 99 lbs. and selling the same for 100 lbs. net is condemned; and that a ton of feed is 2000 lbs. net.

COEFFICIENTS OF DIGESTIBILITY AND NET ENERGY VALUES.

The question of digestion coefficients and energy values of feeding stuffs has been discussed in previous reports.[1] These factors for most of the types of feed reported herein are given in Table I, and for others the reader is referred to the authorities cited.

TABLE I.—COEFFICIENTS OF DIGESTIBILITY AND NET ENERGY VALUES OF FEEDING STUFFS.[1]

Feed.	Average dry matter, lbs. per hundred.	Coefficient of digestibility.				Net energy value, Therms per hundred lbs.
		Protein.	Fiber.	Carbohydrates.	Fat.	
Cottonseed Meal	92.2	84	37	75	95	90.0
Cottonseed Feed	....	58	45	61	90	....
Linseed Meal (old process)	90.0	89	57	78	89	88.9
Linseed Meal (new process)	90.4	86	73	87	95	85.1
Wheat Bran	89.9	76	43	74	62	53.0
Wheat Feed	....	77	36	76	87	....
Wheat Middlings	89.6	77	30	78	88	59.1
Red Dog Flour	....	88	36	88	86	....
Rye Flour	....	80	..	88	90	....
Barley, ground	90.7	88	70	93	86	89.9
Barley Bran	....	85	20	86	87	....
Corn Gluten Meal	90.9	85	55	90	93	84.2
Corn Gluten Feed	91.3	85	76	88	85	80.7
Hominy Feed	89.9	66	76	90	91	81.3
Brewer's Grains	92.5	81	49	57	89	53.4
Malt Sprouts	92.4	77	87	80	85	72.7
Distillers' Grains, Corn	93.4	73	95	81	95	85.1
Distillers' Grains, Rye	92.8	59	..	67	84	56.0
Beet Pulp, dried	91.8	52	83	83	..	75.9
Peanut Cake, without shells	89.3	90	9	84	90	93.6
Soybean Meal, fat extracted	88.2	92	99	100	68	99.7
Cocoanut Cake	90.4	90	23	87	100	83.5

[1] Henry and Morrison, 15th Ed., pp. 118-119; Armsby and Putney, Penn. Exp. Sta., Bull, 142, 1916.

[1] Conn. Exp. Sta. Bull. 212, p. 357, 1918; Bull. 221, pp. 347-351, 1919.

ETHER EXTRACT IN MOLASSES FEEDS.

Our experience with the determination of fat in feeds containing molasses or other saccharine material was summarized in our report last year.[1] Over a period of seven years nearly one half (42 per cent.) of the samples examined gave lower results for ether extract when the procedure of washing out saccharine substances with water before extracting with ether was followed; in the remaining cases the results were higher. The official direct method now prescribes extracting with water before extracting with ether in cases where large amounts of soluble carbohydrates are present. We have followed this plan in cases where the ether extract was below guaranty by direct extraction with ether.

INSPECTION OF 1921.

Remarks on Analyses.

(*Analyses on pages 338-357.*)

The definitions of the various feeding stuffs here given are those adopted by the Association of Feed Control Officials revised to October, 1921.

Cottonseed Meal.

41.12 *Per cent. Protein Cottonseed Meal, Choice Quality,* must be finely ground, not necessarily bolted, perfectly sound and sweet in odor, yellow, free from excess of lint, and by analysis must contain at least 41.12 per cent. crude protein, equivalent to 8 per cent. of ammonia.

Cotton seed meal not fulfilling the above requirements as to color, odor or texture, shall be branded Off Quality.

38.56 *Per cent. Protein Cottonseed Meal, Prime Quality,* must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color, yellow, not brown or reddish, free from excess of lint, and by analysis must contain at least 38.56 per cent. crude protein, equivalent to 7.5 per cent. of ammonia.

Cottonseed meal not fulfilling the above requirements as to color, odor or texture, shall be branded Off Quality.

36 *Per cent. Protein Cottonseed Meal, Good Quality,* must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color, and by analysis must contain at least 36 per cent. crude protein equivalent to 7 per cent. of ammonia.

Cottonseed meal not fulfilling the above requirements as to color, odor or texture shall be branded Off Quality.

Of fourteen samples examined all satisfied their guaranties with the single exception that **18067,** Surety, was 2.62 per cent. low in protein. The average composition of samples examined this year is protein 39.1, fiber 10.9 and fat 7.4 per cent. This is substantially better than the average for the same constituents for the previous six years which shows protein 37.1, fiber 11.9 and fat 6.9 per cent. The average price has been $49.30 per ton. The

[1] Conn. Exp. Sta., Bull. 229, p. 296, 1920.

average for the six-year period just mentioned was $58.80 but this figure reflects the abnormal prices which prevailed at the close of the war when cottonseed meal sold for over $80 per ton.

Linseed Meal.

Linseed Meal is the ground product obtained after extraction of part of the oil from ground flaxseed screened and cleaned of weed seeds and other foreign materials by the most improved commercial processes, provided that the final product shall not contain over six per cent. of weed seeds and other foreign materials and provided further that no portion of the stated six per cent. of weed seeds and other foreign materials shall be deliberately added.

Old Process Oil Meal is the ground product obtained after extraction of part of the oil by crushing, cooking and hydraulic pressure from seeds screened and cleaned of weed seeds and other foreign materials by the most improved commercial processes. When used alone the term "Old Process Oil Meal" shall be understood to designate linseed meal as defined, made by the old process. When used to cover any other product the name of the seed from which it is obtained shall be prefixed to "old process oil meal."

Six samples, all old process meals, substantially met their guaranties in all respects.

Wheat Bran.

Wheat Bran is the coarse outer coating of the wheat kernel as separated from cleaned and scoured wheat in the usual process of commercial milling.

All of the samples examined satisfied their guaranties as to protein and fat. So far as fiber guaranties were given or known they were not exceeded. The average composition, viz., protein 16.6, fiber 9.5 and fat 5.3 per cent. is substantially better than the average for the previous six years, viz., protein 15.7, fiber 10.1 and fat 5.0 per cent.

Wheat Middlings.

Standard Middlings (*Red Shorts or Brown Shorts*) consists mostly of the fine particles of bran, germ and very little of the fibrous offal obtained from the "tail of the mill." This product must be obtained in the usual commercial process of milling.

Gray Shorts (*Gray Middlings or Total Shorts*) consists of the fine particles of the outer bran, the inner bran or bee-wing bran, the germ, and the offal or fibrous material obtained from the "tail of the mill." This product must be obtained in the usual process of commercial milling.

White Shorts or White Middlings consists of a small portion of the fine bran particles and the germ and a large portion of the fibrous offal obtained from the "tail of the mill." This product must be obtained in the usual process of flour milling.

One sample, **17986,** exceeded the maximum fiber guaranty by 2.04 per cent. and exceeded also the tentative limit of fiber pre-

scribed for standard middlings[1] by 1.04 per cent. No deficiencies were found in protein or fat.

The average composition of feeds classed as middlings without further qualification has been, for the previous six years, protein 16.7, fiber 6.9 and fat 5.2 per cent.; the average shown by analyses this year is protein 17.5, fiber 6.9 and fat 5.2 per cent.

Red Dog Flour.

Red Dog Flour consists of a mixture of low-grade flour, fine particles of bran and the fibrous offal from the "tail of the mill."

Only three samples of this material have been examined this year. The guaranties of protein and fat were met, or reasonably substantiated, and the average fiber content did not exceed the tentative standard set for this product, viz., 4 per cent. One sample, **18046**, contained 4.27 per cent. of fiber.

Mixed Feed.

Wheat Mixed Feed (Mill Run Wheat Feed) consists of pure wheat bran and the gray or total shorts or flour middlings combined in the proportions obtained in the usual process of commercial milling.

Six samples were examined and all satisfied their guaranties of protein and fat. One sample, **17972**, exceeded the fiber content fixed for wheat feed[2] but the average was well below the tentative standard. The average for protein, fiber and fat as shown by analyses this year is 17.06, 7.68 and 5.13 per cent. respectively while the average for the same ingredients for the previous six years is 16.3, 7.8 and 5.0 per cent. respectively. It is apparent that protein content has increased while the other constituents have maintained the average.

Rye Products.

Rye Middlings or Rye Feed is the by-product obtained from the manufacture of ordinary "100 per cent" rye flour from cleaned and scoured rye grain.

The two samples of rye feed examined conformed to their guaranties for protein and fat.

Corn Gluten Feed.

Corn Gluten Feed is that portion of commercial shelled corn that remains after the separation of the larger part of the starch and the germs by the processes employed in the manufacture of cornstarch and glucose. It may or may not contain corn solubles.

[1] By the Association of Feed Control Officials, 1921.
[2] Ibid.

Four samples were examined which satisfied their guaranties of protein and fat except in case of **15724** where a deficiency of 1.41 per cent. in fat was found.

Corn Gluten Meal.

Corn Gluten Meal is that part of commercial shelled corn that remains after the separation of the larger part of the starch, the germ and the bran, by the processes employed in the manufacture of cornstarch and glucose. It may or may not contain corn solubles.

Only one sample was examined. It exceeded its guaranty in both protein and fat.

Hominy Feed.

Hominy Feed, Hominy Meal or Hominy Chop is the kiln-dried mixture of the mill run bran coating, the mill run germ, with or without a partial extraction of the oil and a part of the starchy portion of the white corn kernel obtained in the manufacture of hominy, hominy grits and corn meal by the degerminating process.

Eleven samples were examined. Three, **15752, 18060** and **18022** were deficient in fat and one, **17983**, contained an excess of fiber.

Corn Meal.

Only one sample was examined. It was of normal composition and quality.

Distillery and Brewery Products.

Two samples each of distillers' and brewers' dried grains were examined. They satisfied their respective guaranties except in case of **15755** which was 1.44 per cent. low in protein.

Dried Beet Pulp.

Dried Beet Pulp is the dried residue from sugar beets which have been cleaned and freed from crowns, leaves and sand, and which have been extracted in the process of manufacturing sugar.

Seven samples were examined. The guaranties of protein and fat were satisfactorily met and generally exceeded. No significant excess of fiber was found.

Proprietary Mixed Feeds.

The variety of sources from which these mixtures derive their nutrients results in a supplementing of nutritive qualities which is in harmony with modern ideas of efficient feeding. When compounded with materials of approved feeding value free from excess of hulls, screenings, etc., they are desirable feeds. As to

the economy of their use we are unable to discover any logical relation between selling price and composition. The ingredients of which these feeds are composed are generally stated on the tags and this information, although not required by law in this state, is valuable to the feeder.

Of fifty-one samples examined only five failed to satisfy their guaranties, and in only two of these were the deficiencies conspicuous. There was a deficiency in protein of 2.06 per cent. in **18023** and deficiencies in both protein and fat in **18047**, the amounts being 1.37 and 0.91 per cent. respectively.

Poultry Feeds.

Fifteen samples were analyzed. A deficiency in protein of 5.75 per cent. was found in **18008**.

SUMMARY OF DEFICIENCIES

Variations from guaranty greater than one per cent. in protein and in fiber and one-fourth of one per cent. in fat are summarized in Table II.

Table II.—Feeds not Conforming To Guaranties or Otherwise Illegal.

Station No.	Manufacturer and Brand.	Protein Deficiency.	Fat Deficiency.	Fiber Excess.	Remarks.
	Cottonseed Meal				
18067	Surety. American Cotton Oil Co., Memphis, Tenn.	2.62	....	....	.....
17989	Danish. Humphreys-Godwin Co., Memphis, Tenn.	....	....	....	Wire tags, illegal.
15728	Sun. A. C. Westervelt & Co., Memphis, Tenn.	....	....	....	Wire tags, illegal.
	Linseed Meal				
17998	Oil Meal. Kelloggs & Miller, Amsterdam, N. Y.	....	....	....	Wire tags, illegal.
	Wheat Middlings				
17986	Hecker-Jones-Jewell Milling Co., N. Y.	....	....	2.04	.....
	Wheat Feed (Mixed Feed)				
15722	Wirthmore. St. Albans Grain Co., St. Albans, Vt.	....	0.47	....	.....
	Corn Gluten Feed				
15724	Success. U. S. Food Products Corp. Peoria, Ill.	....	1.41	....	.....
	Hominy Feed				
15752	Illinois Snowflake. Illinois Feed & Elevator Co., Bloomington, Ill.	....	0.48	....	.....
17983	White. Kellogg Toasted Corn Flake Co., Battle Creek, Mich.	....	....	2.27	.....
18060	Plymouth. Plymouth Milling Co., Lemars, Iowa	....	2.00	....	.....
18022	Sparr Cereal Co., Marchfield, Wis.	....	0.55	....	.....
	Brewers' Products				
15755	Dried Brewers' Grains. Atlantic Export Co., N. Y.	1.44	....	....	.....
	Proprietary Mixed Feeds.				
18002	Blatchford's Calf Meal, Blatchford Calf Meal Co., Wauregan, Ill.	....	0.39	....	.....
18023	Vitality Milk Ration. Rosenbaum Bros., Chicago, Ill.	2.06	.. ..	....	.....
18026	Nobotheration Stock Feed. C. W. Campbell Co., Westerly, R. I.	....	1.09	....	.....
18047	Delaware. Delaware Mills, Deposite, N. Y.	1.37	0.91	....	.....
	Poultry Feeds				
18008	Wirthmore. St. Albans Grain Co., St. Albans, Vt.	5.75	....	....	.....

TABLE III.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	OIL SEED PRODUCTS.	
	Cottonseed Meal.	
18001	Longhorn. American Cotton Oil Co., Memphis, Tenn.	*Middletown:* Meech & Stoddard, Inc.
		Guaranty
18067	Surety. American Cotton Oil Co., Memphis, Tenn.	*Middletown:* Meech & Stoddard, Inc.
		Guaranty
18065	Monarch. Ashcraft-Wilkinson Co., Atlanta, Ga.	*Hartford:* Garber-Northam Grain Co.
		Guaranty
15747	Paramount. Ashcraft-Wilkinson Co., Atlanta, Ga.	*West Cheshire:* G. W. Thorpe.
		Guaranty
18028	St. Clair. East St. Louis Cotton Oil Co., National Stock Yards, Ill.	*Westerly:* C. W. Campbell Co.
		Guaranty
15726	Bull. Humphreys-Godwin Co., Memphis, Tenn.	*Willimantic:* Willimantic Grain Co.
		Guaranty
17989†	Danish. Humphreys-Godwin Co., Memphis, Tenn.	*Wallingford:* A. E. Hall
		Guaranty
15765	Dixie. Humphreys-Godwin Co., Memphis, Tenn.	*Rockville:* Rockville Milling Co.
		Guaranty
18054	Forfat. Humphreys-Godwin Co., Memphis, Tenn.	*Torrington:* D. L. Talcott
		Guaranty
17994	Economy. Lyle & Lyle, Huntsville, Ala.	*Plantsville:* C. A. Cowles
		Guaranty
15758	Syragold. Syracuse Milling Co., Syracuse, N. Y.	*Somers:* W. C. Everett
		Guaranty
17999	Taylor Commission Co., Atlanta, Ga.	*Middletown:* Meech & Stoddard, Inc.
		Guaranty
15721	Planet. A. C. Westervelt & Co., Memphis, Tenn.	*So. Coventry:* So. Coventry Grain Elevator
		Guaranty
15728†	Sun. A. C. Westervelt & Co., Memphis, Tenn.	*Willimantic:* E. A. Buck Co.
		Guaranty
		Average guaranty
		Average of analyses
		Average digestible
	Linseed Meal, Old Process.	
18043	Amco. American Milling Co., Peoria, Ill.	*New Haven:* R. G. Davis & Sons
		Guaranty
15729	Ground Oil Cake. Archer-Daniels Linseed Co., Buffalo, N. Y.	*Willimantic:* E. A. Buck Co.
		Guaranty

† Wire tags.

INSPECTION OF 1921.

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein (N x 6.25).	Fiber.	Nitrogen-free Extract (Starch, gum, etc.).	Ether Extract (Crude Fat).	
18001	5.59	7.35	43.31	8.13	26.37	9.25	$52.00
.....	....	....	43.00	12.00	25.00	6.00	.....
18067	6.50	5.67	33.38	14.74	33.55	6.16	.....
.....	....	....	36.00	14.00	27.00	5.50	.....
18065	5.38	7.35	44.06	7.73	27.49	7.99	51.00
.....	....	....	43.00	10.00	23.00	6.00	.....
15747	6.94	6.00	36.88	12.99	30.52	6.67	49.00
.....	....	....	36.00	14.00	27.00	5.50	.....
18028	7.03	6.41	36.88	11.70	31.64	6.34	50.00
.....	....	....	36.00	16.00	.....	5.00	.....
15726	6.01	6.77	42.75	8.60	28.88	6.99	43.00
.....	....	....	43.00	10.00	26.00	5.00	.....
17989	6.48	5.61	36.75	14.11	30.31	6.74	49.00
.....	....	....	36.00	15.00	25.00	5.00	.....
15765	6.02	6.09	42.56	8.84	29.18	7.31	50.00
.....	....	....	41.00	10.00	26.00	5.00	.....
18054	5.93	7.34	39.50	9.51	30.00	7.72	52.00
.....	....	....	38.55	12.00	25.00	5.00	.....
17994	6.24	6.63	36.44	11.11	32.37	7.21	49.00
.....	....	....	36.00	14.00	27.00	5.00	.....
15758	6.57	6.60	36.56	12.98	30.23	7.06	48.00
.....	....	....	36.00	15.00	25.00	5.00	.....
17999	6.84	5.90	37.56	11.98	29.31	8.41	48.00
.....	....	....	36.00	14.00	27.00	5.50	.....
15721	6.36	7.08	43.38	7.40	27.01	8.77	52.00
.....	....	....	43.00	10.00	26.00	6.00	.....
15728	5.83	6.28	38.06	12.19	30.60	7.04	48.00
.....	....	....	36.00	15.00	25.00	5.00	.....
.....	....	....	**38.53**	**12.92**	**25.69**	**5.32**	.....
.....	**6.26**	**6.50**	**39.14**	**10.85**	**29.85**	**7.40**	**49.30**
.....	....	....	**32.9**	**4.0**	**22.4**	**7.0**	.....
18043	8.22	5.94	31.06	8.87	40.26	5.65	54.00
....	....	....	30.00	....	....	5.00	....
15729	7.07	5.94	30.31	8.65	39.37	8.66	48.00
....	....	....	31.00	10.00	....	6.00	....

TABLE III.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	OIL SEED PRODUCTS—*Concluded*	
	Linseed Meal, Old Process—Concluded	
17998†	Oil Meal. Kellogg & Miller, Amsterdam, N. Y.	*Middlefield:* Middlefield Grain & Coal Co.
		Guaranty
18050	Linseed Cake. Linseed Products Co., Minneapolis, Minn.	*New Milford:* Geo. T. Soule.
		Guaranty
18016	Linseed Oil Meal. Mann Bros. Co., Buffalo, N. Y.	*Norwich:* Yantic Grain & Products Co.
		Guaranty
17988	Oil Meal. Spencer Kellogg & Sons, Inc., Undercliff, N. J.	*Wallingford:* A. E. Hall
		Guaranty
		Average guaranty
		Average of analyses
		Average digestible
	WHEAT PRODUCTS.	
	Wheat Bran.	
18020	Pennant. E. W. Bailey & Co., Montpelier, Vt.	*Norwich:* Yantic Grain and Products Co.
		Guaranty
18007	Bay State. Bay State Milling Co., Winona, Minn.	*New London:* Conn. Grain Corp.
		Guaranty
15734*	The Blair Milling Co., Atchison, Kans.	*East Haven:* F. A. Forbes
		Guaranty
18056*	Granite. J. G. Davis Co., Rochester, N. Y.	*Torrington:* D. L. Talcott
		Guaranty
15767*	Duluth Imperial. Duluth Superior Milling Co., Duluth, Minn.	*Rockville:* Rockville Grain & Coal Co.
		Guaranty
18019*	Duluth Imperial. Duluth Superior Milling Co., Duluth, Minn.	*Norwich:* Yantic Grain & Products Co.
		Guaranty
18053*	Lucky. Federal Mill & Lockport Elevator Co., N. Y.	*New Milford:* Geo. E. Ackley Co.
		Guaranty
15757	Pure. Grafton Roller Mill Co., Grafton, No. Dakota	*Thompsonville:* Geo. S. Phelps & Co.
		Guaranty
17995*	Choice. Hecker-Jones-Jewell Milling Co., N. Y.	*Plantsville:* C. A. Cowles
		Guaranty
15751	The Jenkinson Mills Co., Williston, No. Dakota.	*West Cheshire:* G. W. Thorpe.
		Guaranty
15738*	The Kaull Milling Co., Kansas City Kans.	*Branford:* S. V. Osborn
		Guaranty
15753	Niagara Pure. Niagara Falls Milling Co., Niagara Falls, N. Y.	*Thompsonville:* Geo. S. Phelps & Co.
		Guaranty

† Wire tags.
* With screenings.

INSPECTION OF 1921—*Continued.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein (N. x 6.25).	Fiber.	Nitrogen-free Extract (Starch, gum, etc.).	Ether Extract (Crude Fat).	
17998	7.97	6.20	31.13	8.73	39.62	6.35	$54.00
....	....	....	31.00	9.00	....	4.00	....
18050	8.20	6.11	29.75	7.84	40.67	7.43	50.00
....	....	....	30.00	....	....	5.00	....
18016	8.25	5.18	35.88	8.18	35.94	6.57	50.00
....	....	....	33.00	10.00	....	6.00	....
17988	8.02	6.27	30.00	8.55	40.78	6.38	50.00
....	....	....	31.00	10.00	....	5.00	....
....	....	....	**31.00**	**9.75**	....	**5.16**	....
....	**7.95**	**5.94**	**31.35**	**8.47**	**39.45**	**6.84**	**51.00**
....	....	....	**27.9**	**4.8**	**30.8**	**6.1**	....
18020	8.84	6.91	16.81	9.92	52.81	4.71	31.00
....	....	....	14.50	10.00	....	4.00	....
18007	8.58	6.32	16.13	9.94	53.78	5.25	30.00
....	....	....	13.00	....	....	3.00	....
15734	8.01	6.58	17.25	8.22	55.34	4.60	25.00
....	....	....	14.50	10.00	....	3.50	....
18056	8.57	5.88	17.00	8.63	56.56	3.36	34.00
....	....	....	14.00	....	....	3.00	....
15767	8.72	6.01	16.75	10.59	52.15	5.78	27.00
....	....	....	15.00	....	....	4.00	....
18019	8.15	5.81	17.13	9.59	53.43	5.89	31.00
....	....	....	15.00	....	....	4.00	....
18053	8.40	6.48	15.56	10.44	53.83	5.29	29.00
....	....	....	12.00	....	....	3.50	....
15757	7.19	6.19	16.75	9.50	54.63	5.74	27.00
....	....	....	15.00	....	....	3.00	....
17995	8.16	6.48	16.00	9.94	50.64	8.78	28.00
....	....	....	14.50	12.00	51.55	3.75	....
15751	7.45	6.59	16.00	10.82	53.36	5.78	25.00
....	....	....	15.49	....	....	4.39	....
15738	8.74	6.54	18.06	8.29	53.54	4.83	27.00
....	....	....	14.50	10.00	....	3.50	....
15753	7.53	6.11	17.94	8.48	54.66	5.28	27.00
....	....	....	16.00	....	....	3.50	....

TABLE III.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	WHEAT PRODUCTS—*Continued.*	
	Wheat Bran—Concluded.	
17992	Niagara Choice. Niagara Falls Milling Co., Niagara Falls, N. Y.	*Meriden:* August Grulich Est.
		Guaranty
17971*	Pillsbury's. Pillsbury Mills, Minneapolis, Minn.	*Ansonia:* Ansonia Flour & Grain Co.
		Guaranty
17969	Quaker City Flour Mills Co., Philadelphia, Pa.	*North Haven:* W. L. Thorpe.
		Guaranty
15766*	Washburn Mills, Minneapolis, Minn.	*Rockville:* Rockville Milling Co.
		Guaranty
18068*	Washburn-Crosby Co., Minneapolis, Minn.	*Middletown:* Meech & Stoddard, Inc.
		Guaranty
18024*	Pioneer. Western Canada Flour Mills Co., Canada	*Jewett City:* Jewett City Grain Co.
		Guaranty
17976*	Atkinson's. Made in Minneapolis, Minn.	*Southport:* C. Buckingham & Co.
		Guaranty
		Average guaranty
		Average of analyses
		Average digestible
	Wheat Middlings.	
17973	Bay State. Bay State Milling Co., Winona, Minn.	*Ansonia:* Ansonia Flour & Grain Co.
		Guaranty
18010*	Dairy Maid. Federal Mill & Elev. Co., Lockport, N. Y.	*New London:* P. Swartz Co.
		Guaranty
17986*	Hecker-Jones-Jewell Milling Co., New York	*Stamford:* W. L. Crabb
		Guaranty
15745*	Rex. Maple Leaf Milling Co., Toronto, Canada	*Hamden:* I. W. Beers
		Guaranty
17991	Niagara. Niagara Falls Milling Co., Niagara Falls, N. Y.	*Meriden:* August Grulich Est.
		Guaranty
18033*	Pillsbury's B. Pillsbury Mills, Minneapolis, Minn.	*Plainville:* Eaton Bros.
		Guaranty
17966	Quaker City. Quaker City Flour Mills Co., Philadelphia, Pa.	*North Haven:* W. L. Thorpe.
		Guaranty
18021*	Alta. Russell Miller Milling Co., Minneapolis, Minn.	*Norwich:* Yantic Grain & Products Co.
		Guaranty
15742*	Snowball. Shane Bros. & Wilson Co., Minneapolis, Minn.	*Guilford:* Fred C. Morse
		Guaranty
18005*	Angelus. Thompson Milling Co., Lockport, N. Y.	*New Britain:* C. W. Lines Co.
		Guaranty
15740*	Geo. Urban Milling Co., Buffalo, N. Y.	*Branford:* S. V. Osborn
		Guaranty

* With screenings.

