State of Connecticut
PUBLIC DOCUMENT No. 24

Forty-sixth Annual Report

OF

The Connecticut Agricultural Experiment Station

Being the annual report for the year ending October 31

1922

PRINTED IN COMPLIANCE WITH STATUTE

New Haven
Published by the State
1923

PUBLICATION

APPROVED BY

THE BOARD OF CONTROL.

The Ryder Printing House, New Haven

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

OFFICERS AND STAFF

16

October, 1922.

BOARD OF CONTROL.

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

James H. Webb, *Vice President* ..... Hamden
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
Edward C. Schneider ..... Middletown

STAFF.

Administration.
E. H. JENKINS, PH.D., *Director and Treasurer.*
W. L. SLATE, JR., B.SC., *Vice Director.*
MISS L. M. BRAUTLECHT, *Librarian and Bookkeeper.*
MISS J. V. BERGER, *Stenographer and Bookkeeper.*
WILLIAM VEITCH, *In charge of Buildings and Grounds.*

Chemistry:

Analytical Laboratory.
E. MONROE BAILEY, PH.D., *Chemist in Charge.*
R. E. ANDREW, M.A.
C. E. SHEPARD,
OWEN L. NOLAN,
HARRY J. FISHER, A.B.
} *Assistant Chemists.*
FRANK SHELDON, *Laboratory Assistant.*
V. L. CHURCHILL, *Sampling Agent.*
MRS. B. P. STORRS, *Clerk.*

Biochemical Laboratory.
T. B. OSBORNE, PH.D., D.SC., *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, *Secretary.*

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., *Assistant.*
H. W. HICOCK, M.F., *Assistant.*
MISS PAULINE A. MERCHANT, *Stenographer.*

Plant Breeding.
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

TABLE OF CONTENTS.

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 October 31, 1922.

The financial reports, however, cover the state fiscal year ending June 30.

Mr. William H. Hall resigned his position as a member of the Board of Control in the winter of 1922, and Prof. Edward C. Schneider of Wesleyan University was appointed in his place.

During the year Miss V. E. Cole resigned her position. With the utmost fidelity and efficiency Miss Cole has served this Station for twenty-five years as librarian and clerk.

On July 1, 1922, Prof. William L. Slate, Jr., having resigned his position as professor of agronomy in the Connecticut Agricultural College where he had served for eight years, became vice-director of this Station.

There have been no other important changes in the Station staff.

The work of the Station, which is constantly expanding, is set forth at some length in the accompanying report of the Station Director, and need not be repeated here.

Respectfully submitted,

GEORGE A. HOPSON,
Secretary.

Report of the Treasurer

July 1, 1921, to June 30, 1922.

E. H. JENKINS, *in account with* THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION for the fiscal year ending June 30, 1922.

RECEIPTS.

Balance on hand, July 1, 1921 (Fertilizer Analysis Fees)		$40.22
State Appropriation (General)	$41,000.00	
State Appropriation (General) (Addition by transfer from Tobacco Appropriation)	121.50	
State Appropriation (Food)	7,500.00	
State Appropriation (Insect Pest)	12,500.00	
United States Appropriation (Hatch)	7,500.00	
United States Apropriation (Adams)	7,500.00	
Fertilizer Analysis Fees	8,681.78	
Lockwood Trust Income (including sale of tree seedlings and Mount Carmel Farm produce)	10,800.00	
Interest on Bank Deposits	145.03	
Connecticut State Department of Health (rent)	200.00	
Sales of Gasoline	304.64	
Sales of Automobile Oil	10.74	
Mileage for use of Station automobiles	25.07	
Miscellaneous	18.13	
		$96,306.89
		$96,347.11

DISBURSEMENTS.

E. H. Jenkins, director, salary	$2,800.00
E. H. Jenkins, treasurer, salary	400.00
V. E. Cole, salary	700.00
L. M. Brautlecht, salary	1,125.00
J. V. Berger, salary	1,040.00
T. B. Osborne, salary	3,200.00
E. Monroe Bailey, salary	3,200.00
R. E. Andrew, salary	2,787.50
C. E. Shepard, salary	2,287.50
W. E. Britton, salary	3,200.00
G. P. Clinton, salary	3,200.00
E. M. Stoddard, salary	2,358.34
W. O. Filley, salary	3,200.00
A. E. Moss, salary	1,000.00
F. A. McCormick, salary	2,316.66

D. F. Jones, salary	$3,200.00
R. N. Copeland, salary	283.34
H. J. Fisher, salary	656.25
P. C. Mangelsdorf, salary	1,500.00
H. W. Hicock, salary	449.98
V. L. Churchill, salary	1,300.00
Wm. Veitch, salary	1,000.00
P. A. Merchant, salary	509.16
G. E. Graham, salary	1,516.68
Alta H. Moss, salary	996.66
Mrs. L. D. Kelsey, salary	739.85
Owen Nolan, salary	1,758.34
Frank Sheldon, salary	1,300.00
G. A. Hopson, salary	966.18
A. J. Boyle	106.25
Henry Kiley	1,411.50
Herbert W. Edwards	1,386.00
Thomas O'Donnell	1,240.33
T. F. Barrows	227.57
George Sherwood	567.00
Richard Merwin	983.00
Frederick Cooper	480.00
Joseph Carmosino	442.00
R. C. Botsford	200.00
Richard Bernardo	555.00
S. J. Morse	426.50
W. W. Morse	376.00
W. E. Dolan	325.50
Ernest Ives	152.17
Labor	716.96
Publications	204.94
Postage	348.55
Stationery	648.50
Telephone and telegraph	241.94
Freight and express	171.92
Gas, electricity, etc.	1,428.74
Coal	2,145.90
Water	139.95
Chemicals	714.51
Laboratory supplies	643.06
Seeds, plants, etc.	180.50
Agricultural and horticultural supplies	112.73
Food samples	85.13
Ice	96.28
Photographic supplies	133.26
Automobile oil	29.92
Miscellaneous supplies	313.97
Fertilizers	667.93
Feeding stuffs	101.81
Library (books and periodicals)	778.95
Library (binding)	510.70
Automobiles	1,020.00
Automobiles (repairs)	469.17
Tools, machinery and appliances	415.50
Tools, machinery and appliances (repairs)	125.02
Furniture and fixtures	518.83
Furniture and fixtures (repairs)	82.14

Scientific apparatus	$178.44	
Scientific apparatus (repairs)	133.52	
Live stock	55.00	
Traveling by the Board	280.81	
Traveling by the Staff	891.19	
Gasoline for automobiles	779.49	
Traveling in connection with Adams Fund Investigations	68.19	
Insurance (fire, burglary and automobile)	972.76	
Insect pest appropriation to State Entomologist	12,500.00	
Contingent	253.72	
Buildings (new)	349.09	
Buildings and land (betterments)	423.71	
Buildings and land (repairs)	1,615.81	
Total disbursements		$89,418.80
Balance on hand, June 30, 1922:		
State general appropriation	$6,224.70	
Miscellaneous receipts	703.61	
		6,928.31
		$96,347.11

NEW HAVEN, CONN., August 19, 1922.

This is to certify that we have audited the accounts of E. H. Jenkins, the Treasurer of The Agricultural Experiment Station, for the fiscal year ending June 30, 1922, 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 year ended June 30, 1922.

RECEIPTS.

Balance on hand, July 1, 1921, Petty Cash Fund	$500.00	
From State Comptroller for vouchers sent by E. H. Jenkins, Director	7,255.53	
Total		$7,755.53

EXPENDITURES.

S. T. Sealy, salary	$2,275.00
Nicholas Matiuck, labor	700.00
Russell Bartlett, labor	187.50
L. E. Rice and others, labor	68.00
Town of Guilford, for Frank Blatchley, labor	439.50
Jos. Krivenski, labor	288.43
F. D. Luddington, labor	107.20
A. Antczak, labor	31.50
Frank Kudlicki, labor	33.83
George Davis, labor	228.80
Roy Clinton, labor	228.80
Elon Bragg, labor	61.75
John Gilbert, labor	404.40
Fred Downs, labor	3.00
James Jordan, labor	222.50
John Kent, labor	3.00
George Lopat, labor	112.57
A. Senchick, labor	41.18
John Vogler, labor	75.00
Stationery	1.49
Telephone and telegraph	3.90
Team and horse hire and carting	60.25
Miscellaneous supplies	41.80
Tools, machinery and appliances	26.00
Automobile oil	8.98
Automobile (new purchase)	1,035.00
Automobile (repairs)	303.10

Automobile insurance	$62.81	
Travel	92.50	
Travel (gasoline for automobiles)	107.74	
Total		$7,255.53
Balance on hand, July 1, 1922, Petty Cash Fund		500.00
		$7,755.53

Of the total amount expended in the year as above ($7,255.73), there was spent for

Supervision		$3,932.32
*Maintenance:		
Madison	$187.50	
Guilford	445.50	
Branford	129.75	
East Haven	90.00	
New Haven	618.60	
West Haven	273.10	
Fairfield	1,293.76	
Stamford	285.00	
		$3,323.21
		$7,255.53

*Of the expense of maintenance in the towns, three-quarters is to be paid by the towns, as follows: Madison, $140.63; Guilford, $334.12; Branford, $97.31; East Haven, $67.50; New Haven, $463.95; West Haven, $204.83; Fairfield, $970.32; Stamford, $213.75. Total, $2,492.41.

REPORT OF E. H. JENKINS, Director

IN ACCOUNT WITH

Tobacco Research Appropriation

(Public Acts, 1921, Chap. 184)

For the fiscal year ended June 30, 1922.

RECEIPTS.

From State Comptroller for vouchers sent by E. H. Jenkins, Director	$6,480.02

EXPENDITURES.

Labor (Louis Evans)	$800.00	
Labor (others)	1,076.07	
Publications	38.33	
Stationery	4.38	
Telephone and telegraph	11.75	
Team and horse hire and carting	279.01	
Freight and express	35.86	
Water	5.25	
Seeds, plants, etc	88.30	
Agricultural and horticultural supplies	5.60	
Photographic supplies	5.80	
Miscellaneous supplies	208.41	
Fertilizers	1,453.98	
Tools, machinery and appliances (new)	701.30	
Tools, machinery and appliances (repairs)	.10	
Furniture and fixtures (new)	254.07	
Traveling expenses	382.82	
Insurance	75.00	
Buildings (betterments)	90.00	
Buildings (repairs)	963.99	
Total		$6,480.02

Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

BULLETIN 240 AUGUST, 1922

BEING THE

Twenty-Seventh Report

ON

Food Products

AND

Fifteenth Report on Drug Products

Part I (Commercial Vitamine Preparations)

By E. M. BAILEY.

The Potency of Some Commercial Vitamine Preparations as Compared with that of Dry Brewers' Yeast

BY E. M. BAILEY

with the collaboration of

HELEN C. CANNON AND H. J. FISHER.

INTRODUCTION.

It has been said that the discovery of vitamines has not shown us what to eat but has shown us rather, why we eat what we do; in other words it has demonstrated the logic of the mixed diet. With a free range of choice man and lower animals have instinctively chosen those natural foods which are necessary for adequate nourishment. However, under modern social and economic conditions and other circumstances beyond our control, freedom of choice in dietary matters may often become more a theoretical consideration than an accomplished fact. Thus famine may reduce the available supply of food; transportation facilities may interrupt its adequate distribution; extremes of climate may limit the variety; and the manipulation of natural food-stuffs in the so-called refining processes of commercial practice may remove essential constituents. Again, invalidism or convalescence may so impair appetite that the food intake may become insufficient in kind or quantity.

The exact chemical nature of vitamines is, at present, entirely speculative and the complete story of their significance in the diet remains to be told; nevertheless experimental evidence shows that a lack of these food factors results, directly or indirectly, in serious nutritional derangement. Thus has arisen much discussion, both in scientific and popular literature, upon the subject of deficiency diseases.

It is not our purpose here to discuss such diseases as beri-beri and scurvy, now, by consensus of opinion, attributed to faulty diets; nor such disorders as ophthalmia and polyneuritis which

can be developed and cured at will in experimental animals by dietetic measures. For such information the reader is referred to various texts and monographs.[1]

Whatever may be the ultimate status of vitamines in therapeutics it may be remarked that the spectacle of an animal brought to a moribund condition on a diet intentionally made deficient in water-soluble B, for example, and recovering within the lapse of a few hours when a minute quantity of the lacking constituent is supplied, affords a most striking demonstration of the potency of these obscure factors. No doubt such demonstrations have linked vitamines with the idea of curative potency.

It is generally conceded that there is no danger of vitamine deficiency (avitaminosis), in the average mixed diet of the normal individuals; but in the case of infants on artificial diets or in cases of malnutrition, whenever found, the question of vitamine supply may well be taken into serious consideration. The extent to which vitamine-rich materials can be reasonably prescribed by physicians must be left to their more matured judgment based upon further clinical experience and observation. Much biased advertising literature and some popular discussions have conveyed the impression that everyone needs supplemental administrations of vitamines. A host of commercial vitamine preparations which purport to contain one or all of the necessary food factors in various degrees of concentration have appeared simultaneously with, or closely in the wake of, this publicity campaign. Some are offered to the medical profession on strictly ethical standards; others are offered to the laity under more or less extravagant claims. In response to numerous inquiries regarding the potency of these numerous products this station has undertaken to investigate some of the preparations more widely advertised in this state. Our attitude on the subject is quite similar to that which we hold with respect to diabetic foods, viz., that they should be offered under as definite statements regarding their substance, quality and strength as can be made; and that they should not be offered under declarations which foster the practice of self-medication. A statement of proximate composition, within reasonable limits, enables the physician or dietitian to decide whether

[1] Sherman, H. C. and Smith, S. L. *The Vitamins*. The Chemical Catalog Company, Inc., New York.
Plimmer, V. G. and R. H. A. *Vitamines and the Choice of Food*. Longmans, Green & Co., New York.
Lister Institute and Medical Research Committee. *Report on the Present Knowledge Concerning Accessory Food Factors (Vitamines)*. London.
Harrow, Benjamin. *Vitamines*. E. P. Dutton & Co., New York.
Funk, C. *The Vitamines*. Williams & Wilkins, Co., Baltimore.
Ellis, C. and Macleod, A. L. *Vital Factors in Foods*. D. Van Nostrand Co., New York.

or not a particular brand of diabetic food is suitable for the patient; or at least it furnishes a basis for intelligent determination of the patient's tolerance. So, in the case of vitamine preparations, biological methods of testing have been so far perfected that a reasonable statement of potency can be declared; and, in our opinion, the burden of responsibility properly rests with the manufacturer to ascertain and declare the potency of his product as a reasonable guide to its intelligent use. The indiscriminate offering of vitamin-bearing remedies under labels suggesting wide curative or remedial properties places them at once in the category of the ordinary patent or proprietary medicine.

One of the most prominently exploited sources of vitamine is yeast. Therapeutic properties have been ascribed to yeast since very remote times, but the discovery that it is comparatively rich in water-soluble B vitamine has given new impetus to the belief in the value of yeast in the diet. The majority of preparations which we have examined declare or imply either the presence of yeast or of water-soluble B vitamine and we have therefore chosen to evaluate them on the basis of their potency with respect to this factor whether from yeast or other source. We have proceeded on the reasonable hypothesis that a preparation which, in one hundred milligram doses, does not exhibit the potency shown by one hundred milligrams of a good grade of dry brewers' yeast, employed under comparable conditions, does not justify a claim of superior therapeutic value as a source of water-soluble B vitamine. We have, therefore, not attempted to evaluate, by means of increased dosage, the concentration of vitamine B in preparations which failed to equal or approximate the potency shown by our control product. Neither have we attempted to determine the potency of the various preparations with respect to other types of vitamines (vitamines A and C), whether or not such claims were made.

PLAN OF EXAMINATION.

Chemical analyses: The basis of judgment and comparison as to the potency of the various products examined is, of course, their effect when fed to experimental animals. In addition, however, determinations of certain proximate chemical constituents have been made which throw some light upon the general nature of the preparations.

The materials used were fed in the state and condition as offered for sale. Moisture was determined in all samples, but only in two cases, viz., in Fleischmann's yeast and Vegex, was account taken of water content in fixing the daily rations. Fleischmann's yeast was fed with a correction of 66 per cent and Vegex with a

correction of 32 per cent for moisture. Other preparations contained from three to eight per cent of moisture and were regarded as dry material and so fed.

Biological tests: Tablets or powders were reground when necessary and pressed into 50 or 100 milligram tablets in a tableting machine. Moist or pasty preparations were weighed on an analytical balance for each feeding. Yeastone (Merck) could not be reduced to satisfactory tablets. The pills were finely pulverized, after which 100 milligram portions were weighed and placed in gelatin capsules. For feeding, the contents of a capsule was emptied into the vitamine cup. For controls 100 millgram, 50 milligram and 25 milligram tablets of dry brewers' yeast were used.

Young albino rats were the experimental animals used in all cases. The basic plan was to test each preparation upon three animals and, accordingly, three separate series of tests were made. In Series I, 100 milligrams of the dry material, or an amount of moist preparation equivalent thereto, were fed to each rat once daily. Series II was a repetition of Series I except that the sexes were reversed and in case of such products as had produced normal growth, or growth approaching normal, on the first trial the daily dose was reduced to 50 milligrams. In Series III 50 or 100 milligram doses were fed according to results obtained in preceding trials. For this series new samples of the vitamine products were used except in the case of Vita Zest of which a second sample could not be secured. (In a few instances fourth trials were made either to test smaller doses or to check previous trials). With Fleischmann's yeast numerous samples were tried, a fresh cake being purchased every three days and kept properly refrigerated during that time.

The plan of an individual test was as follows:[1]

A young rat was placed in an individual cage with a sufficient supply of food,[2] adequate in all respects except that it was lacking water-soluble B vitamine, constantly before it. The weight of the animal was charted twice each week with such intermediate check weights as circumstances required. With water-soluble B absent from the diet appetite fails, food intake is diminished and body weight declines. When the animal had shown a persistent and conspicuous decline in weight the trial unit quantity of commercial vitamine preparation was added to its diet daily. The duration of the test depended upon the behavior of the animal.

[1] Procedure of Osborne, Mendel and Wakeman.

[2] Composed as follows: casein 18 parts, starch 54 parts, lard 15 parts, butter-fat 9 parts, inorganic salts 4 parts. (For the composition of the inorganic salt mixture see Osborne and Mendel, Jour. Biol. Chem., 37, 572).

If it recovered and increased in weight the trial was terminated when the animal had acquired its normal weight. If it did not recover but continued to decline the commercial vitamine under test was withdrawn, an equal quantity of dry brewers' yeast substituted and the recovery period made sufficiently long to demonstrate that the animal still possessed recuperative powers. Dry brewers' yeast was administered in all cases where the commercial preparation itself did not bring the animal to normal. In general a trial period of about thirty days, unless necessarily terminated earlier, was allowed and followed by a recovery period of about twenty-one days.

LIST OF PRODUCTS.

The following preparations were examined:

Brewers' Yeast (Control).
Cerevisine, (tablets and granules).
Fleischmann's Yeast.
Ironized Yeast.
Magic Yeast.
Medic Yeest.
Merck's Yeast, Medicinal, (tablets and powder).
Metagen.
Phos-pho Vitamine.
Phytamin.
Vegex.
Vi-ta-co.
Vitamon, Mastin's.
Vita Zest.
Yeastamine.
Yeast Foam Tablets.
Yeastone.
Yeastonic.
Yeast Vitamine-Harris (tablets).
Yeast Vitamine-Harris (powder).
Yeast Vitamine, Nuxated Brand.

RESULTS OF EXAMINATION.

Information regarding the products examined as given on the labels or in accompanying literature, the results of partial chemical analyses and of biological tests together with growth charts are given in the following pages. It may be restated here that the quantities of dry brewers' yeast fed at the end of the experimental periods were equal to the quantities of commercial vitamine fed during the corresponding experimental periods.