INSPECTION OF 1921—*Continued.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein (N x 6.25).	Fiber.	Nitrogen-free Extract (Starch, gum, etc.).	Ether Extract (Crude Fat).	
17992	8.46	6.29	17.19	9.15	53.82	5.09	$29.00
....	....	....	16.00	....	....	3.50	....
17971	8.77	5.98	16.50	9.91	53.70	5.14	28.00
....	....	....	13.00	....	....	4.00	....
17969	8.85	6.33	15.38	8.54	56.17	4.73	27.00
....	....	....	13.00	....	....	3.00	....
15766	9.18	6.36	16.50	9.89	53.00	5.07	25.00
....	....	....	13.00	....	....	4.00	....
18068	8.84	6.65	15.63	10.09	54.39	4.40	....
....	....	....	13.00	....	....	4.00	....
18024	9.29	5.94	16.56	9.13	53.44	5.64	29.00
....	....	....	14.50	....	....	3.50	....
17976	7.13	6.52	16.25	9.78	54.97	5.35	30.00
....	....	....	13.00	....	....	4.00	....
....	....	....	14.15	10.50	....	3.64	....
....	8.36	6.31	16.60	9.51	53.92	5.30	28.27
....	....	....	12.6	4.0	40.1	3.3	....
17973	11.24	2.85	17.38	2.61	61.92	4.00	40.00
....	....	....	14.00	....	....	2.00	....
18010	8.25	4.72	16.38	6.36	59.25	5.04	30.00
....	....	....	13.00	....	....	3.00	....
17986	6.85	5.29	17.50	10.54	53.96	5.86	28.00
....	....	....	15.50	8.50	54.24	4.50	....
15745	8.72	4.47	17.63	7.93	55.42	5.83	28.00
....	....	....	16.00	....	....	5.50	....
17991	8.13	4.80	18.13	7.98	55.42	5.54	30.00
....	....	....	16.50	....	....	3.50	....
18033	9.09	5.35	16.88	8.56	55.58	4.54	33.00
....	....	....	14.00	....	....	4.00	....
17966	8.62	3.78	16.69	4.47	61.33	5.11	36.00
....	....	....	14.00	....	....	4.00	....
18021	7.99	5.10	19.00	8.01	53.50	6.40	34.00
....	....	....	15.00	....	....	4.50	....
15742	9.16	4.37	18.75	5.36	57.59	4.77	34.00
....	....	....	16.00	....	....	4.00	....
18005	8.38	4.76	16.94	7.16	57.85	4.91	32.00
....	....	....	11.00	....	....	3.00	....
15740	8.39	5.40	16.06	7.95	56.99	5.21	30.00
....	....	....	15.00	9.50	....	4.00	....

TABLE III.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	WHEAT PRODUCTS—*Concluded*	
	Wheat Middlings—Concluded	
18061*	Victor. Victor Flour Mills, Victor, N. Y.	*Winsted:* E. Manchester & Sons
		Guaranty
15720*	Standard. Washburn-Crosby Co., Minneapolis. Minn.	*Stafford Springs:* Dennis Grain Mill
		Guaranty
17974*	Atkinson's. Made in Minneapolis, Minn.	*Southport:* C. Buckingham & Co.
		Guaranty
		Average guaranty
		Average of analyses
		Average digestible
	Red Dog Flour.	
18046	Marshall Milling Co., Marshall, Minn.	*Danbury:* F. C. Benjamin
		Guaranty
18062	Komo. St.Paul Milling Co., St. Paul, Minn.	*Hartford:* Meech Grain Co.
		Guaranty
18041	Adrian. Washburn-Crosby Co., Minneapolis, Minn.	*New Haven:* R. G. Davis & Sons
		Guaranty
		Average guaranty
		Average of analyses
		Average digestible
	Wheat Feed (Mixed Feed).	
15754	Grafton. Grafton Roller Mill Co., Grafton, No. Dakota	*Thompsonville:* Geo. S. Phelps & Co.
		Guaranty
18045*	Pillsbury's Fancy. Pillsbury Mills, Minneapolis, Minn.	*Danbury:* H. E. Meeker
		Guaranty
15741	Occident. Russell Miller Milling Co., Minneapolis, Minn.	*Guilford:* Fred C. Morse
		Guaranty
15722	Wirthmore. St. Albans Grain Co., St. Albans, Vt.	*South Coventry:* South Coventry Grain Elev.
		Guaranty
17972	Gold Mine. Sheffield King Milling Co., Minneapolis, Minn.	*Ansonia:* Ansonia Flour & Grain Co.
		Guaranty
18057	Kent. Williams Bros. Co., Kent, Ohio	*Winsted:* E. Manchester & Sons
		Guaranty
		Average guaranty
		Average of analyses
		Average digestible

*With screenings.

INSPECTION OF 1921—*Continued.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein (N. x 6.25).	Fiber.	Nitrogen-free Extract (Starch, gum, etc.).	Ether Extract (Crude Fat).	
18061	8.56	5.37	17.50	7.38	55.29	5.90	$33.00
....	....	....	17.50	....	....	5.00	....
15720	9.61	5.03	17.69	7.67	54.71	5.29	26.00
....	....	....	14.00	....	....	4.00	....
17974	9.46	4.13	18.25	5.08	58.14	4.94	30.00
....	....	....	15.00	....	....	5.00	....
....	....	....	14.75	....	....	4.00	....
....	8.74	4.67	17.48	6.93	56.95	5.23	31.71
....	....	....	13.5	2.1	44.4	4.6	....
18046	9.88	3.60	18.06	4.27	59.85	4.34	44.00
....	....	....	15.00	....	....	4.00	....
18062	8.87	4.63	19.50	3.61	57.74	5.65	54.00
....	....	....	16.00	....	....	4.00	....
18041	9.68	2.63	16.75	2.99	64.18	3.77	43.00
....	....	....	16.00	....	....	4.00	....
....	....	....	15.66	....	....	4.00	....
....	9.47	3.62	18.10	3.62	60.60	4.59	47.00
....	....	....	15.93	1.30	53.32	3.95	....
15754	8.17	5.62	17.13	8.25	55.23	5.60	29.00
....	....	....	14.00	....	....	2.70	....
18045	8.53	4.59	17.94	6.49	57.21	5.24	36.00
....	....	....	14.00	....	....	4.00	....
15741	8.87	5.72	19.00	8.41	52.04	5.96	28.00
....	....	....	16.00	....	....	4.50	....
15722	8.68	4.43	16.75	6.40	59.54	4.20	38.00
....	....	....	15.00	....	....	4.50	....
17972	8.74	5.34	16.44	9.39	54.79	5.30	30.00
....	....	....	15.00	....	....	4.50	....
18057	8.84	5.27	15.13	7.18	59.10	4.48	38.00
....	....	....	16.00	....	....	3.50	....
....	....	....	15.00	....	....	3.95	....
....	8.64	5.16	17.06	7.68	56.33	5.13	33.16
....	....	....	13.14	2.76	42.82	4.44	....

TABLE III.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	RYE PRODUCTS.	
18040	Feed. Boutwell Milling Co., Troy, N. Y.	*New Haven:* R. G. Davis & Sons
		Guaranty
18055	Irving Mills Feed. Van Vechting Milling Co., Rochester, N. Y.	*Torrington:* D. L. Talcott
		Guaranty
	MAIZE PRODUCTS.	
	Corn Gluten Feed.	
15733	Buffalo. Corn Products Refining Co., N. Y.	*East Haven:* F. A. Forbes
		Guaranty
18000	Douglas. Penick & Ford., Inc., Chicago, Ill.	*Middletown:* Meech & Stoddard, Inc.
		Guaranty
17970	Staley's. A. E. Staley Mfg. Co., Decatur, Ill.	*Ansonia:* Ansonia Flour & Grain Co.
		Guaranty
15724	Success. U. S. Food Products Corp., Peoria, Ill.	*Willimantic:* Willimantic Grain Co.
		Guaranty
		Average guaranty
		Average of analyses
		Average digestible
	Corn Gluten Meal.	
18030	Diamond. Corn Products Refining Co., N. Y.	*Westerly:* C. W. Campbell Co.
		Guaranty
	Hominy Feed.	
17978	Homco. American Hominy Co., Indianapolis, Ind.	*Norwalk:* C. E. Slauson Co.
		Guaranty
15737	Emco. Evans Milling Co., Indianapolis, Ind.	*Branford:* S. V. Osborn
		Guaranty
15752	Illinois Snowflake. Illinois Feed & Elevator Co., Bloomington, Ill.	*Thompsonville:* Geo. S. Phelps & Co.
		Guaranty
17983	White. Kellogg Toasted Corn Flake Co., Battle Creek, Mich.	*Stamford:* W. L. Crabb
		Guaranty
18003	Badger. Chas. A. Krause Milling Co., Milwaukee, Wis.	*Middletown:* Meech & Stoddard, Inc.
		Guaranty
15743	Choice Steam Cooked. Miner-Hillard Milling Co., Wilkes-Barre, Pa.	*Guilford:* Fred C. Morse
		Guaranty
18066	Mystic. Mystic Mills, Sioux City, Iowa	*Hartford:* Garber-Northam Grain Co.
		Guaranty

INSPECTION OF 1921—*Continued.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein (N x 6.25).	Fiber.	Nitrogen-free Extract (Starch, gum, etc.).	Ether Extract (Crude Fat).	
18040	8.79	3.81	15.44	4.29	64.49	3.18	$32.00
....	....	....	13.50	....	....	3.00	....
18055	8.64	3.28	16.50	3.95	64.33	3.30	29.00
....	....	....	13.00	....	....	2.00	....
15733	6.50	5.13	25.50	7.15	52.52	3.20	38.00
....	....	....	23.00	....	....	1.00	....
18000	6.83	4.31	23.25	6.73	56.74	2.14	38.50
....	....	....	23.00	....	....	1.00	....
17970	8.50	3.60	24.44	6.62	54.43	2.41	40.00
....	....	....	23.00	....	....	1.00	....
15724	6.63	4.08	23.75	7.83	54.12	3.59	38.00
....	....	....	23.00	9.00	....	5.00	....
....	....	....	**23.00**	....	....	**2.00**	....
....	**7.11**	**4.28**	**24.23**	**7.08**	**54.47**	**2.83**	**38.62**
....	....	....	**20.6**	**3.9**	**49.0**	**2.6**	....
18030	7.79	1.56	45.25	11.61	30.73	3.06	54.00
....	....	....	40.00	....	....	1.00	....
17978	6.67	2.72	10.94	5.07	66.59	8.01	35.00
....	....	....	10.00	6.00	....	6.00	....
15737	8.49	2.99	11.75	4.97	62.13	9.67	34.00
....	....	....	10.00	7.00	55.00	7.50	....
15752	9.94	1.25	9.50	1.90	73.39	4.02	30.00
....	....	....	9.50	3.00	....	4.50	....
17983	6.57	2.51	11.00	7.27	65.62	7.03	37.00
....	....	....	10.00	5.00	55.00	5.00	....
18003	8.08	3.01	12.25	3.46	65.78	7.42	31.00
....	....	....	10.00	5.00	....	5.00	....
15743	8.55	2.13	10.81	4.68	68.19	5.64	31.00
....	....	....	10.00	5.00	....	4.00	....
18066	8.24	2.31	10.56	4.10	68.07	6.72	32.00
.....	....	....	8.50	5.00	65.00	4.00	.....

TABLE III.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	MAIZE PRODUCTS—*Concluded.*	
	Hominy Feed—Concluded	
15750	The Patent Cereal Co., Geneva, N. Y.	*West Cheshire:* G. W. Thorpe.
		Guaranty
18017	Plymouth. Plymouth Milling Co., Lemars, Iowa	*Yantic:* Yantic Grain & Products Co.
		Guaranty
18060	Plymouth. Plymouth Milling Co., Lemars, Iowa	*Winsted:* E. Manchester & Sons
		Guaranty
18022	Sparr Cereal Co., Marchfield, Wis.	*Yantic:* Yantic Grain & Products Co.
		Guaranty
		Average guaranty
		Average of analyses
		Average digestible
	Corn Meal.	
18069	Meech & Stoddard, Inc., Middletown	*Middletown:* Meech & Stoddard, Inc.
	DISTILLERS' PRODUCTS.	
18042	Corn Distillers' Dried Grains. American Milling Co., Peoria, Ill.	*New Haven:* R. G. Davis & Sons
		Guaranty
18059	Rossville Distillers' Dried Grains. The Rossville Co., Lawrenceburg, Ind.	*Winsted:* E. Manchester & Sons
		Guaranty
	BREWERS' PRODUCTS.	
15755	Dried Brewers' Grains. Atlantic Export Co., N. Y.	*Thompsonville:* Geo. S. Phelps & Co.
		Guaranty
15732	Fleischmann's Dried Grains. Fleischmann Co., Peekskill, N. Y.	*East Haven:* F. A. Forbes
		Guaranty
	DRIED BEET PULP.	
18004	Dried Beet Pulp. Clover Leaf Milling Co., Buffalo, N. Y.	*New Britain:* Stanley Svea Grain & Coal Co.
		Guaranty
18027	Dried Molasses-Beet Pulp. Larrowe Milling Co., Detroit, Mich.	*Westerly:* C. W. Campbell
		Guaranty
15744	Dried Beet Pulp. Larrowe Milling Co., Detroit, Michigan	*Hamden:* I. W. Beers
		Guaranty
17980	Dried Beet Pulp. Larrowe Milling Co., Detroit, Mich.	*Norwalk:* C. E. Slauson Co.
		Guaranty
17987	Dried Beet Pulp. Larrowe Milling Co., Detroit, Mich.	*Wallingford:* A. E. Hall
		Guaranty
17964	Dried Beet Pulp. Michigan Sugar Co., Saginaw, Mich.	*North Haven:* W. L. Thorpe
		Guaranty

INSPECTION OF 1921—*Continued.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein (N, x 6.25).	Fiber.	Nitrogen-free Extract (Starch, gum, etc.).	Ether Extract (Crude Fat).	
15750	6.97	2.78	11.38	5.15	67.97	5.75	$30.00
.....	....	....	10.00	5.00	60.00	5.00	.....
18017	6.84	2.62	11.31	4.22	66.40	8.61	34.00
.....	....	....	10.00	.....	.....	8.50	.....
18060	8.28	2.00	10.13	3.52	69.57	6.50	37.00
.....	....	....	10.00	.....	.....	8.50	.....
18022	7.76	2.16	10.25	4.10	68.28	7.45	34.00
.....	....	....	10.00	9.00	.....	8.00	.....
.....	....	....	9.81	5.55	58.44	6.00	.....
.....	7.85	2.40	10.89	4.40	67.48	6.98	33.18
.....	....	....	7.2	3.3	60.7	6.4	.....
18069	9.82	1.40	9.38	2.06	73.29	4.05	.....
18042	5.31	1.54	29.69	11.72	37.77	13.97	38.00
.....	....	....	28.00	15.00	30.00	8.00	.....
18059	5.34	3.15	31.13	12.17	35.40	12.81	53.00
.....	....	....	30.00	13.00	.....	10.00	.....
15755	5.85	3.45	23.56	12.28	47.55	7.31	39.00
.....	....	....	25.00	14.00	.....	6.00	.....
15732	5.03	2.45	19.94	16.33	48.46	7.79	25.00
.....	....	....	17.00	21.00	.....	6.00	.....
18004	7.69	3.21	9.38	19.45	58.81	1.46	37.00
.....	....	....	8.00	20.00	58.00	0.50	.....
18027	6.39	6.19	9.63	15.29	61.77	0.73	31.00
.....	....	6.00	8.00	20.00	54.00	....	.....
15744	6.21	3.09	8.93	20.13	60.98	0.66	35.00
.....	....	....	8.00	.....	.....	0.50	.....
17980	6.39	3.50	9.13	18.37	61.67	0.94	35.00
.....	....	....	8.00	20.00	58.00	0.50	.....
17987	5.83	2.67	9.88	20.09	60.59	0.94	.....
.....	....	....	8.00	20.00	58.00	0.50	.....
17964	6.32	3.53	9.69	19.95	59.63	0.88	32.00
.....	....	....	8.00	.....	.....	0.50	.....

TABLE III.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	DRIED BEET PULP—*Concluded*	
18011	Dried Beet Pulp. The Ubiko Milling Co., Cincinnati, Ohio	*Mystic:* Mystic Grain Co. Guaranty Average guaranty Average of analyses Average digestible
	PROPRIETARY MIXED FEEDS. *Horse, Dairy and Stock Feeds.*	
18002	Blatchford's Calf Meal. Blatchford Calf Meal Co., Waukegan, Ill	*Middletown:* Meech & Stoddard, Inc. Guaranty
18049	Schumacher Calf Meal. Quaker Oats Co., Chicago, Ill	*New Milford:* Geo. T. Soule Guaranty
18006	Portage Horse Feed. Akron Feed & Milling Co., Akron, Ohio	*New London:* Conn. Grain Corp. Guaranty
17982	Armour's Horse Feed. Armour Grain Co., Chicago, Ill	*Stamford:* W. L. Crabb Guaranty
18038	Big 4 Horse Feed. Clover Leaf Milling Co., Buffalo, N. Y	*New Haven:* Crittenden-Benham Co. Guaranty
15739	Morhaste Horse Feed. Curtiss Grain Corp., Buffalo, N. Y	*Branford:* S. V. Osborn Guaranty
15762	Kingfalfa Horse Feed. Hales & Hunter Co., Chicago, Ill	*Manchester:* Little & McKinney Guaranty
15759	Hamlin's Quality Feed. Dwight Hamlin, Pittsburgh, Pa	*Hazardville:* A. D. Bridges Sons Guaranty
17967	Besco Heavy Grain Horse Feed. G. C. Haste, Inc., New York	*North Haven:* W. L. Thorpe Guaranty
18025	Algrane Horse Feed. H-O Co.'s Mills, Buffalo, N. Y	*Westerly:* C. W. Campbell Co. Guaranty
18037	Chelsea Horse Feed. Park & Pollard Co., Boston, Mass	*Waterbury:* Spencer Grain Co. Guaranty
18031	Peters Arab Horse Feed. M. C. Peters Mills Co., Omaha, Neb	*Bristol:* Goodsell Bros. Guaranty
15756	Green Cross Horse Mixed Feed. Quaker Oats Co., Chicago, Ill	*Thompsonville:* Geo. S. Phelps & Co. Guaranty
15763	Mogul Mixed Feed. Quaker Oats Co., Chicago, Ill	*Manchester:* Little & McKinney Guaranty
18048	Wirthmore Pig Feed. C. M. Cox, Boston, Mass.	*New Milford:* Geo. T. Soule Guaranty
17963	Larrowe Hog Feed. Larrowe Milling Co., Detroit, Mich	*Rockville:* Rockville Grain & Coal Co. Guaranty

INSPECTION OF 1921—*Continued.*

Station No.	Pounds per Hundred. Water.	Ash.	Protein (N. x 6.25).	Fiber.	Nitrogen-free Extract (Starch, gum, etc.).	Ether Extract (Crude Fat).	Price per ton.
18011	5.81	2.96	10.06	19.73	60.34	1.10	$32.00
.....	....	....	8.00	20.00	60.00	0.50	.....
.....	....	....	**8.00**	**20.00**	**57.60**	**0.50**	.....
.....	**6.37**	**3.59**	**9.52**	**19.00**	**60.57**	**0.95**	**33.66**
.....	....	....	**5.0**	**15.8**	**50.2**	....	.....
18002	8.58	5.81	24.56	7.02	49.42	4.61	87.00
.....	....	....	24.00	.....	.....	5.00	.....
18049	7.24	6.22	20.63	2.42	54.48	9.01	98.00
.....	....	....	18.00	.....	.....	8.00	.....
18006	5.43	5.41	11.63	9.66	65.29	2.58	38.00
.....	....	....	10.00	.....	.....	2.00	.....
17982	6.50	4.53	12.13	10.64	61.30	4.90	44.00
.....	....	....	11.00	.....	.....	4.00	.....
18038	4.40	5.75	9.00	11.13	65.79	3.93	33.00
.....	....	....	9.00	.....	.....	2.00	.....
15739	6.48	5.86	9.63	8.85	65.45	3.73	35.00
.....	....	....	7.00	14.00	.....	3.00	.....
15762	5.49	6.93	11.56	12.04	61.60	2.38	42.00
.....	....	....	10.00	.....	.....	2.00	.....
15759	4.88	6.14	8.88	13.13	64.77	2.20	39.00
.....	....	....	9.00	.....	.....	1.50	.....
17967	5.27	4.11	10.81	8.28	67.61	3.92	42.00
.....	....	....	9.00	.....	.....	2.00	.....
18025	7.70	5.44	10.81	10.31	61.82	3.92	34.00
.....	....	....	11.00	9.75	.....	4.00	.....
18037	4.11	7.33	8.63	10.86	66.22	2.85	37.00
.....	....	....	9.00	.....	.....	2.00	.....
18031	5.64	6.30	11.00	10.73	63.64	2.69	43.00
.....	....	....	10.00	.....	.....	2.00	.....
15756	5.93	6.27	12.13	11.33	61.77	2.57	38.00
.....	....	....	10.00	.....	.....	2.50	.....
15763	5.16	7.36	9.25	16.80	58.99	2.44	42.00
.....	....	....	10.00	.....	.....	2.50	.....
18048	8.43	10.15	20.25	8.10	47.22	5.85	49.00
.....	....	....	18.00	.....	.....	5.00	.....
17963	8.14	5.99	23.13	7.60	48.46	6.68	58.00
.....	....	....	18.00	.....	.....	5.00	.....

TABLE III.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	PROPRIETARY MIXED FEEDS—*Continued.*	
	Horse, Dairy and Stock Feeds—Continued.	
18013	Nobotheration. C. W. Campbell Co., Westerly, R. I.	*Mystic:* J. L. Manning Co.
		Guaranty
15760	Unicorn Dairy Ration. Chapin & Co., Hammond, Ind.	*Hazardville:* A. D. Bridge's Sons
		Guaranty
15748	Eshelman's 25 Dairy Ration. John W. Eshelman & Son, Lancaster, Pa.	*West Cheshire:* G. W. Thorpe.
		Guaranty
15727	Grandin's Twin-Six Dairy Feed. D. H. Grandin, Milling Co., Jamestown, N. J.	*Willimantic:* Willimantic Grain Co.
		Guaranty
17996	Read The Tag Dairy Feed. H-O Cereal Co., Inc., Buffalo, N. Y.	*Plantsville:* C. A. Cowles.
		Guaranty
17962	Larro Dairy Feed. Larrowe Milling Co., Detroit, Mich.	*Rockville:* Rockville Grain & Coal Co.
		Guaranty
18058	Red Star Dairy Feed. E. Manchester & Sons, Winsted.	*Winsted:* E. Manchester & Sons
		Guaranty
17990	Barford's Balanced Ration. Meech & Stoddard, Inc., Middletown	*Meriden:* Meriden Grain & Coal Co.
		Guaranty
18070	Experimental Dairy Ration. Meech & Stoddard, Inc., Middletown	*Middletown:* Meech & Stoddard, Inc.
		Guaranty
18036	Stevens 44 Dairy Ration. Park & Pollard Co., Boston, Mass.	*Waterbury:* Spencer Grain Co.
		Guaranty
17965	Pillsbury's Dairy Ration. Pillsbury Flour Mills Co., Minneapolis, Minn.	*North Haven:* W. L. Thorpe.
		Guaranty
17979	Protena Dairy Feed. Purina Mills Co., Ralston	*Norwalk:* C. E. Slauson Co.
		Guaranty
18039	Purina Cow Chow. Purina Mills, St. Louis	*New Haven:* Crittenden-Benham Co.
		Guaranty
15719	Big Q Dairy Ration. Quaker Oats Co., Chicago, Ill.	*Stafford Springs:* Dennis Grain Mill
		Guaranty
18023	Vitality Milk Ration. Rosenbaum Bros., Chicago, Ill.	*Jewett City:* Jewett City Grain Co.
		Guaranty
15730	Syragold Dairy Feed. Syracuse Milling Co., Syracuse, N. Y.	*Willimantic:* Boston Grain Co.
		Guaranty
15749	Red Brand Ti-O-Ga Dairy Feed. Tioga Mill and Elev. Co., Waverly, N. Y.	*West Cheshire:* G. W. Thorpe.
		Guaranty

INSPECTION OF 1921—*Continued.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein (N. x 6.25).	Fiber.	Nitrogen-free Extract (Starch, gum, etc.).	Ether Extract (Crude Fat).	
18013	8.25	4.04	20.44	6.10	56.36	4.81	$37.00
.....	.....	.....	20.00	9.00	.....	4.00	.....
15760	6.72	8.02	25.25	8.23	45.76	6.02	47.00
.....	.....	.....	24.00	.....	.....	4.50	.....
15748	7.22	4.82	27.75	9.46	45.52	5.23	41.00
.....	.....	.....	25.00	.....	.....	5.00	.....
15727	7.04	5.57	24.44	9.01	48.10	5.84	41.00
.....	.....	.....	22.00	12.00	.....	5.00	.....
17996	5.98	5.27	23.63	7.26	52.62	5.24	40.00
.....	.....	.....	20.00	9.50	.....	5.00	.....
17962	8.42	4.88	21.50	11.72	49.05	4.43	45.00
.....	.....	.....	20.00	.....	.....	3.50	.....
18058	7.36	5.94	23.25	10.40	46.23	6.82	48.00
.....	.....	.....	23.00	.....	.....	4.00	.....
17990	7.35	5.17	20.06	8.84	51.83	6.75	44.00
.....	.....	.....	19.00	.....	.....	5.50	.....
18070	8.60	4.60	17.38	8.09	56.36	4.97	.....
.....	.....	.....	.....	.....	.....	.....	.....
18036	7.16	7.25	23.38	13.63	42.45	6.13	44.00
.....	.....	.....	24.00	.....	.....	5.00	.....
17965	8.03	7.27	19.75	9.75	50.21	4.99	45.00
.....	.....	.....	19.00	.....	.....	4.00	.....
17979	4.86	7.56	19.56	9.51	53.86	4.65	35.00
.....	.....	.....	16.50	.....	.....	3.50	.....
18039	3.28	7.11	26.56	11.47	46.33	5.25	51.00
.....	.....	.....	24.00	.....	.....	4.30	.....
15719	7.47	5.59	20.56	10.33	49.69	6.36	48.00
.....	.....	.....	21.00	.....	.....	4.50	.....
18023	7.02	7.15	22.94	9.44	48.53	4.92	48.00
.....	.....	.....	25.00	.....	.....	4.50	.....
15730	6.84	6.21	25.50	9.14	44.23	8.08	43.00
.....	.....	.....	24.00	.....	.....	4.50	.....
15749	7.12	6.50	27.88	10.38	42.36	5.76	42.00
.....	.....	.....	23.00	11.00	.....	3.50	.....