STATION NO. 18441, DRY BREWERS' YEAST (CONTROL).

The brewers' yeast used was the dry commercial product reground. This is the yeast which has been studied and used so extensively by Osborne and Mendel in their investigations of vitamines.

Chemical examination: Partial analysis showed the following composition:

Moisture 7.90 per cent; ash 7.08 per cent; total nitrogen 7.24 per cent, water-soluble nitrogen 1.53 per cent, water-insoluble nitrogen 5.71 per cent. Reaction, faintly acid to litmus.

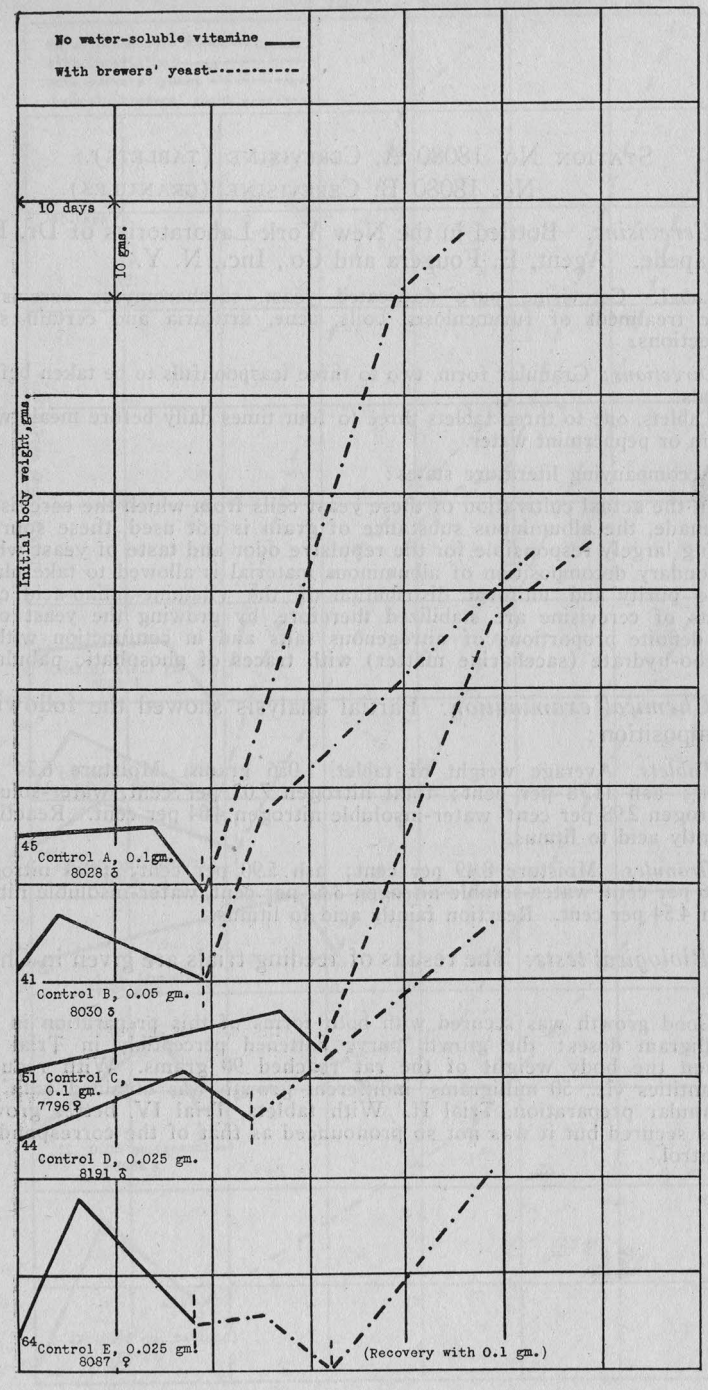
The ash content may vary considerably with different types of yeast although the limits stated are not materially different, viz., for top yeast 2.5 to 11.5 per cent; for bottom yeast 3.5 to 10.1 per cent. Potassium phosphate is the most conspicuous constituent of the ash. On the ash-free, dry material several investigators agree upon a nitrogen content of 11.5 per cent for top yeast and 8.7 per cent for bottom yeast.[1]

Biological tests: The results of feeding trials are given in Chart I.

No comment is necessary upon the growth curves other than to note that with 25 milligram doses failure resulted in one of the two trials made. Control E, however, was made with a rat of considerable size; a better result was obtained with an animal of less initial body weight (Control D). Attention is directed also to Chart XI, Trial IV in which fair recovery was made with 25 milligrams after failure. It is evident that this dose approaches the lower limit of efficiency, and that it may or may not be effective depending upon the recuperative power of the animal, and particularly its degree of maturity.

[1] Allen. Commercial Org. Anal., Vol I, p. 208, 4th Ed.

CHART I. STATION NO. 18441, DRY BREWERS' YEAST (CONTROL).



Station No. 18080 A, Cerevisine (tablets).
No. 18080 B, Cerevisine (granules).

Cerevisine. Bottled in the New York Laboratories of Dr. Ph. Chapelle. Agent, E. Fougera and Co., Inc., N. Y.

Label: Cerevisine pure desiccated yeast, saccharomyces cerevisiae. For treatment of furunculosis, boils, acne, urticaria and certain skin affections.

Directions: Granular form, two to three teaspoonfuls to be taken before meals.

Tablets, one to three tablets three to four times daily before meals with plain or peppermint water.

Accompanying literature states:

In the actual cultivation of these yeast cells from which the cerevisine is made, the albuminous substance of grain is not used, these sources being largely responsible for the repulsive odor and taste of yeast when secondary decomposition of albuminous material is allowed to take place. The purity and uniform distribution of the vitamine-amino-acid contents of cerevisine are stabilized therefore, by growing the yeast cells in definite proportions of nitrogenous salts and in conjunction with a carbo-hydrate (saccharine matter) with traces of phosphatic pabulum.

Chemical examination: Partial analysis showed the following composition:

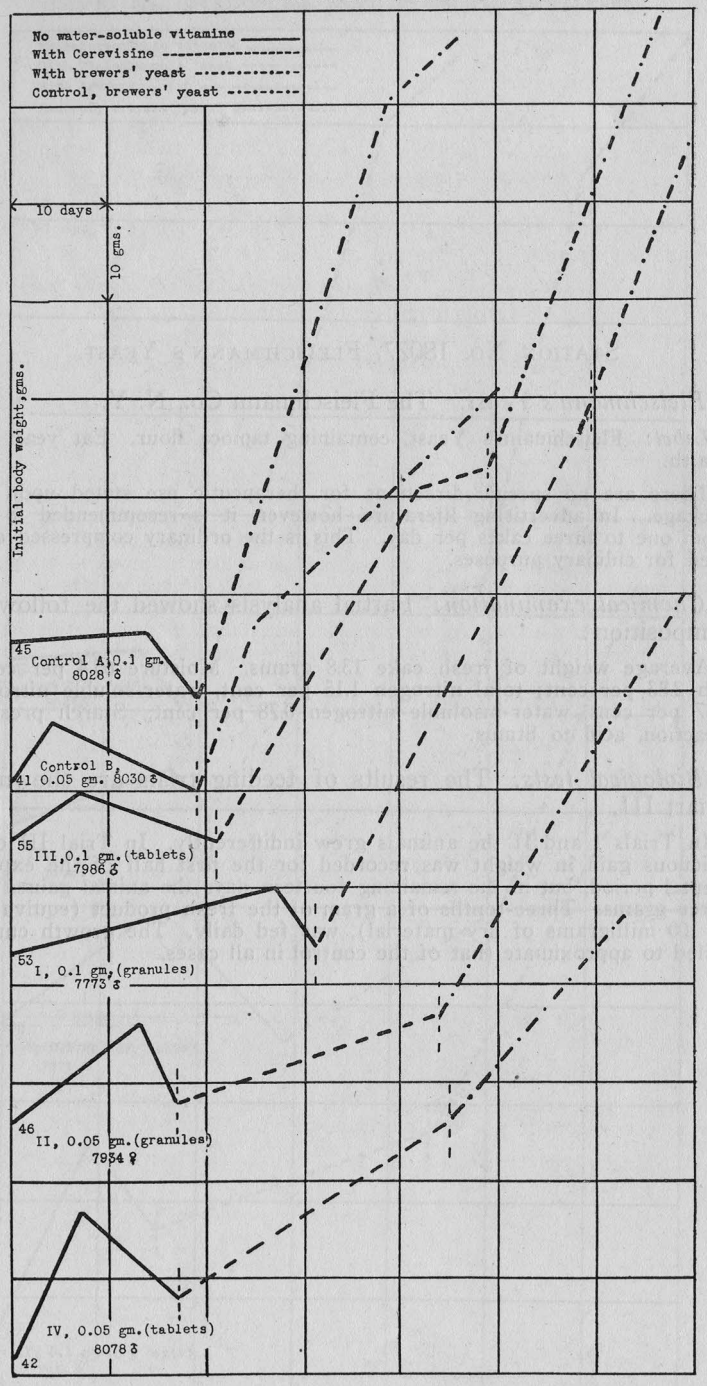
Tablets. Average weight of tablet, 1.056 grams. Moisture 6.74 per cent; ash 11.78 per cent; total nitrogen 7.02 per cent, water-soluble nitrogen 2.98 per cent, water-insoluble nitrogen 4.04 per cent. Reaction, faintly acid to litmus.

Granules. Moisture 8.49 per cent; ash 5.90 per cent; total nitrogen 8.16 per cent, water-soluble nitrogen 3.62 per cent, water-insoluble nitrogen 4.54 per cent. Reaction faintly acid to litmus.

Biological tests: The results of feeding trials are given in Chart II.

Good growth was secured with both forms of this preparation in 100 milligram doses; the growth curve flattened perceptibly in Trial III when the body weight of the rat reached 90 grams. With reduced quantities viz., 50 milligrams, indifferent growth was obtained with the granular preparation, Trial II. With tablets, Trial IV, better growth was secured but it was not so pronounced as that of the corresponding control.

Chart II. Station No. 18080 A, Cerevisine (tablets).
No. 18080 B, Cerevisine (granules).



Station No. 18077, Fleischmann's Yeast.

Fleischmann's Yeast. The Fleischmann Co., N. Y.

Label: Fleischmann's Yeast, containing tapioca flour. Eat yeast for health.

There are no specific directions for therapeutic use stated upon the package. In advertising literature, however, it is recommended to eat from one to three cakes per day. This is the ordinary compressed cake used for culinary purposes.

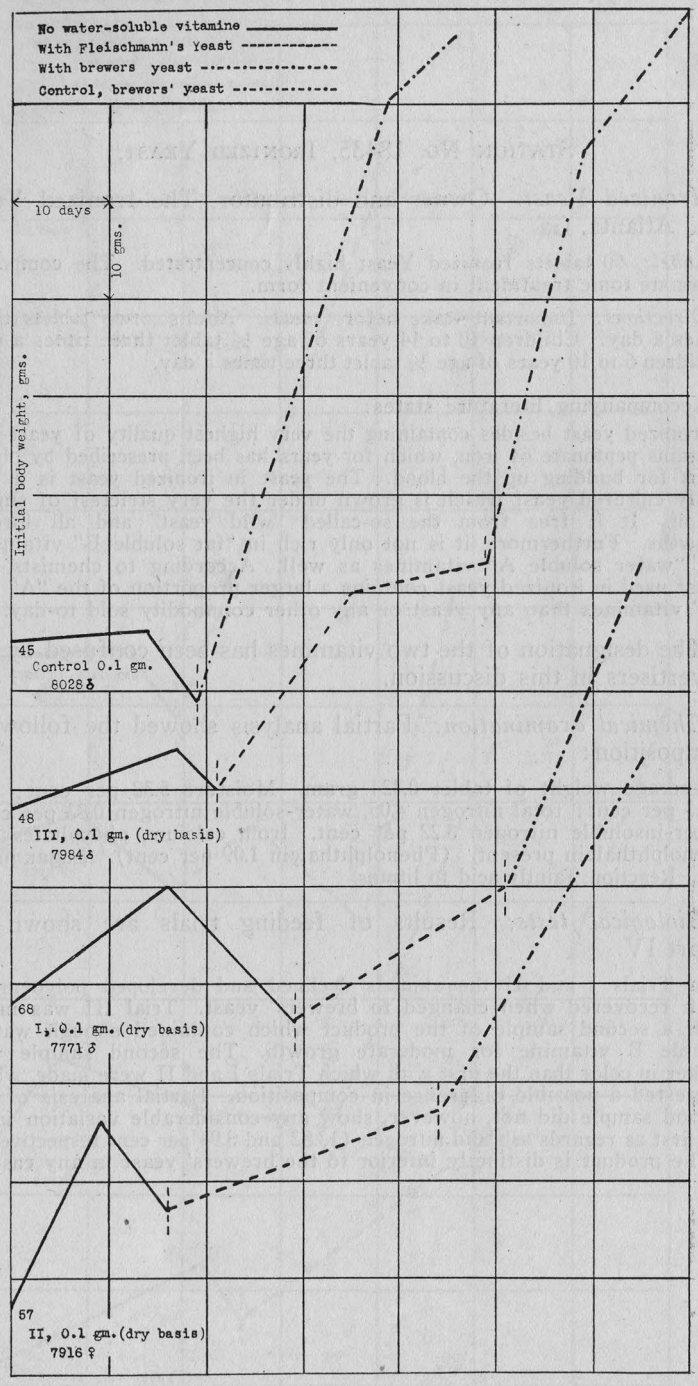
Chemical examination: Partial analysis showed the following composition:

Average weight of fresh cake 13.8 grams. Moisture 65.4 per cent; ash 2.83 per cent; total nitrogen 1.15 per cent, water-soluble nitrogen 0.37 per cent, water-insoluble nitrogen 0.78 per cent. Starch present. Reaction, acid to litmus.

Biological tests: The results of feeding trials are shown in Chart III.

In Trials I and II the animals grew indifferently. In Trial III conspicuous gain in weight was recorded for the first half of the experimental period, but in the remaining fourteen days the animal gained but three grams. Three-tenths of a gram of the fresh product (equivalent to 100 milligrams of dry material), was fed daily. The growth curves failed to approximate that of the control in all cases.

Chart III. Station No. 18077, Fleischmann's Yeast.



Station No. 18435, Ironized Yeast.

Ironized Yeast. Owner and distributor, The Ironized Yeast Co., Atlanta, Ga.

Label: 60 tablets Ironized Yeast highly concentrated. The compound vitamine tonic treatment in convenient form.

Directions: Important—take before meals. Adults: two tablets three times a day. Children 10 to 14 years of age ½ tablet three times a day. Children 6 to 10 years of age ½ tablet three times a day.

Accompanying literature states:

Ironized yeast besides containing the very highest quality of yeast also contains peptonate of iron, which for years has been prescribed by physicians for building up the blood. The yeast in ironized yeast is a specially cultured yeast which is grown under the very strictest of supervision. It is free from the so-called "wild yeast" and all foreign growths. Furthermore, it is not only rich in "fat soluble B" vitamines but "water soluble A" vitamines as well. According to chemists, the yeast used in ironized yeast contains a larger proportion of the "A" and "B" vitamines than any yeast or any other commodity sold to-day.

The designation of the two vitamines has been confused by the advertisers in this discussion.

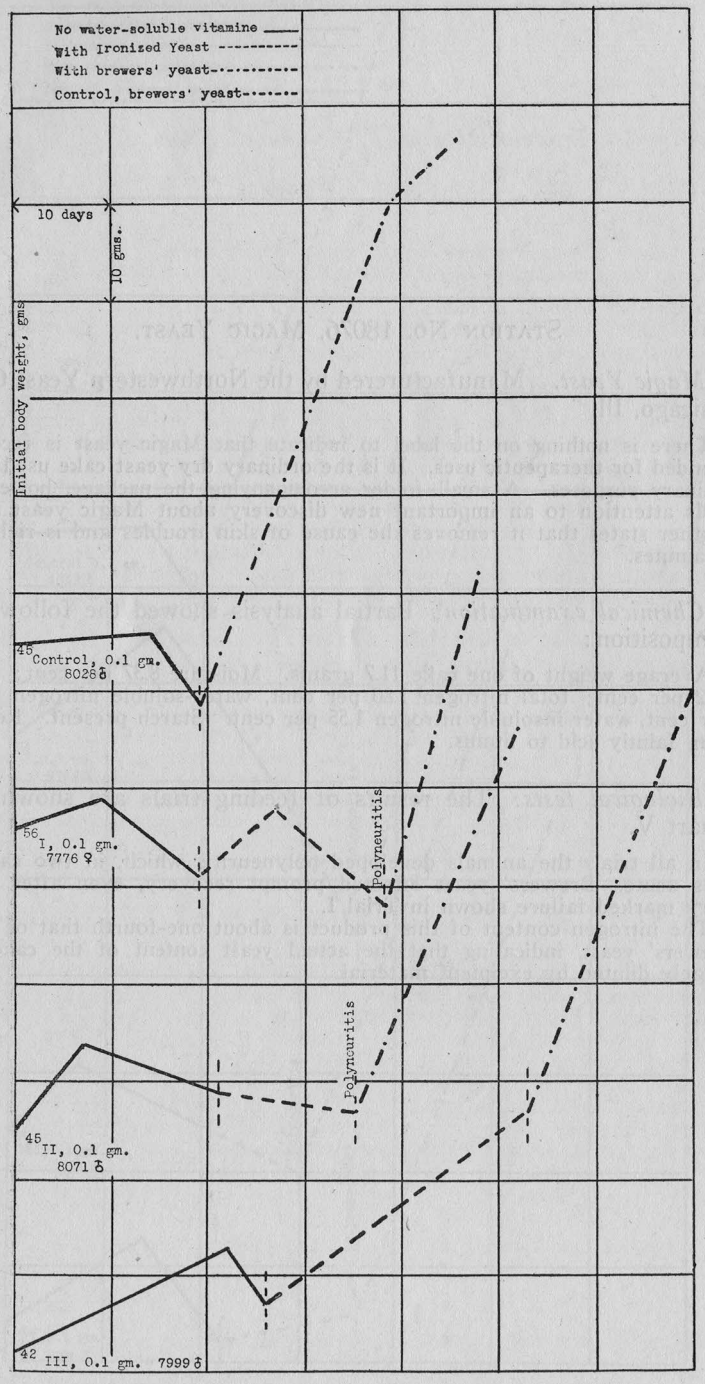
Chemical examination: Partial analysis showed the following composition:

Average weight of tablet 0.424 gram. Moisture 5.32 per cent; ash 15.13 per cent; total nitrogen 4.05, water-soluble nitrogen 0.83 per cent, water-insoluble nitrogen 3.22 per cent. Iron, calcium, phosphates and phenolphthalein present. (Phenolphthalein 1.09 per cent). Sugar present. Reaction, faintly acid to litmus.

Biological tests: Results of feeding trials are shown in Chart IV.

In Trials I and II the animals declined and developed polyneuritis. Both recovered when changed to brewers' yeast. Trial III was made with a second sample of the product which contained enough water-soluble B vitamine for moderate growth. The second sample was darker in color than the first with which Trials I and II were made, which suggested a possible difference in composition. Partial analysis of the second sample did not, however, show any considerable variation from the first as regards ash and nitrogen (13.82 and 3.94 per cent respectively). The product is distinctly inferior to the brewers' yeast in any case.

Chart IV. Station No. 18435, Ironized Yeast.



STATION NO. 18076, MAGIC YEAST.

Magic Yeast. Manufacturered by the Northwestern Yeast Co., Chicago, Ill.

There is nothing on the label to indicate that Magic yeast is recommended for therapeutic uses. It is the ordinary dry yeast cake used for culinary purposes. A small folder accompanying the package, however, calls attention to an important new discovery about Magic yeast and further states that it removes the cause of skin troubles and is rich in vitamines.

Chemical examination: Partial analysis showed the following composition:

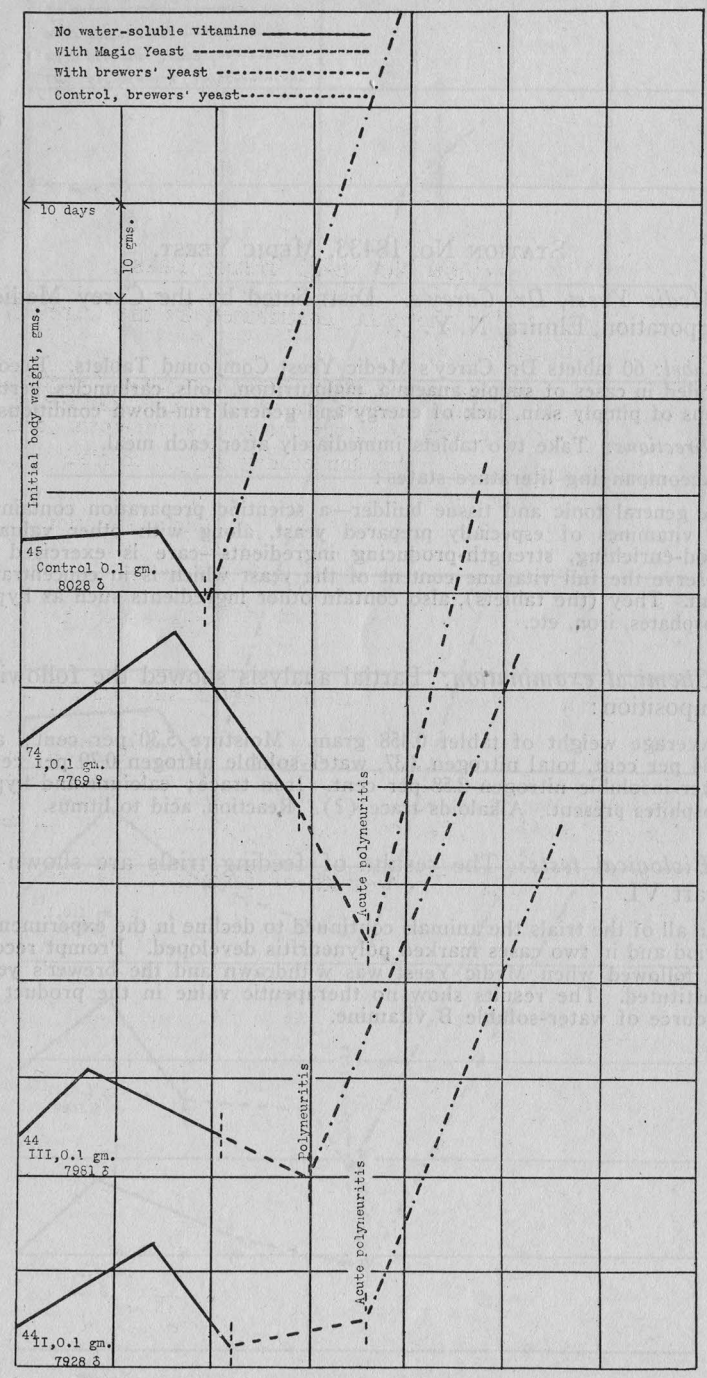
Average weight of one cake 11.7 grams. Moisture 8.37 per cent; ash 2.22 per cent; total nitrogen 1.80 per cent, water-soluble nitrogen 0.25 per cent, water insoluble nitrogen 1.55 per cent. Starch present. Reaction, faintly acid to litmus.

Biological tests: The results of feeding trials are shown in Chart V.

In all trials the animals developed polyneuritis which, in two cases, was acute. Brewers' yeast effected prompt recovery, even after the very marked failure shown in Trial I.

The nitrogen content of this product is about one-fourth that of the brewers' yeast, indicating that the actual yeast content of the cake is largely diluted by excipient material.

CHART V. STATION NO. 18076, MAGIC YEAST.



Station No. 18433, Medic Yeest.

Medic Yeest, Dr. Carey's. Distributed by the Carey Medical Corporation, Elmira, N. Y.

Label: 60 tablets Dr. Carey's Medic Yeest Compound Tablets. Recommended in cases of simple anaemia, malnutrition, boils, carbuncles, certain forms of pimply skin, lack of energy and general run-down conditions.

Directions: Take two tablets immediately after each meal.

Accompanying literature states:

A general tonic and tissue builder—a scientific preparation containing the vitamines of especially prepared yeast, along with other valuable blood-enriching, strength-producing ingredients—care is exercised to conserve the full vitamine content of the yeast which is in concentrated form. They (the tablets), also contain other ingredients such as hypophosphates, iron, etc.

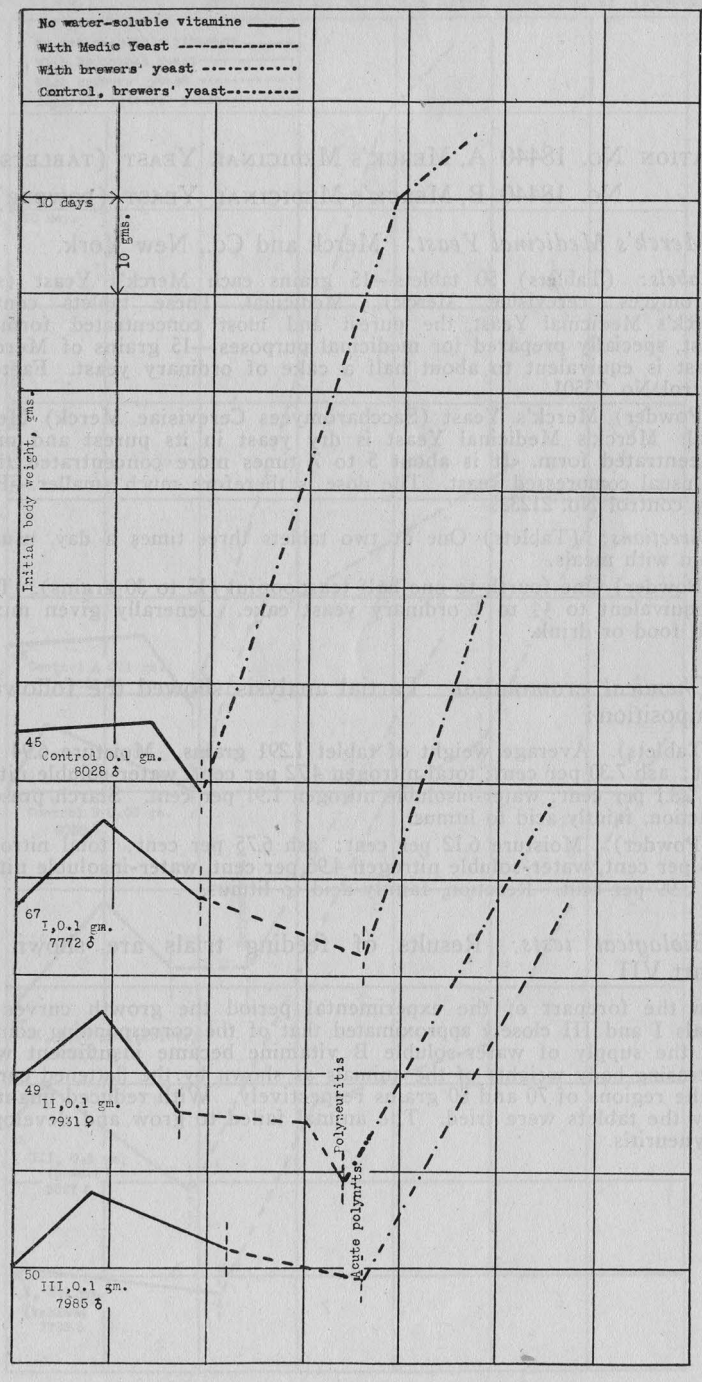
Chemical examination: Partial analysis showed the following composition:

Average weight of tablet 0.458 gram. Moisture 5.30 per cent; ash 24.34 per cent, total nitrogen 3.37, water-soluble nitrogen 0.79 per cent; water-insoluble nitrogen 2.58 per cent. Iron trace; calcium and hypophosphites present. Alkaloids trace (?). Reaction, acid to litmus.

Biological tests: The results of feeding trials are shown in Chart VI.

In all of the trials the animals continued to decline in the experimental period and in two cases marked polyneuritis developed. Prompt recovery followed when Medic Yeest was withdrawn and the brewer's yeast substituted. The results show no therapeutic value in the product as a source of water-soluble B vitamine.

Chart VI. Station No. 18433, Medic Yeest.



Station No. 18440 A, Merck's Medicinal Yeast (tablets).
No. 18440 B, Merck's Medicinal Yeast (powder).

Merck's Medicinal Yeast. Merck and Co., New York.

Labels: (Tablets) 50 tablets—15 grains each Merck's Yeast (saccharomyces cerevisiae Merck), Medicinal. These tablets contain Merck's Medicinal Yeast, the purest and most concentrated form of yeast, specially prepared for medicinal purposes.—15 grains of Merck's Yeast is equivalent to about half a cake of ordinary yeast. Factory control No. 23501.

(Powder) Merck's Yeast (Saccharomyces Cerevisiae Merck) Medicinal. Merck's Medicinal Yeast is dry yeast in its purest and most concentrated form. It is about 5 to 7 times more concentrated than the usual compressed yeast. The dose is therefore much smaller.—Factory control No. 21232.

Directions: (Tablets) One or two tablets three times a day, usually given with meals.

(Powder) One fourth to one-half teaspoonful (15 to 30 grains). This is equivalent to ½ to 1 ordinary yeast cake. Generally given mixed with food or drink.

Chemical examination: Partial analysis showed the following composition:

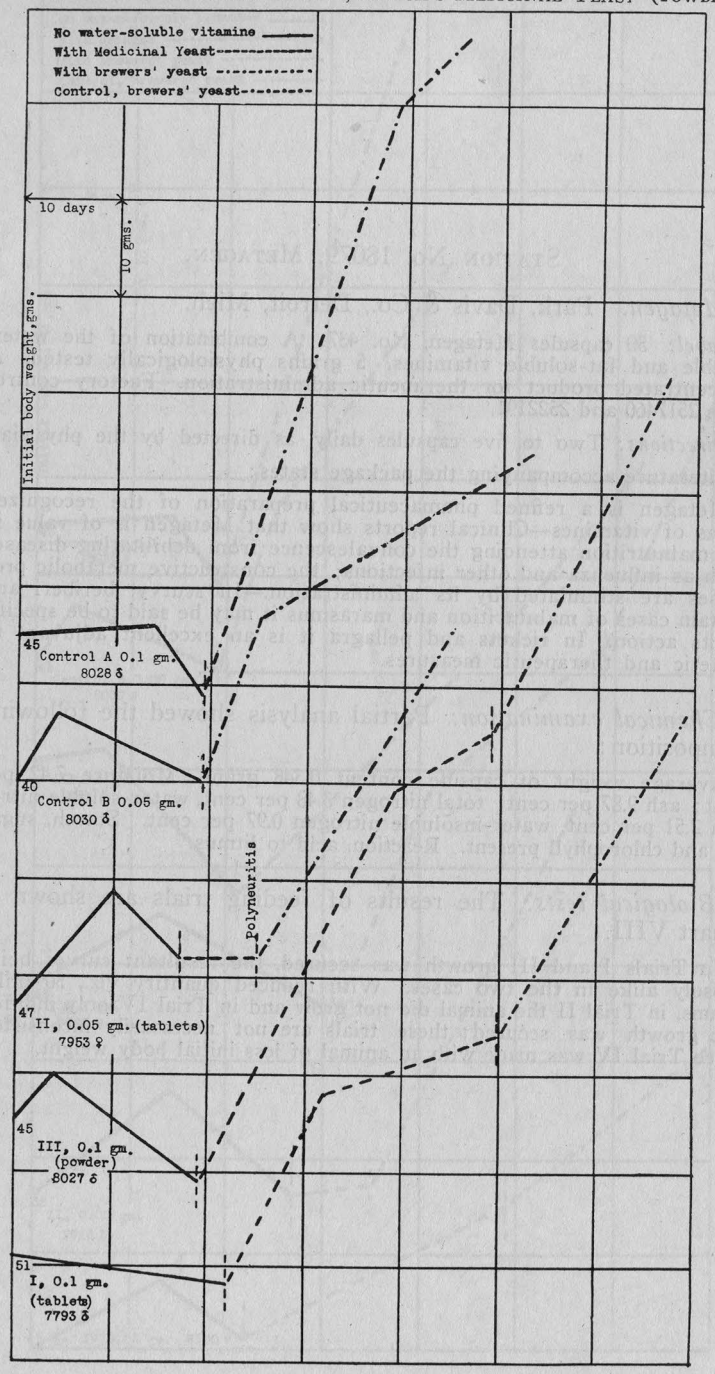
(Tablets). Average weight of tablet 1.291 grams. Moisture 6.94 per cent; ash 7.30 per cent; total nitrogen 4.72 per cent, water-soluble nitrogen 28.1 per cent; water-insoluble nitrogen 1.91 per cent. Starch present. Reaction, faintly acid to litmus.

(Powder). Moisture 6.12 per cent; ash 6.75 per cent; total nitrogen 8.95 per cent, water-soluble nitrogen 4.96 per cent, water-insoluble nitrogen 3.99 per cent. Reaction, faintly acid to litmus.

Biological tests: Results of feeding trials are shown in Chart VII.

In the forepart of the experimental period the growth curves in Trials I and III closely approximated that of the corresponding control but the supply of water-soluble B vitamine became insufficient with increasing body weights of the animals as shown by the flattened curves in the regions of 70 and 80 grams respectively. With reduced quantity only the tablets were tried. The animal failed to grow and developed polyneuritis.

Chart. VII. Station No. 18440 A, Merck's Medicinal Yeast (tablets).
No. 18440 B, Merck's Medicinal Yeast (powder).



Station No. 18079, Metagen.

Metagen. Park, Davis & Co., Detroit, Mich.

Label: 50 capsules Metagen, No. 437. A combination of the water-soluble and fat-soluble vitamines. 5 grains physiologically tested. A concentrated product for therapeutic administration. Factory control Nos. 2517460 and 2522191.

Directions: Two to five capsules daily, as directed by the physician.

Literature accompanying the package states:

Metagen is a refined phamaceutical preparation of the recognized types of vitamines—Clinical reports show that Metagen is of value in the malnutrition attending the convalescence from debilitating diseases such as influenza and other infections; the constructive metabolic processes are stimulated by its administration.—In scurvy, beriberi and certain cases of malnutrition and marasmus it may be said to be specific in its action. In rickets and pellagra it is an excellent adjuvant to dietetic and therapeutic measures.

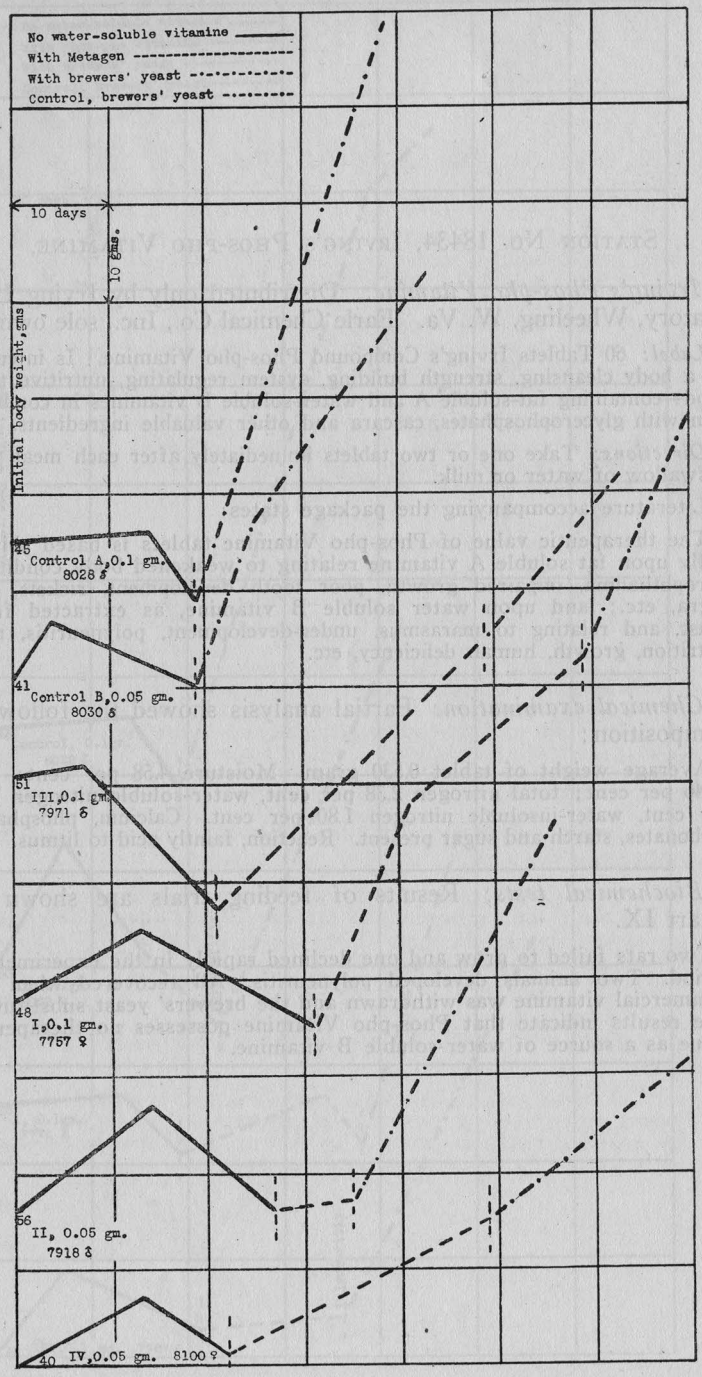
Chemical examination: Partial analysis showed the following composition:

Average weight of capsule content 0.348 gram. Moisture 7.42 per cent; ash 9.87 per cent; total nitrogen 3.48 per cent, water-soluble nitrogen 2.51 per cent, water-insoluble nitrogen 0.97 per cent. Starch, sugar fat and chlorophyll present. Reaction, acid to litmus.

Biological tests: The results of feeding trials are shown in Chart VIII.

In Trials I and III growth was secured, the resultant curves being closely alike in the two cases. With reduced quantity viz., 50 milligrams, in Trial II the animal did not grow and in Trial IV only indifferent growth was secured; these trials are not necessarily inconsistent since Trial IV was made with an animal of less initial body weight.

Chart VIII. Station No. 18079, Metagen.



STATION NO. 18434, IRVING'S PHOS-PHO VITAMINE.

Irving's Phos-pho Vitamine. Distributed only by Irving Laboratory, Wheeling, W. Va. Earle Chemical Co., Inc., sole owners.

Label: 60 Tablets Irving's Compound Phos-pho Vitamine. Is intended as a body cleansing, strength building, system regulating, nutritive tonic food—containing fat-soluble A and water-soluble B vitamines in combination with glycerophosphates, cascara and other valuable ingredients.

Directions: Take one or two tablets immediately after each meal with a swallow of water or milk.

Literature accompanying the package states:

The therapeutic value of Phos-pho Vitamine tablets is based principally upon fat soluble A vitamine relating to weakened body condition, xerophthalmia, impaired growth, poor tooth development, rickets, pellagra, etc.; and upon water soluble B vitamine, as extracted from yeast, and relating to marasmus, under-development, polyneuritis, malnutrition, growth, human deficiency, etc.