TABLE III.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	PROPRIETARY MIXED FEEDS—*Concluded.*	
	Horse, Dairy and Stock Feeds—Concluded.	
18018	Biles Ready Dairy Ration. Ubiko Milling Co., Cincinnati, Ohio	*Yantic:* Yantic Grain & Products Co.
		Guaranty
15725	Hi-Lo Dairy Ration. U. S. Food Products Co., Peoria, Ill.	*Willimantic:* Willimantic Grain Co.
		Guaranty
18044	Tes-Ted Dairy Feed. U. S. Food Products Co., Peoria, Ill.	*New Haven:* R. G. Davis & Sons
		Guaranty
18009	Iroquois Stock Feed. Armour Grain Co., Chicago, Ill.	*New London:* P. Swartz Co.
		Guaranty
18012	Pennant Brand Stock Feed. E. W. Bailey & & Co., Swanton, Vt.	*Mystic:* Mystic Grain Co.
		Guaranty
18026	Nobotheration Stock Feed. C. W. Campbell Co., Westerly, R. I.	*Westerly:* C. W. Campbell Co.
		Guaranty
18047	Delaware. Delaware Mills, Deposite, N. Y.	*Brookfield:* C. R. Dubia
		Guaranty
18014	New England Stock Feed. H-O Co.'s Mills, Buffalo, N. Y.	*Mystic:* J. L. Manning Co.
		Guaranty
18015	Homestead Stock Feed. Illinois Feed & Elevator Co., Bloomington, Ill.	*Yantic:* Yantic Grain & Products Co.
		Guaranty
18052	Bull Brand Stock Feed. Maritime Milling Co., Buffalo, N. Y.	*New Milford:* Geo. E. Ackley Co.
		Guaranty
18051	M. & S. Stock Feed. Meech & Stoddard, Inc., Middletown	*New Milford:* Geo. E. Ackley Co.
		Guaranty
18035	Stock Feed. Park & Pollard Co., Boston, Mass.	*Waterbury:* Spencer Grain Co.
		Guaranty
18968	Iowa Stock Feed. Purity Oats Co., Davenport, Iowa	*North Haven:* W. L. Thorpe.
		Guaranty
15746	Schumacher Sugured Feed. Quaker Oats Co., Chicago, Ill.	*Hamden:* I. W. Beers
		Guaranty
15764	White Diamond Stock Feed. Quaker Oats Co., Chicago, Ill.	*Manchester:* Little & McKinney
		Guaranty
15731	Charlestock Feed. St. Albans Grain Co., St. Albans, Vt.	*Willimantic:* Boston Grain Co.
		Guaranty
15723	Wirthmore Stock Feed. St. Albans Grain Co., St. Albans, Vt.	*South Coventry:* South Coventry Grain Elev.
		Guaranty
17975	Syragold Stock Feed. Syracuse Milling Co., Syracuse, N. Y.	*Southport:* C. Buckingham & Co.
		Guaranty

INSPECTION OF 1921—*Continued.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein (N. x 6.25)	Fiber.	Nitrogen-free Extract (Starch, gum, etc.).	Ether Extract (Crude Fat).	
18018	7.30	7.82	23.06	8.91	44.76	8.15	$47.00
.....	....	....	24.00	10.00	50.00	5.00	.....
15725	6.89	6.51	23.94	8.63	49.16	4.87	39.00
.....	....	....	22.00	9.00	.....	4.00	.....
18044	8.04	7.71	26.13	8.97	44.18	4.97	43.00
.....	....	....	24.00	9.00	.....	5.00	.....
18009	7.46	5.51	11.38	12.51	57.07	6.07	28.50
.....	....	....	10.00	.....	.....	4.00	.....
18012	7.04	4.03	9.13	10.62	63.00	6.18	32.00
.....	....	....	9.00	10.00	.....	5.00	.....
18026	9.06	4.24	11.00	11.63	60.16	3.91	31.00
.....	....	....	10.00	12.00	.....	5.00	.....
18047	9.74	4.46	8.63	8.52	65.56	3.09	36.00
.....	....	....	10.00	.....	.....	4.00	.....
18014	7.33	4.71	9.44	11.40	62.82	4.30	36.00
.....	....	....	9.50	.....	.....	4.00	.....
18015	8.78	2.58	8.75	8.20	68.44	3.25	34.00
.....	....	....	9.00	.....	.....	3.00	.....
18052	8.12	3.76	11.56	11.12	61.26	4.18	33.00
.....	....	....	11.00	.....	.....	4.00	.....
18051	8.47	3.51	9.63	9.27	64.69	4.43	33.00
.....	....	....	9.00	.....	.....	3.00	.....
18035	8.67	5.02	8.38	9.74	65.11	3.08	32.00
.....	....	....	9.00	.....	.....	2.50	.....
17968	7.61	4.26	9.69	12.11	62.34	3.99	34.00
.....	....	....	10.00	12.75	.....	4.00	.....
15746	6.92	4.98	11.38	11.95	60.59	4.18	34.00
.....	....	....	10.00	.....	.....	3.25	.....
15764	6.95	3.77	8.56	11.16	66.06	3.50	32.00
.....	....	....	8.00	14.00	60.00	3.00	.....
15731	6.76	3.56	10.00	9.71	64.79	5.18	31.00
.....	....	....	10.00	14.00	50.00	4.00	.....
15723	8.12	2.48	9.31	5.90	69.30	4.89	32.00
.....	....	....	9.00	.....	.....	4.00	.....
17975	8.06	4.96	11.00	11.68	59.71	4.59	32.00
.....	....	....	9.00	.....	.....	3.00	.....

TABLE III.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	POULTRY FEEDS	
17984	Cak-Cak Laying Mash. Armour Grain Co., Chicago, Ill.	*Stamford:* W. L. Crabb.
		Guaranty
17985	Iroquois Poultry Mash. Armour Grain Co., Chicago, Ill.	*Stamford:* W. L. Crabb.
		Guaranty
17977	Blatchford's Fill the Basket Egg Mash. Blatchford's Calf Meal Co., Wauregan, Ill.	*Norwalk:* C. E. Slauson Co.
		Guaranty
18029	Nobotheration Dry Mash. C. W. Campbell Co., Westerly, R. I.	*Westerly:* C. W. Campbell Co.
		Guaranty
18034	Eshelman's Laying Mash. John W. Eshelman & Son, Lancaster, Pa.	*Plainville:* F. B. Newtown Est.
		Guaranty
15761	Red Comb Egg Mash. Hales & Hunter Co., Chicago, Ill.	*Manchester:* Little & McKinney
		Guaranty
18032	Laying Mash. H-O Cereal Co., Inc., Buffalo, N. Y.	*Bristol:* Goodsell Bros.
		Guaranty
18064	Blue Top Laying Mash. Chas. A. Krause Milling Co., Milwaukee, Wis.	*Hartford:* Garber-Northam Grain Co.
		Guaranty
17997	M. & S. Dry Mash. Meech & Stoddard, Inc., Middletown	*Middlefield:* Middlefield Grain & Coal Co.
		Guaranty
18063	M. & S. Dry Mash. Meech & Stoddard, Inc., Middletown	*Hartford:* Meech Grain Co.
		Guaranty
17981	Lay or Bust. Park & Pollard Co., Boston, Mass.	*Norwalk:* C. E. Slauson Co.
		Guaranty
17993	Purina Chicken Chowder. Purina Mills, St. Louis	*Meriden:* August Grulick Est.
		Guaranty
15718	Ful-O-Pep Dry Mash. Quaker Oats Co., Chicago, Ill.	*Stafford Springs:* DennisGrain Mill
		Guaranty
18008	Chic-Chuck Concentrated Poultry Food. Russia Cement Co., Gloucester, Mass.	*New London:* P. Swartz Co.
		Guaranty
15735	Wirthmore Buttermilk Mash Feed. C. M. Cox Co., Boston, Mass.	*East Haven:* F. A. Forbes.
		Guaranty
15736	Dried Buttermilk. Buttermilk Sales Co., Chicago, Ill.	*East Haven:* F. A. Forbes.

MISCELLANEOUS SAMPLES.

Partial or complete analyses of feeding stuffs submitted by individuals during the past year are given in Table IV. This station is not responsible for the sampling of these materials but only for the accuracy of the analyses of the samples as received by us. We are justified in making such examinations only insofar as they may be of public interest and concern and to this end as complete information as may be given should accompany samples thus submitted; that is to say, brand, name, manufacturer and guaranty should be stated if known. Most of the samples thus examined were for the purpose of checking guaranties or for information to be used in the compounding of rations.

INSPECTION OF 1921—*Concluded.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein (N. x 6.25).	Fiber.	Nitrogen-free Extract (Starch, gum, etc.).	Ether Extract (Crude Fat).	
17984	7.07	7.15	21.75	8.01	50.18	5.84	$54.00
.....	....	....	20.00	.....	.....	3.00	.....
17985	8.07	4.42	16.69	20.22	43.58	7.02	51.00
.....	....	....	15.00	.....	.....	4.00	.....
17977	6.10	14.35	20.63	8.67	45.19	5.06	75.00
.....	....	....	19.00	.....	.....	4.00	.....
18029	8.81	10.41	18.88	7.54	48.43	5.93	47.00
.....	....	....	18.00	.....	.....	2.00	.....
18034	8.59	8.10	23.50	5.70	47.08	7.03	53.00
.....	....	....	20.00	.....	.....	5.00	.....
15761	7.07	8.83	16.13	5.00	57.31	5.66	63.00
.....	....	....	16.00	.....	.....	4.50	.....
18032	7.45	4.86	17.56	4.50	60.10	5.53	47.00
.....	....	....	17.00	6.00	.....	4.50	.....
18064	8.28	7.09	20.38	7.03	51.98	5.24	60.00
.....	....	....	20.00	.....	.....	5.00	.....
17997	7.77	7.72	18.13	6.81	54.64	4.93	56.00
.....	....	....	12.00	8.00	.....	3.00	.....
18063	7.47	8.01	19.31	6.87	53.38	4.96	58.00
.....	....	....	12.00	.....	.....	3.00	.....
17981	6.60	9.58	20.56	5.79	52.92	4.55	53.00
.....	....	....	18.00	.....	.....	1.50	.....
17993	7.56	7.27	19.75	8.58	51.42	5.42	60.00
.....	....	....	19.00	.....	.....	4.00	.....
15718	8.09	9.67	21.75	7.54	47.32	5.63	68.00
.....	....	....	20.00	.....	.....	4.00	.....
18008	6.31	48.39	39.25	1.17	3.26	1.62	72.00
.....	....	....	45.00	.....	.....	2.00	.....
15735	7.33	6.05	19.75	6.15	56.12	4.60	52.00
.....	....	....	20.00	...	.....	4.00	.....
15736	8.01	10.71	33.00	.....	38.86	9.42	165.00

TABLE IV.—ANALYSES OF FEEDING STUFFS,

Station No.	Material.	Submitted by
	HAY, ENSILAGE, ETC.	
16576	Hay	*Orange:* Fairlea Farm
18589	Silage	Fairlea Farm
16574	Silage	Fairlea Farm
18573	Alfalfa	Fairlea Farm
16575	Alfalfa	Fairlea Farm
16572	Alfalfa Meal	Fairlea Farm
	WHEAT PRODUCTS.	
18250	Wheat Feed	*Middletown:* Meech & Stoddard, Inc.
18251	Red Dog	Meech & Stoddard, Inc.
	CORN PRODUCTS.	
17003	Farmer Jones Gluten Feed	*Newtown:* E. S. Lovell
16467	Stowell's Evergreen Sweet Corn Seed	*Middletown:* F. C. Hubbard
	COTTONSEED PRODUCTS.	
18668	Cottonseed Feed	*Wallingford:* W. S. Fushey
	OAT PRODUCTS.	
18477	Ground Oats	*Rockville:* H. B. Pomeroy
18478	Ground Oats	H. B. Pomeroy
16606	Ground Oats	*Colchester:* L. Broder
	BEET PULP.	
16573	Beet Pulp	*Orange:* Fairlea Farm
17408	Beet Pulp	*Suffield:* Hill Top Farm
	DISTILLERS' GRAINS.	
17820	Distillers' Grains	*Bridgeport:* C. L. Bill
16653	Distillers' Grains	*Fairfield:* R. H. Holcomb
	STOCK FEED, POULTRY FEEDS, ETC.	
17787	Delaware Dairy Feed	*Brookfield:* C. R. Dubia
18562	Dairy Ration	*Farmington:* Winchell Smith's Grist Mill
16969	Mule and Horse Feed	*Hartford:* American Sumatra Tobacco Co.
16970	Mule and Horse Feed	American Sumatra Tobacco Co.
16728	Horse Feed	American Sumatra Tobacco Co.
16727	Horse Feed	American Sumatra Tobacco Co.
16980	Arrow Head Mule Feed	American Sumatra Tobacco Co.
18475	Badger Stock Feed	Garber-Northam Grain Co.
18476	Badger Stock Feed	Garber Northam Grain Co.

SUBMITTED BY INDIVIDUALS.

Station No.	Pounds per Hundred.						Remarks.
	Water.	Ash.	Protein (N x 6.25).	Fiber.	Nitrogen-free Extract (Starch, gum, etc.).	Ether Extract (Crude Fat).	
16576	15.35	5.16	8.90	13.31	53.53	3.75	
18589	66.05	1.68	2.25	9.98	19.26	0.78	
16574	82.14	1.12	1.72	5.72	8.85	0.45	
18573	8.95	5.71	12.64	36.64	34.29	1.77	
16575	14.85	10.21	21.66	31.94	19.76	1.58	
16572	7.66	7.92	12.75	33.45	36.50	1.72	
18250	7.04	.....	17.25	7.51	.....	7.00	Guaranty, Protein 13, Fiber 12, Fat 3.
18251	7.67	.....	17.50	1.77	.....	4.31	Guaranty, Protein 15, Fiber 10, Fat 4.
17003	.....	.....	25.75	.....	.....	.....	Guaranty, Protein 23.
16467	15.22	.....	.....	.....	.....	.....	
18668	.....	.....	35.94	.....	.....	.....	
18477	.....	.....	13.00	.....	.....	.....	
18478	.....	.....	12.75	.....	.....	.....	
16606	.....	.....	12.38	.....	.....	.....	
16573	8.34	3.58	9.38	18.11	59.57	1.02	
17408	.....	4.26	9.50	.....	.....	.....	Ash insol. in acid 0.83.
17820	91.6	.....	1.60	.....	.....	.....	
16653	78.04	0.99	4.22	1.46	13.96	1.33	
17787	.....	.....	24.13	.....	.....	.....	
18562	7.68	.....	22.50	.....	.....	5.49	
16969	.....	.....	12.38	.....	.....	.....	
16970	.....	.....	11.31	.....	.....	.....	
16728	.....	.....	10.63	.....	.....	.....	
16727	.....	.....	10.50	.....	.....	.....	
16980	.....	.....	9.73	.....	.....	.....	
18475	.....	.....	8.75	.....	.....	.....	
18476	.....	.....	8.69	.....	.....	.....	

TABLE IV.—ANALYSES OF FEEDING STUFFS

Station No.	Material.	Submitted by
	STOCK FEED, POULTRY FEEDS, ETC.—*Concluded*	
17625	Stock Feed	*Middletown:* State Hospital for Insane
17626	Stock Feed	State Hospital for Insane
18523	Stock Feed	State Hospital for Insane
18524	Special Dairy Feed	The Coles Co.
17406	Four All Stock Feed	*Milwaukee: Wis.,* Smith Milling Co.
17405	Smith's Balanced Ration	Smith Milling Co.
17407	Vitex Dairy Ration	Smith Milling Co.
17894	Hog Feed	*New Milford:* W. B. Hatch
18637	Meat Scrap	Herman F. Engleman
18647	Dried Buttermilk	*Norwich:* H. Ojyrerman
16571	Dairy Ration	*Orange:* Fairlea Farm
16570	Stock Feed	Fairlea Farm
18568	Stock Feed	Fairlea Farm
18567	Dairy Ration	Fairlea Farm
17907	Crosby's Ready Ration	*Shelton:* J. H. Loverin
18141	Chick Feed	*West Hartford:* G. L. Ellsworth
18179	Beef Scrap	*Yantic:* Yantic Grain Co.
	MISCELLANEOUS.	
18252	Stock Molasses	*West Cornwall:* S. R. Scoville
17641	Feed Molasses	*Lakeville:* H. F. Hamlin
17642	Feed Molasses	H. F. Hamlin
17643	Feed Molasses	H. F. Hamlin
17657	Corn Juice from Silo	*Hartford:* Thos. Holt
17867	Silo Liquid	*Guilford:* Wilcox Bros.
18235	Low Grade Flour	*Storrs:* Conn. Agr. College
18711	Bean Meal	*Middletown:* John H. Fay
16719	Feed	*Cromwell:* A. N. Pierson
16368	Nears Mixture Stock Food	*Kent:* F. B. Segar
16369	Gold Medal Stock Food	F. B. Segar
16370	Carpenter Stock Food	F. B. Segar
16526	Gold Medal Stock Food	*Washington:* Dodge Farm

SUBMITTED BY INDIVIDUALS—*Concluded.*

Station No.	Pounds per Hundred. Water.	Ash.	Protein (N x 6.25).	Fiber.	Nitrogen-free Extract (Starch, gum, etc.).	Ether Extract (Crude Fat).	Remarks.
17625	10.76	.....	15.25	.....	.....	4.80	
17626	10.76	.....	15.25	.....	.....	4.88	
18523	6.57	5.89	22.75	9.43	47.78	7.58	
18524	.....	.....	22.81	.....	.....	.....	
17406	10.04	.....	15.13	12.01	.....	4.30	Guaranty, Protein 12, Fiber 12, Fat 4.
17405	10.29	.....	18.25	10.39	.....	5.09	
17407	9.73	.....	27.13	12.56	.....	6.17	
17894	.....	.....	55.88	.....	.....	.....	Guaranty, Protein 55-65.
18637	5.30	22.41	39.95	.....	.....	.....	
18647	8.02	10.70	34.89	.....	36.59	9.80	Guar., Moisture 6, Ash 8.7 Protein 36.1, Fat 7.2.
16571	8.54	6.58	21.25	10.33	47.48	5.82	
16570	9.05	4.01	14.50	7.28	59.31	5.85	
18568	6.85	5.24	19.38	8.28	54.87	5.38	
18567	7.31	5.18	19.63	8.09	54.41	5.38	
17907	.....	.....	26.88	.....	.....	.....	
18141	.....	.....	17.06	.....	.....	.....	
18179	.....	.....	45.13	.....	.....	.....	Guaranty, Protein 45.
18252	19.41	9.02	4.19	.....	58.58	.....	Sugar, calc. as invert, 58.58
17641	18.37	.....	2.74	.....	62.72	.....	" " " " 62.72
17642	24.62	.....	4.13	.....	58.93	.....	" " " " 58.93
17643	24.69	.....	4.25	.....	55.94	.....	" " " " 55.94
17657	92.40	1.37	1.31	.....	0.72	.....	" " " " 0.72; alcohol 1.10.
17867	.....	.....	.....	.....	.....	.....	Alcohol 1.22.
18235	.....	.....	15.75	.....	.....	.....	
17811	.....	.....	4.88	.....	.....	.....	Probably carob bean and pod meal.
16719	.....	.....	12.25	.....	.....	.....	
16368	.....	.....	.....	.....	.....	.....	[1]
16369	.....	.....	.....	.....	.....	.....	[2]
16370	.....	.....	.....	.....	.....	.....	[3]
16526	.....	17.23	16.25	.....	.....	.....	[4]

[1] Contains charcoal, sulphur, salt, carbonates, Epsom salt, vegetable bitters; probably also fenugreek.

[2] Substantially same as 16368.

[3] Contains charcoal, sulphur, salt; probably also flaxseed meal and fenugreek.

[4] Substantially same as 16368.

CONNECTICUT
AGRICULTURAL EXPERIMENT STATION
NEW HAVEN, CONN.

BULLETIN 239 MAY, 1922

WILDFIRE OF TOBACCO IN CONNECTICUT

By GEORGE P. CLINTON and FLORENCE A. McCORMICK

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The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

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WILDFIRE OF TOBACCO IN CONNECTICUT.

GEORGE P. CLINTON AND FLORENCE A. MCCORMICK.

Introduction.

State Survey. The question of establishing a sub-station for tobacco experimentation having been presented to the Director of the New Haven Station early in 1920 by County Agent B. G. Southwick of Hartford County, it was decided that before any definite decision was given there should be made some preliminary investigations. These were to include a canvass of the opinions of tobacco growers toward such a proposition and a survey of the tobacco districts, to determine the diseases and injuries with which the growers had to contend. In 1920 this survey was undertaken by the joint financial coöperation of the Experiment Station, the Hartford County Farm Bureau and the Extension Service of the Connecticut Agricultural College. Somewhat similar work was undertaken by the Massachusetts Station in that state. In Connecticut the work resolved itself largely into a disease survey of tobacco seedbeds and fields, for which Mr. Southwick served as a scout, in connection with his interviews with the growers, and the writers as the botanical investigators of the troubles brought to light.

After the preliminary work of seedbed examinations by Mr. Southwick and Dr. Clinton in May and June, it was decided to facilitate the field work by establishing, during July and August, a small laboratory at the Farm Bureau headquarters in Hartford with Dr. McCormick in charge, Dr. Clinton being in Europe. During the entire season of 1921 the work was continued with even more intensity. No field laboratory was maintained this year at Hartford, the work being done at New Haven, but considerable experimental work was carried on at the Station's new tobacco farm at Windsor, the state by that time having authorized by law tobacco investigations for which an appropriation was given. Mr. G. E. Graham, assistant in the botanical department of the Experiment Station, helped with the various experiments there and elsewhere in 1921.

In the disease survey considerable data were obtained, much of which, however, was merely an extension of the knowledge of diseases and injuries that had been previously studied more or less intensively by the Station botanist. It is hoped to present this and further data in future bulletins from this department. One of the striking features of the survey was the discovery of a tobacco disease, new to the state, which has now proved to be quite serious under certain conditions. It is with this trouble, popularly known as wildfire, that this bulletin has to deal.

Nature of the Disease. As a result of one of the field examinations in late June, 1920, Mr. Southwick sent to New Haven plants from Tariffville showing an unusual leaf spot trouble, but no definite information concerning it was obtained at that time because of the poor condition of the material when received. Later at Hartford Dr. McCormick, in examinations of other material brought to the laboratory by a grower from Poquonock, found the diseased spots accompanied by bacteria with which she was able to produce infection on healthy plants.

The subsequent studies of the disease by the writers have been made, 1st, to thoroughly convince themselves of its bacterial nature, since some growers have been very sceptical as to its identity and the damage it might cause, and 2d, to find practical methods for its control, since, in 1920 and even more so in 1921, it proved a serious trouble in certain localities and fields.

General Description. The disease is generally limited to the leaves, and under certain conditions does not prove serious, but with the right weather conditions its possibilities of injury are unusually great. It belongs with the leaf spot troubles of which several have been found in this state. It differs, however, from all the other leaf spots by certain definite characters, usually evident to the ordinary observer. In both the seedbed and field, infected plants develop yellow discolorations in the normally green tissues and these spots are usually rounded and about the size of a finger tip. In their center there is a small point of white to brownish dead tissue that indicates the origin of the spot. In time the dead center encroaches on the yellow discoloration limiting it to a more or less narrow encircling band, the so-called halo. If numerous enough the spots cause death of intervening tissues so that eventually a very large part of the leaf surface is killed in an irregular way as if by sun scorch. The appearance then is much like the so-called rust that follows calico, but usually even at this late stage the yellow halo rings are still evident for definite identification.

Distribution.

In Other Countries. Because the blue mold, a menace to tobacco in certain parts of Asia and Australia, has recently appeared in this country, some persons have thought that wildfire has been imported from similar tobacco districts into the United States. Wolf and Moss (33, p. 25.) in 1919 stated that "it is presumably identical with a disease which has been recently reported from Connecticut and from the Philippine Islands." So far as Connecticut is concerned their statement was correct. The disease mentioned from the Philippine Islands is evidently that briefly described by Reinking (22, p. 130.) also in 1919. It is impossible to tell definitely from Reinking's preliminary description whether or not he is dealing with the wildfire or some of the other bacterial spots now known on tobacco.

Very recently Fromme (7, p. 37.) called attention to a disease in Africa which is described (evidently by the editor Klerck, 19.) in the Journal of the Department of Agriculture, Union of South Africa, in March, 1921, as follows:

"A tobacco disease occurring in the Piet-Retief District and known to farmers as 'Verterende roest,' was brought to our notice by the Chief of the Tobacco and Cotton Division. An officer of this Division was detailed to investigate the matter; the disease starts on the lower leaves which at first appear to be maturing prematurely, and spreads to the upper leaves. The disease was prevalent on the experiment station as well as on neighboring farms, and it was stated that only 10 per cent. of the 1920 crop reached its normal development, the remaining plants being stunted. Considerable losses had also been suffered on other farms which were visited. The 'verterende roest' is due to a bacterium which is being carefully studied in the laboratory, with a view to devising preventive measures which may be tested on a practical scale next season. Specimens of the tobacco affected by a similar trouble have also been received from Rhodesia; these are also under investigation." A month later he further states "The bacterial disease of tobacco previously recorded from the Piet-Retief District is now spreading rapidly at Marikana in the Rustenburg District, and is probably very widespread. So far as this investigation of this disease has gone, it bears a very strong resemblance to the wildfire in tobacco recorded in the United States."

In the same publication, Evans (34) in January, 1922, makes the following definite statement:

"Tobacco Wild Fire (*Bacterium tabacum*), a serious disease, was investigated. It occurs extensively in the Pietersburg and Rustenburg Districts. It was sent to us first from Rhodesia. Preliminary studies from Rhodesian material were made, and it is intended, if possible, to carry out field experiments in connection with preventive measures during the coming season."

The preceding quotation would seem definitely to decide the nature of the South African disease but Klerck (19), in the February issue of the Journal, again put it in the doubtful category by the following remarks:

"Wild-fire and angular spot of tobacco has been causing considerable anxiety amongst tobacco growers, and appears to be spreading rapidly. During the season 1920-21, this disease was only reported from the Government experiment stations at Rustenburg and Piet-Retief, from certain farms in the Piet-Retief District, and one in the Rustenburg District. During the present season specimens have been identified from three more farms within fifty miles of Rustenburg, and also from Groot Marico and Swaziland. A detailed study of this disease and the organisms concerned has been carried out by Mr. W. E. Schlitz, of this Division, and the South African organism compared with cultures obtained from America, and some interesting results have been obtained. The South African organism is identical with *Bacterium angulatum*, the bacterium connected in the states with angular leaf spot. The lesions on tobacco leaves found in the field and those produced by inoculation resemble 'wild-fire' but the organism concerned is not the 'wild-fire' organism, *B. tabacum*, which has not once been isolated. A full account of these investigations will be published at a later date."

It is evident from the testimony, so far as published, that this disease in S. Africa needs even more critical examination as to its relationships and it suggests to us that perhaps wildfire and angular spot in the United States also should be more carefully compared. The following data, however, satisfies the writers as to the identity of the African trouble with the American wildfire.

In January, receiving a letter from Wolf, in which he stated that Miss E. M. Doidge, of Pretoria, South Africa, had written him that wildfire had appeared in that section, we wrote Miss Doidge and received the following letter, dated March 6th:

"In reply to your letter of the 30th January, I may say that nothing further has been published on the occurrence of Wildfire in South Africa, but that there appears to be no doubt as to the identity of the disease which was prevalent in our tobacco fields last season with the American Wildfire. I am sending under separate cover some dried specimens as requested."

An examination of these specimens from Rustenburg (dated Jan. 2, 1922) showed their similarity in appearance to our Connecticut disease. Attempts to inoculate pricked greenhouse plants with water in which the crushed infected tissues had been soaked for several hours, were unusually successful despite the fact that the specimens had been enclosed in an envelope containing naphthaline flakes, apparently for the purpose of disinfecting them.

In the recent visit to the New Haven Station, Dr. Butler, of Kew, England, stated that he had seen a somewhat similar leaf spot of tobacco in India or in the adjacent islands, but had made no special study of it, and was in doubt as to its nature.

In the United States. The discovery of wildfire in this country seems to have been made first in North Carolina, at least Wolf and Foster, (31, p. 361.) in 1917, noted it as a new disease found there in the seedbeds and fields and gave a name to the germ which caused it. Early the next year they (32.) published a scientific description of the germ, *Bacterium tabacum,* and gave a more detailed account of the trouble which they listed as also occurring in Virginia. In September, 1920, Garner (3.) reported it from Maryland, Chapman (3.) from Massachusetts, and Valleau (3.) from Kentucky; while in October, Hesler (13.) recorded it from Tennessee and Johnson (13.) (*in litt.,* temporary escapes at Madison) from Wisconsin. In 1921 it was reported, in June, by Westbrook (29.) from Georgia, and in July, by Orton (20.) from Pennsylvania, and Clayton (4, apparently also reported in 1920,) from Ohio. Besides the above states Ludwig (10.) in August, 1921, reported it questioningly from South Carolina, and the writers received in the fall a dried specimen from Vermont, sent by Lutman, that proved to be this disease. In a letter recently received from Burger, he states that the disease has now also been identified in Florida. It seems, therefore, to have been found in thirteen or fourteen states east of the Mississippi where tobacco is most commonly grown.

In Connecticut. Wolf and Moss' note that "presumably" wildfire occurred in Connecticut, was based on statements of Johnson, in charge of U. S. Department of Agriculture tobacco experiments in New England, who has since told the writers that he saw the disease during the growing season of 1919 at a certain farm in Suffield. As no previous mention of this was made to Station authorities here, his observations were unknown to them until after the definite identification of the disease a year later.

In the summer of 1918 Beinhart, at that time the U. S. Government tobacco agent in New England, called to the senior writer's attention a leaf spot trouble of tobacco in a tent in which he had experiments at Buckland. This trouble seemed to be different from the ordinary spots seen here, and both thought it might be either a fertilizer or bacterial spot, but no study was made of it, and apparently specimens were not collected, or if collected were lost, so we cannot be sure of its identity. During the last of July, 1919, the senior writer collected an inconspicuous tobacco leaf spot at East Windsor Hill that was not carefully examined at the time. Recent more critical examination of this specimen shows it to be the wildfire, so far as one can be positive from the examination of dried material.

Late in June, 1920, as stated before, County Agent Southwick obtained specimens of an unusual tobacco trouble at Tariffville, which later was found elsewhere. Dr. McCormick, at the Hartford laboratory, upon examination of material from various sources, showed these to be a bacterial trouble, both by the presence of bacteria in the diseased tissues and by the production of similar spots on healthy tobacco leaves from crushed tissue of the diseased leaves. Specimens of the disease were sent by her to Dr. Smith, of the U. S. Department of Agriculture, and he definitely pronounced it wildfire. This then, was the first positive identification of the trouble in the state, so far as the writers are concerned.

Following the newspaper agitation of the subject in 1921, occasional growers have expressed the belief that the disease was not necessarily new but that outbreaks of it had occurred locally years before. This does not seem very plausible, since with all the United States tobacco investigators who have been in the state, and the local ones, who have watched the tobacco troubles rather closely, it is unlikely that it would have entirely escaped detection. If not native this brings up for consideration the manner in which it may have been introduced into Connecticut.

Possible Methods of Introduction.

Theoretically there are a number of different ways in which the germ of wildfire may have been brought into the state. We can discuss them briefly under the following headings.

Mats, etc. Some growers have advanced the theory that the germ was brought in from foreign countries on the matting used to bale imported tobacco, especially Sumatra. This matting is sometimes sold to the growers and used on their beds for shade in sunny and for protection in freezing weather. One grower who used it on the ground just before the plants came up had an idea that he got infection in his seedbed in this manner. He, at least, by this use obtained favorable moisture conditions for the spread of wildfire possibly already there. If the disease is foreign in origin, it is quite reasonable to suppose that mats, etc., from infected districts may have been the means of introducing the germs here. However, there is no direct evidence to this effect.

Fertilizers. Another of the out-of-state materials used on tobacco farms are the fertilizers and of these cotton seed meal, coming from the south, both because of its source and its organic nature, has come under suspicion more generally than the strictly chemical fertilizers. Our attempts to produce the disease on leaves of individual plants in the greenhouse, by sprinkling cotton seed meal from various sources on them, failed in every case. It would seem, therefore, that cotton seed meal was not a very probable means of its introduction.

Tobacco stems, imported from the south as a source of potash fertilizer, have also been under suspicion. Ordinarily the grower does not use them in his seedbeds, though he may sometimes make the seedbed on an old tobacco field or very close to it. Wolf and Foster (32, p. 457.), who investigated tobacco stems as one of the possible sources of infection, failed to get cultures from them, and conclude as follows: "Furthermore, in the preparation of tobacco stems for incorporation with fertilizer material they are subjected to a sufficient degree of heat to insure complete sterilization." Whether the ordinary tobacco stems as shipped direct from the factories after stripping off the leaves, and possibly more or less mixed with unfermented tissues, are a source of infection, has never been proven. Such few attempts at producing the disease from tobacco stems as we attempted were negative. It is conceivable, even if unproven, that they may be an occasional agent of introduction, but now that the disease is already here they do not seem to be such a serious menace as to prohibit their use for general field purposes. For this possible occasional danger, and other reasons, however, it is unwise to ever use tobacco stems on seedbeds.

Seed. We now come to the most probable agent of wildfire introduction into the state. Both Fromme and Wolf are convinced from their studies that it is a seed-borne disease, and that this is a common way in which it is carried over winter, and so naturally tobacco seed would most satisfactorily account for its distribution to new districts, especially from the south, where the

disease was first noticed, to our own state where it appeared more recently. For example Wolf and Moss (33, p. 30.) say: "As has already been stated, the pods are subject to attack, thus making it entirely possible for the seed to become contaminated." Fromme (6, p. 29.) makes the following statements along similar lines:

> "If seed were selected from plants entirely free from disease there would be no danger of infection from this source. Unfortunately, the diseases are now so general that it is difficult to find disease free fields, and the selection of disease free seed is therefore possible in only an occasional field. Seed treatment is therefore necessary to insure against introduction of the disease into the bed on the seed."

Having shown that the disease is carried by the seed in some cases, the question of its introduction here in this way may now be considered. There is no doubt that growers, Government and Station investigators have at different times grown plants from seed produced outside the state or even outside the country. So far as we can learn the Station has only upon two occasions, many years ago, used seed that was grown elsewhere. On one of these occasions Sumatra seed from Florida was obtained for the first shade tobacco grown here. In recent years we know personally of others who have used tobacco seed here that was grown in states where the wildfire has since been found. It is entirely supposable that the wildfire may have been brought in with this seed and escaped especial notice on the plants grown therefrom.

Just to show that seed grown elsewhere has been used here, we quote from a bulletin by Shamel (23, pp. 6, 11.) published some years ago before wildfire was known.

> "In all of the crops grown from freshly imported seed, there appeared a large proportion of abnormally early, small heavy leaved types, commonly called freaks. * * * * These freaks were particularly noticeable in the crops grown from freshly imported Cuban seed. * * * If it is desirable for the grower to test foreign, imported or new seed of any kind, it should be done on a small scale, etc. * * * * A field was set out with plants grown from imported seed, which were attacked by a fungous root disease, and all died with the exception of a few plants."

Seedlings. It is not a common thing for seedling plants to be brought into the state from elsewhere. No doubt it is sometimes done on the border line of this state and Massachusetts in the Connecticut valley, but such cases would hardly account for the introduction of wildfire since it was found here shortly before it was in Massachusetts. Upon one occasion we know of experimental plants used here that were grown either at Washington or Kentucky, but here again we have no evidence that they were infected either before or after they were brought in. Altogether this source does not seem quite as probable a method of introduction as by seed, though within the realm of possibility.

Upon the whole it seems too late now to actually prove the exact

way by which the disease first got a foothold here, and certainly no one intentionally brought it in. Introduction through seed, however, seems to have been the most probable method.

Agents of Dispersal.

Almost equally well do certain of the ways already discussed, concerning the means of introduction of the germs into the state, apply to their dispersal over the state when once introduced. State spread, however, often involves only short distances and there are additional factors that need to be considered. The discussion presented here, under similar headings, avoids repetition of preceding statements so far as possible.

Seed. We have taken for granted the conclusion of Fromme and Wolf that the disease is in part seed-borne, and so have made no extensive efforts to isolate the germ from seed. While others have observed the wildfire spots on the seed-pods, we failed to find any so affected in a careful search during the season of 1921. In 1920 Mr. Southwick gave us seed-pods that were supposed to have shown wildfire spots on them, but we failed to obtain any diseased seedlings grown from the same. We do not doubt that seed-pods can become so infected, but from our experience it seems probable that this takes place only in certain favorable seasons and perhaps then not to so great an extent here as in the south. There can be no question that seed may be contaminated in other ways than through infected seed-pods. For example, in the process of blowing or cleaning seed there is a chance that seed free from the germs might become contaminated by dust ladened with the germs. One cannot be too careful, therefore, in obtaining seed originally free from these bacteria to protect it from later exposure to them. Our experience leads us to doubt that seed has been the chief source of yearly infection in Connecticut. Quite a number of farmers have told us that their seed was gathered a few years before the wildfire was known here and that they had no trouble with wildfire in their seedbeds from the same seed until last year or the year before. It would seem in some of these cases, therefore, that the seed was not the source of the infection.

On the other hand there have come to us one or two cases where it seemed probable that the seed was the source of infection. For example, a grower who was known to have had it in his fields in 1920, grew some of the Round Tip tobacco in 1920, and used the seed next year. The wildfire appeared in his seedbed where this was grown, and also in at least three other seedbeds of growers to whom he had given the seed. In two of these places it appeared earlier, if not confined to the seedbeds containing this Round Tip seed. Some of this seed was obtained by us and planted in the greenhouse late in the season and at least one of the young plants

showed a wildfire spot on a leaf or two. It would seem that this seed then may have been a source of spreading the disease somewhat, though we failed in our attempts to isolate the germ from it.

Seedlings. There is no doubt that one of the most common methods of spreading the disease has been by the seedling plants set in the fields. A great many growers either do not, for one cause or another, grow all the plants they need, or in some cases depend entirely on outside sources for the same. No doubt for economical reasons this is the best course to pursue for certain small growers. With the advent of the wildfire, however, one needs to be especially careful how he buys his plants. He cannot watch another's seedbed as he can his own, and as wildfire is often masked in the plants, he cannot be sure of what he is getting unless the plants come from a region where wildfire has not yet appeared or he has evidence that the plants were grown under the best possible conditions for its prevention.

We have heard of a number of cases where persons knowingly or unknowingly have purchased plants from seedbeds that contained wildfire infected plants. In some instances this has happened where the purchaser had seedbeds of his own in which wildfire did not occur and thus he brought it into his field from outside sources. Perhaps the best illustration of this was a case in Suffield, where a grower in 1920 furnished plants to a number of growers who had wildfire in their fields that year apparently for the first time. Yet the seedbeds of this man looked unusually well and wildfire was not found in them until the planting season was over.

Tools, Cloth, etc. We do not have any direct evidence of spread of the disease by means of tools, etc., used in a diseased seedbed or field, carrying the germs later to another free from the trouble. We doubt if this frequently happens, yet a reasonable amount of care should be used as regards planters, cultivators, etc., in seeing that they are clean when taken from one field to another. Refuse tobacco should not be used on seedbeds under any condition.

Another factor that needs to be taken into consideration is the use of old tent cloth as a seedbed covering. If this came from an infected field the year previous it has been shown by Fromme and Wolf that it may prove a source of infection. We have no personal evidence along this line but do know that Florida authorities are considering barring the importation of second-hand tent cloth from Connecticut into that state. Wolf and Moss (33, p. 32.) make the following definite statement:

> "When seeds of known healthy origin were used in certain of these beds [free from the disease], and the beds were covered with new cloths, the plants remained free from wildfire. When, however, other of the beds were planted with seed from the same source and covered with cloths taken from beds which had been affected with wildfire during the previous year, the disease appeared."

Insects. In the same article from which we have just quoted, the writers (p. 30.) state, that they failed to find wildfire carried by thrips that were abundant on diseased plants but that,

"Flea-beetles, however, are to be regarded as carriers of infection, since the wildfire organism has been isolated from individuals which had been feeding upon diseased plants. Transmission of wildfire by these insects is a fact supported indirectly by the frequency with which the disease appears around the holes which they have eaten through the leaves."

In Connecticut the most suspicious insect carriers that we have noticed are also the tobacco flea-beetles and these chiefly in the seedbeds. We have frequently seen them abundant in certain seedbeds and absent or infrequent in others. Some of these beds were abundantly infected with wildfire and often the halos centered around the small spots which had been eaten by the flea-beetles. In an effort to confirm this evidence Dr. McCormick, with Mr. Zappe of the entomological department, tried to produce wildfire with flea-beetles. These were gathered from infected plants, or fed with them for a short time, and then placed on healthy plants under bell-jars and imprisoned there for some days. In none of the plants experimented with did any wildfire develop. However the experiments were too limited in number to be of great value. We are convinced that they may in some cases become an important factor in the spread of the wildfire within the seedbeds, and possibly carry it outside to adjacent beds. Similar experiments with lice also failed.

Man. Here, perhaps next to seed and seedlings, one finds the most common carrier of the disease. Usually no care is taken when the beds are pulled that the workers do not carry the disease to the other beds which, after handling diseased plants, they might do. Again growers from one locality visit seedbeds in another and more or less miscellaneous handling of the plants occurs. Growers seem to be somewhat alert in this respect now, as many of them have been rather cautious as to indiscriminate inspection of their beds, while some few have posted signs for visitors to keep away from the beds. Perhaps in the exchange of plants from one locality to another infected dirt may be carried in on the shoes or in the uncleaned baskets used to transfer the plants. Care is needed in these respects also.

To illustrate how the disease may be carried into a bed in an inconspicuous way, which after it occurs would be impossible of detection if one did not have the facts, we may cite the following personal experience. In a seedbed at New Haven, planted under conditions where wildfire would not occur, we tried to inoculate some of the plants with a fungous disease, somewhat related to the blue mold, that occurs on certain weeds not uncommon in tobacco beds. The infected leaves were gathered twice in regions

of the state where wildfire did not occur and these, under proper moisture conditions, were placed on the tobacco seedlings in marked spots in the bed. Both having failed, they were gathered a third time from a seedbed where wildfire was common. This time the fungus again failed to develop but wildfire appeared on the plants within a few days, at the particular spot where the leaves were placed. Now this weed, Lambs Quarters (*Chaenopodium albidum*), is not infected with wildfire but by contact with infected tobacco plants evidently carried some of the germs mechanically on the leaves to the experimental seedbed and infection resulted from these under the favorable moisture conditions provided.

Wind and Rain. While certain weather conditions have much to do with the development of wildfire in the seedbed, once it gains entrance there, we cannot be so positive about the wind and rain as agents of its introduction into the seedbed. It seems reasonable to suppose that even if one did sterilize his seed, soil, frames, etc., that the germs of adjacent soil might be spattered in by rains or even more probably be blown in with infected dust. This would not mean much if it were not for the fact that it is vitally necessary to keep the disease *entirely out of the seedbed* if one wishes to escape injury in the field. We have more positive observations on these points, however, when it comes to spread in the field, but we shall speak of them later on.

Overwintering of the Germs.

Seeds. Our discussion of infected seeds under the preceding headings will largely cover the possibility of one year old seed overwintering the germ and the re-infection of seedlings the next year. Just how long the germs can remain attached to the dry seeds and still retain their viability is not known. So far no one has shown that the seed itself is invaded by the germs so it is presumed that the overwintering is by germs accidentally attached to the seed coats. It is very doubtful if such germs can retain their vitality as long as the tobacco seed, which often germinates fairly well when eight to ten years old. Rapp (Okla. Agr. Sta. Bull. 131 : 37.) has recently found with the bacterial blight of beans that two and three year old seed gave blight-free plants. This is a case where the beans themselves are sometimes invaded, and so presumably a longer viability of the bacteria would be found here than with the tobacco germ, other things being equal.

Cloth, Sash, etc. We have no data of our own showing that the germ may be carried over the winter on the boards, sash, or cloth used on diseased beds or fields the previous year. Yet there seem to be sufficient data, as far as the cloth is concerned, furnished by Wolf and Fromme from the south. What difference the

greater severity of our winters would have regarding overwintering we cannot tell, but if at all it would be unfavorable rather than favorable. Fromme (8, p. 1.) has recently published the following incidents to show infection from the use of old cloth.

"The germs of blackfire (angular spot) and wildfire may be carried on old canvas and cause infection in the plant bed. This was proved by experiments and also by the following cases. R. H. Mantiply of Amherst County used seed that had been treated but did not boil his canvas. Tilden Gooch used the same seed and boiled his canvas. Wildfire and blackfire were found in Mr. Mantiply's bed and not a trace of either could be found in the bed of Mr. Gooch."

The only incident along this line that we can cite for Connecticut is where a grower sterilized both the seed and the soil but not the sash, cloth or boards used on his beds. It was in those beds that the first appearance of wildfire in Connecticut in 1921 was found. Apparently in this case the germs carried over in the materials used in making the seedbeds, or, less probably, were carried in from other unknown sources.

Soil. Soil probably may be the source of infection in some seedbeds and fields, yet data absolutely proving this is difficult to obtain. We have little convincing data along this line, in fact so far as field infection goes, it does not seem to hold a very important part. But an occasional holding over in the field is quite a different matter from that in the seedbed where an infection, no matter how slight or infrequent, can become an important means of further spread. As yet we have made no attempt to isolate the germ from wintered-over soil exposed to infection the previous year, but our attempts to infect tobacco plants in the greenhouse directly with such soil were successful in one out of several different trials. Wolf and Moss, *loc. cit.* pp. 30-1, also, make the following definite statement of a case in North Carolina:

"In the tests on transmission through soil, old plant beds, which had borne diseased plants and which were not 'fired' prior to planting, were used. Seed from a locality where wildfire was absent were sown in these beds, and new cloth was used as covers. The disease developed in some of these beds."

Tobacco Refuse. It seems certain that where a field or seedbed has been badly infected with wildfire and the diseased plants were left there that the germs can, to a certain extent, be carried over in the more or less disintegrated tissues. This might be the way it is carried in the soil where it is supposed to have survived as stated above. Infected tobacco refuse from indoors thrown on the fields or seedbeds in the spring might also supply the infecting germs in some cases. Our few attempts to inoculate greenhouse plants with outdoor overwintered tobacco refuse were successful in one case. Evidence along this line is also indicated in the following extract from Fromme (8, p. 1.):

"The disease may live over in the field and infect the next crop where tobacco follows tobacco. Evidence of this was obtained in several cases but in some other cases it was equally true that the disease had not lived over in the field. It is believed that the time of plowing had a great deal to do with this and that the danger from this can be greatly lessened if the land is plowed in the fall or early spring, *so that the suckers have time to rot in the soil* before the crop is set. There was also more carry-over of the disease in the field during the mild winter of 1920-21 than would be true in ordinary seasons."

Detailed Distribution in the State.

Survey. As previously mentioned, a tobacco disease survey of the state was started in 1920 and continued in 1921. For Hartford County, B. G. Southwick, County Agent, gave valuable help in both seasons. In the spring of 1920 Mr. Southwick and Dr. Clinton spent considerable time on the seedbeds and during the summer Mr. Southwick frequently, and Dr. McCormick occasionally, made field trips. The work was not undertaken especially for wildfire investigation, though the discovery the first year that the disease was widespread in the state was the most important feature of the work, and largely influenced the nature of the work the second year. In 1921 Mr. Southwick, with Dr. Clinton, again gave much of his time during the whole season to the examination of seedbeds and fields. The writers are especially indebted to him for first information about, and aid in visiting, many of the farms containing infected plants in Hartford County.

Little work outside of Hartford County was done in 1920, but in 1921 tobacco seedbeds and fields in Tolland, Middlesex, Litchfield and Fairfield counties were also examined and additional data obtained. County Agents E. E. Tucker, of Tolland, and J. H. Fay, of Middlesex, were also helpful in aiding investigations in their respective counties.

In 1920. In the survey of seedbeds in 1920, which ended about the first of June, no cases of wildfire were found. However later in the season, after it had been found in the fields, Mr. Southwick reported that he examined one or two seedbeds from which infected fields had been set, and found a few infected plants in these. Of course in the early seedbed examinations, as nothing was known then about the presence of wildfire in the state, the disease may have been overlooked. On the other hand, it could not have been at all conspicuous since care was taken to find all troubles of any nature that showed either on the leaves or the roots.

This same year in the fields the disease was first discovered the latter part of June, and during the remainder of the season it was looked for particularly, and was eventually found in twenty-one other fields. The known distribution by the end of the 1920 season is shown in Table I.

TABLE I. KNOWN INFECTIONS PREVIOUS TO 1921.

Infected Fields, 1918.

No.	Place.	Town.	County.
1(?)	Buckland,	Manchester,	Hartford.

Infected Fields, 1919.