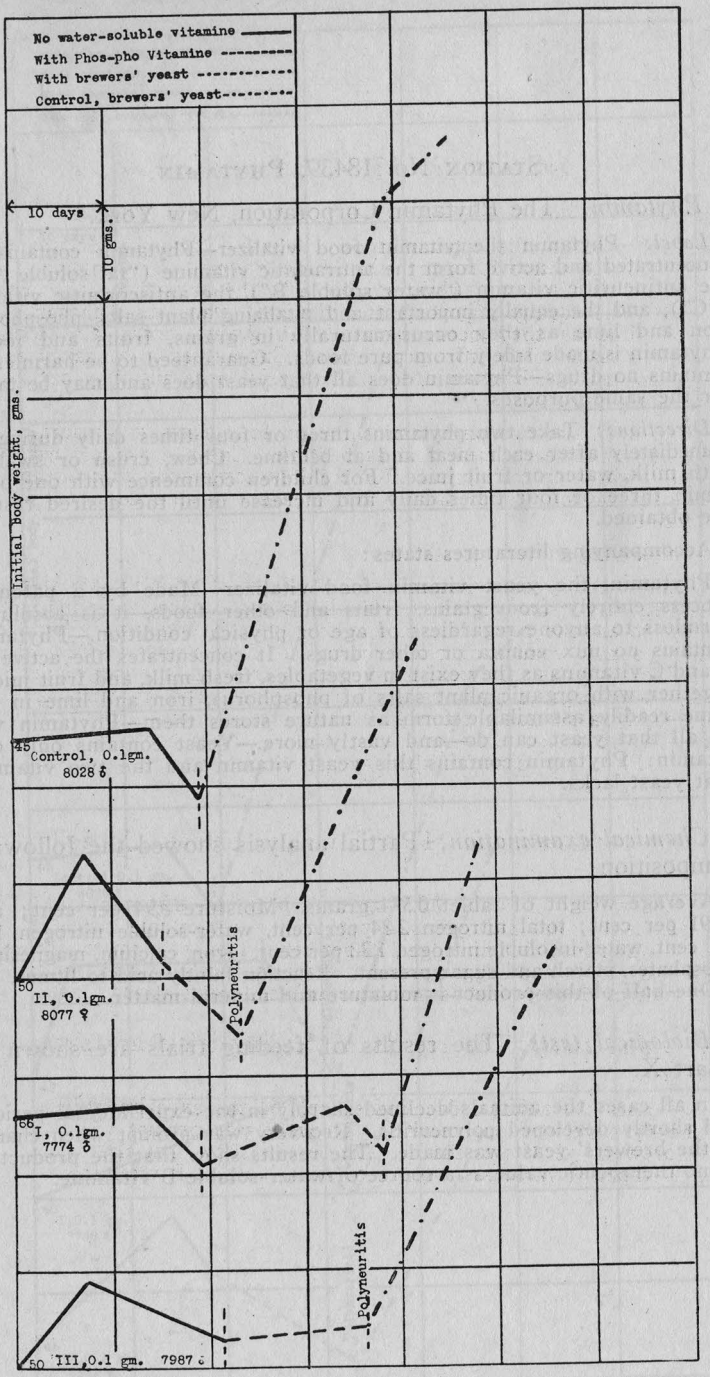
Chemical examination: Partial analysis showed the following composition:

Average weight of tablet 0.530 gram. Moisture 4.58 per cent; ash 32.46 per cent; total nitrogen 2.38 per cent, water-soluble nitrogen 0.58 per cent, water-insoluble nitrogen 1.80 per cent. Calcium, phosphates, carbonates, starch and sugar present. Reaction, faintly acid to litmus.

Biochemical tests: Results of feeding trials are shown in Chart IX.

Two rats failed to grow and one declined rapidly in the experimental period. Two animals developed polyneuritis. All recovered when the commercial vitamine was withdrawn and the brewers' yeast substituted. The results indicate that Phos-pho Vitamine possesses no therapeutic value as a source of water-soluble B vitamine.

CHART IX. STATION NO. 18434, PHOS-PHO VITAMINE.



Station No. 18439, Phytamin.

Phytamin. The Phytamin Corporation, New York.

Label: Phytamin the vitamin food vitalizer—Phytamin contains in concentrated and active form the antirachitic vitamine ("fat soluble A"), the antineuritic vitamin ("water soluble B"), the antiscorbutic vitamin ("C"), and the equally important and vitalizing plant salts, phosphorus, iron and lime as they occur naturally in grains, fruits and foods. Phytamin is made solely from pure foods. Guaranteed to be harmless—contains no drugs—Phytamin does all that yeast does and may be taken for the same purposes.

Directions: Take two phytamins three or four times daily during or immediately after each meal and at bedtime. Chew, crush or swallow with milk, water or fruit juice. For children commence with one phytamin three or four times daily and increase until the desired results are obtained.

Accompanying literatures states:

Phytamin, the yeast vitamin food vitalizer—Made by a patented process entirely from grains, fruits and other foods, it is absolutely harmless to anyone regardless of age or physical condition.—Phytamin contains no nux vomica or other drugs. It concentrates the active A, B and C vitamins as they exist in vegetables, fresh milk, and fruit juices, together with organic plant salts of phosphorus, iron and lime in the same readily assimilable form as nature stores them—Phytamin will do all that yeast can do—and vastly more.—Yeast contains only one vitamin: Phytamin contains this yeast vitamin and the two vitamins that yeast lacks.

Chemical examination: Partial analysis showed the following composition:

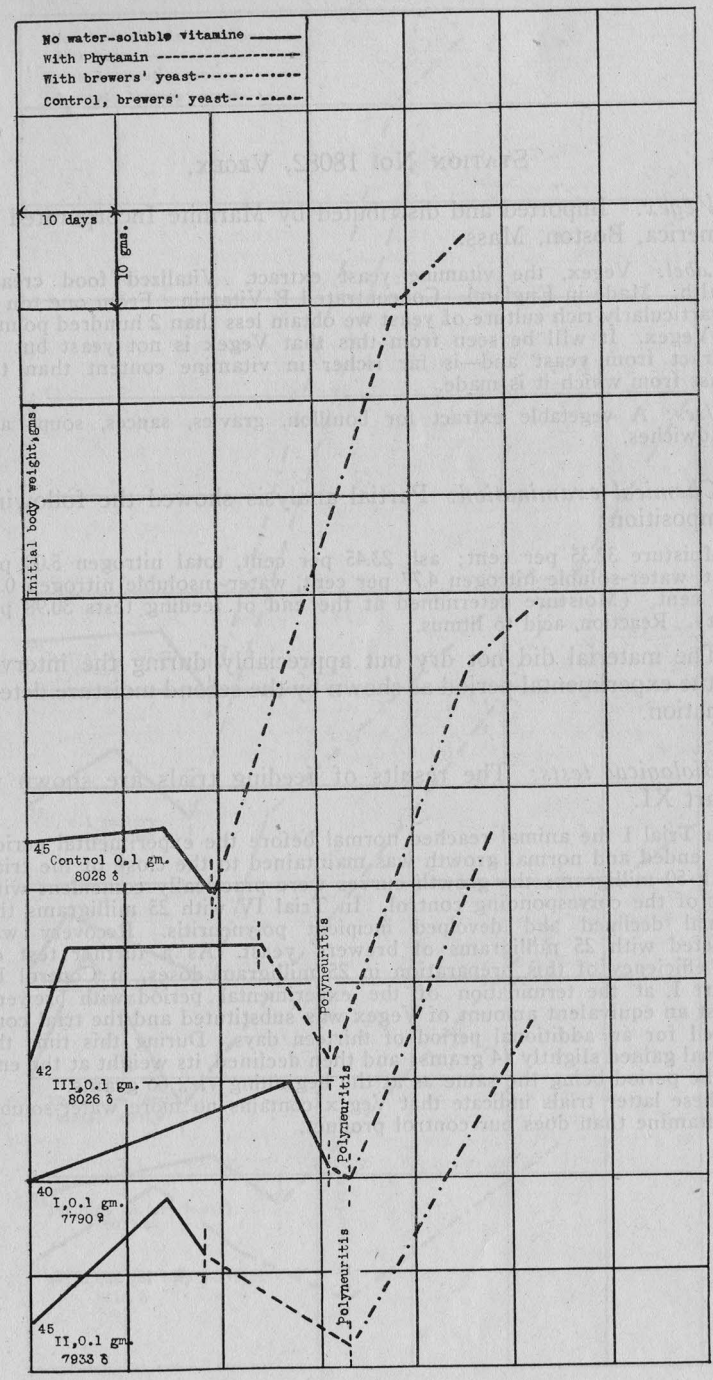
Average weight of tablet 0.574 grams. Moisture 8.94 per cent; ash 40.91 per cent; total nitrogen 2.24 per cent, water-soluble nitrogen 1.02 per cent, water-insoluble nitrogen 1.22 per cent. Iron, calcium, magnesium, phosphates, starch and sugar present. Reaction faintly acid to litmus.

One half of this product is moisture and mineral matter.

Biological tests: The results of feeding trials are shown in Chart X.

In all cases the animals declined sharply in the experimental periods and shortly developed polyneuritis. Recovery was prompt when change to the brewers' yeast was made. The results show that the product is of no therapeutic value as a source of water-soluble B vitamine.

Chart X. Station No. 18439, Phytamin.



STATION NO. 18082, VEGEX.

Vegex. Imported and distributed by Marmite Incorporated of America, Boston, Mass.

Label: Vegex, the vitamine yeast extract. Vitalized food creates health. Made in England. Concentrated B Vitamin. From one ton of a particularly rich culture of yeast we obtain less than 2 hundred pounds of Vegex. It will be seen from this that Vegex is not yeast but an extract from yeast and—is far richer in vitamine content than the yeast from which it is made.

Uses: A vegetable extract for bouillon, gravies, sauces, soups and sandwiches.

Chemical examination: Partial analysis showed the following composition:

Moisture 32.35 per cent; ash 23.45 per cent, total nitrogen 5.00 per cent, water-soluble nitrogen 4.77 per cent, water-insoluble nitrogen 0.23 per cent. (Moisture determined at the end of feeding tests 30.98 per cent). Reaction, acid to litmus.

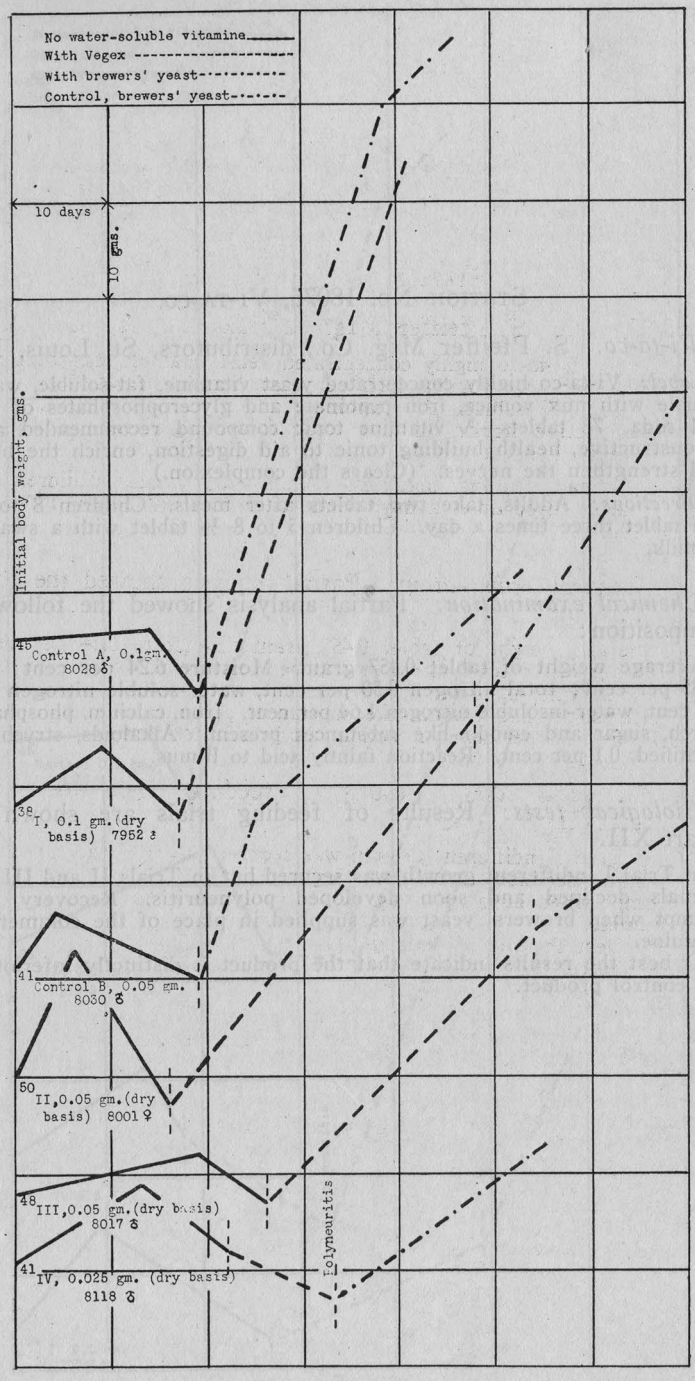
The material did not dry out appreciably during the interval of the experimental period as shown by the second moisture determination.

Biological tests: The results of feeding trials are shown in Chart XI.

In Trial I the animal reached normal before the experimental period was ended and normal growth was maintained to the close of the trial. With 50 milligrams the growth curves were practically coincident with that of the corresponding control. In Trial IV with 25 milligrams the animal declined and devolped incipient polyneuritis. Recovery was effected with 25 milligrams of brewers' yeast. As a further test of the efficiency of this preparation in 25 milligram doses, in Control D, Chart I, at the termination of the experimental period with brewers' yeast an equivalent amount of Vegex was substituted and the trial continued for an additional period of thirteen days. During this time the animal gained slightly (4 grams) and then declined, its weight at the end of the period being the same as at the beginning viz., 66 grams.

These latter trials indicate that Vegex contains no more water-soluble B vitamine than does our control product.

CHART XI. STATION NO. 18082, VEGEX.



Station No. 18075, Vi-ta-co.

Vi-ta-co. S. Pfeiffer Mfg. Co., distributors, St. Louis, Mo.

Label: Vi-ta-co highly concentrated yeast vitamine, fat-soluble, water-soluble with nux vomica, iron peptonate and glycerophosphates of lime and soda. 75 tablets—A vitamine tonic compound recommended as a reconstructive, health building tonic to aid digestion, enrich the blood and strengthen the nerves. (Clears the complexion.)

Directions: Adults, take two tablets after meals. Children 8 to 14, one tablet three times a day. Children 5 to 8 ½ tablet with a swallow of milk.

Chemical examination: Partial analysis showed the following composition:

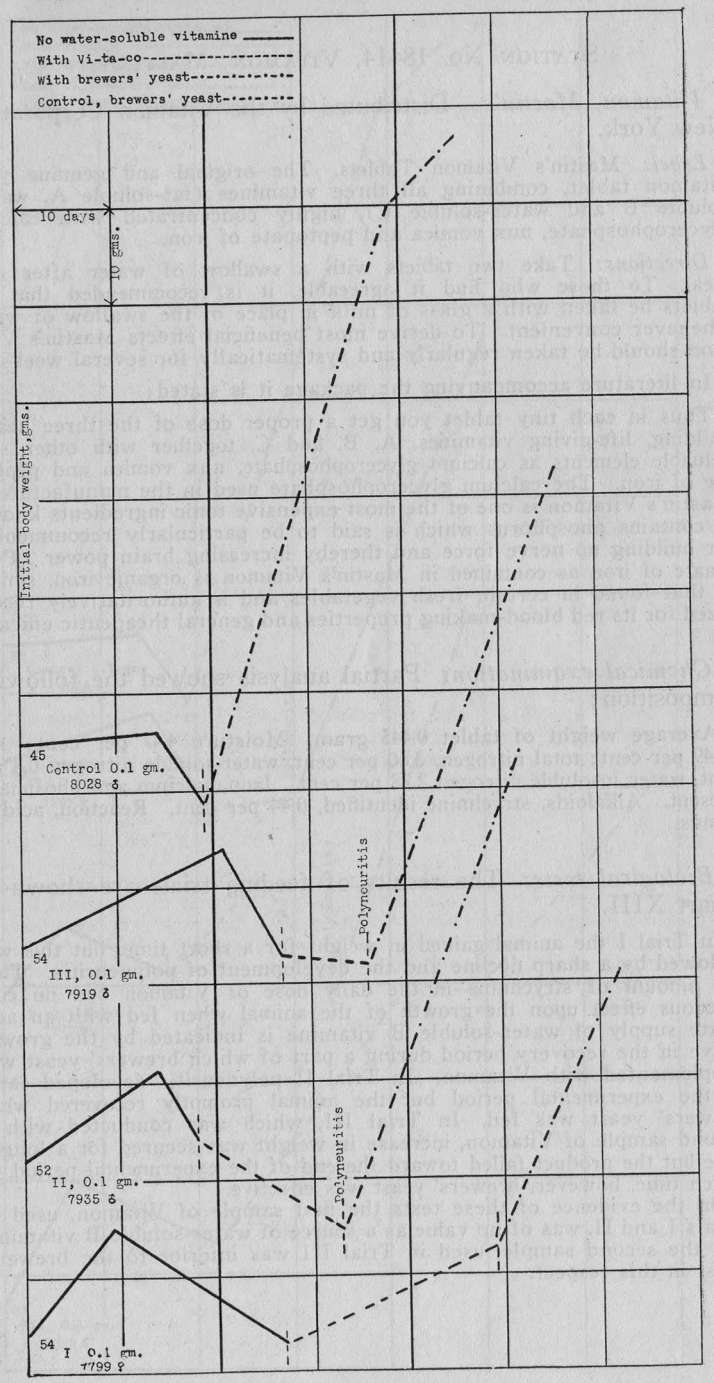
Average weight of tablet 0.457 gram. Moisture 6.24 per cent; ash 17.85 per cent; total nitrogen 3.50 per cent, water-soluble nitrogen 1.86 per cent, water-insoluble nitrogen 1.64 per cent. Iron, calcium, phosphates, starch, sugar and emodin-like substances present. Alkaloids, strychnine identified, 0.1 per cent. Reaction faintly acid to litmus.

Biological tests: Results of feeding trials are shown in Chart XII.

In Trial I indifferent growth was secured but in Trials II and III the animals declined and soon developed polyneuritis. Recovery was prompt when brewers' yeast was supplied in place of the commercial vitamine.

At best the results indicate that the product is distinctly inferior to the control product.

Chart XII. Station No. 18075, Vi-ta-co.



Station No. 18414, Vitamon, Mastin's.

Vitamon, Mastin's. Distributed by the Vitamon Corporation, New York.

Label: Mastin's Vitamon Tablets. The original and genuine yeast vitamon tablet, combining all three vitamines (fat-soluble A, water-soluble B and water-soluble C), highly concentrated with calcium glycerophosphate, nux vomica and peptonate of iron.

Directions: Take two tablets with a swallow of water after each meal. To those who find it agreeable, it is recommended that the tablets be taken with a glass of milk in place of the swallow of water whenever convenient. To derive most beneficial effects Mastin's Vitamon should be taken regularly and systematically for several weeks.

In literature accompanying the package it is stated:

Thus in each tiny tablet you get a proper dose of the three health building, life-giving vitamines, A, B, and C, together with other such valuable elements as calcium glycerophosphate, nux vomica and peptonate of iron. The calcium glycerophosphate used in the manufacture of Mastin's Vitamon is one of the most expensive tonic ingredients known. It contains phosphorus which is said to be particularly recommended for building up nerve force and thereby increasing brain power. Peptonate of iron as contained in Mastin's Vitamon is organic iron, similar to that found in certain fresh vegetables and is authoritatively recognized for its red blood-making properties and general theapeutic efficacy.