No.	Place.	Town.	County.
1(?)	East Windsor Hill,	South Windsor,	Hartford.
1	West Suffield,	Suffield,	Hartford.

Infected Seed Beds, 1920.

No.	Place.	Town.	County.
1(?)	Floydville,	E. Granby,	Hartford.
1	West Suffield,	Suffield,	Hartford.

Infected Fields, 1920.

No.	Place.	Town.	County.
2	East Granby,	E. Granby,	Hartford.
1	Warehouse Point,	E. Windsor,	Hartford.
1	S. Glastonbury,	Glastonbury,	Hartford.
11	Suffield,	Suffield,	Hartford.
6	:Poquonock: :Windsor :	Windsor,	Hartford.
1	Windsor Locks,	Windsor Locks,	Hartford.

In 1921. As this year especial attention was given to the disease, wildfire was found in a great many more seedbeds and fields than in 1920. This was partly due to the extra search for the trouble, and also in part because it was undoubtedly more widespread and serious than the previous year. Of the 122 seedbeds (122 growers) that were examined, it was found in fifty-one, and seventy-one were free from the trouble so far as could be seen at the time of the examination. As most of these beds were examined only once there is more or less doubt whether all of these listed as free remained so during all of the season. In fact we have data showing that, in a few cases, beds pronounced apparently free of wildfire at the time of the examination were either not entirely free, or later developed the trouble, so that it was carried in sufficient amount into the fields to eventually cause serious injury.

In the field inspections 125 fields, belonging to about as many different growers, were examined and in sixty-seven wildfire was more or less prominent as compared with fifty-eight fields that were apparently free of the disease. Of the sixty-seven infected fields we can loosely classify them, according to the amount of wildfire that showed at the time of the last examination, as follows: thirty-four with little injury, that is less than 5% loss; eighteen with a moderate amount; eight with much; and seven with very serious injury, in a few cases reaching almost a total loss. The condensed data of distribution obtained in 1921 is given in Table II.

TABLE II. INFECTED AND FREE SEEDBEDS AND FIELDS, 1921.

		Seed Beds.		*Fields.*	
Town.	County.	Infected.	Free.	Infected.	Free.
Brookfield,	Fairfield,	0	6	0	4
Sherman,	Fairfield,	0	0	0	9
Barkhamsted,	Litchfield,	1	0	3	1
Kent,	Litchfield,	0	6	0	0
New Hartford,	Litchfield,	0	0	0	1
New Milford,	Litchfield,	0	19	0	15
Avon,	Hartford,	1	0	1	0
Berlin,	Hartford,	0	0	0	1
Bloomfield,	Hartford,	3	0	1	0
Canton,	Hartford,	0	0	0	1
E. Granby,	Hartford,	5	0	7	0
E. Hartford,	Hartford,	2	7	6	2
E. Windsor,	Hartford,	1	3	2	0
Enfield,	Hartford,	2	0	5	1
Glastonbury,	Hartford,	1	2	0	0
Granby,	Hartford,	1	1	5	0
Hartland,	Hartford,	0	0	0	7
Manchester,	Hartford,	2	1	3	0
Simsbury,	Hartford,	3	1	4	0
Suffield,	Hartford,	3	3	5	0
S. Windsor,	Hartford,	3	1	4	0
Windsor,	Hartford,	16	2	8	1
Windsor Locks,	Hartford,	0	0	2	0
Cromwell,	Middlesex,	0	9	0	8
Middletown,	Middlesex,	0	0	0	3
Portland,	Middlesex,	0	7	0	3
Ellington,	Tolland,	4	3	7	0
Somers,	Tolland,	2	0	4	1
Vernon,	Tolland,	1	0	0	0
Totals 29.	5	51	71	67	58

Distribution. Examination of these tables shows that wildfire has now been found in three of the five counties of the state where tobacco is grown commercially, namely in Hartford, Tolland and Litchfield counties, but not, so far as we have data, in Middlesex or Fairfield counties. By far the greatest center of infection lies in Hartford county north of the city of Hartford. The disease has been found in over half of the towns of this county and these include nearly all of the towns where tobacco is grown to any extent. Much less is found in the southern towns than in the northern ones. Hartford county grows more tobacco than all the rest of the New England counties combined. Of the twenty-nine towns in the county four grew no tobacco, nine in less amount than twenty-five acres, while the other sixteen grew it as one of, if not their chief crop.

In Tolland county to the east of Hartford, the tobacco region is largely limited to the towns bordering on Hartford county, and in the three most northern of these wildfire has been found just as abundantly as in the adjacent towns in that county. Tolland next

to Hartford grows the most tobacco in this state, but not one-tenth of that grown in Hartford.

Middlesex county to the south of Hartford grows tobacco in three or four towns on its northern border. Fortunately, so far, we have been unable to find wildfire in any of these. As this district is somewhat cut off from the infected region to the north there is some hope that with care the disease may be kept out of it.

Litchfield county to the west of Hartford grows tobacco in two distinct regions. One of these embraces two or more of the towns bordering on Hartford, and wildfire has been found in one of these to a slight extent. To the north of Hartford county come the tobacco counties of Massachusetts and wildfire exists there also. The counties already mentioned in general make up the tobacco region of the Connecticut river valley, the great tobacco district of New England.

The second tobacco region in this state lies in the valley of the Housatonic river in the northern part of Fairfield and the southwestern part of Litchfield county, embraced chiefly in five or six towns. So far a general survey of this region has not revealed the presence of wildfire there. As this district is even more isolated from the infected region than is the tobacco grown in Middlesex county, there is a still better possibility of keeping the disease out of it. This region has a small tobacco acreage, like that in Middlesex, in fact all of the tobacco grown in these three counties is less than that grown in Tolland county.

Disease in the Seedbeds.

Appearance. On May 2, 1921, Mr. Southwick asked Dr. Clinton to examine, at East Windsor Hill, tobacco beds with which the grower was having trouble. The plants at this time were quite small, the largest leaves being about one-half inch long. The trouble showed at the tips, or less frequently at the upper edges of the leaves, the infected tissues rapidly rotting and drying up (Plate XXIX f). With favorable moisture conditions present the rot continued until nothing of the blades remained and the plants then shriveled up, leaving vacant spots in the beds (Plate XXIX e). With less favorable moisture conditions the rotten tissues, of greater or less extent, dried up and fell off, leaving the rest of the mutilated leaf apparently healthy. The general appearance was so much like the result of dampening-off fungi, common in tobacco seedbeds, that we were surprised, upon a preliminary examination at that time, to find no suspicious mycelium present in the tissues. On the other hand in certain intercellular spaces in the rotten tissues evident masses of bacteria were present, so that we concluded, temporarily, that the trouble was of a bacterial nature, possibly the bacterial soft rot. Specimens brought to the laboratory seemed to confirm this view.

About a week after the first examination, Mr. Southwick asked Dr. Clinton to examine another bed at Poquonock having similar trouble. At this time the plants had grown so that some of the leaves were an inch or more in length. While the dampening-off rot was present as before, it was not so conspicuous, and there were beginning to appear yellow bordering areas in advance of these rotted tissues; also isolated yellow "halo" spots within the leaf blades were to be seen. This proved that the trouble was the true wildfire disease. An examination on this date, May 8th, also showed that the first beds seen had now developed these characteristic halo spots.

So far as we are aware this rot stage of wildfire has not been described before, in fact Wolf and the other writers do not give a very detailed description of the disease in the seedbed. We have since seen it in many other seedbeds and in every case the halo or yellow spots developed later. This convinces us that this wet rot is the first stage of the disease in the seedbeds. We have not seen it on the larger plants. It seems probable that with very young plants the first leaves come in contact with the ground and, if the wildfire germs are present, this favors early invasion through the large stomates at the tip or margin of the leaf into the intercellular spaces. This environment, especially with the greater amount of moisture present, facilitates a rapid rotting of the tissues and a greater production of bacteria. We have not as yet studied this stage carefully enough to state positively that these more abundant bacteria are all wildfire germs. The first stage then, according to our belief, develops more as a soft rot trouble and chiefly from the tip or edges of the leaves inward.

The second stage we consider the halo or yellow spot which comes on quickly after the first and on the somewhat larger plants. These spots also may begin at the tip or edge of the leaf, in which case they are semicircular in outline, or they may start more slowly within the tissues as small circular yellow spots that gradually enlarge, eventually becoming about half an inch in diameter. Their abundance on the leaf depends upon the number of infections and the size of the leaf. In leaves of plants of the size for transplanting half a dozen or more may show on a single leaf, and eventually may run together and become somewhat irregular in shape. At the center of each of these circular yellow spots is a small whitish or blackish speck, the point of origin of the disease. In some cases this is insect-injured tissue, usually a small hole eaten out by flea-beetles, but in most cases it is merely the position of the stomates or breathing pores through which the bacteria originally gained entrance between the guard cells into the intercellular space beneath. There they multiplied, killed the tissue in their immediate vicinity and caused a slow death of the surrounding tissue, showing first by the injury to the chlorophyll grains, thus forming the yellow halo spot. Plate XXX a.

The third stage does not usually appear to any extent in the seedbeds. This is where the yellow spots die, turning white or brown, and if placed thickly enough on leaves, cause the intervening healthy tissues also to die. Before the disease reaches this stage the plants have usually been transplanted into the field. Our experience so far has been that the plants left in the infected seedbed do not seem to continue the disease in the progressive way that one would expect from its aggressive first appearance there. This may be because the moisture conditions, after the covers are permanently removed and watering is infrequent, are not so favorable, but it is also probably due in part to the slow growth of the thickly set and competing plants, a condition that seems unfavorable for rapid development of the disease anywhere.

Conditions favoring the Disease. Of course the first essential is that the germ should already be present in the seedbed or be carried there in some manner. We have already discussed the various sources of infection such as soil, equipment, fertilizers, and such active agents of introduction as spattering rain, wind, insects and man. But even if present the active development of the germs depends on other conditions, such as the weather, the method of watering, and the airing of the beds. These latter are quite important factors and will be discussed further, but before doing so it might be well to mention one phase of the fertilizer proposition. A good many growers have the idea that nitrate of soda has some influence on the development of wildfire in seedbeds. The only evidence we have obtained is that with the disease present in the seedbeds the liberal use of this fertilizer incidentally has some part in a more rapid spread of the disease, other things being the same, because of the quick growth of the plants, a condition that favors the spread.

Weather. It was quite evident in the spring of 1921 that there were certain periods in which seedbed infection appeared and progressed more rapidly than at other times. The first favorable period was when the plants were quite young, about the first of May, as has already been pointed out. After this first outbreak, due in part to the greater care given the seedbeds by the growers because of the agitation started against wildfire, the spread did not seem so rapid, and certainly infected plants were not so conspicuous in the beds.

During the first part of the week of May 22-28 there were several days of cold wet weather so that by the end of the week there began a second outbreak that was even more conspicuous than the first because of the large size of the plants at this time and the consequent prominent halo spots that appeared abundantly on the leaves. Even when plants were selected from beds that did not show the disease to the ordinary observer, the grower did not always escape trouble in the field because incipient or masked infections were already there.

Glass versus Cloth. The grower cannot control weather conditions, though he can usually provide somewhat against their ill effect. For example he can help by the type of covering used in the seedbeds. Our inspections in the infected regions indicated that the beds with glass are less likely to develop serious cases of wildfire than the cloth beds. If we take the percent. each of glass and cloth-covered beds that developed wildfire as compared with those free, as shown by our total inspection, we find that the cloth beds really had a much smaller percentage. This means nothing, however, as most of the growers in the districts free from wildfire, especially in the Housatonic valley, happen to use cloth almost entirely, while in the infected regions of the Connecticut valley, glass seems to have the preference. The cloth beds do not keep out the rain and so at times they are much damper than the glass beds. Also they are not aired so well, and on the whole they are colder and shadier and water does not evaporate so quickly from the leaves. It is this water on the leaves, if it stands on them any great length of time, that causes serious development of wildfire. With the glass bed the rain does not get on the plants if care is used, and the sash can be partially raised even in rainy weather so that the plants can be aired and water kept out at the same time. However, if the sash leaks and water becomes abundant in spots, wildfire often gets a start there. Plate XXIX a-b.

Watering and Airing. As a rule watering of the beds should be as light as compatible with good growth and should be made at that time of day when the plants have opportunity to dry off. Perhaps the early morning or late afternoon is the best time, since there is less likelihood of sun scorch at these times. Beds made on wet soils or well protected against wind are difficult to keep dry and free from wildfire. Much of the water that stands on the leaves, however, is water of transpiration given off from the leaves. If the air of the bed is saturated, this water does not evaporate into the air, but accumulates as small drops all over the leaves. Airing the beds prevents this. Airing somewhat at night, when there is no danger of frost, helps to keep water of transpiration off the leaves.

Susceptible Varieties. So far as the seedbed inspection revealed there was no indication whatever that the varieties commonly grown in Connecticut had any degree of immunity. Wildfire was found bad on Broadleaf, Cuban, Havana and Round Tip. There were also beds of each of these that showed large, moderate and little amounts of the disease, and the percent. of beds showing these different amounts was not very different for any of the above varieties. Whether particular resistant strains of the above can be found we do not know, but it seems very doubtful unless the nature of the variety is changed; so control of the disease will not come along this line, at least for some time to come.

Damage. While we have seen wildfire very prominent in certain beds, if it were confined to the seedbeds as certain fungous troubles are, we would not consider it a disease of sufficient importance to cause much anxiety on the part of the grower. Of course in the wet rot stage it does cause the loss of some plants, clearing out small spots in the bed. Older plants, too, are often injured enough to misshape them or cause them to be smaller and less vigorous. The real danger, however, comes from the menace of infected plants when transferred to the field. Even a few infected plants in the bed because of this menace are very undesirable, and of course if abundant are the possible source of complete failure of the crop. The approximate amount of wildfire in the seedbeds examined in 1921 is shown in the following table:

TABLE III. WILDFIRE IN SEEDBEDS IN 1921.

Variety.	No. Bad.	No. Moderate.	No. Little.	No. Free.
Broadleaf,	3	2	9	19*
Cuban,	3	4	8	5
Havana,	4	3	6	46**
Round Tip,	2	3	4	1

* Many of these were in Portland wildfire-free district.
** These were mostly in the Housatonic wildfire-free district.

The seedbed then is the strategic point for control of the disease, and fortunately this is where it can be controlled with the least effort. This leads up to a discussion of the best methods for control.

Control Measures. Seed Treatment. Certain precautionary measures against introduction of the germs and care in ventilating and watering the plants, have been discussed. In the south the investigators place considerable stress on seed treatment. We doubt if this is quite so important a factor in the spread of the trouble in the north. While we have evidence of its being carried by the seed, there seems to be so many other ways by which infection occurs that seed treatment alone would prove of little value. Virginia investigators have been the most active in the seed treatment campaign in the south. In 1921 it is stated by Thomas (26.) that about 2,500 farmers planted treated seed. Fromme (6, p. 30.) first advocated soaking the seed in formalin 1 oz. to 1 pint of water for 15 minutes. Later the same investigator (8, p. 2.) recommended the corrosive sublimate treatment, using 1 part of this poison to 1,000 parts water and soaking the seed also for 15 minutes. Our experience with both of these treatments has been that with certain seed the treatments, especially with the formalin, have been rather severe, killing part of the seed so that we believe that 10 minutes is long enough for the formalin. Where seed was gathered several years ago, before the appearance

of wildfire, or where gathered recently from free fields, there is no particular need of treating it. We know of only one Connecticut grower who treated (in part) his seed in 1921, and it was at his place that we first found the wildfire.

Soil, etc., Sterilization. Where infection has occurred in the bed the preceding year, steam sterilization of the soil should be practiced the next, or else the beds moved to new land not in tobacco recently. If we were to judge from our examination of seedbeds alone we would find that sterilized seedbeds gave a far higher percentage of wildfire than the unsterilized beds, but here again it was a question merely of location, since very few of the beds in the Housatonic valley, which is free from wildfire, are sterilized. The beds should receive a good steam sterilization, say for 30 minutes at a pressure above 100 lbs. It is well, where possible, to extend this sterilization to the paths immediately around the beds. Sterilization of the soil and seed is not sufficient, as has been shown in the south, so that this should include the boards, sash and cloth used in the construction of the beds, if these materials have at all been exposed to the germs. This can best be done by sprinkling them all over thoroughly with formalin at the rate of 1 to 30 of water, and piling them up under cover to dry out slowly; or the cloth can be boiled for an hour.

We are quite sure that steam sterilization of the soil alone is not effective against the appearance of wildfire. In the Connecticut river valley steam sterilization of soil is a common practice, yet wildfire was found just as commonly in the infected districts in the steam sterilized beds as in those that were not. This was, at least largely, because the seed, boards, sash and cloth were not sterilized also. We know of no place where all of these precautions were taken.

Spraying. In 1921 wildfire appearing in the seedbeds in so many places, it was necessary to devise other methods of control. There were apparently just two things that could be done under these conditions, namely, spraying the beds and careful watering and ventilation of them. Both of these seemed to give promising results where put in practice. The writers had had no experience in spraying tobacco seedbeds and the opinion of scientists had been that spraying is not generally effective against bacterial diseases. Bordeaux mixture, where no injury results, has on the whole proved the most satisfactory fungicide, so this was selected for experimentation, and as flea-beetles seemed to be concerned with spreading the trouble, lead arsenate was added as an insecticide. We did not know, however, whether injury might result from this spray, but, from the relationship of tobacco to the potato, with which we have had much experience in spraying, concluded to try the above on a badly infected bed at Poquonock. The senior writer sprayed this bed on May 8th, and the grower sprayed it

again the next day. This was the first time, to the writers' knowledge, Bordeaux was used as a treatment against wildfire. No harm resulting from these treatments, at the meeting at Windsor of tobacco growers called to discuss wildfire, Dr. Clinton advocated the spraying of tobacco beds with 4-4-50 Bordeaux, with lead arsenate added. Many growers sprayed their beds from one to several times during the rest of the season with either homemade or commercial Bordeaux mixtures.

As a result, from our subsequent experience and that of others, we are convinced that spraying of tobacco beds should be made one of the routine practices of tobacco growing as long as there is danger from wildfire. We have seen no serious injury from spraying with Bordeaux mixture, though in some cases we have sprayed the young plants fourteen different times covering an interval of as many weeks. We have seen a little injury from spraying, of a sun-scorch type, when the plants were uncovered and sprayed in strong sunlight. Similar injury might result from careless watering.

We have evidence that plants thoroughly coated with the spray do not become infected anything like unsprayed plants in the same beds. Spraying to be most effective, however, must start before the appearance of wildfire and be continued until the end of the transplanting season. We would start with the young plants that have just taken root and whose largest leaves are about the size of a thumb nail, and spray every week thereafter. Spraying we believe is the only remedy that prevents spread of the wildfire in a seedbed no matter what the source of its introduction. Homemade Bordeaux being cheaper and apparently somewhat more effective, we prefer it to commercial brands though most growers like to buy a prepared mixture rather than make it themselves. We do not as yet advocate commercial lime-sulphur and have had little experience with the dusts. A fifty gallon barrel of Bordeaux properly applied should be sufficient to go over once a six-foot bed of 400 to 500 feet in length.

One cannot be too careful to see that the plants he is to set out are absolutely free from the trouble. This does not mean that if a grower finds a little of it in his seedbed, he should neglect this bed and purchase plants elsewhere. Unless he has had opportunity to thoroughly acquaint himself with the seedbeds from which he purchases plants and knows that they are free from this disease (or at least better than his own if he cannot obtain plants from wildfire-disease-free beds) he had better stick to his own beds and make efforts to eliminate or at least prevent further spread of the wildfire.

If a grower finds that the best thing for him to do is use his own plants in which wildfire has appeared because of his neglect, he should start at once to attempt to eradicate the disease. We

use the word *attempt* since we believe it will be difficult to absolutely eradicate it once it has appeared, although it may be so masked as to seem to disappear entirely. Growers in 1921 attempted this by killing certain beds or parts of beds, (Plate XXIX d) with formalin (one to fifteen parts water) sprinkled over the bad spots. Care in airing has to be used in this case so that the fumes do not extend beyond the sprinkled spot and injure other plants. One sprinkling will not always entirely kill plants of some size. If these spots are few in number it is just as well to pull up all the plants in these spots and those on their border and destroy them. Spraying, as advocated above, should then be begun and especial care given in airing and watering, and the beds be watched for any further infection, always removing any suspicious plants at once.

Disease in the Fields.

General Appearance. The first stage in the field is the halo yellow spot state (Plate XXXI a) already described under the seedbed infections. On the larger leaves of the field plants, of course, many more of these halo spots eventually appear. Naturally badly infected plants are rarely set out by the growers. Growth of plants is slow at first after transplanting and little spread takes place then. If the weather is also dry no spread occurs, and as the older infected leaves wither up and fall off there comes a time when the disease seems to have largely disappeared. The grower is then apt to conclude that his plants have outgrown the trouble. With later wet or muggy weather of several days duration, however, the wildfire can reappear with startling suddenness. As the plants gain in size it will be found that the wildfire is largely confined to the older and lower leaves. With age and conditions favorable for spreading, the upper leaves also become infected, until at the end of the season the uppermost small leaves of the flowering branches may even show the trouble.

Once the disease gets a good start the old yellow halo spots gradually give place to white or brown spots of varying shades, the chlorophyll having disappeared and the tissues die (Plate XXXI b). This is when the serious injury from the disease really begins. These spots are still roundish and usually show a more or less evident yellow border, the remnant of the halo stage. If the spots are now abundant enough on the leaf the intervening tissue may die and the whole leaf become irregularly spotted and eventually brittle and worthless. The final injury is indicated by the number of leaves thus destroyed and the partial injury to the remaining spotted ones. The greatest injury comes just after the disease spreads over the plants during the period of wet weather and the sun suddenly appears again. The halo spots then turn to brown irregular burn-like areas (Plate XXXI c). This transfor-

mation often takes place quickly and so probably is largely a mechanical injury to the badly infected tissues. One grower claimed that most of the injury in his field occurred in a few hours after such a rainy period was followed by bright sunshine.

Conditions favoring Spread. Infected Seedlings. The first, and by far the most important, factor we need to consider in field infections is the seedlings used in setting out. Our experience last year indicated that if the grower can set his field with plants absolutely free of wildfire he has very little to fear from this disease. As a rule the greater amount of infection in the seedbed the greater amount of injury one may expect in his field. This does not always hold, however, and it does not necessarily mean that if one grower has it bad in his seedbed and his neighbor has only a moderate amount, that the former will have the poorer crop. Often the field conditions are factors in the greater or less spread of the disease. It is likewise true that a moderate number of the diseased plants scattered over the field, with very favorable conditions for spread, can by the end of the season injure the crop as completely as would a large number.

It is always best, however, to play safe if one can do so. For example, we know of a grower who had a moderate amount of wildfire develop in his beds. These beds were later sprayed a few times and the disease was kept down so that it no longer appeared conspicuous. The plants as a whole were unusually nice looking and healthy. This grower would not use these plants but went to a district some distance away and bought plants that were known to be free of this disease. The plants otherwise were not as good as those in his own seedbeds. A neighbor knowing that wildfire had occurred in this man's beds, but seeing how well they looked, bought the beds for his own use. He did not use especial effort to throw out the wildfire plants though they at that time were not prominent as such. He did notice after the plants were set out that there were some in the field. However, dry weather followed and the wildfire seemed to be disappearing. Then, suddenly, there came on a more favorable period and the wildfire spread rapidly through that part of the field where diseased plants had been seen, and to a less extent where they were not so conspicuous. He became alarmed and began to prime his plants earlier than he naturally would have done, and in this way avoided a part of the very serious injury that would have resulted had the plants not been primed. The other man grew a crop not injured at all, although his field had a less favorable start than it would have had with his own plants. A little wildfire in one or two spots on just a few plants finally appeared, but whether from the soil or accidentally carried into the field in some manner we could not determine.

It is not an uncommon practice for a grower who runs short of

plants to purchase additional ones from another grower without especial attention being paid to them except their general vigorous appearance, which may be very deceptive so far as the presence of wildfire is concerned. Such plants in setting are often scattered more or less throughout the fields with his own plants. In case they happen to come from beds containing wildfire while his own were entirely free, their presence thus scattered through the fields may largely nullify the advantage he had with his own disease-free plants.

If it is necessary to buy plants outside, one should be sure that they are as free from this trouble as his own, and if possible plant them in blocks by themselves to prevent any outside spreading if infected, or to protect them if free, from his own possibly infected plants. We know of growers who were fairly free from wildfire in their own seedbeds but who brought the disease in by purchased plants which they happened to keep together in certain parts of their fields, and as a consequence the disease developed much more prominently there than elsewhere.

Method of Handling Seedlings. Another factor that seems to be very favorable to spreading the disease before planting is the manner in which the seed plants are handled after pulling from the beds. Often the plants are wet down all over and allowed to stand for some time before planting. Where wet closely packed plants, some of which are infected with wildfire, are left in the baskets over night in a damp atmosphere, the disease will spread further according to our experience. If the plants cannot be used soon after pulling, it is just as well to keep water off the leaves, although if necessary the basket may be kept on moist ground with a good air circulation above.

Certain of the crosses experimented with at the Windsor farm in 1921 came from a seedbed in which wildfire was present. This could not be avoided as they were the only plants of the kind to be obtained. Another mistake was made in pulling the plants on a Saturday or Sunday and keeping them in a damp place until Monday. As a result of this treatment wildfire developed in this field even worse than it did in another set with badly diseased plants as a wildfire experiment. At least two growers have told us of a somewhat similar experience where they kept wet plants in baskets in cellars over night. These wet plants were set together in fields otherwise planted with freshly pulled seedlings from the same bed. Wildfire in each field first showed prominently in those particular parts set with the hold-over plants.