Chemical examination: Partial analysis showed the following composition:

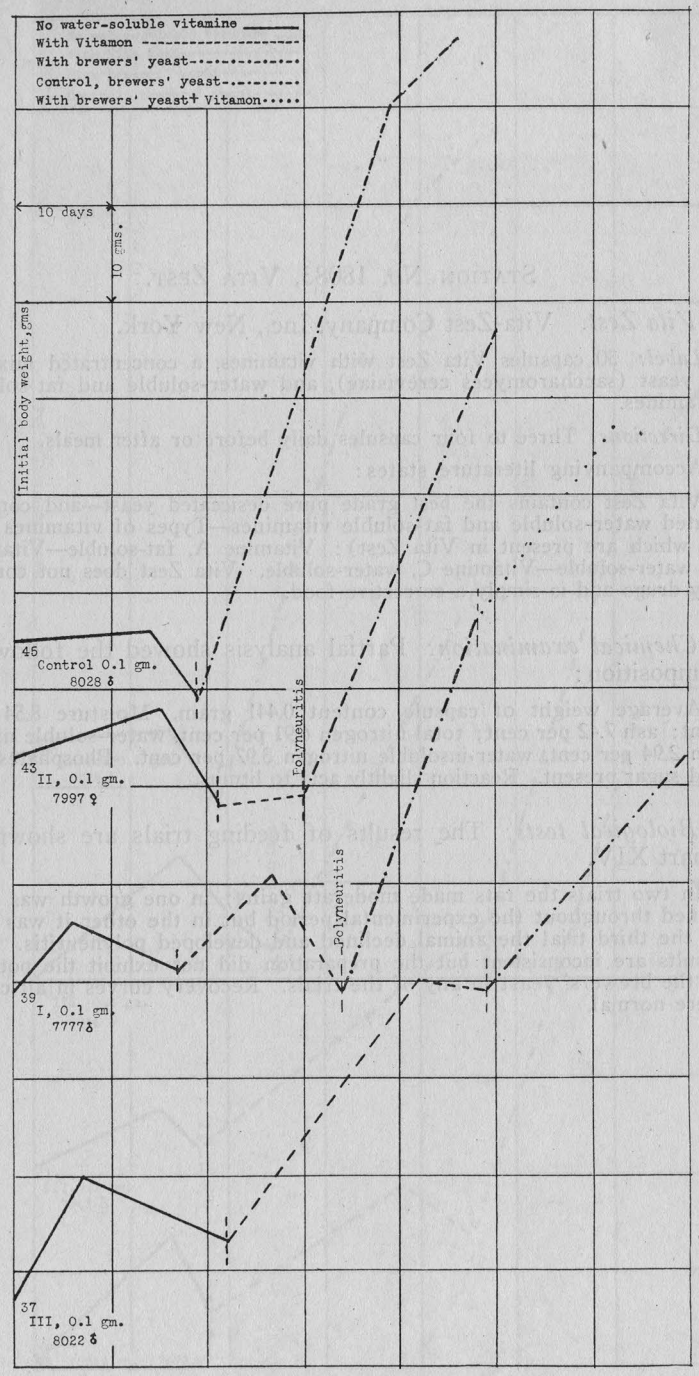
Average weight of tablet 0.445 gram. Moisture 4.47 per cent; ash 17.49 per cent; total nitrogen, 3.60 per cent, water-soluble nitrogen 0.8 per cent, water insoluble nitrogen 2.78 per cent. Iron, calcium and phosphates present. Alkaloids, strychnine identified, 0.44 per cent. Reaction, acid to litmus.

Biological tests: The results of feeding trials are shown in Chart XIII.

In Trial I the animal gained in weight for a short time, but this was followed by a sharp decline and the development of polyneuritis. That the amount of strychnine in the daily dose of Vitamon had no conspicuous effect upon the growth of the animal when fed with an adequate supply of water-soluble B vitamine is indicated by the growth curve in the recovery period during a part of which brewers' yeast was supplemented with Vitamon. In Trial II polyneuritis developed early in the experimental period but the animal promptly recovered when brewers' yeast was fed. In Trial III, which was conducted with a second sample of Vitamon, increase in weight was secured for a longer time but the product failed toward the end of the experimental period, at which time, however, brewers' yeast was effective.

On the evidence of these tests the first sample of Vitamon, used in Trials I and II, was of no value as a source of water-soluble B vitamine, and the second sample, used in Trial III was inferior to the brewers' yeast in this respect.

Chart XIII. Station No. 18414, Vitamon.



STATION NO. 18083, VITA ZEST.

Vita Zest. Vita-Zest Company, Inc., New York.

Label: 50 capsules Vita Zest with vitamines, a concentrated mixture of yeast (saccharomyces cerevisiae), and water-soluble and fat-soluble vitamines.

Directions: Three to four capsules daily before or after meals.

Accompanying literature states:

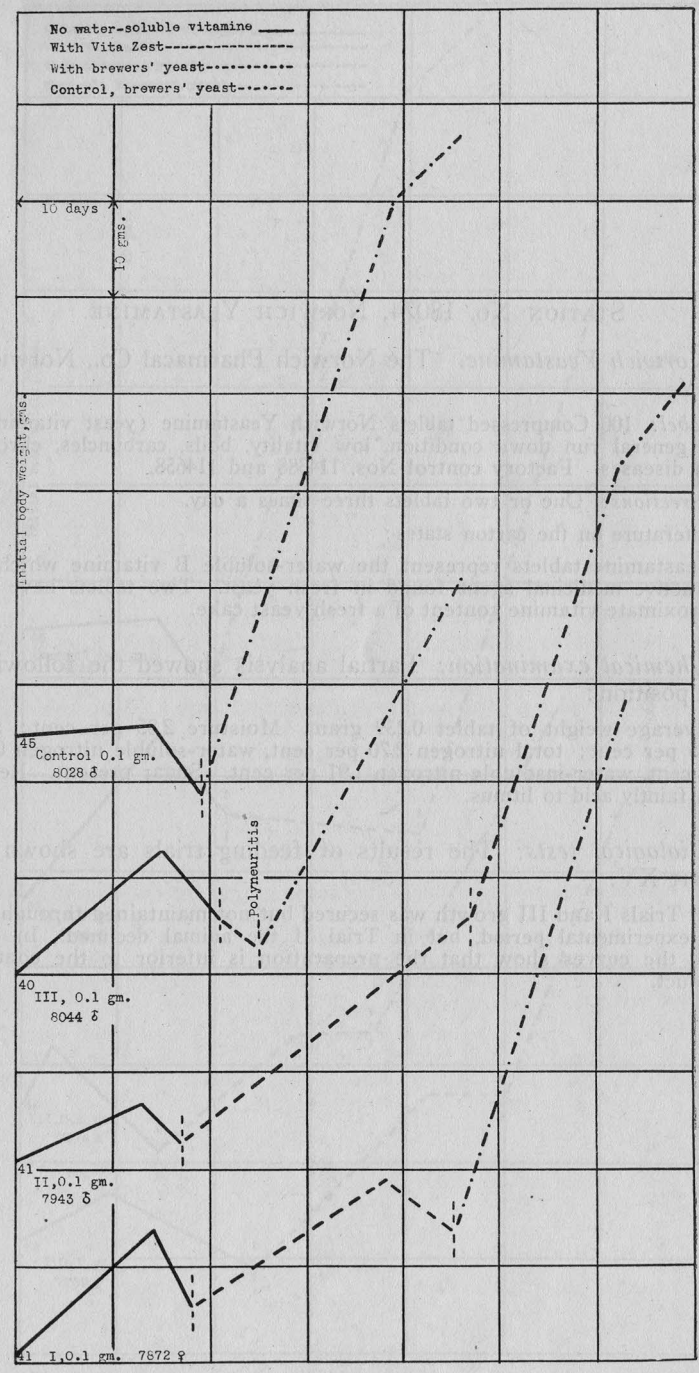
Vita Zest contains the best grade pure desiccated yeast—and concentrated water-soluble and fat-soluble vitamines—Types of vitamines (all of which are present in Vita Zest): Vitamine A, fat-soluble—Vitamine B, water-soluble—Vitamine C, water-soluble. Vita Zest does not contain any drugs and is simply a corrective food.

Chemical examination: Partial analysis showed the following composition:

Average weight of capsule content 0.441 gram. Moisture 8.54 per cent; ash 7.42 per cent; total nitrogen 6.91 per cent, water-soluble nitrogen 2.94 per cent, water-insoluble nitrogen 3.97 per cent. Phosphates, fat and sugar present. Reaction slightly acid to litmus.

Biological tests: The results of feeding trials are shown in Chart XIV.

In two trials the rats made moderate gains; in one growth was sustained throughout the experimental period but in the other it was not. In the third trial the animal declined and developed polyneuritis. The results are inconsistent but the preparation did not exhibit the potency of the brewers' yeast in any of the trials. Recovery curves in all cases were normal.



Station No. 18074, Norwich Yeastamine.

Norwich Yeastamine. The Norwich Pharmacal Co., Norwich, N. Y.

Label: 100 Compressed tablets Norwich Yeastamine (yeast vitamine). For general run down condition, low vitality, boils, carbuncles, chronic skin diseases. Factory control Nos. 114388 and 114658.

Directions: One or two tablets three times a day.

Literature on the carton states:

Yeastamine tablets represent the water-soluble B vitamine which is the active medicinal agent found in fresh yeast. Two tablets have the approximate vitamine content of a fresh yeast cake.

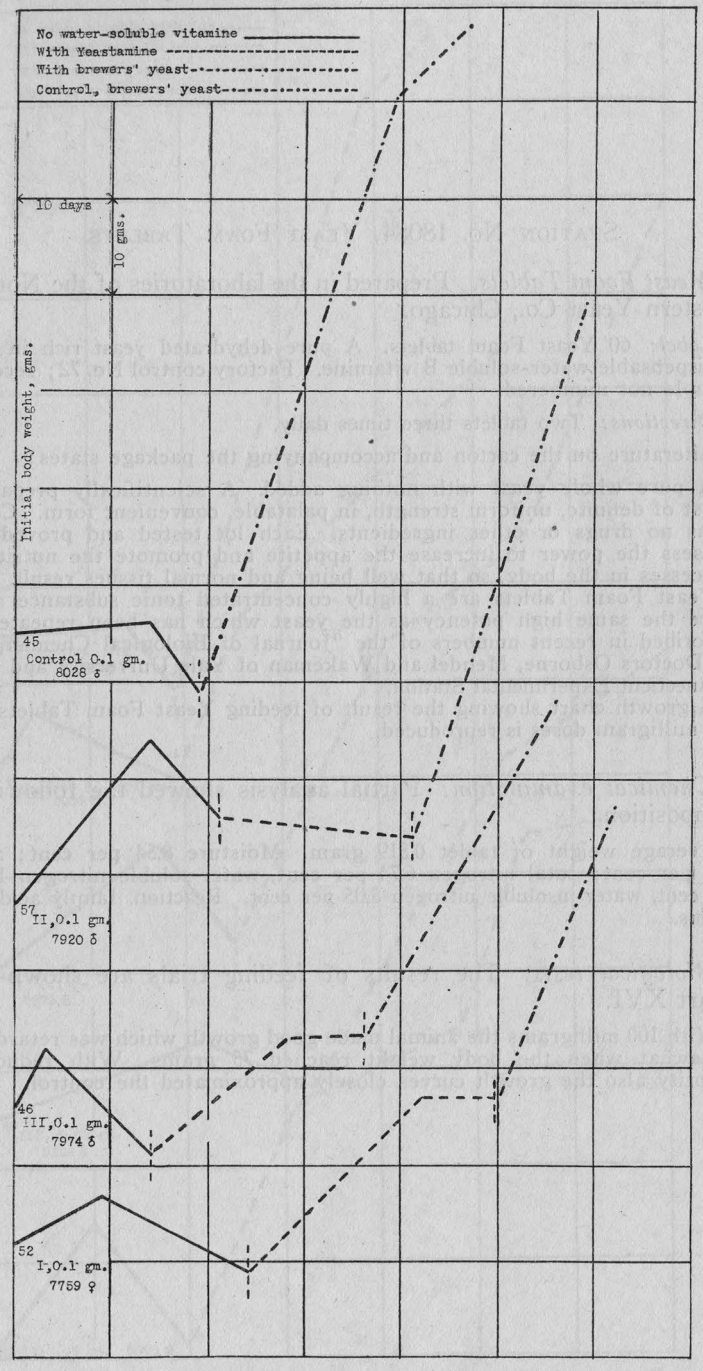
Chemical examination: Partial analysis showed the following composition:

Average weight of tablet 0.239 gram. Moisture 2.85 per cent; ash 13.65 per cent; total nitrogen 2.70 per cent, water-soluble nitrogen 0.79 per cent, water-insoluble nitrogen 1.91 per cent. Sugar present. Reaction faintly acid to litmus.

Biological tests: The results of feeding trials are shown in Chart XV.

In Trials I and III growth was secured but not maintained throughout the experimental period, but in Trial II the animal declined. In any case the curves show that the preparation is inferior to the control product.

Chart XV. Station No. 18074, Norwich Yeastamine.



STATION NO. 18084, YEAST FOAM TABLETS.

Yeast Foam Tablets. Prepared in the laboratories of the Northwestern Yeast Co., Chicago.

Label: 60 Yeast Foam tablets. A pure dehydrated yeast rich in the indispensable water-soluble B vitamine. Factory control No. 72; second sample not numbered.

Directions: Two tablets three times daily.

Literature on the carton and accompanying the package states:

A pure whole yeast with nothing added. A scientifically prepared yeast of definite, uniform strength, in palatable, convenient form. Contains no drugs or other ingredients. Each lot tested and proved to possess the power to increase the appetite and promote the nutritive processes in the body, so that well being and normal tissues result.

Yeast Foam Tablets are a highly concentrated tonic substance and have the same high potency as the yeast which has been repeatedly described in recent numbers of the "Journal of Biological Chemistry," by Doctors Osborne, Mendel and Wakeman of Yale University and the Connecticut Experimental Station.

A growth chart showing the result of feeding Yeast Foam Tablets in 200 milligram doses is reproduced.

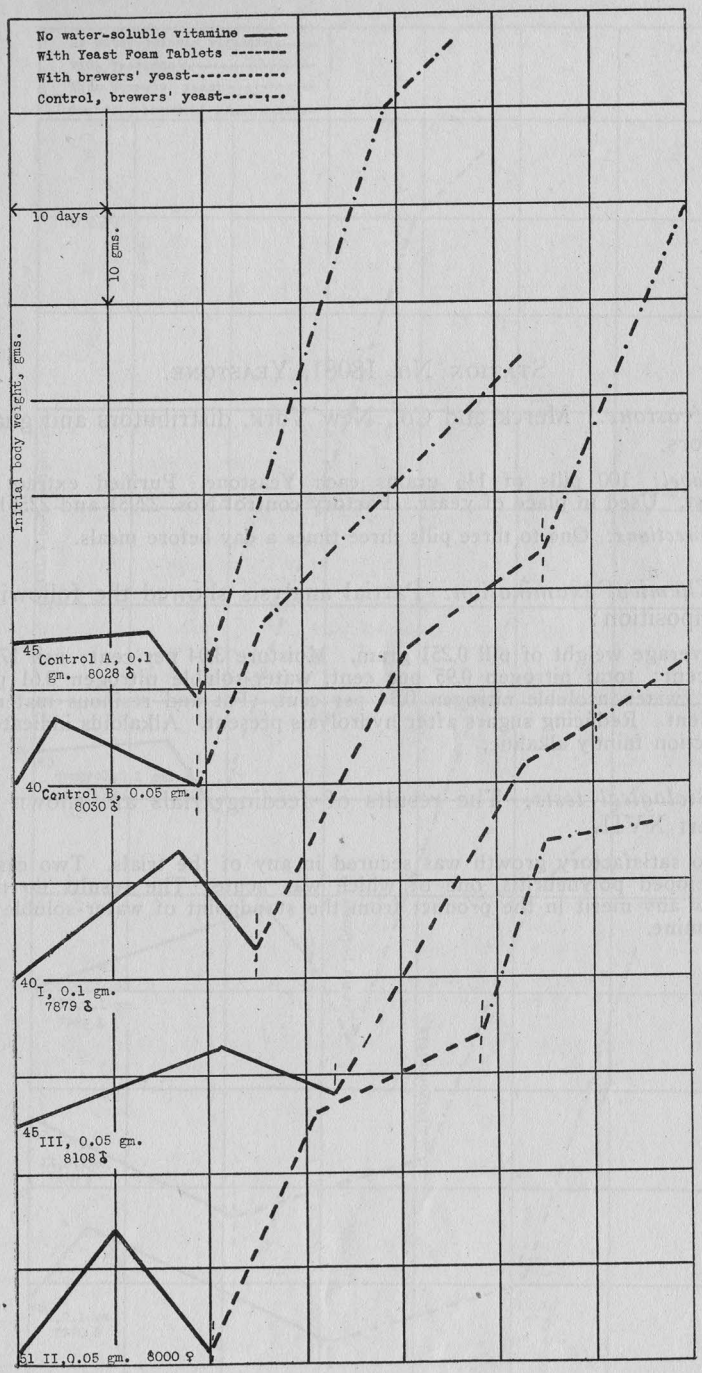
Chemical examination: Partial analysis showed the following composition:

Average weight of tablet 0.519 gram. Moisture 8.54 per cent; ash 5.52 per cent; total nitrogen 6.74 per cent, water-soluble nitrogen 1.69 per cent, water-insoluble nitrogen 5.05 per cent. Reaction, faintly acid to litmus.

Biological tests: The results of feeding trials are shown in Chart XVI.

With 100 milligrams the animal made good growth which was retarded somewhat when the body weight reached 75 grams. With reduced quantity also the growth curves closely approximated the control.

CHART XVI. STATION NO. 18084, YEAST FOAM TABLETS.



Station No. 18081, Yeastone.

Yeastone. Merck and Co., New York, distributors and guarantors.

Label: 100 pills of 1½ grains each Yeastone. Purified extract of yeast. Used in place of yeast. Factory control Nos. 22951 and 22561.

Directions: One to three pills three times a day before meals.

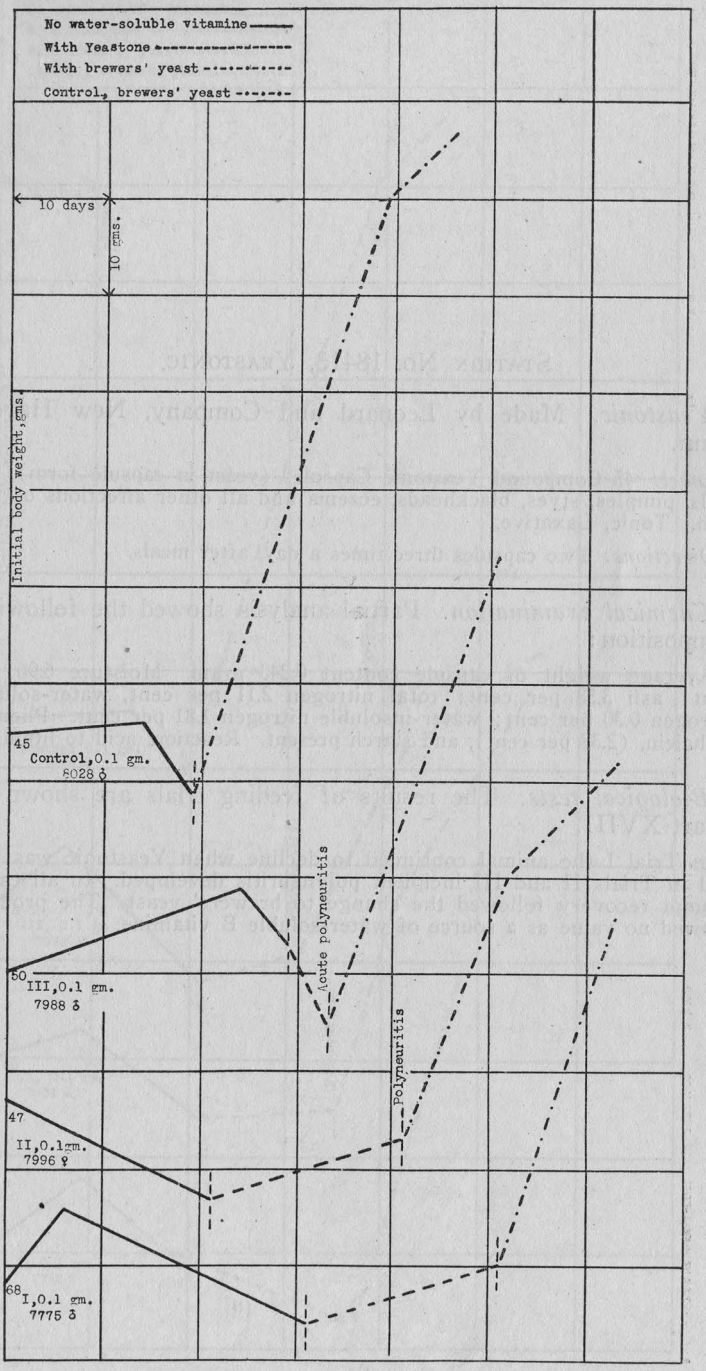
Chemical examination: Partial analysis showed the following composition:

Average weight of pill 0.251 gram. Moisture 3.04 per cent; ash 17.14 percent; total nitrogen 0.95 per cent, water-soluble nitrogen 0.61 per cent, water-insoluble nitrogen 0.34 per cent. Fat and resinous material present. Reducing sugars after hydrolysis present. Alkaloids indicated. Reaction faintly alkaline.

Biological tests: The results of feeding trials are shown in Chart XVII.

No satisfactory growth was secured in any of the trials. Two cases developed polyneuritis, one of which was acute. The results do not show any merit in the product from the standpoint of water-soluble B vitamine.

Chart XVII. Station No. 18081, Yeastone.



STATION No. 18413, YEASTONIC.

Yeastonic. Made by Leonard and Company, New Haven, Conn.

Label: 45 Compound Yeastonic Capsules (yeast in capsule form), for boils, pimples, styes, blackheads, eczema and all other affections of the skin. Tonic, Laxative.

Directions: Two capsules three times a day, after meals.

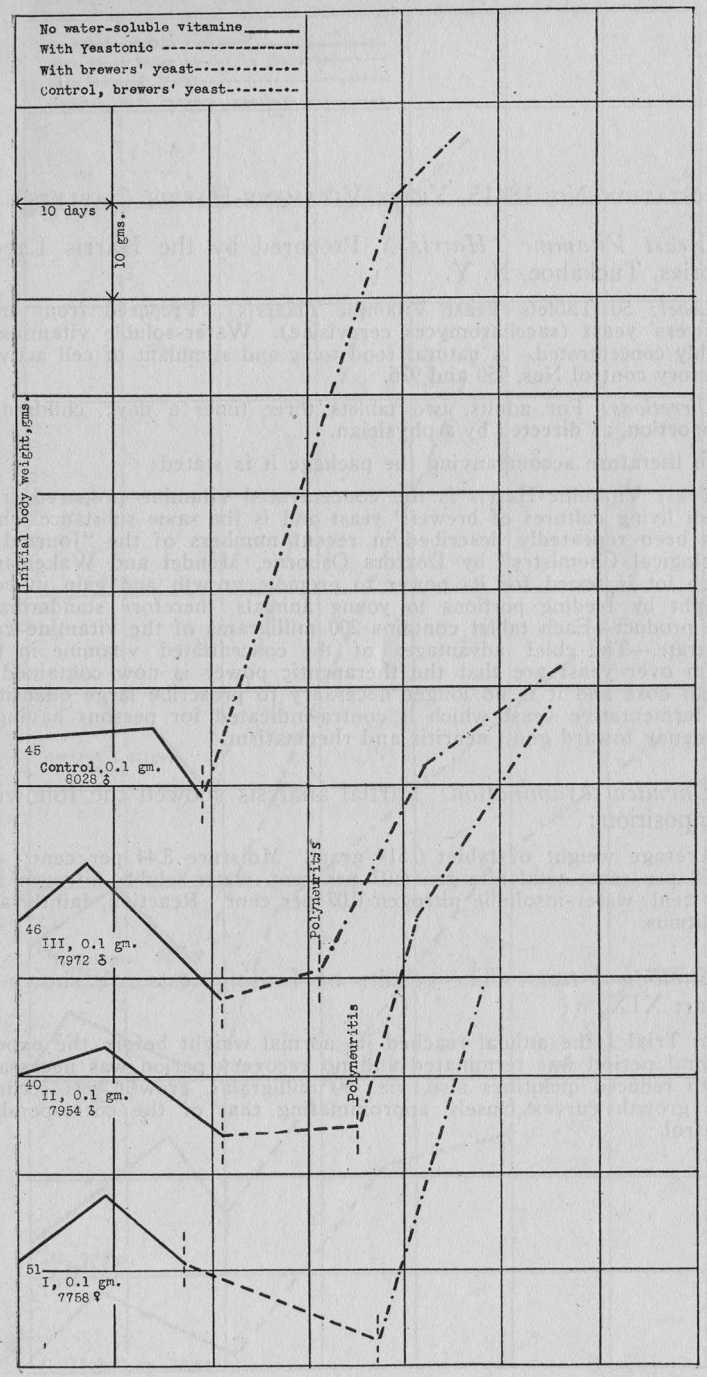
Chemical examination: Partial analysis showed the following composition:

Average weight of capsule content 0.243 gram. Moisture 6.96 per cent; ash 3.58 per cent; total nitrogen 2.11 per cent, water-soluble nitrogen 0.30 per cent; water-insoluble nitrogen 1.81 per cent. Phenolphthalein, (2.38 per cent), and starch present. Reaction, acid to litmus.

Biological tests: The results of feeding trials are shown in Chart XVIII.

In Trial I the animal continued to decline when Yeastonic was fed and in Trials II and III incipient polyneuritis developed. In all cases prompt recovery followed the change to brewers' yeast. The product showed no value as a source of water-soluble B vitamine.

CHART XVIII. STATION No. 18413, YEASTONIC.



Station No. 18415, Yeast Vitamine-Harris (tablets).

Yeast Vitamine (Harris). Prepared by the Harris Laboratories, Tuckahoe, N. Y.

Label: 50 Tablets Yeast Vitamine (Harris). Prepared from fresh brewers' yeast (saccharomyces cerevisiae). Water-soluble vitamine B highly concentrated. A natural food tonic and stimulant of cell activity. Factory control Nos. 950 and 976.

Directions: For adults, two tablets three times a day; children in proportion, as directed by a physician.

In literature accompanying the package it is stated:

Yeast Vitamine-Harris is the concentrated vitamine prepared from fresh living cultures of brewers' yeast and is the same substance which has been repeatedly described in recent numbers of the "Journal of Biological Chemistry" by Doctors Osborne, Mendel and Wakeman—Each lot is tested for its power to promote growth and gain in body weight by feeding portions to young animals, therefore standardizing the product—Each tablet contains 200 milligrams of the vitamine concentrate.—The chief advantages of the concentrated vitamine in this form over yeast are that the therapeutic power is now contained in small dose and it is no longer necessary to prescribe large quantities of fermentative yeast which is contra-indicated for persons having a tendency toward gout, neuritis and rheumatism.

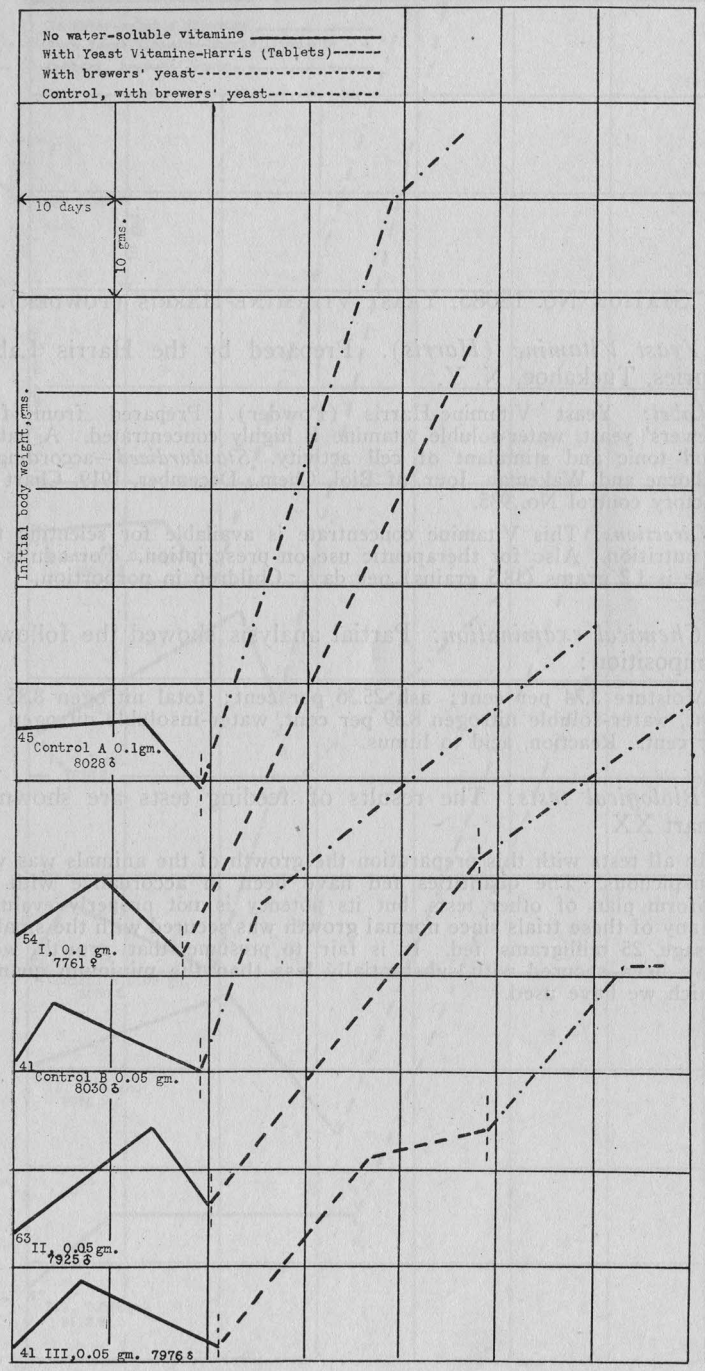
Chemical examination: Partial analysis showed the following composition:

Average weight of tablet 0.514 gram. Moisture 3.44 per cent; ash 13.58 per cent; total nitrogen 6.03 per cent, water-soluble nitrogen 5.96 per cent, water-insoluble nitrogen 0.07 per cent. Reaction, faintly acid to litmus.

Biological tests: The results of feeding tests are shown in Chart XIX.

In Trial I the animal reached its normal weight before the experimental period was terminated and no recovery period was necessary. With reduced quantities also, viz., 50 milligrams, growth was secured, the growth curves closely approximating that of the corresponding control.

Chart XIX. Station No. 18415, Yeast Vitamine-Harris (tablets).



STATION NO. 18085, YEAST VITAMINE-HARRIS (POWDER).

Yeast Vitamine (Harris). Prepared by the Harris Laboratories, Tuckahoe, N. Y.

Label: Yeast Vitamine-Harris (Powder). Prepared from fresh brewers' yeast, water-soluble vitamine B highly concentrated. A natural food tonic and stimulant of cell activity. *Standardized*—according to Osborne and Wakeman, Jour. of Biol. Chem., December, 1919, Chart III. Factory control No. 985.

Directions: This Vitamine concentrate is available for scientific tests in nutrition. Alsc for therapeutic use on prescription. For adults the dose is 1.2 grams (18.5 grains) per day. Children in porportion.

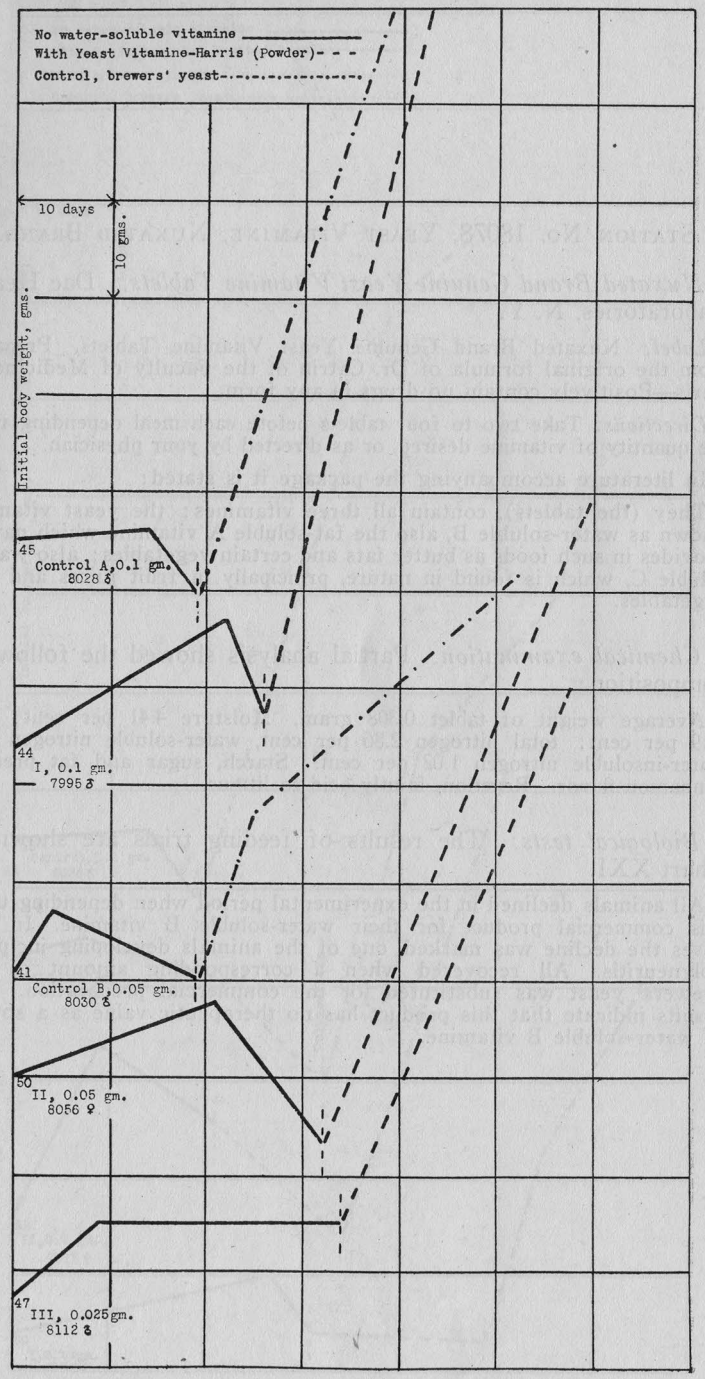
Chemical examination: Partial analysis showed the following composition:

Moisture 3.74 per cent; ash 25.36 per cent; total nitrogen 8.85 per cent, water-soluble nitrogen 8.59 per cent, water-insoluble nitrogen 0.26 per cent. Reaction, acid to litmus.

Biological tests: The results of feeding tests are shown in Chart XX.

In all tests with this preparation the growth of the animals was very conspicuous. The quantities fed have been in accordance with the uniform plan of other tests, but its potency is not properly evaluated in any of these trials since normal growth was secured with the smallest dosage, 25 milligrams, fed. It is fair to presume that growth would have been secured with substantially less than the minimum quantity which we have used.

CHART XX. STATION NO. 18085, YEAST VITAMINE-HARRIS (POWDER).



STATION NO. 18078, YEAST VITAMINE, NUXATED BRAND.

Nuxated Brand Genuine Yeast Vitamine Tablets. Dae Health Laboratories, N. Y.

Label: Nuxated Brand Genuine Yeast Vitamine Tablets. Prepared from the original formula of Dr. Catrin of the Faculty of Medicine of Paris—Positively contain no drugs in any form.

Directions: Take two to four tablets before each meal depending upon the quantity of vitamine desired, or as directed by your physician.

In literature accompanying the package it is stated:

They (the tablets), contain all three vitamines; the yeast vitamine known as water-soluble B, also the fat-soluble A vitamine which nature provides in such foods as butter fats and certain vegetables; also water-soluble C, which is found in nature, principally in fruit juices and raw vegetables.

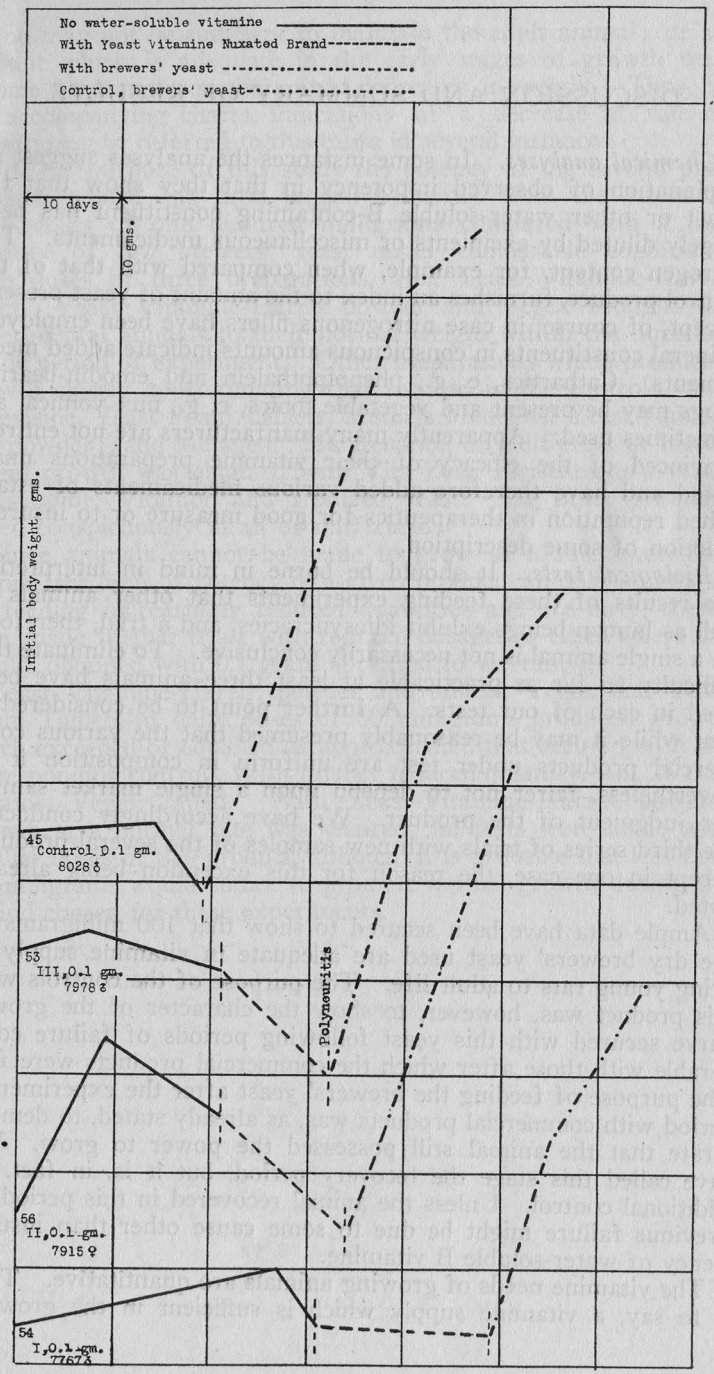
Chemical examination: Partial analysis showed the following composition:

Average weight of tablet 0.308 gram. Moisture 4.41 per cent; ash 4.19 per cent; total nitrogen 2.86 per cent, water-soluble nitrogen 1.84 water-insoluble nitrogen 1.02 per cent. Starch, sugar and fat present. Cinnamon flavor. Reaction, faintly acid to litmus.