Infected Fields. The next point to consider is, will a field set with plants free from the disease later become infected? We believe it can under certain conditions. This will not likely happen, however, in such isolated regions as the Housatonic valley, or the towns of Cromwell, Portland or Middletown of Middlesex county.

It may not even occur in fields in a badly infected region. That it does occur is shown in the example cited under conditions favoring spread. In any case it is not likely to become serious if the field is at all isolated from infected fields. Where an infected crop was grown on the land the previous year, the rotted or rotting leaves, especially of the suckers, may possibly be the source of an infection here and there. The encouraging thing about this is that they apparently are not the source of any serious field infections.

We know a grower who had a little wildfire in his field in 1919 but paid no especial attention to it. In 1920 in the same field he had it so seriously that he made an effort to keep wildfire out of his seedbed in 1921, with the result that the plants set that year were fairly if not entirely free, and so in much better shape than the year before. His crop this year on the same land showed no ill effects from wildfire, although showing some slight signs of it. This would not have been the case if the germ had carried over abundantly in the soil, as the season on the whole was favorable for the development of the trouble.

Soil, Fertilizers, etc. We cannot speak very definitely about different types of soil as regards the development of this disease, since we have seen it on all types, sometimes worse on one and sometimes worse on an entirely different type. In general we are inclined to believe that a soil that dries out quickly would not favor the spread of the trouble as readily as a wet one. Likewise a field on a hillside would not be so bad as one in a lower or less protected position. Yet we have seen fields where the worst infections were on the higher, drier spots. This was when the field as a whole was too wet, however. Perhaps a favorable location for the spread may be held back by the slight infection to start with, or an unfavorable one be aided by an original heavy infection of the plants. In such cases neither will prove as bad as where both factors are favorable for the rapid spread.

So far as fertilizers are concerned we can only say that the use of any fertilizer that favors rapid growth is more likely to help infection, during a period of weather favorable to the spread of the disease, than where the fertilization is such that slower or less satisfactory growth takes place. Our field fertilization experiments were not extensive, but so far as they proved anything they showed that the plants with added fertilizer, especially that with nitrate of soda, giving more rapid growth, were the worst infected.

Speaking along this line before tobacco growers at Suffield in 1921 Garner (11.), of the U. S. Department of Agriculture, said:

"It has been found that, other things being equal, an increase in the nitrogen supply of the plant increases its susceptibility to leaf spot, for nitrogen promotes a rapid, tender, 'watery' type of development. This conclusion is based on extensive observations in the field by means of fertilizer plot tests and other field and laboratory studies. * * * * As a general propostion applying nitrate of soda or other quickly available form of nitrogen to young tobacco seedlings should be avoided as far as possible and if used at all, an excess should be guarded against. On the other hand, a liberal supply of potash in suitable form tends to increase the resistance of the plant against leaf spot by promoting a more substantial hardy type of growth. Potash alone cannot be relied upon as a means of control but at times it is of great value and is to be recommended as a safeguard both in the field and in the seedbed."

Rain and Wind. These factors have to be considered somewhat together since they often act simultaneously; at least wind without rain has no effect unless it is by occasionally carrying the wildfire germs into fields through dust. This last statement is based largely on supposition rather than proof. We do know positively, however, that rainy weather of some duration, with or without wind, is favorable to the rapid development of wildfire. There were only two periods during 1921 that favored spread of wildfire in the fields. The first of these came the week of June 26th to July 2d, the latter half being especially favorable for the spread. Growers first began to notice this increase on July 2d, and by the 4th the injury was very pronounced. Previous to this time the disease had spread little or none even in fields that were set with plants badly infected. This led some growers to believe that there was nothing to fear from this trouble.

The only other time during the year when there was a general spread was about the last of July and the first of August when there was a similar prolonged moist period. This was when the most damage occurred, as the previous period had spread the disease so that it was abundant or wide spread in many fields. However, even with this last serious development there were some rather badly injured fields that had spots in which the plants were not hurt to any great extent.

In the first spread the rain was accompanied by a high wind that in itself caused much damage to the plants, but entirely independent of this was its effect on the spread of the wildfire. This wind came from the west, or more accurately from the northwest. That it had something to do with the spread of the wildfire was shown in fields exposed to its full sweep. Here the wildfire developed at first most prominently on that side of the plants exposed to the wind. This phenomenon had been noticed the previous year. It can be explained by the dashing of the rain drops onto the ground with consequent spattering of the muddy water containing the germs onto the leaves. These germs may have been washed off the plants or may have been carried into the soil by the infected dead leaves that gradually disintegrated there. These suppositions are borne out somewhat by our infection experiments with muddy water from infected soil.

In contrast to this condition there were other fields, more protected from the wind, that showed no special infection of the plants on one side over the other. There were also particularly protected

fields or spots where the total spread was not nearly so great. In some of these cases other factors entered. In the Station field, for instance, where the plants were shaded by barns, hedge rows, etc., there never was the spread that there was in the more open places. Protection against the wind and rain accounted for this in part, but it was also due to the slower, smaller growth from shading and poorer fertilizing. We saw another field, protected on two sides by a forest, where the growth and the wildfire infection were both much less than in the more open and exposed part. In a dry season rather unfavorable for wildfire it is quite possible that the reverse of these results might occur since here the shaded parts would have better moisture conditions.

The effect of a rainy or a dry season on wildfire development has been evident in the southern states where this disease first appeared. It has not increased each year but its severity has been entirely regulated by the moisture of the growing season. For example, in most of the southern states last year it was much drier than usual, and the result was that wildfire was inconspicuous. In other wet years wildfire has threatened the industry by its severity. We may expect similar variations in this state; in other words, if one were able to foretell the weather he could predict the severity of wildfire that year.

Distance of Spread. We have no records of the spread of the disease *from a distance* into an isolated field by means of wind or even by insects. In fact infection by these agents would be an extremely difficult matter to absolutely prove, but so far as our observations go, it does not seem that either is a *common* method of field infections. If this does occur the infections are so infrequent as to prove of little consequence. On the other hand we have seen many cases where we are sure that the disease has spread from infected plants in the field to those near by and even from one field to another separated only by a short distance. In such cases the spread seems to go most rapidly with the wind or the wind driven rain. A few examples will illustrate this.

At the Station's Windsor farm several rows of disease-free seedlings from New Haven were set out late. These had badly diseased plants on one side and plants with little disease on the other. While the rain storms of late June and early July were largely away from these plants toward the badly infected, they soon became infected, at first largely on the side toward the badly infected but in time all over. In another place disease-free tobacco plants were beside infected, but so that the wind came from the diseased ones to them, and here the general infection was much more rapid. A more isolated field entirely out of the direction of the wind from the diseased plants, showed only slight infections here and there, but mostly on the end towards the diseased plants. The wildfire, however, was so slow here in getting a start that it never became serious.

A grower near Windsor Locks set out a couple of rows containing infected plants on one side of his field in which there was no disease. It spread slowly to the next row or two but not further in, at least not before the middle of the season when last seen by us. Another grower near Broadbrook had in July a badly infected field with the last one or two rows from another source fairly free. Just beyond these and a narrow grass roadway was another field almost entirely free, the wildfire having spread only to a few plants in the first row or two next the diseased field. We know of another field at East Granby badly injured, while the adjacent field of another farmer separated by a rod or two of grass remained practically uninjured during the whole season, the most infections being next the badly infected field. In another badly infected field at Hockanum wildfire spread only slightly to the corner of a field overlapping but separated by a grass roadway.

These and other instances, together with the probable fact that the germs do not carry over to any great extent in the fields, lead us to conclude that if the grower keeps the trouble out of his seedbed he need not fear serious injury in his field.

Varieties Injured. While we have proved that the different varieties grown in the seedbeds showed no difference in susceptibility to this disease, the fact remains that in the field they are not all injured to the same degree, even when the percent. of infected plants set out was the same. This does not mean that in the field certain varieties acquire immunity but rather that the type of growth and the manner of handling the plants seem to influence the spread of the disease as the plants grow to maturity. In general we can classify Broadleaf and Havana as being more subject to injury, and Round Tip and Cuban as being less.

There is little doubt that Broadleaf on the whole will suffer more from this disease than Havana, though fields of the latter are also frequently severely injured. The large drooping Broadleaf leaves coming in greater contact with the ground, seem to offer the best conditions for infection of any of the varieties. The fact that Havana has the leaves more erect and so not so frequently in touch with the ground, especially the higher ones, seems to help lessen infection somewhat. Where Havana plants are primed the infection is somewhat checked by removal of the infected leaves before the end of the growing season. Some growers take advantage of this and by early priming try to keep partially ahead of the spread, or at least pick the leaves if possible before serious injury occurs. This is never done with Broadleaf so all the leaves are exposed throughout the season.

Round Tip as compared with Havana suffered less, partly because the leaves of this variety are always primed. Other factors tending to lessen its infection are the shorter and broader leaves, separated more widely on the stem with the last ones borne much higher from the ground and the more vigorous root system that

keeps the plants from lopping over in heavy winds. We have not had opportunity to examine a sufficient number of Round Tip fields to state that these advantages always hold. We got some rather badly infected plants in certain of our field experiments where there was no priming made.

Undoubtedly the Cuban tobacco grown in the tents suffered the least of any of the varieties and we have no records of any very serious losses with this variety. Not only does it have all of the advantages mentioned for the Round Tip (except the strong root system) but it also has the further one of partial protection of the tent against the whipping rain storms that seem to bring the most infections. Even in cases where we know considerable infection on the young plants was carried into the tents the resulting injury was not nearly as serious as similar infections produced out in the open on Broadleaf and Havana. However, it can be said that on the whole the grower of tent tobacco took more precautions to prevent this trouble, both in the seedbeds and the fields, than did the growers of Havana and Broadleaf.

Damage. According to the variety and the degree of freedom from the disease we could find all the way from no loss up to a total loss. In a number of fields we estimated the damage around 60 to 70%. When a field is injured to this extent it is very doubtful if it pays to harvest the crop, because the subsequent cost of harvesting, curing, etc., will sometimes be greater than the return from such a crop.

The damage caused in all of the 125 fields inspected, estimated at the time of the last inspection, is shown by varieties in the following table. Of course these fields were inspected at different dates and some only once, so the final damage may have been greater than given here. Apparently no further injury results after the crop is harvested, as there is no evidence that the wildfire spreads on the leaves after hanging in the barns.

Variety.	Very bad, over 50%.	Bad, 25-50%.	Moderate, 5-10%.	Little, Less than 5%.	Free.
Broadleaf,	5	5	8	12	8
Cuban,	0	0	2	9	0
Havana,	2	3	6	10	50*
Round Tip.	0	0	2	3	0

* Chiefly in the wildfire-free Housatonic valley.

The damage by wildfire to Connecticut tobacco is more serious, even with the same percent. of injury, than it is in most other states for the simple reason that all the tobacco grown here is for wrappers. The same injury to a leaf used as a wrapper means much more than it does to a leaf used for a binder, filler, or for other purposes. The injured tissues have that lifeless quality which

is so objectionable because of brittleness but whether or not the burn is affected we cannot state. In the field the infected tissues do not often fall out to any extent but are more subject to injury in the handling during curing, fermentation, etc. The color is also affected. These factors would not be so objectionable in tobacco used for other purposes. If the spots are small and infrequent perhaps no great objection would be raised as spots of various kinds in the past have sometimes been sought for rather than avoided. Another consideration besides the use to which the tobacco is put, in estimating the financial loss, is the value of the product. Wrapper tobacco is sold for a higher price than any other tobacco, and in the tent-grown reaches its highest value in this country. Therefore a 50% injury to a dollar-a-pound tobacco means a loss of fifty cents as compared with a loss of five cents on a ten cent tobacco similarly injured. In view of these facts it is much more essential that the disease be controlled here than it would be in some of the southern states.

Control Measures. What are the control measures that can be taken when the grower finds that he has the wildfire in his field? In the first place these must be confined largely to the early stage, as not much can be done with the older fields. There are only two measures of any value of which we know and these are: 1st, Destruction of infected plants, and 2d, Removal of the infected leaves. A third measure that has been suggested is spraying or dusting the plants with a fungicide. We have tried spraying in a preliminary way, but feel that even if this may be helpful in retarding the spread, as it did in our experiments, it is generally not a practical method of control because of the cost and the unknown effect of the spray on the quality of the mature leaf. The other two methods may be discussed further under their separate headings.

Destruction of Infected Plants. This may involve only a few plants or the plowing up of the whole field. Let us consider the former first. After setting out their fields in 1921 a good many growers found that the disease was showing on the small plants. Some few then went over their fields and removed these diseased plants and reset with healthy ones. Where the diseased plants are not very abundant we believe that this is a good practice. The time to do this is within two or three weeks after the plants are set out and are just beginning to grow. The plants pulled up we believe should be placed in baskets and carried off the field. As the plants are small at this time this will not involve much extra labor. Handling of the healthy plants should be avoided, and the field reset as soon as possible with healthy plants. We doubt if this method is practical after the plants have grown to any considerable extent, because of the greater amount of work involved, and the resulting unevenness of the field if reset.

We have no positive data as to the value of this treatment but

only the knowledge that theoretically we have removed so many plants that would have served as centers of spread under favorable conditions. Not all of the infected plants will have been removed, even with a second careful inspection of the field, as the disease will be so masked on some of the leaves as to escape detection. If, however, a large percentage has been removed, this should help delay the spread and under some conditions certainly would serve to protect the field against the more serious injury that would have resulted with a greater infection to start with.

Where there was considerable infection in a field some of the growers plowed up the whole field and reset with other plants. This is a practice that can be followed only when the plants are small and one is sure that the new plants put out are freer of the disease than those plowed up. The question arises whether or not these plants plowed in may not serve as source of infection for the new plants. We believe that this infection is at least possible under some conditions, but whether or not it is ever a serious menace we have no data as yet to make a positive statement. We do know of at least one field where the infected plants were plowed under, which after replanting remained fairly free from the disease until danger of serious infection, at least, was past. We heard of another field seriously injured in 1920 that was plowed up when the plants were of some size and reset, and in this case also the disease did not make any headway later. The late replanting gave a fair growth but quality was lacking in the crop. This is a thing that must be taken into consideration in plowing up infected fields, namely, it must be done in time so that the replanted crop can thoroughly mature. The season of 1921 was more favorable than most seasons in this respect since the frosts held off unusually late, allowing late planted fields to mature.

It is not always easy to decide whether or not to plow up a field. We know, for example, of a grower of tent tobacco who had a considerable amount of wildfire in the plants when set out. The plants were of some size when, because of the abundance of wildfire, he was advised to plow up the field. Because of the difficulty of plowing them under, he let them grow finally, and got a crop fairly free from injury. He might not have been so lucky if this crop had been Broadleaf, for no doubt the tent and priming helped to keep down the disease in this case. Each grower will have to settle his own policy after careful inspection of his field as no hard and fast rule can be laid down to govern all cases.

Removal of Infected Leaves. If the infected crop has begun to grow and it is too late or inadvisable to plow it up, there is still a possibility of partial control by picking off all lower leaves showing any signs of infection. In fact, if the plants have only a few infected leaves it is better to pick off all the leaves below these as well, whether or not they show halo spots. On such leaves the infection may be present and still not be very

evident because of their yellowed and often withered condition. They are of no commercial value anyway. On young plants the removal of these leaves, if there are still several healthy green ones remaining, does little injury to the growth. After the plants have made some growth it may be found that the first removal was not sufficient and a second or even a third be required. In the latter case if many large leaves are removed the plants are later hindered in their growth. In other words, the removal of leaves once or twice before or shortly after the plants have started to grow seems practical, but if required again, where the final leaves of commercial value have to be removed, it is of very doubtful value. The removal therefore should be with fairly small plants and include leaves of no commercial value and should take place before there has been much chance for field infection from the infections actually brought from the seedbed. Leaves removed should, for greater security, be carried off the field.

We know of one or two growers who practiced this removal and felt that it had resulted in a more limited field infection. These were cases of Cuban tent-grown tobacco and it looks as if the best results would be obtained with this variety. These lower leaves are of no value and often are picked off and thrown on the ground so that only a little more care and effort is required to do a good job. The advantage would be to get rid of a considerable number of infections and also to remove those lower leaves that come in contact with the ground from which secondary infection might start. The usual priming that follows in these fields then should help to keep in check further serious injury.

With primed Havana similar treatment might be helpful to a less degree but with unprimed Havana and Broadleaf the value is uncertain. In these cases it would naturally be limited to the very early stages of growth. Once it becomes necessary to pull off the large or commercial leaves, it is doubtful if one can check the disease enough to pay for the extra expense of removal, loss of leaves removed and injury to the growth of the plant that results. We know of a few cases of infected Broadleaf of some size where removal under these conditions did not seem to be of any value.

Our own experiments at Windsor were rather unfavorable to removal of leaves as a means of retarding the spread of the disease. The leaves here were removed from some of the rows once and from others twice, with check rows with leaves unremoved. Eventually the disease spread about as badly to those rows with leaves removed once or twice as to those with leaves unremoved, and the second late removal checked somewhat the rapidly growing plants. In this experiment, however, there was no protection against re-infection of the plants after their infected leaves were removed, since they were always side by side or nearly so with rows from which no leaves were removed. Because

of this it is quite possible that much of the value of removal was lost compared with an entire field in which total removal is practiced.

Seedbed and Field Experiments.

These are miscellaneous experiments tried during 1921 in an effort to learn something about the development, spread and control of wildfire. It is partly from these and the laboratory studies that our preceding statements have been made. Quite a number of the field experiments were not followed closely after it became evident that wildfire was general in the plants experimented with, as little further information was to be gained. Upon the whole we did not aim to collect figures to illustrate the results, but rather depended on general examinations.

Spraying and Dusting Seedbeds. It must be borne in mind that the treatment of seedbeds was begun in most cases after the wildfire appeared in them. In a few cases wildfire did not develop much further, or at all, either in the sprayed or unsprayed parts, so here conclusions could be drawn only of the general effect of the fungicides on the young plants. In most cases Bordeaux mixture was used, and this was usually the homemade 4-4-50 strength, and almost always had lead arsenate in it. In one or two cases Bowker's Pyrox or other commercial Bordeaux mixtures were used, and in one place Bordeaux dust was compared with Bordeaux mixture. Altogether spraying tests were made in nine different beds in the following places: three at Rainbow; one at Poquonock; three at East Hartford; one at East Windsor Hill; one at New Haven.

Seedbeds 1-2, Rainbow. Each seedbed had the same treatment and other conditions were the same: Havana, glass, soil sterilized, flea-beetles rather abundant; used lead arsenate in each spraying; sprayed five times, May 9, May 20, May 27, June 3, June 20; wildfire scattered irregularly in spots in beds before treatments began. Plot 1, Check, no treatment (except received spraying first time), 35 feet of each bed. Plot 2, Homemade Bordeaux, 4-4-50, on twenty-five feet of each bed. *Results:* Final examinations showed that wildfire did not develop further in the sprayed plots, and while its spread in the checks was not so rapid as earlier, the difference between them was marked by the characteristic halo spots on unsprayed plants close up to the line separating the two plots. Likewise the flea-beetle injury was much more evident on the unsprayed plants. The grower did not use these beds (he also destroyed with formalin four other more badly infected beds, see Plate XXIX d) but bought disease-free plants elsewhere; he had no trouble in his fields. Another farmer bought the experimental beds but we did not examine his field except very early in the season when very little wildfire showed.

Seedbed 3, Rainbow. Same place and variety as beds 1-2, but

with soil unsterilized, cloth covers and planted very late, after appearance of wildfire in the other beds. Spraying was started on the very young plants soon after coming up (largest leaves size of finger-nail) and before any wildfire showed. Care was used in watering, and airing was always good. Sprays, all containing lead arsenate, applied seven times, as follows: May 27, June 3, June 10, June 20, June 28, July 6, July 14. Plot 1, Check, no treatment, first 20 feet of bed. Plot 2, General Chemical Co. Bordeaux, 3½ lbs. to 50 gals. water, next 20 feet of bed. Plot 3, Bordeaux mixture, homemade, 4-4-50, 20 feet of bed. Plot 4, Bowker's Pyrox, 10 lbs. to 50 gals. water, last 20 feet of bed. *Results:* June 20th wildfire appeared in the Check plot in a single spot, and eventually showed abundantly in several spots, one or two entirely isolated from first. Weather was not very favorable, except once for spread, so disease finally became more or less masked. Eventually it also appeared in a very small spot in Plot 2, but did not seem to spread. This plot was nearest to the check, and seemed least protected by spray as the sediment was not so evident on leaves after spraying. No wildfire was seen at any time in the other two sprayed plots.

Seedbed 4, Poquonock. Havana, soil sterilized, beds with glass but uncovered most if not all of the time. Wildfire showed a little in spots over bed before treatment began. Spray, containing lead arsenate, was applied five times, May 11, May 15, May, 20, May 27, June 3. Plot 1, Check, no treatment (except received spray the first time) first 12 feet in bed. Plot 2, Bordeaux mixture, homemade, 4-4-50, on rest of bed, 50 feet. *Results:* This and the other beds of the grower were among the first to show wildfire, but because of care in airing and one or two general sprayings, the disease never became very prominent after its first appearance. In our experimental plots there was no further development in the sprayed one, and apparently but little more in the check. However, plants used from the other beds developed a conspicuous wildfire outbreak in the field in early July.

Seedbed 5, East Hartford. Broadleaf, soil sterilized, glass alternating with cloth sash. Wildfire appeared shortly before first spraying, spotting bed more in some plots than in others. Used lead arsenate in all sprays which were applied four times, May 18, May 24, June 1, June 8. Plot 1, Check, no treatment, 8 feet at end of bed. Plot 2, Bordeaux mixture, homemade, 4-4-50, next 40 feet. Plot 3, Bordeaux mixture, homemade, 2-2-50, 32 feet of bed. Plot 4, Bowker's Pyrox, 10 lbs. to 50 gals. water, last 48 feet of bed. *Results:* Before treatment most wildfire showed in the Bordeaux plots, but did not increase afterward and really became less conspicuous; also no further development occurred in the Pyrox plot. The check plot had least of any to start with, and because of good airing and watering, it did not increase very

much. Care was used in selecting plants from this and bed 6 for field planting, and wildfire was never conspicuous there.

Seedbed 6, East Hartford. Same grower and conditions as bed 5, but only three sprayings given, the first being omitted. Experimental plots 1-4 with same treatment as in bed 5. Wildfire more prominent in this bed when treatments began, especially in the sprayed plots. *Results:* Wildfire checked in all the sprayed plots, as there was no further development there, but in the check plot it developed further in spots. A little burn, of the sun-scorch type, resulted after the second spraying of June 1st, probably because made in too strong sunlight on recently uncovered plants.

Seedbed 7, East Hartford. Same grower as of beds 5-6 but bed late planted and in more shaded, damper spot, covered with cloth only. Four treatments on same dates as bed 5. Plot 1, Check. Plot 2, 2-2-50 Bordeaux. Plot 3, 4-4-50 Bordeaux. *Results:* Very good place for development of wildfire but germs apparently absent as no wildfire was seen either before or after the experiment in any of the plots. No spray injury.

Seedbed 8, East Windsor Hill. Broadleaf, beds not sterilized, glass. No lead arsenate used in any of the three sprayings (as flea-beetles not evident) made on May 18, May 24, and June 1. Wildfire evident in about two-thirds of bed before spraying began. Plot 1, Check, no treatment, 8 feet of bed. Plot 2, Bordeaux, homemade, 4-4-50, remaining 40 feet. *Results:* Wildfire was checked entirely in sprayed part of bed and became less conspicuous in time. In the check it developed so that it was more prominent even though masked and hidden by the crowded plants at the end of the experiment. Other beds were sprayed at least once by the grower, kept well aired, and he took his plants only from the least infected parts of the beds. However he got a fair sprinkling of infected plants in the field, and eventually suffered about 15% loss from wildfire. If he had not used this care in the beds and in selecting his plants, his loss, without doubt, would have been much greater.

Seedbed 9, New Haven. Havana, soil unsterilized, cloth cover. This was planned to test value of dusting as compared with spraying, using both Bordeaux and Lime Sulphur dust as well as Bordeaux mixture and commercial L. & S. solution. Some of the plots whose seed was soaked with water containing wildfire germs did not come up so only Bordeaux mixture and Bordeaux dust were used. The experiment was started in the fall and five treatments were given in the seedbed, on Oct. 4, Oct. 10, Oct. 19, Oct. 26, and Nov. 6. After the last treatment, however, a few plants from each plot were transferred to small flats in the greenhouse and treatments continued there during the next nine weeks. Plot 1, Check, no treatment, seed sterilized with formalin. Plot 2, seed and soil sprayed with wildfire germs before planting; dusted well each time with Glidden's Bordeaux dust. Plot 3, seed and soil sprayed with wildfire germs before planting; sprayed well each time with homemade, 4-4-50 Bordeaux. *Results:* No wildfire developed on any of the plants in the seedbeds or in the greenhouse. No evident injury resulted from spraying with Bordeaux mixture fourteen times. Soon after dusting began it was seen that these plants were yellowing and injured somewhat; they were more or less stunted by subsequent treatments and never grew as large as those sprayed.

Killing Plants with Formalin. This was tried only in two beds. Formalin at rate of 1 to 15 of water was liberally sprinkled with an ordinary sprinkling can on marked wildfire spots. The next day the plants were all dead; The photograph (Plate XXIX c) shown here was taken several days later. Care was used not to get the liquid outside the spots and the beds had the sash off at the time. No injury showed outside the sprayed spots. We have seen older beds where all the plants were sprayed and many leaves killed but the plants started to grow again. It is evidently harder to kill large than small plants, but in these cases less liquid or a weaker strength may have been used. See Plate XXIX d.