Biological tests: The results of feeding trials are shown in Chart XXI.

All animals declined in the experimental period when depending upon this commercial product for their water-soluble B vitamine. In two cases the decline was marked, one of the animals developing incipient polyneuritis. All recovered when a corresponding amount of the brewers' yeast was substituted for the commercial preparation. The results indicate that this product has no therapeutic value as a source of water-soluble B vitamine.

CHART XXI. STATION NO. 18078, YEAST VITAMINE NUXATED BRAND.



DISCUSSION AND SUMMARY OF RESULTS.

Chemical analyses. In some instances the analyses suggest an explanation of observed impotency in that they show that the yeast or other water-soluble B-containing constituent has been largely diluted by excipients or miscellaneous medicaments. The nitrogen content, for example, when compared with that of the control product, furnishes an index to the amount of yeast present, except, of course, in case nitrogenous fillers have been employed. Mineral constituents in conspicuous amounts indicate added medicaments. Cathartics, e. g., phenolphthalein and emodin-bearing drugs may be present and vegetable tonics, e. g., nux vomica, are sometimes used. Apparently many manfacturers are not entirely convinced of the efficacy of their vitamine preparations unassisted and have therefore added various medicaments of established reputation in therapeutics for good measure or to insure a reaction of some description.

Biological tests. It should be borne in mind in interpreting the results of these feeding experiments that other animals as well as human beings exhibit idiosyncracies, and a trial, therefore, on a single animal is not necessarily conclusive. To eliminate this difficulty so far as practicable at least three animals have been used in each of our tests. A further point to be considered is that while it may be reasonably presumed that the various commercial products under test are uniform in composition it is, nevertheless, fairer not to depend upon a single market sample for judgment of the product. We have accordingly conducted the third series of trials with new samples of the several products except in one case, the reason for this exception being already noted.

Ample data have been secured to show that 100 milligrams of the dry brewers' yeast used are adequate in vitamine supply to bring young rats to adult life. The purpose of the controls with this product was, however, to show the character of the growth curve secured with this yeast following periods of failure comparable with those after which the commercial products were fed. The purpose of feeding the brewers' yeast after the experimental period with commercial products was, as already stated, to demonstrate that the animal still possessed the power to grow. We have called this stage the recovery period, but it is, in fact, an additional control. Unless the animal recovered in this period its previous failure might be due to some cause other than insufficiency of water-soluble B vitamine.

The vitamine needs of growing animals are quantitative. That is to say, a vitamine supply which is sufficient in the growing

period may not be sufficient to maintain the adult animal; or an amount which is adequate in the early stages of growth may become inadequate as the animal increases in weight. Thus, in the accompanying charts, indications of a decrease in rate of growth may be referred to this cause in several instances.

For the purpose of this study the potency of the several products examined has been judged primarily from the effect of daily doses of one hundred milligrams compared with a like quantity of dry brewers' yeast under comparable conditions. Such doses of three preparations, viz., Yeast Vitamine-Harris tablets, Yeast Vitamine-Harris powder and Vegex brought the experimental animals to their normal weight within the duration of the period of experiment. Other preparations which produced growth closely approximating that secured in the controls were Cerevisine, Yeast Foam Tablets, Merck's Medicinal Yeast (tablets and powder), and Metagen. Maintenance, or indifferent or inconsistent growth was obtained with Vita Zest, Fleischmann's yeast, Yeastamine, Vitamon and Ironized yeast. The other products failed conspicuously in all of our trials.

Since animals cannot be made to grow at a rate exceeding normal, the limit of potency of a given product can only be judged by feeding increasingly reduced quantities and we have, therefore, made further trials with reduced dosages in cases where the results obtained with 0.1 gram appeared to warrant it.

Yeast Vitamine-Harris, powder and tablets, Vegex and Yeast Foam Tablets in daily doses of 50 milligrams produced growth which exceeded or equalled or approximated that secured with the corresponding control. With further reduced quantity, viz., 25 milligrams, Vegex failed. With Yeast-Vitamine-Harris, powder, growth at a normal rate was secured; no tests were made with smaller doses of this product, although it is probable that less than 25 milligrams would suffice to promote normal growth during the period chosen for these experiments.

Connecticut
Agricultural Experiment Station

NEW HAVEN, CONN.

BULLETIN 241 NOVEMBER, 1922

Fertilizer Report for 1922

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

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

OFFICERS AND STAFF

October, 1922.

BOARD OF CONTROL.

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

James H. Webb, *Vice-President*.....Hamden
George A. Hopson, *Secretary*.....Mount Carmel
E. H. Jenkins, *Director and Treasurer*.....New Haven
Joseph W. Alsop.....Avon
Charles R. Treat.....Orange
Elijah Rogers.....Southington
Edward C. Schneider.....Middletown

STAFF.

Administration.
E. H. Jenkins, Ph.D., *Director and Treasurer.*
W. L. Slate, Jr., B.Sc., *Vice-Director.*
Miss L. M. Brautlecht, *Bookkeeper and Librarian.*
Miss J. V. Berger, *Stenographer and Bookkeeper.*
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
Owen L. Nolan
Harry J. Fisher, A.B.
Assistant Chemists.
Frank Sheldon, *Laboratory Assistant.*
V. L. Churchill, *Sampling Agent.*
Mrs. Alta Moss Storrs, *Clerk.*

Biochemical Laboratory.
T. B. Osborne, Ph.D., D.Sc., *Chemist in Charge.*

Botany.
G. P. Clinton, Sc.D., *Botanist.*
E. M. Stoddard, B.S., *Pomologist.*
Miss Florence A. McCormick, Ph.D., *Pathologist.*
G. E. Graham, *General Assistant.*
Mrs. W. W. Kelsey, *Secretary.*

Entomology.
W. E. Britton, Ph.D., *Entomologist; 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 Gypsy Moth Work.*
Samuel T. Sealy, *Deputy in Charge of Mosquito Control.*
Miss Gladys M. Finley, *Stenographer.*

Forestry.
Walter O. Filley, *Forester.*
A. E. Moss, M.F., *Assistant.*
H. W. Hicock, M.F., *Assistant.*
Miss Pauline A. Merchant, *Stenographer.*

Plant Breeding.
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.

Report on Commercial Fertilizers, 1922

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 requested, will not publish the information.

In 1922, 60 individuals and firms registered for sale in this state 482 brands of commercial fertilizers, classified as follows:

Mixed fertilizers	303
Cotton seed meal and castor pomace	33
Other chemicals and unmixed materials	146
Total	482

The number of firms is less by 16 and the number of brands less by 62 than last year.

The brands which have been registered at this Station for the year 1922 are here listed as required by Statute.

To the brands registered for 1921 in our last report should be added:

East St. Louis Cotton Oil Co., National Stockyards, Ill.
St. Clair Brand Cotton Seed Meal

American Agricultural Chemical Co., 2 Rector St., New York, N. Y.
Bowker's Lawn and Garden Dressing
Castor Pomace
Complete Potato Mixture
Cotton Seed Meal
Double A Tobacco Fertilizer
Dry Ground Fish
Fine Ground Bone
Fish and Potash
5-4-3 Tobacco Fertilizer
Grass and Lawn Top Dressing
Grass and Oats Fertilizer
Ground Tankage
High-Grade Acid Phosphate
Monarch Potato Manure
Muriate of Potash
Nitrate of Soda
Precipitated Bone
Pulverized Sheep Manure
7% Potash Fertilizer
16% Acid Phosphate
Special Ground Bone
Sulphate of Ammonia
Sulphate of Potash
Tobacco Special
Universal Phosphate
Bradley's Complete Manure for Potatoes and Vegetables
Bradley's Complete Manure for Top Dressing Grass and Grain

Bradley's Complete Tobacco Manure
Bradley's Corn Phosphate
Bradley's New Method Fertilizer
Bradley's Northland Potato Grower
Bradley's Potato Fertilizer
Bradley's Potato Manure
Bradley's Valley Tobacco Fertilizer
Bradley's XL Superphosphate of Lime
Great Eastern General
Great Eastern Northern Corn Special
Great Eastern Potato Manure
Listers Celebrated Tobacco Fertilizer
Listers Complete Tobacco Fertilizer without Potash
Listers Complete Tobacco Manure
Listers Corn and Potato Fertilizer
Listers Eastern Pride Fertilizer
Listers 4-8-4 Fertilizer
Listers Standard Pure Superphosphate of Lime
Listers Success Fertilizer
National Complete Tobacco Fertilizer
National Eureka Potato Fertilizer
National 5-4 Tobacco Manure
National Market Garden Fertilizer
National Potato Phosphate
National Special Tobacco
National Universal Phosphate
National XXX Fish and Potash
Packers' Union Animal Corn Fertilizer
Packers' Union Potato Manure
Packers' Universal Fertilizer
Quinnipiac Climax Phosphate
Quinnipiac Corn Manure
Quinnipiac Market Garden Manure
Quinnipiac Phosphate
Quinnipiac Potato Manure
Quinnipiac Potato Phosphate
Quinnipiac Wrapper Leaf Brand Tobacco Manure
Wheeler's Corn Fertilizer
Wheeler's Cuban Tobacco Grower
Wheeler's Potato Manure
Williams & Clark's Americus Ammoniated Bone Superphosphate
Williams & Clark's Americus Corn Phosphate
Williams & Clark's Americus High-Grade Special for Potatoes and Vegetables
Williams & Clark's Americus Potato Manure
Williams & Clark's Potato Phosphate
Williams & Clark's Prolific Fertilizer
Williams & Clark's Seed Leaf Tobacco Manure

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

Apothecaries Hall Co., Waterbury, Conn.
Acid Phosphate
Bone

Bone Meal
Bone and Meat Tankage
Castor Pomace
Dry Ground Fish
Liberty Corn, Fruit and All Crops 2-8-2
Liberty Fish, Bone and Potash.
Liberty 4-8-6
Liberty High-Grade Tobacco Manure
Liberty Market Gardeners' Special
Liberty Tobacco Special (Cotton Seed Meal Base)
Liberty Top Dresser for Grass and Grain
Muriate Potash
Nitrate Soda
Precipitated Bone
Sheep Manure
Sulphate of Ammonia
Sulphate Potash
Tankage

Armour Fertilizer Works, 305 Broadway, New York, N. Y.

Armour's Big Crop Acid Phosphate 16%
Armour's Big Crop Fertilizer 5-8-5
Armour's Big Crop 4-8-7
Armour's Big Crop 4-8-6
Armour's Big Crop 4-6-10
Armour's Big Crop 4-10-0
Armour's Big Crop 3-8-4
Armour's Big Crop Potato and Onion 4-8-4
Armour's Big Crop Tobacco Special 5-4-5
Armour's Corn Grower 2-8-2
Armour's 5-4-3 for Tobacco 5-4-3
Armour's General Crop 1-7-1
Armour's Nitrate of Soda
Bone Meal 3-50
Castor Pomace
Ground Fish
Ground Tankage 9-15
Muriate of Potash
Precipitated Bone
Sheep Manure
Sulphate of Potash
Tankage 6-30

Ashcraft-Wilkinson Company, Trust Co. of Georgia Bldg., Atlanta, Ga.

Helmet Brand Prime Cotton Seed Meal
Monarch Brand Choice Prime Cotton Seed Meal
Paramount Brand Good Cotton Seed Meal

Atlantic Packing Co., New Haven, Conn.

Atlantic 5-8-7
Atlantic 4-8-6
Atlantic Grain Fertilizer
Atlantic Potato Phosphate
Atlantic Special Vegetable
Atlantic 3-8-3
Atlantic Tobacco Grower
Atlantic Tobacco Manure 5-8-6

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

Castor Pomace

Barrett Co., 40 Rector St., 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 Market Garden
Berkshire Potato and Vegetable Phosphate
Berkshire Tobacco Special
Berkshire Tobacco Starter
Castor Pomace
Double Manure Salts
Dry Ground Fish
Fine Ground Bone
Ground Sheep Manure
Muriate of Potash
Nitrate of Soda
Precipitated Bone Phosphate
Sulphate of Potash

Blish, F. T., Hardware Co., South Manchester, Conn.

Complete Tobacco Fertilizer
Corn and Potato Phosphate
Market Garden Fertilizer
Top Dressing for Grass

Boardman, F. E., Middletown, Conn.

Boardman's Fertilizer for Potatoes and General Crops
Boardman's Tobacco Fertilizer

Bowker Fertilizer Co., 60 Trinity Place, New York, N. Y.

Bowker's 16% Acid Phosphate
Bowker's All Round Fertilizer
Bowker's Connecticut Valley Tobacco Fertilizer
Bowker's Corn, Grain and Grass Phosphate
Bowker's Early Potato Manure
Bowker's Fisherman's Brand Fish and Potash
Bowker's Hill and Drill Phosphate
Bowker's Lawn and Garden Dressing
Bowker's Potato and Vegetable Phosphate
Bowker's Square Brand Farm and Garden Phosphate
Bowker's Sure Crop Phosphate
Bowker's Tobacco Grower
Maryland 16% Acid Phosphate
Maryland Corn Phosphate
Maryland High Potash Fertilizer
Maryland Standard Fertilizer
Maryland Truck Garden Fertilizer
Stockbridge Early Crop Manure
Stockbridge Market Garden Manure

Stockbridge Potato and Vegetable Manure
Stockbridge Tobacco Manure
Stockbridge Top Dressing and Forcing Manure

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

Buckeye Cotton Oil Co., Cincinnati, Ohio.
"Buckeye" Good Cotton Seed Meal, Good Quality

Cameron-Daniel Co., Atlanta, Ga.
Good Cotton Seed Meal

Chittenden, E. D. Co., Bridgeport, Conn.
Chittenden's Acid Phosphate 16%
Chittenden's Castor Pomace
Chittenden's Complete Grain with 3% Potash
Chittenden's Complete Tobacco and Onion Grower with 6% Potash from Sulfate
Chittenden's Complete Tobacco and Onion Grower with 4% Potash (Sulfate)
Chittenden's Dry Ground Fish
Chittenden's Potato Special with 4% Potash
Chittenden's Potato Special with 6% Potash
Chittenden's Tobacco Special with 5% Potash from Sulfate

Clark, Everett B. Seed Co., Milford, Conn.
Clark's Special Mixture Corn Starter with 2% Potash
Clark's Special Mixture for General Use with 4% Potash
Clark's Special Mixture for Potatoes with 6% Potash
Clark's Special Mixture Tip Top Brand
Nitrate of Soda
16% Acid Phosphate

Coe-Mortimer Co., 2 Rector St., New York, N. Y.
E. Frank Coe's Celebrated Special Potato Fertilizer
E. Frank Coe's Columbian Corn and Potato Fertilizer
E. Frank Coe's Connecticut Wrapper Grower
E. Frank Coe's Gold Brand Excelsior Guano
E. Frank Coe's New Englander Special
E. Frank Coe's Red Brand Excelsior Guano
E. Frank Coe's Special Grass Top Dressing
E. Frank Coe's 16% Superphosphate
E. Frank Coe's Standard Potato Fertilizer
E. Frank Coe's Tobacco Leaf Fertilizer

Connecticut Fat Rendering & Fertilizing Corp., West Haven, Conn.
Tankage

Consolidated Rendering Co., 40 North Market St., Boston, Mass.
Acid Phosphate
Castor Pomace
Ground Bone (3-24)
Ground Bone (2.5-26)

Ground Fish
Muriate Potash
Nitrate Soda
Sulphate Ammonia
Sulphate Potash
Tankage 9-20
Tankage 6-30

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

Eastern States Farmers' Exchange, 292 Worthington St., Springfield, Mass.
16% Acid Phosphate
Bone 3-50
Castor Pomace
Dry Ground Fish 11%
Ground Bone 10-10
Ground Tankage 4½-45
Muriate of Potash
Nitrate of Soda
Sulphate of Ammonia
Sulphate of Potash
Tankage 7-15
5-4-0
5-4-5
5-8-5
4-8-4
4-8-7
4-10-0
3-8-4
2-8-2

East St. Louis Cotton Oil Co., National Stock Yards, Illinois.
St. Clair Brand Cotton Seed Meal

Essex Fertilizer Co., 39 North Market St., Boston, Mass.
Essex Fish Fertilizer 3-8-3 for All Crops
Essex 5-8-7 for Potatoes and Vegetables
Essex 4-8-4 for Potatoes, Roots and Vegetables
Essex Market Garden 3-8-4 for Vegetables and Grass
Essex 1-10-1 for Grain and Grass
Essex Tobacco 5-5-5
Essex Tobacco 5-4-3
Essex 2-8-2 for Farm and Garden

Frisbie, L. T. Co., New Haven, Conn.
Castor Pomace
Dry Ground Fish
Fine Bone Meal
Ground Bone
Frisbie's Corn and Grain Fertilizer
Frisbie's 5-8-7
Frisbie's Market Garden
Frisbie's Special
Frisbie's Special Vegetable and Potato Grower

Frisbie's Superphosphate
Frisbie's Tobacco Grower
Frisbie's Tobacco Manure 5-8-6
Frisbie's Top Dresser 7-5-4

Green-Miller Co., 724 Atlanta Trust Co. Bldg., Atlanta, Ga.
Good Cotton Seed Meal

Humphreys-Godwin Co., Memphis, Tenn.
Bull Brand Cotton Seed Meal
Danish Brand Cotton Seed Meal
Dixie Brand Cotton Seed Meal

International Agricultural Corporation, Buffalo Fertilizer Works, 126 State St., Boston, Mass.
Bone Meal
Buffalo Complete Tobacco
Buffalo Crop Grower
Buffalo Economy
Buffalo Farmers' Choice
Buffalo High-Grade Manure
Buffalo New England Special
Buffalo Phosphate and Potash
Buffalo Sixteen Per Cent
Buffalo Tobacco Grower
Buffalo Tobacco Producer
Buffalo Top Dresser and Starter
Buffalo Vegetable and Potato
Dry Ground Fish

Jones, Robin, Phosphate Co., Nashville, Tenn.
Ground Rock Phosphate

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

Levering Fertilizer Co., Inc., 708 Keyser Bldg., Baltimore, Md.
Bone Meal
Levering General Fertilizer
Levering Market Garden
Levering Old Reliable Phosphate
Levering Potato Phosphate
Levering Potato Special
Levering Tobacco Special
Levering 16% Acid Phosphate
Muriate of Potash
Nitrate of Soda

Lovitt, L. B. & Co., Memphis, Tenn.
"Lovitt Brand" Cotton Seed Meal
"Neal's Choice" Cotton Seed Meal
"Thirty Six Brand" Cotton Seed Meal

Lowell Fertilizer Co., 40 North Market St., Boston, Mass.
Lowell Animal Brand 3-8-4 for All Crops
Lowell Bone Fertilizer 2-8-2 for Corn, Grain, Grass and Vegetables.
Lowell Empress Brand 1-10-1 for Grain and Vegetables
Lowell 5-8-4 for Vegetables and Grass
Lowell 5-8-7 for Potatoes and Vegetables
Lowell 4-8-4 for Potatoes, Corn and Vegetables
Lowell 4-6-10 for Potatoes and Vegetables
Lowell 3-6-10 for Corn, Potatoes and Vegetables
Lowell Tobacco 5-5-5
Lowell Tobacco 5-8-6
Lowell Tobacco 5-4-3
Lowell 2-8-3 for Vegetables and Grain
Lowell 2-8-6 for Grain, Grass and Potatoes