Field Experiments with Infected Seedlings. These were experiments with plants of different varieties selected from various infected beds and transplanted at New Haven and the Windsor tobacco farm, where they could be especially watched to see how the disease progressed later.

Windsor Experiments. The tobacco plants were set out June 7th at the Windsor tobacco farm with eight rows to a plot, except plot 5 which had six. The rows averaged about 150 plants. The Broadleaf, Havana and Round Tip plants in plots 1, 3 and 5 were obtained from seedbeds bad with wildfire, at least in spots, and infected seedlings were selected as far as possible. As check to these, plots 2, 4 and 6 were set with plants free, or nearly free from wildfire. Table IV shows the results of the examination of all the plants on June 28, before there was any appreciable spread of wildfire, but late enough for any masked seedbed infections to show. The check plots had only a few slightly infected leaves and these were all removed on this date, check plot 6 being the worst of these but still with less than 3% slightly infected plants as compared with 67% in the Havana wildfire plots. There was no check, wildfire-free, Broadleaf plot. After the July 4th spread the disease became general in the infected plots and even spread considerably into the check or free plots. In these it appeared most abundantly in the rows next the infected plots and by the end of the season had spread generally through the rows, but never so bad as in the wildfire plots. The west end of all the plots, both wildfire and check, never developed nearly as much wildfire as the east end which was more exposed and better fertilized.

TABLE IV. WILDFIRE PLANTS ON STATION FIELD, WINDSOR.

Plot.	*Row.*	*Locality.*	*Variety.*	*Seedlings Condition.*	*Total Plants.*	*Inf. Plants.*	*% Infected.*
1	1-8,	Rainbow,	Broadleaf,	Bad,	1113	439	39.0
2	9-16,	Suffield,	Havana,	Free,	1375	1	.08
3	17-24,	Suffield,	Havana,	Very Bad,	1254	837	67.0
4	25-32,	Windsor,	Round Tip,	Trace,	1197	13	1.0
5	33-38,	Suffield,	Round Tip,	Bad,	777	386	50.0
6	39-46,	Windsor,	Round Tip,	Trace,	1006	32	3.0

While the examination of June 28 showed that the Havana wildfire Plot 3 had the highest infection, 67%, Round Tip Plot 5 next with 50%, and Broadleaf, Plot 1, the least with 39%, after the favorable weather ending July 4th it was seen that the spread was greatest in the Broadleaf, next in the Havana, and least in the Round Tip. This agrees with our experience elsewhere that these varieties are injured differently in the field. While no counts were made over the whole plots as on June 28th, counts on July 27 of a few of the unsprayed plants, given in Table VIII, at the least injured end of the field bring out this same variation in spread according to variety. For example, all 8 unsprayed Broadleaf plants taken as they came in the row were infected and had 55 infected leaves showing 1576 wildfire spots, as against 19 infected Havana plants similarly counted with only 71 infected leaves containing 602 spots and 16 out of 19 counted Round Tip plants with 48 infected leaves containing 204 spots. Figuring from this data the ratio of spots per plant in each variety, the difference would be still more marked since the Broadleaf plant would have 196 spots, the Havana 32, and the Round Tip only 11, despite the fact that the Havana seedlings were the worst and the Broadleaf the least infected to start with.

New Haven Experiments. At New Haven the plants from different sources were set out in small numbers in a garden plot so that they were all close together. There was no very evident development until July 5th, just at the end of the favorable moist weather for spreading already mentioned. Before this time in most cases the disease became less rather than more evident, as the infected leaves matured and disappeared. In one case (No. 1585) however, the disease became more evident soon after planting as it was masked in the seedlings when set out. The disease-free plants from New Milford remained practically free until July 5th, when they became more or less abundantly infected, largely from infected leaves previously buried under them, but partly by spread from the nearby infected plants. We shall speak of these later. The condition of all plants as regards wildfire on July 11, together with other data, is shown in Table V. An examination of these data shows that no varieties had any pronounced freedom from the disease when closely planted in small plots with others, with no topping, priming, etc., to limit the spread; in other words the Cuban tobacco became infected almost as badly as the Broadleaf.

TABLE V. WILDFIRE PLANTS IN STATION GARDEN, NEW HAVEN.

Exp. No.	Locality.	Variety.	Date of setting.	Seedling cond.	Plants set.	Plants lived.	Condition of Plants on July 11th. No. free.	Little.	Mod.	Bad.
1569	E. Windsor Hill,	Havana,	May 26,	Consid.,	25	24	0	23	1	0
1570	E. Windsor Hill,	Broadl.,	May 26,	Bad,	50	32	0	13	15	4
1576	Windsor,	Havana,	May 28,	Consid.,	25	12	1	9	2	0
1577	E. Granby,	Havana,	May 28,	Consid.,	50	37	0	16	18	3
1579	Suffield,	Round Tip,	June 1,	Bad,	18	13	0	4	8	1
1582	W. Suffield,	Havana,	June 4,	Very bad,	55	48	0	7	26	15
1583	E. Granby,	Cuban,	June 4,	Consid.,	18	13	0	2	5	6
1584	Warehouse Point,	Havana,	June 9,	Bad,	17	17	0	0	8	9
1585	Glastonbury,	Broadl.,	June 9,	Very little,	114	109	1	30	65	13
1587	Ellington,	Broadl.,	June 11,	Bad,	26	24	0	8	14	2
1588	N. Milford,	Havana,	June 15,	Free,	38	38	1	13	17	7
1588a	N. Milford,	Havana,	June 15,	Free,	11	8	2	5	1	0

Infection from the Soil. Certain of the wildfire-free Havana plants (1588, Table V.) from New Milford had wildfire leaves buried in the soil under them on June 15th. After the first field outbreak, showing July 4th, these plants became abundantly infected. As they were near other wildfire plants the infection may have in part come from these, but we believe most of it came from the germs in the soil from the buried leaves, as the eight check plants (1588a) under which no leaves were buried, had only 13% with moderate and bad infections as compared with 63% in the others. These checks, too, were more exposed to the other infected plants nearby. The infections also showed more on the sides of the plants under which the leaves were buried. Later, soil from under the plants where the leaves were buried was sprayed with water onto plants in the greenhouse and a few infection spots appeared. These experiments seem to confirm our field observations that the spattering rains carry infection from the soil to the leaves.

Spread of Disease in Marked Fields. In order to determine the spread of wildfire under ordinary field conditions, six fields were selected that were set out by growers with plants from seedbeds having no, a little, and considerable wildfire. These included all four varieties of tobacco grown in Connecticut. On the first examination or two, up to July 4th before there was any field spread, these infected plants were marked by numbered labels stuck in the ground by them. After the spread, note was merely taken of total infected plants and severity of attack. It was thought that by marking the infected plants at first it could be seen whether or not subsequent infections clustered around these, but the spread when it did occur was usually so rapid and general that no special centers of distribution were noticed. Details of these fields and their inspections are given in the following paragraphs and Table VI.

Field 1, Windsor. This was Havana tobacco planted with seedlings obtained from Portland, where there was no wildfire in the seedbeds or anywhere near them. Care was used not to infect them in any way during transportation and planting. They were put out in a low, somewhat wet and isolated field that at least had never had any serious outbreak of wildfire. Inspection of Table VI shows that this field remained entirely free of infection until July 5th and that no general spread occurred later. Just after the first spread, examination showed on July 5th only seven infected plants in the field,—five of these had only a single spot on a leaf, and the other two had several spotted leaves. These latter appeared as if infected when set out and they might have served as the source of infection for the others. They were pulled up and all the other infected leaves were removed. The second examination on July 21 showed only five additional infected leaves,

four with two or three infected spots and one with ten. Most of these leaves were in the vicinity of the moderately infected plants previously pulled up. Priming was begun soon after so no further data were obtained but no injury resulted. This and Field 2 showed the value of setting with wildfire-free seedlings.

Field 2, Rainbow. This was a Round Tip field set with plants from a wildfire-free bed. No wildfire showed on the inspected plants at any of the four examinations made from June 20 to August 3d. As this field was near infected seedbeds that had been destroyed after it was planted, its freedom from wildfire indicates that the disease is not commonly carried any distance. The grower, however, was careful about the disease getting a start, as he did not use any of his own plants. In other rows in the same field with our plot and on Havana tobacco near-by, a few wildfire spots finally appeared.

Field 3, East Granby. In this case the infected Cuban plants were marked under a tent. These came from the grower's seedbeds that showed considerable wildfire, but care was used to avoid infected plants as much as possible. The few found on the 1st and 2d examinations, June 3 and 15, were all seedbed infections and averaged, on the last date, about 1½% for the marked rows. The next examination was delayed until July 14, at which time the field was being primed the first time, so counts could not be made, but it was evident that the spread, while it may have included more plants, was so light on these that no very evident damage occurred, and the subsequent primings would keep ahead of the trouble. Injury to this field, apparently, was not over 1%.

Field 4, Windsor. Broadleaf was planted in this field from a seedbed that showed considerable wildfire. Inspections on June 3 and 20 were before any field spread, and showed on the last date about 6% seedbed infection. After the first spread in the field on July 6, this was over 12%. The grower after the second inspection removed all the infected leaves from the experimental plot, and this may have lessened the spread, for in two rows in which the leaves had not been removed counts on July 6 gave 51% infection. This field was not followed further so the final damage caused was not determined. The infection at the start, however, was abundant enough to cause serious injury judging from other similar fields.

Field 5, Windsor. The field was set with Havana plants mentioned under seedbed spraying test No. 4, so there was a moderate amount of infection to start with. The rows selected happened to have less than other parts of the field, and our first inspection of June 20 revealed no infection whatever. It was quite probable if these plants had been examined earlier, soon after they were set out, some infected leaves would have been found that later disappeared and so gave a false impression of freedom from

disease. After the first spread, counts on July 5 showed 10% of these plants infected. This was not nearly so high as in other parts of the field and the amount per plant was not so serious. The grower started in priming about the middle of July so no counts were made on the next inspections. For this particular part of the field the disease was kept in check by the priming and weather so that probably less than 5% injury resulted.

Field 6, Suffield. This Havana field certainly had a good chance for injury as it was set from the grower's badly diseased seedbeds with no particular care to avoid wildfire plants. As a result of our first count on June 3, we found that the average infection for the two marked plots was 36% and twelve days later, before any spread, this increased to 42% because of the masked seedbed infections developing. On July 8 after the first field spread, it had reached 90% and of course was very bad on some of the plants. One of the plots was protected from the wind by a barn and also happened to get fewer infected plants to start with, 31% as compared with 69%, so the final damage here was much less than in the other plot at the further side of the field. We estimated the total damage to the field to be about 20%, and if it had not been harvested early, just before the second infection period (the last of July), this would have been considerably greater. As it was, counts made on July 8th in the badly infected plot showed 23% of the plants badly injured, 41% moderately, 34% slightly, and only 2% free from wildfire.

TABLE VI. INFECTION IN MARKED FIELDS AT DIFFERENT DATES.

Field.	Locality.	Variety.	Condition Seedlings.	Total Plants Marked.	No. Inf. Plants on Examinations: 1st.	2d.	3d.	4th.
1	Windsor,	Havana,	Free,	4294	0 Je. 20	7 Jl. 5	10 Jl. 21	Priming; no injury.
2	Rainbow,	R. Tip,	Free,	2000	0 Je. 20	0 Je. 28	0 Jl. 5	0 Aug. 3
3	E. Granby,	Cuban,	Mod.,	6030	75 Je. 3	84 Je. 15	Priming; Jl. 14	Priming; no damage.
4	Windsor,	Broadl.,	Consid.,	1978	51 Je. 3	104 Je. 20	242 Jl. 6	No later data.
5	Windsor,	Havana,	Mod.,	1733	0 Je. 20	183 Jl. 5	Priming. Jl. 21	Plowed up. Aug. 3
6	Suffield,	Havana,	Bad,	733	265 Je. 3	310 Je. 15	656 Jl. 8	Cut Jl. 26

Removal of Infected Leaves. These plants, Jones' experimental plots with crosses, were set out June 4th at the Windsor tobacco farm. The plants came from a seedbed in which wildfire developed conspicuously, and the plants were kept moist in baskets for one or two days before planting; wildfire was very evident soon after they started to grow. There were four rows in each

plot. On June 20 the first counts were made and all infected leaves removed from rows 1-2 of each plot. On July 6 counts were again made and all infected leaves again removed from row 1 of each plot. Unfortunately counts were never made of infected plants and leaves in rows 3-4 and of rows 1-2 after July 6th. However, observations made at this date and later showed little difference in apparent infection between the plants in the rows in which the leaves were never removed and those that had been removed once and twice. In fact the first count showed infected plants (see Table VII) in row 1 of the different plots ranging from 15% to 81%, and yet on the second count the least infected rows had just as high a percent. of infection as the others, the range for all being only 97% to 100%. The first removal average from 1.8 to 5.2 leaves per infected plant for the different plots and the second from 4.1 to 5.4 leaves.

That the first removal had little result in stopping later infection is shown by the great number of leaves removed in each case at the second removal. No harm was done by the first removal, but the second one took off leaves of which 50% were of commercial value. This removal also showed in somewhat lessened growth of the plants subsequently. The second removal was made after the first spread of the disease in early July; if it had been made before this, say about June 27, less harm to the plants and more effect on the spread of the wildfire might have resulted. Again the plants with the leaves removed were so close to those that did not have the leaves removed, that re-infection from them was easy and so may have nullified the effect of their removal. As an experiment under the conditions which it was tried, it did not show any favorable result from the removal of the infected leaves.

TABLE VII. REMOVAL OF INFECTED LEAVES FROM FIELD TOBACCO.

Exp. No.	Plot.	Row.	Total plants.	1st removal. Inf. pl.	1st removal. Inf. lvs.	2d removal. Inf. pl.	2d removal. Inf. lvs.	% Inf. plants. 1st tm.	% Inf. plants. 2d tm.	No. inf. leaves per inf. plants. 1st tm.	No. inf. leaves per inf. plants. 2d tm.
2121	1	1	150	121	254	146	603	81	97	2.1	4.1
		2	...	109	191	...	...	..	..	1.8	..
2122	2	5	155	113	288	152	676	73	98	2.6	4.4
		6	...	90	260	...	...	..	..	2.9	..
2123	3	9	162	139	324	161	759	86	99	2.3	4.7
		10	...	95	253	...	...	..	..	2.8	..
3141	4	13	160	106	292	159	826	66	99	2.8	5.2
		14	...	122	325	...	...	..	..	2.7	..
3142	5	17	142	74	186	142	589	52	100	2.5	4.1
		18	...	...	197	...	...	..	..	2.1	..
3143	6	21	156	110	315	152	733	71	97	2.9	4.8
		22	...	95	290	...	...	..	..	3.1	..
4121	7	25	170	30	98	170	877	18	100	3.3	5.2
		26	...	48	145	...	...	..	..	3.0	..
4122	8	29	164	25	129	161	864	15	98	5.2	5.4
		30	...	38	155	...	...	..	..	4.1	..

Fertilizer Experiments. These rather simple fertilizer tests were made on the infected seedling plots 1-6 at the Station's Windsor tobacco farm. The field had already been given what growers would consider a rather moderate amount of fertilizer, consisting of one application of Olds & Whipple's tobacco manure at the rate of a ton per acre. It was decided to divide the field into three strips running crosswise of the plots. The first thirty-eight feet received nitrate of soda at the rate of 250 lbs. per acre; the second got sulphate of potash at the same rate; while the third and largest strip received no further fertilization. The plants at this time, July 12, had grown considerably. No counts were made as other factors entered into the problem; for example, the greater protection against wind, etc., of the plants at the further end of the field which received no further fertilization. However, it was evident that the first or nitrate of soda strip made the best growth, and had the most wildfire. The sulphate of potash strip also made a fair growth, somewhat less than the nitrate of soda, and had less wildfire. The check was the poorest in growth and had the least wildfire; this plot, however, would not have been considered sufficiently fertilized. Just how much was due to poor fertilization and consequent slow hardy growth of the tobacco, and how much to the greater wind protection, in the limiting of wildfire spread in the check, could not be determined.

Spraying Field Plants. These experiments were conducted on plants at the Station's Windsor tobacco farm. Plants in plots 1-6 already mentioned were used in part. The last ten plants in rows 2 to 46, making 450 plants in all, were sprayed five different times with homemade, 4-4-50, Bordeaux mixture, without lead arsenate, on the following dates: June 20, June 28, July 6, July 14, July 26. These plants had been set out on June 7, and included plants both badly diseased and practically free from wildfire. It happened that the end of the field sprayed was the end in which wildfire did not spread so rapidly or extensively as the opposite end, but this makes no difference between the sprayed and unsprayed plants compared here.

In order to determine the effect of the spraying, the sprayed plants in two rows of each plot (except plot 1 with one row) were compared on July 27 with the same number of unsprayed plants in the same rows and next to them. This count was just before the first priming and at a time when wildfire had completed its spread from the first infections of early July. The details are given in Table VIII. This shows that in every case the sprayed plots had fewer infected plants, leaves and spots than the corresponding unsprayed plots. There had, however, been much less spread in the sprayed and unsprayed wildfire-free or nearly free plants than on those that were badly infected when set out.

The average of the totals showed that the unsprayed had one

and a half times as many infected plants, two and a half times as many infected leaves and over eight times as many wildfire spots as the sprayed plants. A plant was called infected if only a single wildfire spot showed on it, so the true value of the control by spraying is shown by the number of spots. It must be remembered, too, that some infections on the sprayed plants were there before spraying began.

A second fact shown in the table is that most of the infections on the sprayed plants were on the end of the rows next to the infected unsprayed plants (see end of Table VIII), as the near end had 17 as compared to 15 infected plants at the further end, and almost twice as many infected leaves, and three times as many wildfire spots. This indicates that had the sprayed plants been entirely isolated there would have been even fewer infections. Where wildfire was bad on the plant to start with, the beneficial effect from the spraying was more marked than where there was little, for the unsprayed plants on the former developed over eight times as many spots as on the sprayed, while the latter only six times as many.

TABLE VIII. EFFECT ON WILDFIRE OF SPRAYING FIELD PLANTS WITH BORDEAUX MIXTURE.

Plot.	Rows.	Variety.	Condition of Seedlings.	Treatment.	Total Plants.	Infected Plants.	Infected Leaves.	Total leaf Spots.
1	2	Broadl.,	Wildfire bad,	Bordeaux,	8	8	31	209
1	2	Broadl.,	Wildfire bad,	Unsprayed,	8	8	55	1576
2	15–16	Havana,	No wildfire,	Bordeaux,	18	6	7	10
2	15–16	Havana,	No wildfire,	Unsprayed,	18	11	21	62
3	23–24	Havana,	Wildfire bad,	Bordeaux,	19	12	21	57
3	23–24	Havana,	Wildfire bad,	Unsprayed,	19	19	71	602
4	31–32	R. Tip,	Trace wildfire,	Bordeaux,	20	3	3	3
4	31–32	R. Tip,	Trace wildfire,	Unsprayed,	20	2	2	7
5	37–38	R. Tip,	Wildfire bad,	Bordeaux,	19	8	11	18
5	37–38	R. Tip,	Wildfire bad,	Unsprayed,	19	16	48	204
6	45–46	R. Tip,	Trace wildfire,	Bordeaux,	19	0	0	0
6	45–46	R. Tip,	Trace wildfire,	Unsprayed,	19	2	2	3
1–6	Totals	all vars.,	Little & much,	Bordeaux,	103	37	73	297
1–6	Totals	all vars.,	Little & much,	Unsprayed,	103	58	199	2454
First	4 Plants	all vars.,	All rows,	Bordeaux,	22	15	24	70
Last*	4 Plants	all vars.,	All rows,	Bordeaux,	22	17	42	215

*Next the unsprayed plants in same row, while the first four, of the ten sprayed plants, were away from them.

Laboratory Studies.

Cultures. Cultures of *Bacterium tabacum* are obtained fairly easily from the wildfire spots on tobacco leaves. The method finally used by us was to soak small pieces of the infected leaf tissue for about one minute in corrosive sublimate solution, 1 to 1,000. After washing these in sterilized water, they were crushed with a sterilized scalpel in a test tube containing about 5 c.c. sterilized beef broth. This was sometimes allowed to incubate for an hour or more, after which one to three drops were introduced into a test tube of melted beef-peptone agar, which, after thorough shaking, was poured into a Petri dish. From the resulting isolated colonies, pure cultures were eventually obtained. Practically all cultures were grown at room temperature without the use of an incubator. A variation of this method, used in the beginning, consisted of grinding the tissue with a few c.c. of water in a mortar with sand, all of which had been sterilized. About three drops of the liquid were smeared over the surface of hardened agar in a Petri dish. See Plate XXXII c-d.

Attempts to obtain cultures from old dried leaves and from seeds were tried in several cases, but it was difficult to isolate the germ, even when it was known to be present. Finally from one of the old dried leaf tissue nine months old, cultures were obtained, but not from the other leaves or seeds. This may have been due to over-sterilization or to faulty technique, since the same crushed unsterilized tissues when applied in moisture directly to pricked leaves often gave quite successful inoculations.

In general, no effort was made to distinguish between the dead center and the living yellow halo of the spots in obtaining cultures. However, to satisfy ourselves that bacteria were not confined either to the dead spots or to the yellow halo surrounding them, material was selected several times from each of these restricted areas and it was equally easy to obtain the germ from either region. No attempts were made to isolate the germ from seed-pods or ribs of the leaves. We have no doubt, however, that the germ can be isolated from either when infected.

Considerable variation existed in the virulence of the germ obtained in pure culture, depending upon the age of the same. In general, young, recently inoculated cultures were more virulent than those several months old that had been frequently renewed. An old culture received from Wolf also seemed to have lost its virulence. However, on Dec. 30th we made successful inoculations with a culture that had not been renewed since June 6th. In this particular case the culture had been kept at room temperature and had been dried out for some time, but before using it was soaked in water for several hours. The manner in which the inoculation is made is also an important factor of its success, a subject which will be discussed later.

The Organism. The germ is readily stained with gentian violet, fuchsin, etc., but these alone do not bring out the flagella. After trying several methods, our best results were with Moore's modification of Loeffler's stain. Our description of the bacteria are based chiefly on slides stained in this manner.

In common with most bacteria it is difficult to distinguish this species entirely by its morphology. Its pathogenicity to tobacco is its striking characteristic. There are, however, certain discrepancies in the characters assigned to it by Wolf and Foster (32.) and those observed by us. For this reason a brief discussion of it here is desirable.

The size of the organism, as stated by them, varies "from 2.4 to 5 by 0.9 to 1.5μ, the most common size being 3.3 by 1.2μ." According to our measurements, we find it varying from 1.3 to 2.5μ in length by 0.6 to 0.8μ in width. Slagg (24, p. 25.) obtained measurements which agree very well with our own, since he gives the length as varying from 1.4 to 2.8μ and the width from 0.5 to 0.75μ. The largest size described by Wolf and Foster may have been due to measuring, as one, individuals which had not been completely divided. In our stained slides the bacteria are frequently seen in pairs in various stages of division, and in measuring these one is sometimes uncertain whether to consider them as a single or two germs. The measurements we have given here are limited to those of isolated individuals. In general, the germs are short rods with rounded ends, about two or three times as long as broad. See Plate XXXII a.

Wolf and Foster distinctly say that these bacteria have one polar flagellum. Slagg, on the other hand, states that the germ isolated by him from Kentucky and Connecticut had from three to six polar flagella. We have found from one to four flagella, with one or two doubtful cases where there may have been five. Most of the bacteria seen by us had one or two flagella. Counts of several hundred show about the following proportion: 40% with one flagellum, 45% with two flagella, 13% with three, and 2% with four. The number of flagella found, however, seems to us to depend somewhat upon the success that attended their staining. Where only one is found, one cannot be sure but that others may have been broken off, especially if a single flagellum comes off at an angle to the polar end. Very frequently one finds detached fragments of the flagella on the slide and the varying length of those attached indicates that portions have been broken off. On one of our slides the appearance of the rather stiff, coarse flagella, commonly one at a pole, suggested that they might have been accidentally coalesced in the manipulations. That this does occur is shown by frequent individuals, in certain slides, where a branching effect is produced by the flagella coalescing for a greater or less extent and then separating into two or more. A forked or pronged effect

is thus frequently given. In general, the flagella seem to be two or three times the length of the bacterium, though shorter ones were obtained which were probably broken off. See Plate XXXII b.

In this connection, it might be well to consider the characteristics of *Bacterium angulatum* as given by Fromme and Murray (Journ. Agr. Res. 16: 225.). In table form they mention five points that distinguish this germ from *Bacterium tabacum*. Three of these relate to the manner of liquifying gelatine, acid formation with saccharose, dextrose, etc., and growth in the closed arms of fermentation tubes. These seem to be chiefly differences of degree rather than of kind and so cannot be considered of as great importance as the other two which relate to size of the germ and number of flagella. They state that *Bacterium angulatum* varies from 2 to 2.5μ in length and is 0.5μ wide. Contrasted with Wolf and Foster's measurements of *Bacterium tabacum* these measurements are distinct but vary little from those found by Slagg and us for the latter germ. They give the number of flagella as varying from three to six. This also is quite different from the single flagellum mentioned by Wolf and Foster, but agrees fairly well with the number found by us, and exactly with the number given by Slagg for *Bacterium tabacum*.

From the preceding considerations it will be seen that the morphological differences between *Bacterium angulatum,* angular leaf spot, and *Bacterium tabacum*, wildfire, are not so marked as originally considered by Fromme and Murray. This may account for the confusion of the tobacco bacterial spot from Africa, mentioned by Klerck (19), where the spots are said to resemble those of wildfire while the germ agrees with the angular leaf spot organism. Undoubtedly a comparative study of the two germs and their effects on their host from different regions of the world is needed to bring out their real differences.

Methods of Inoculation. Altogether several hundred infection experiments were tried with the wildfire germ on tobacco. These were mostly under greenhouse conditions; some, however, were carried on outdoors under varying natural conditions. In the greenhouse, inoculations were made at all times of the year. According to the environmental conditions and the manner of inoculation, different results were obtained. The former we will consider later. The latter may be described briefly here as follows:

(1) The first method tried consisted merely of placing pure cultures of the germs, or the crushed tissues containing them, in a moderate amount of water and pouring it over the leaves to be infected. A variation of this method consisted in dropping with a medicine dropper the water containing the germs on the host. This method proved the least satisfactory of any of those tried. It was most successful when the conditions for natural infections outdoors were present. It was not so effective in the greenhouse unless

those conditions were simulated. However, it was very satisfactory when the tissues to be infected were injured so that the germs could gain entrance through the injured places. The injury was usually accomplished by pricking the tissues with a sterilized needle. Unless the environmental conditions were unusually favorable the infections almost always were limited to these pricked spots. This was especially true in our winter experiments. See Plate XXX b.

(2) The second method employed was to spray pure cultures of the germ in water on the plants by means of an atomizer. This was very successful outdoors when natural conditions were just right. In the greenhouse, it was most successful when accompanied by needle pricks in the tissues, as noted before. The disadvantages of this very successful method lies in the fact that the atomizer has to be thoroughly sterilized each time after a culture from a different source is used.

(3) This method consisted of pricking the tissues in definite places with a needle which, after being sterilized, had been introduced into a pure culture. The advantage of this method, which is also almost always successful, is due largely to infection taking place only at definitely marked points.

In any of these methods efforts were made to keep the plants under favorable moist conditions for a few hours after the inoculation. This was done in part by spraying with water, placing them under a bell jar or in a shady position, or by making the inoculations on a cloudy or moist day.

Relation to Environment. As has already been shown in this paper, environmental factors are very important in determining the spread of the disease in nature. The same holds true in relation to artificial infection, especially when no puncturing or injuring of the tissues is provided for entrance of the germ. The two factors of most importance are favorable moisture conditions and rapid growth of the host. In the greenhouse experiments, especially during the winter, these two factors did not always occur, and especially with the very slow growing plants infections were limited unless the tissues were punctured.

To secure more favorable conditions, the plants, some time previous to inoculation, were frequently placed under bell jars to facilitate the opening of the stomates, thus favoring the entrance of the germs. Likewise in the heat of early summer a cheese-cloth tent was built on the ground in the greenhouse to shade the plants and to retain a more moist atmosphere.

It might be stated here that the greenhouse conditions under which we worked were such that there was little or no accidental infection. Very little care was needed to keep the check plants isolated from the infected ones on this account, especially in the cooler months. This failure to spread will not hold true in nature where, under certain conditions, the disease spreads rapidly from

infected to free plants. These differences are well illustrated by the following experience. A number of small plants in the greenhouse were artificially inoculated without puncturing, only a few spots appearing on all of them. The plants were kept for some time under these conditions with no spread whatever of the infection, although they were frequently sprinkled. Later the plants were taken out of the crocks and transplanted in an isolated place outdoors. They began to grow more rapidly, and when a moist, favorable period arrived the wildfire spread suddenly and abundantly all over the newer leaves.

Relation to Host. Although in the greenhouse experiments we were most successful with those inoculations where the tissues were punctured, there is no doubt in our minds that in nature, where the disease suddenly spreads under favorable environment, the infections usually take place through the uninjured tissues. This undoubtedly occurs by the passage of the motile germs through the open stomates. Examination of the tobacco leaves shows that the stomates are abundant on both the upper and lower surfaces, although somewhat more numerous on the lower. Under favorable environmental conditions for the opening of the stomates, both outdoors and in the greenhouse, we were able to produce abundant infections on the uninjured tissues by applying the germs alone either to the upper or lower surface of the mature or nearly mature leaves. However, when they were sprayed over the immature leaves rarely did infection occur. Similar freedom from infection of young leaves is seen in nature and indicates that entrance takes place through the stomates, which in these leaves are not so fully developed or liable to be open. Furthermore, that it was a question of open stomates and not of the age of the tissues, is shown by the fact that young leaves are very easily infected after puncturing.

This last statement leads us to a consideration of the age of the tissues in reference to their susceptibility to artificial infection. In several cases we tried comparative tests in inoculating over-ripe and somewhat yellowing leaves, with those in their prime and the young or immature leaves, all on the same plant. Where the puncturing method was used we found that the young leaves apparently show the most successful infections, especially by sharper contrast of the halo spots with the normal tissues, and possibly by their larger size. This contrast was nearly as evident on the leaves in their prime, but much less so on the older over-ripe leaves. On the latter, especially when yellowed, the infections were frequently not very evident, and as the general yellowing progressed they become entirely obscured. To our minds, this is explained by the fact that young leaves have more food for growth, and as the chlorophyll granules are the parts more directly attacked, leaves in their prime furnish a more favorable environment than do the old yellowing leaves.

Tissues Invaded. When we employed the puncturing method of inoculation we found it equally easy to secure infections in the leaf parenchyma, ribs, or the stems of growing greenhouse plants. No attempts were made to inoculate the floral parts or seed-pods. Certain differences showed in the results of infection at these three different points of inoculation. For example, in the leaf blades, round yellow halo spots that eventually reached a diameter of one-half inch or so were the common result. In time, as the spots reached their maximum size, dead centers of more or less extent appeared, but these were not so common or quick to develop as with natural infections outdoors.

If these inoculations were made on the veins, nearly similar results were obtained. When, however, the inoculations were made on the midrib, yellowing was more extended in a linear direction up and down either side of the same and less definitely marked off from the surrounding healthy green tissues. Likewise some of the yellowing extended out along the lateral divergent ribs. Soon dead spots appeared in the tissues parallel to the midrib, and frequently smaller ones along the lateral ribs. This indicates more of an up and down spread, as if the germ or its toxin followed the course of the veins. It made little difference whether the midrib was inoculated near its apex or its base, as the disease seems to spread as readily downward as upward. Plate XXX c.

Where the young stems were inoculated below, but away from the base of the leaf, an elongated blackening of the tissues occurred in the vicinity of the puncture. In time the leaf immediately above showed yellowing and spotting, somewhat similar to that described for the inoculations of the midrib. In some cases upper leaves away from the point of inoculation showed a slight yellowing of the leaf blade in the vicinity of the midrib. Whether this yellowing had anything to do with the immediate presence of the germs, or was merely a secondary result, we did not determine. A single attempt to inoculate plants with such leaves was unsuccessful. Neither did we try to determine, by inoculation tests or staining, the presence of the germs widespread in stems or the midribs. In the parenchyma, however, both in the dead centers and yellow halo spots, the presence of the germs was demonstrated both by staining and by inoculations with tissues from these restricted regions.

Methods of Survival. Cotton Seed Meal. We have already mentioned our failure to secure infection of tobacco plants by means of cotton seed meal. In these tests eighty-one samples of cotton seed meal, recently collected over the State by the Station's sampling agent, were used on greenhouse plants in the spring of 1921. A small amount of each fertilizer was soaked for a short time in water and then sprinkled over a small tobacco plant in a

crock. It is to be regretted that no punctures were made in the leaves of the plants to secure more certain infection if the germs were present. However, other plants similarly sprinkled with germs in water at the same time of year were successfully inoculated. These results seem to indicate that this fertilizer is not a means by which the germs are carried over from one year to another. This is the only fertilizer, except tobacco stems, in which it is at all likely that the germs could be carried from the south.

Tobacco Stems. Similar experiments were tried in a few cases with commercial tobacco stems, such as are used in field fertilization, but of unknown origin, and of leaves and stems of wildfire tobacco overwintered in a barn. No results were obtained from any of these. The barn-cured wildfire tobacco when first used was about a year old and the inoculated plants were unpunctured. This may account for our failure to secure successful infection from it, since we later secured successful infection from dried herbarium wildfire leaves equally old when the puncturing method was used. This barn wildfire tobacco was used again on punctured leaves, when it was a year and a half old, but no successful inoculations resulted. We believe, however, with this method we could secure successful inoculations with barn-cured wildfire tobacco that is not over a year old.

Dried Herbarium Leaves. In the winter of 1922 we attempted to isolate the germ from dried, herbarium, wildfire, tobacco leaves of varying ages. We were unsuccessful in all of these except two. Both were from seedling tobacco leaves from the same source collected early in May, 1921, and the cultures were isolated in February, 1922, over nine months later. Successful inoculations were made with the isolated germ. Failure to isolate this germ from the other sources was not due to death, but rather to the presence of other germs and lack of sufficient attempts to secure it. This was proved by the later successful inoculation of pricked leaves with these crushed herbarium leaves soaked in water. By this method infections were obtained from this dried material in twenty out of twenty-seven attempts. The leaves were from thirteen different sources, eight of which were tried successfully from one to three times, and one tried successfully twice and unsuccessfully once, while four were tried unsuccessfully one or two times. Four other inoculations were made with a mixture of tissues from two to four of these sources, but each limited to the dampening off, the halo or the dead center stage, all of which were successful.

The material used was obtained from both seedbed and field plants of several varieties of 1921 tobacco. All but two were from material collected in the State, one from Vermont and the other from Florida. We secured infections with the Vermont, but not with the Florida material. Only one attempt, however, was made with the latter. The leaves in the various experiments had

been dried from 198 to 298 days when used for inoculation. Success was had with the oldest, as well as with the youngest. There was considerable variation in the vigor of development of the infection spots, even on the same plant. Material from different sources also seemed to show variation in vigor. These experiments prove that the germs can retain their viability, at least for a considerable period, in dried material that has not been exposed to the elements. There is no question, therefore, that refuse from barn-cured wildfire tobacco is a menace if used on land planted with tobacco the following year.

A single one of these experiments will suffice to illustrate the average results obtained, using Infection Numbers 2042 and 3003: The leaves were gathered from a wildfire field at Somers, Conn., Aug. 26, 1921, and separate inoculations were made Mar. 7 and Mar. 17, 1922. Both were successful. In the first, three leaves on each plant were pricked with a needle about eight times before the water containing the crushed infected tissues was poured over them. Inoculation 2042 was made on three plants and about a week later showed five, nine and sixteen fair to good infection spots at the punctured places. One infection spot appeared at an unpunctured place, which was very unusual in these experiments. Inoculation 3003 was made on a single plant with an indefinite number of pricks in the three leaves. An examination ten days later showed seven good and eight fair infection spots on two of the leaves and none on the third.

Later similar infection experiments were tried with older dried herbarium wildfire leaves collected in 1920. These experiments were made in late April, 1922. The leaves had been dried in these cases from 573 to 651 days when crushed and placed in water on the plants. They were from twelve different fields in Connecticut. In none of these did any of the inoculations take. This seems to indicate that the germs can not retain their vitality much over a year in the old dried leaves.

Seed. We were unsuccessful in six attempts to isolate the wildfire germ from supposedly infected 1920 Round Tip tobacco seed, these being made one or two years after it was gathered. We also failed to secure infection from water in which the same seed had been soaked several hours. Several months previously the same seed planted in the greenhouse had given one infected seedling and we have reason for believing that it was the source of infection in several seedbeds in 1921.

We artificially infected unsterilized tobacco seed with the wildfire germ but in the one or two attempts to re-isolate it we also failed because of the presence of other bacteria. However, one month after the seed was inoculated infections were secured when it was soaked in water and this was applied to punctured plants. The same seed several days after inoculation was placed outdoors,

protected from the rain but exposed to the cold, from Feb. 14 to April 18. On the latter date part of it was soaked in water several days and then applied to punctured plants which later showed a few infections. About two weeks later the experiment was repeated with even better results. These experiments, while not entirely satisfactory, indicated on the whole that the germ may retain its viability on tobacco seed for some months.

Overwintered Refuse. We have tried several times to infect punctured greenhouse plants with infected refuse from tobacco plants that had overwintered in the field. Badly disintegrated leaves, from the Station garden plot already mentioned, were gathered at different times. These were ground up further and soaked from one hour to several days in water. This water with some fragments of the tissue was poured over needle-punctured plants. Altogether twenty-seven plants were thus inoculated and on these we succeeded in securing three poor and three fair to good infection spots. These experiments indicate that the germs, to a certain extent, can be wintered over in infected leaves left outdoors in the field and undoubtedly under favorable conditions are the source of occasional infections the succeeding year. From our experience this is not a great menace in the field, but should be a warning to the grower not to leave tobacco refuse in the seedbeds after the plants have been pulled. This overwintering is also shown somewhat by the following experiment. On Feb. 1st artificially infected plants were changed from a warm to a cold greenhouse and on March 1st placed outdoors. They were thus exposed for some time to freezing weather. The soaked crushed infected tissues from these gave vigorious infections on punctured greenhouse plants late in April.

Soil. We have already mentioned the experiment where infected leaves were buried in the soil under disease free plants which later became infected, and the successful inoculations made with the same soil a month or two later after the leaves had become entirely disintegrated. This showed that the germs could be carried in the soil for a short period.

We have further data that indicate that they may be carried over the winter in this manner at least to a limited extent. Samples of soil on different occasions in March and April were taken from the Station garden plot which the previous year had grown wildfire plants that had been allowed to rot in place. After sifting off the coarse particles of soil the fine particles were soaked in water for several hours and applied to pricked tobacco plants in the greenhouse. The first experiment with six plants produced no results. In the second experiment with three plants, each produced a single fair to good infection spot. Of course these germs may have come from the very finely disintegrated tobacco tissues rather than from germs entirely free in the soil, but the general statement that they carry over in the soil is approximately correct

since it is difficult to distinguish between the mineral part and the fine humus of the soil.

In a tobacco seedbed, however, on which pure cultures of the wildfire germ were sprayed in the fall, we failed to secure infection of plants the next spring by spraying on pricked leaves water in which this soil was soaked.

Infection of Sprayed Plants. Our field experiments showed that seedlings and field plants sprayed with Bordeaux mixture were partially or entirely protected from infection according to the number and efficiency of the treatments. This was also tested out with artificial infections in the greenhouse and similar results were obtained. On several occasions pricked plants were inoculated by atomizing with the germ as follows: 1, Check plants inoculated but no other treatment; 2, Plants sprayed with Bordeaux mixture immediately before inoculation; 3, Plants sprayed with Bordeaux mixture immediately after inoculation; 4, Plants sprayed with Bordeaux mixture immediately before and after inoculation. In the latter case infection never took place unless the puncture was at a point poorly protected by the spray. Where the plants were sprayed either before or after inoculation there was only an occasional infection. On the unsprayed plants infection took place at practically all the punctured spots.

Infection with African Material. We were very successful in making infections with wildfire tobacco leaves received from Miss Doidge, collected in Rustenburg, Transvaal, Jan. 2, 1922. These inoculations were made in both April and May, 1922, and were equally successful in both cases, infection appearing at most of the many pricked places on which the water containing the crushed infected tissues was applied. These infections were typical and fully as virulent as inoculation from our own cultures made at the same time.

Infection of Other Hosts. In nature we have never seen wildfire on any of the weeds or cultivated plants in or adjoining the seedbeds or tobacco fields. Our experiments to infect other hosts at first were limited to the tomato and a cultivated species of flowering tobacco. In neither were the leaves pricked before inoculating and this may account for the failure in both cases. Later inoculations on pricked leaves of young plants of tomato, pepper, eggplant, jimson weed and pokeweed were tried. Three plants were used in each case and each had from thirty to fifty pricked places. Apparently all of these failed of infection, except possibly the pepper and the eggplant. On the former three or four and on the latter one slight faint yellowish spots appeared at punctured places. These possible infections, however, were quite indefinite as compared with those that appeared in the tobacco plants similarly inoculated at the same time.

Wolf and Foster (32, p. 452.) originally claimed to have inoculated tobacco with wildfire obtained from cowpeas. In a later publication, however, Wolf and Moss (33, p. 32.) state that "all efforts to prove that the wildfire organism is parasitic in plants other than tobacco have thus far failed." These inoculated plants included potatoes, tomatoes, peppers, eggplants, jimson weed and horse nettle, all of which are related to tobacco. Chapman and Anderson (2, p. 74.) succeeded in inoculating "petunia, eggplant and pokeweed (*Phytolacca decandra*) by spraying with suspensions of bacteria in water in the same way in which tobacco plants were usually inoculated. Some of the leaves in each case were wounded by puncture with a sterile needle." They also isolated the germ from spots on tomatoes growing in an infected tobacco seedbed.

Recommendations for Control.

Seedbeds. (1) If wildfire developed at all in the beds the previous year, either make beds on new land away from all possible sources of infection, or sterilize the old beds and paths with steam heat. Heat the soil for 20 to 30 minutes at a pressure of at least 100 lbs. Boards, sash and cloth used on beds or fields previously infected should be thoroughly sprinkled all over with formalin, 1 to 25 parts of water, and piled in a dry place to slowly dry off; or the cloth can be heated in *boiling* water for one hour.

(2) Use seed known to have come from a wildfire-free field and which has been protected at all times from subsequent contamination. If in doubt place seed in a cheesecloth bag in a jar and soak for 10 to 15 minutes in a corrosive sublimate solution, rate of 1 part of corrosive sublimate [Poison!] to 1,000 parts water. Then wash thoroughly with pure water and dry immediately.

(3) Use as little water on plants as is consistent with good growth and apply at such times as it will most quickly dry off the leaves without sun-scorch injury. Air the beds when feasible both day and night, and especially in moist weather, in the best possible ways to prevent water of transpiration settling on the leaves.

(4) No matter what the previous treatment, as a final precaution spray the plants with Bordeaux mixture; if homemade use the 4-4-50, or if commercial as recommended on package. Begin treatment on the very young seedlings soon after roots start and largest leaves are the size of a finger-nail, and repeat spraying each week until the season for pulling is over. Clean up seedbeds at end of setting and plant beds with a different crop if desired.

Fields. (1) In setting out the fields use only plants known to come from the wildfire-free seedbeds. If impossible to get these, select only the plants apparently free of the disease and from parts of the beds least infected. Plant as soon as pulled and keep water off the leaves while in the baskets.

(2) About a week after setting out plants go over the field and remove diseased plants, and if possible make a second similar

inspection about a week or ten days later. Take plants pulled up off the field. Reset with healthy plants.

(3) In case these inspections show the field badly infected, plow it up and reset with healthy plants, providing this can be done in time to insure the newly set field properly maturing before danger from frosts.

(4) In some cases, especially where the tobacco is primed, it may be preferable, instead of resetting or doing nothing, to go over the field once or twice and remove the infected and non-commercial lower leaves. These also should be taken off the field, instead of being thrown on the ground. The first removal should be made about a week after planting and the second after the plants have started to grow.

LITERATURE.

Most of the following papers have been referred to in the preceding discussions. They include practically all of the literature relating to wildfire. Some of them are merely brief notes on the presence of the disease in certain localities.

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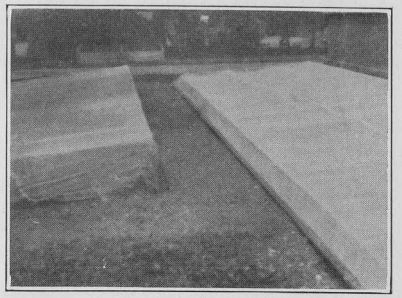
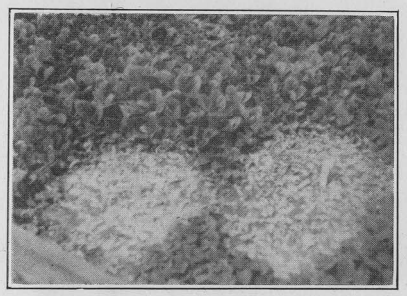
TYPES OF TOBACCO SEEDBEDS.

a. Glass Sash, p. 383.



b. Cloth Covers, p. 383.

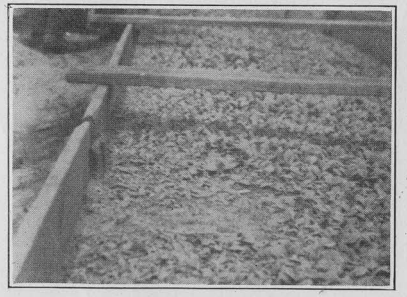
WILDFIRE PLANTS KILLED WITH FORMALIN.



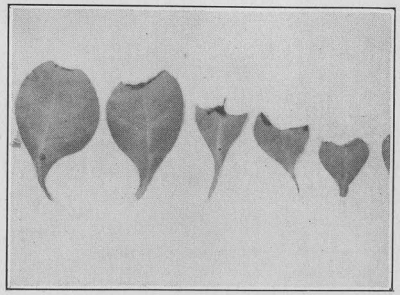
c. Isolated Spots, p. 401.

d. Whole Beds, p. 401.

FIRST OR DAMPENING-OFF STAGE.



e. Dead Spot, p. 380.



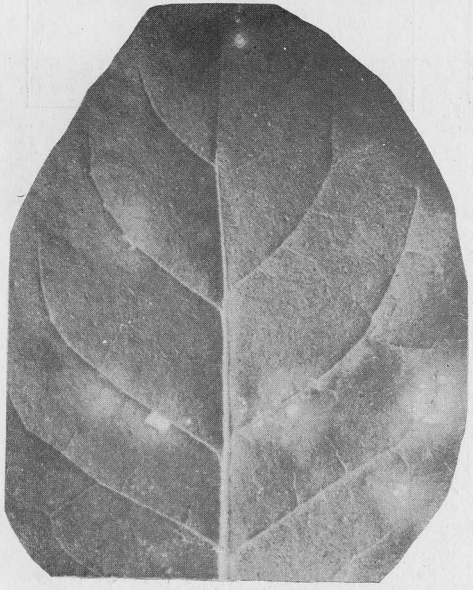
f. Infected Leaves, p. 380.

PLATE XXX.

NATURAL INFECTIONS.

a. Leaves from Seedbed, p. 381.

ARTIFICIAL INFECTIONS.



b. In Leafblade, p. 414.

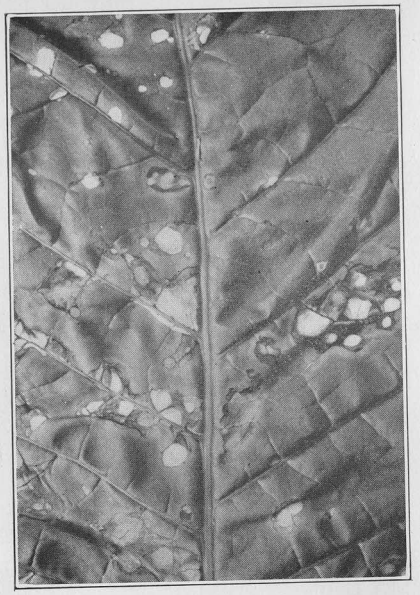
c. In Midrib, p. 416.

SECOND OR HALO STAGE OF WILDFIRE.

PLATE XXXI.

INDIVIDUAL LEAVES.

a. Second or Halo Stage, p. 387.



b. Third or Sunscorch Stage, p. 387.

BROADLEAF PLANTS.

c. This Field almost completely Ruined, p. 387.

WILDFIRE IN FIELD PLANTS.

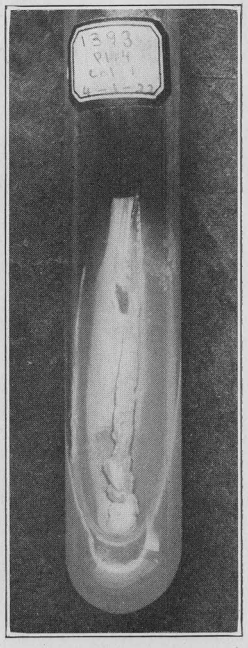
PLATE XXXII.

PHOTOMICROGRAPHS OF THE GERM.

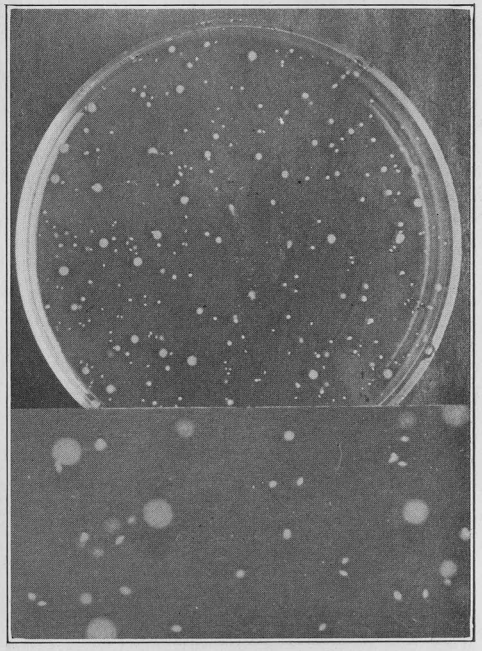
a. Many Germs, p. 412
x 500 diam.

b. Showing Flagella, p. 413.
x 1500 diam.

ARTIFICIAL CULTURES.



c. In Test-tube, p. 411.



d. In Petri Dish, p. 411.

THE GERM OF WILDFIRE.

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