Lyle & Lyle, Huntsville, Ala.
Alabama Brand Cotton Seed Meal
Economy Brand Cotton Seed Meal
Lyle's Best Brand 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 Onion Manure
Mapes Potato Manure
Mapes Pure Ground Bone
Mapes Tobacco Ash Constituents
Mapes Tobacco Manure Wrapper Brand
Mapes Tobacco Starter Improved
Mapes Top Dresser

Mitchell, Walter L., 699 Forest Road, New Haven, Conn.
Mitchell's 5-8-7
Mitchell's Ground Raw Rock Phosphate Flour
Mitchell's 2-8-2
16% Acid Phosphate

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

Nature's Plant Food Co. of Maine, 43 Commercial St., Boston, Mass.
Nature's Plant Food

New England Fertilizer Co., 40 A North Market St., Boston, Mass.
New England Corn Phosphate 2-8-2 for Grain and Vegetables
New England 5-8-7 for Potatoes and Market Gardens
New England 4-8-6 for Potatoes and Vegetables
New England Superphosphate 3-8-4 for All Crops
New England Tobacco 5-5-5

New England Tobacco 5-4-3
New England Tobacco Manure 5-8-6
New England 2-8-3 for Vegetables and Grain

Nitrate Agencies Co., 104 Pearl St., New York, N. Y.
Naco Brand High-Grade Acid Phosphate
Naco Brand Muriate of Potash
Naco Brand Nitrate of Soda
Naco Brand Sulphate of Potash
Naco Brand Tankage

Norwegian Nitrogen Products Co., Inc., 17 State St., New York, N. Y.
Norwegian Nitrate of Lime

Nothern, W. C., Little Rock, Arkansas.
Standard Brand Cottonseed Feed Meal

Olds & Whipple, Inc., 164 State St., Hartford, Conn.
Acid Phosphate
Double Manure Salts
High-Grade Muriate of Potash
High-Grade Sulphate of Potash
Nitrate of Soda
Precipitated Bone Phosphate
Steamed Bone
Sulphate of Ammonia
O & W Bone and Potash Compound
O & W Complete Corn, Onion and Potato Fertilizer
O & W Complete Tobacco Fertilizer
O & W Dry Ground Fish
O & W Grass Fertilizer
O & W High Grade Potato Fertilizer
O & W High-Grade Starter and Potash Compound
O & W High-Grade Tobacco Starter
O & W Special Corn, Onion and Potato Fertilizer
O & W Top Dressing for Grass

Parmenter & Polsey Fertilizer Co., 41 North Market St., Boston, Mass.
Parmenter & Polsey 5-8-4 for Potatoes, Corn and Vegetables.
Parmenter & Polsey 5-8-7 for Potatoes and Market Gardens
Parmenter & Polsey 5-5-5
Parmenter & Polsey 5-4-3
Parmenter & Polsey 4-8-4 for Potatoes, Corn and Vegetables
Parmenter & Polsey Plymouth Rock Brand 3-8-4 for All Crops
Parmenter & Polsey 2-8-2 for Farm and Garden

Platt, Frank S., Co., 450 State St., New Haven, Conn.
Platco Special 4-8-6

Potash-Marl, Inc., 15 East 40th St., New York, N. Y.
Potash-Marl

Poultry Feed Co., 431 South Dearborn St., Chicago, Ill.
Premier Brand Pulverized Poultry Manure

Proto-Feed & Guano Co., 4121 So. LaSalle St., Chicago, Ill.
Master Brand Pulverized Sheep Manure

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

Rogers & Hubbard Co., The, Portland, Conn.
Hubbard's "Bone Base" Fertilizer for Oats and Top Dressing
Hubbard's "Bone Base" Fertilizer for Seeding Down
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
Rogers & Hubbard's Climax Tobacco Brand
Rogers & Hubbard's Complete Phosphate
Rogers & Hubbard's 4-8-4 Phosphate
Rogers & Hubbard's Potato Phosphate
Rogers & Hubbard's Soluble Tobacco Manure
Rogers & Hubbard's Tobacco Grower, Vegetable Formula
Acid Phosphate
Castor Pomace
Cottonseed Meal
Dry Ground Fish
Nitrate of Soda
Sulphate of Ammonia
Sulphate of Potash

Royster, F. S., Guano Co., 1604 Munsey Bldg., Baltimore, Md.
Nitrate of Soda
Royster's Arrow Head 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 Prime Fish Brand
Royster's Pure Raw Bone Meal
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 Castor Pomace
Sanderson's Complete Tobacco Grower
Sanderson's Corn Superphosphate
Sanderson's Dry Ground Fish
Sanderson's Fine Ground Bone
Sanderson's Ground Tankage
Sanderson's Formula A
Sanderson's Formula B

Sanderson's Ground Tankage
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 Sulphate of Ammonia
Sanderson's Sulphate of Potash
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 Super Phosphate Crop Grower
Swift-Sure Super Phosphate Potato No. 1
Swift-Sure Super Phosphate Potato Special
Swift-Sure Super Phosphate Tobacco and General Use
Swift-Sure Super Phosphate Tobacco Starter

Springfield Rendering Co., Springfield, Mass.

Springfield Animal Brand, 3-8-4
Springfield 4-8-6
Springfield Market Garden Grower and Top Dresser 5-8-7
Springfield Special Potato, Onion and Vegetable, 4-8-4
Springfield Tobacco Special 5-5-5

Virginia-Carolina Chemical Co. (of Delaware), Equitable Bldg., 120 Broadway, New York, N. Y.

Bone Meal
Nitrate of Soda
Sheep Manure
V-C Champion Brand
V-C Cherokee Brand
V-C Double Owl Brand
V-C Eureka Brand
V-C Fish, Phosphate and Potash Brand
V-C Indian Chief Brand
V-C Owl Brand
V-C Perfection Brand
V-C Plow Brand
V-C Universal Brand

What Cheer Chemical Co., Inc., 188 Grotto Ave., Pawtucket, R. I.

Ground Bone
What Cheer Superior Brand

Wilcox Fertilizer Co., Mystic, Conn.

Acid Phosphate
Eldredge Fish and Potash
Ground Blood and Meat Tankage
Muriate of Potash
Nitrate of Soda
Pure Ground Bone
Sulphate of Potash

Wilcox Complete Superphosphate
Wilcox Corn Special
Wilcox Dry Ground Fish
Wilcox 5-8-7 Fertilizer
Wilcox Fish and Potash
Wilcox 4-8-4 Fertilizer
Wilcox Grain Fertilizer
Wilcox Grass and Truck Fertilizer
Wilcox Potato Fertilizer
Wilcox Potato and Vegetable Phosphate
Wilcox Tobacco Special

Witherbee, Sherman & Co., 2 Rector St., New York, N. Y.

Barium-Phosphate
Witherbee's Truck Grower

Woodruff, S. D., & Sons, Orange, Conn.

Woodruff's Home Mixed Fertilizer

Worcester Rendering Co., Auburn, Mass.

Prosperity Brand Complete Dressing
Prosperity Brand Corn and Grain
Prosperity Brand Market Garden
Prosperity Brand Potato and Vegetable
Royal Worcester Ground Steam Bone
Royal Worcester Ground Tankage

During the year, V. L. Churchill, the sampling agent of the Station, has visited 102 towns and villages in the state and has drawn 558 samples for analysis, including all the registered brands which were found on sale.

Classification of Fertilizers Analyzed.

4. *Raw materials containing nitrogen and phosphoric acid:*			
Fish manures		26	93
Slaughter-house tankage		13	98
Bone manures		33	99
Mixed bone and tankage		2	102
Garbage tankage		2	102
5. *Mixed fertilizers:*			
Nitrogenous superphosphates without potash		12	105
Nitrogenous superphosphates containing potash		282	108
Home mixtures, etc.		53	134
6. *Miscellaneous fertilizers, amendments and waste products:*			
Wood ashes		9	140
Sheep manure, etc.		12	140
Tobacco residues		2	142
Peat or muck		4	142
Miscellaneous wastes		4	142
Soils		18	143
		837	

I. RAW MATERIALS CHIEFLY VALUABLE FOR NITROGEN.

NITRATE OF SODA.

Twenty-four samples of this material have been examined and are here reported.

Only one, No. **18802,** failed to meet its guaranty.

No. **18828,** containing only 13.56 per cent of nitrogen, was sent as a factory product which "had been once melted for factory use."

No. **18880** is not Chilian nitrate, but a product of the fixation of atmospheric nitrogen.

Cost: The prices reported range from 18.1 to 24 cents per pound of nitrogen, and the average of all is 19.7 cents per pound.

19217. Sold by Olds & Whipple, Inc., Hartford. Sent by Hatheway & Steane, Hartford.

18933. Sold by The Rogers & Hubbard Co., Portland. Stock of Edward O. Douglass, Suffield.

18827. Sold by the Apothecaries Hall Co., Waterbury. Stock of Connecticut School for Boys.

19142. Sold by Berkshire Fertilizer Co., Bridgeport. Stock of John Dorsey, Farmers' Exchange, Putnam.

19061. Sold by Olds & Whipple, Inc., Hartford. Stock of Fassler & Silberman, Hartford.

18844. Sold by Olds & Whipple, Inc., Hartford. Sent by Hatheway & Steane, Hartford.

19228. Sold by Olds & Whipple, Inc., Hartford. Sent by Hatheway & Steane, Hartford.

18843. Sold by Olds & Whipple, Inc., Hartford. Sent by Hatheway & Steane.

18790. Sold by Everett B. Clark Seed Co., Milford. Sampled at the factory.

18797. Sold by Sanderson Fertilizer & Chemical Co., New Haven. Sampled at the factory.

18869. Sold by Olds & Whipple, Inc., Hartford. Sampled at factory.

19041. Sold by Armour Fertilizer Works, New York. Stock of J. D. Kelsey & Son, Madison.

19285. From Consolidated Rendering Co., Boston, Mass. Sold by L. T. Frisbie Co., New Haven. Sent by J. E. Shepard, South Windsor.

18876. Sold by Berkshire Fertilizer Co., Bridgeport. Sampled at the factory.

19064. Sold by Wilcox Fertilizer Co., Mystic. Stock of Spencer Bros., Inc., Suffield.

19374. Sold by Eastern States Farmers' Exchange, Springfield, Mass. Stock of J. D. Kelsey & Son, Madison.

19346. Sold by Virginia-Carolina Chemical Co., New York. Stock of Silliman Hardware Co., New Canaan.

19439. Sold by F. S. Royster Guano Co., Baltimore, Md. Stock of W. S. Brown, Trumbull.

18802. Sold by Consolidated Rendering Co., Boston, Mass. Stock of L. T. Frisbie Co., New Haven.

18828. Sent by Albert C. Sherwood, Bristol.

18865. Sold by American Agricultural Chemical Co., New York. Stock of H. S. Davis, New Haven.

18880. Made by Norwegian Nitrogen Products Co. Stock of Berkshire Fertilizer Co., Bridgeport.

18914. Sent by Huntington Bros., Windsor.

19026. Sold by Consolidated Rendering Co., Boston, Mass. Sent by A. E. Plant Sons Co., Branford.

TABLE I. ANALYSES OF NITRATE OF SODA.

Station No.	Per cent of Nitrogen. Guaranteed.	Found.	Cost per ton.	Nitrogen costs cents per pound
19217	15.00	16.00	$58.00	18.1
18933	15.63	15.64	57.00	18.2
18827	15.00	15.54	57.00	18.3
19142	14.80	15.72	58.00	18.4
19061	15.00	15.48	60.00	18.4
18844	15.00	15.64	58.00	18.5
19228	15.00	15.62	58.00	18.6
18843	15.00	15.60	58.00	18.6
18790	....	15.60	59.00	18.9
18797	15.00	15.60	60.00	19.2
18869	15.00	15.56	60.00	19.3
19041	14.81	15.68	60.50	19.3
19285	15.50	15.74	62.00	19.7
18876	14.80	15.66	65.00	20.7
19064	15.00	15.56	65.00	20.7
19374	14.80	14.72	63.90	21.7
19346	14.80	15.66	75.00	23.9
19439	15.00	15.60	75.00	24.0
18802	15.50	15.28	....	....
18828	....	13.56	....	....
18865	15.00	15.54	....	....
18880	14.80	16.00	....	....
18914	....	15.62	....	....
19026	15.00	15.56	....	....

SULPHATE OF AMMONIA.

The seven samples analyzed were the following:

18866. Sold by Apothecaries Hall Co., Waterbury. Stock of R. W. Hine, Cheshire.

19144. Sold by The Barrett Co., New York City. Stock of John Dorsey, Farmers' Exchange, Putnam.

19467. Sold by Eastern States Farmers' Exchange, Springfield, Mass. Stock of C. K. Andrews, West Woods Farmers' Association, Mt. Carmel.

18874. Sold by Olds & Whipple, Inc., Hartford. Sampled at the factory.

18875. Sold by The Barrett Co., New York City. Stock of Berkshire Fertilizer Co., Bridgeport.

18800. Sold by Consolidated Rendering Co., Boston, Mass. Stock of L. T. Frisbie Co., New Haven.

19540. Sold by Sanderson Fertilizer & Chemical Co., New Haven. Stock of Preston Co-operative Exchange, Norwich.

All of these samples meet their guaranties, and their composition is fairly uniform.

Cost: The cost of nitrogen in sulphate of ammonia has ranged from 14.3 to 16.8 cents per pound, an average of 15.6 cents. During the present season, this has been the cheapest source of available nitrogen in our market.

TABLE II. ANALYSES OF SULPHATE OF AMMONIA.

Station No.	Per cent of Nitrogen. Guaranteed.	Found.	Cost per ton.	Nitrogen costs cents per pound
18866	20.56	20.92	$60.00	14.3
19144	20.75	20.80	60.84	14.6
19467	20.55	20.54	63.60	15.5
18874	20.58	20.92	69.00	16.5
18875	20.75	20.82	70.00	16.8
18800	20.50	20.64	....	....
19540	20.16	20.94	....	....

COTTON SEED MEAL.

In Table III are given the analyses of 168 samples. Most of them represent car lots, used as fertilizers for tobacco.

GUARANTIES.

Of the 168 samples, 24, or about 15 per cent, failed to meet their guaranties. In thirteen cases, the failure involved 0.20 per cent or more, as follows:

		Nitrogen deficiency.
19275	Ashcraft-Wilkinson Co.	0.37
18631	Humphreys-Godwin Co.	0.27
18656	Humphreys-Godwin Co.	0.84
18672	Humphreys-Godwin Co.	0.21
18686	Humphreys-Godwin Co.	0.20
18687	Humphreys-Godwin Co.	0.26
18688	Humphreys-Godwin Co.	0.90
18841	Humphreys-Godwin Co.	0.26
18929	Humphreys-Godwin Co.	0.27
19218	Humphreys-Godwin Co.	0.42
19420	Humphreys-Godwin Co.	0.29
19509	Humphreys-Godwin Co.	0.20
19543	L. B. Lovitt & Co.	0.36

COMPOSITION AND COST.

Only three grades of cotton seed meal have been sold to any considerable extent as fertilizers. Their guaranties are as follows:

5.76 per cent Nitrogen equivalent to 7.0% ammonia and 36% protein.
6.56 per cent Nitrogen equivalent to 8.0% ammonia and 41% protein.
6.88 per cent Nitrogen equivalent to 8.3% ammonia and 43% protein.

Of the first or lowest grade, 19 samples (3 below guaranty) had an average content of 5.83 per cent nitrogen, the cost of which averaged 44.6 cents per pound, chiefly in car lots.

Of the medium grade, 107 samples (18 below guaranty) guaranteed 6.56 per cent of nitrogen, had an average of 6.66 per cent nitrogen, the cost of which averaged 37.3 cents per pound, chiefly in car lots.

Of the highest grade meal, 30 samples (4 below guaranty) guaranteed 6.88 per cent nitrogen, averaged 6.95 per cent of nitrogen, the cost of which averaged 37.3 cents per pound.

During this season the medium and highest grades have been the better purchase, their nitrogen costing 7 cents per pound less than the lower grade.

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., Atlanta, Ga.				
17840	Aco.	The Rogers & Hubbard Co., Portland	6.55	6.59	$42.00
18981	Aco. A.C.L. 46521	Louis Wetstone, Hartford	6.64	6.59	48.75
18982	Aco. A.C.L. 43885	Louis Wetstone, Hartford	6.62	6.59	48.75
18983	Aco. 5389	Louis Wetstone, Hartford	6.58	6.59	48.75
18984	Aco. 46913	Louis Wetstone, Hartford	6.78	6.59	48.75
19261	Aco. 38348	American Sumatra Tobacco Co., Bloomfield	7.00	6.59	.....
19262	Aco. 27812	American Sumatra Tobacco Co., Bloomfield	6.63	6.59	.....
19263	Aco. 10839	American Sumatra Tobacco Co., Bloomfield	6.90	6.59	.....
19264	Aco. 32574	American Sumatra Tobacco Co., Bloomfield	6.69	6.59	.....
19265	Aco. 26489	American Sumatra Tobacco Co., Bloomfield	6.40	6.59	.....
19266	Aco. 43855	American Sumatra Tobacco Co., Bloomfield	6.46	6.59	.....
19267	Aco 27505	American Sumatra Tobacco Co., Bloomfield	6.92	6.59	.....
19268	Aco. 160207	American Sumatra Tobacco Co., Bloomfield	6.71	6.59	.....
19269	Aco. 39775	American Sumatra Tobacco Co., Bloomfield	7.00	6.59	.....
19277	Aco. 36810	American Sumatra Tobacco Co., Bloomfield	6.64	6.59	.....
19312	Aco. 29937	American Sumatra Tobacco Co., Bloomfield	6.78	6.59	.....
19313	Aco. 32332	American Sumatra Tobacco Co., Bloomfield	6.67	6.59	.....
19314	Aco. 36841	American Sumatra Tobacco Co., Bloomfield	6.40	6.59	.....
19315	Aco. 43067	American Sumatra Tobacco Co., Bloomfield	6.96	6.59	.....
19390	Aco. 45457	American Sumatra Tobacco Co., Bloomfield	6.64	6.59	.....
19391	Aco. 80170	American Sumatra Tobacco Co., Bloomfield	6.73	6.59	.....
19392	Aco. 58105	American Sumatra Tobacco Co., Bloomfield	6.55	6.59	.....
19419	Aco. N. C. & St. L. 15724.	American Sumatra Tobacco Co., Bloomfield	6.56	6.59	.....
19103	Longhorn, A.C.L. 43042	Spencer Bros., Inc., Suffield	7.16	6.88	55.50
19102	Longhorn, A.C.L. 33182	Spencer Bros., Inc., Suffield	7.34	6.88	55.50
19079	Surety. So. 15423	Spencer Bros., Inc., Suffield	5.97	5.76	51.50
19799	40901	The Coles Co., Middletown	5.70	5.76	56.00
19395	24461	American Sumatra Tobacco Co., Bloomfield	6.80	...	.....

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.
	Ashcraft-Wilkinson Co., Atlanta, Ga.				
19273	Helmet. 31211	American Sumatra Tobacco Co., Bloomfield	6.59	6.59	.....
19274	Helmet. 33609	American Sumatra Tobacco Co., Bloomfield	6.52	6.59	.....
19275	Helmet. 34849	American Sumatra Tobacco Co., Bloomfield	6.22	6.59	.....
19276	Helmet. 35486	American Sumatra Tobacco Co., Bloomfield	6.64	6.59	.....
19278	Helmet. 65506	American Sumatra Tobacco Co., Bloomfield	6.63	6.59	.....
19279	Helmet. 131724	American Sumatra Tobacco Co., Bloomfield	6.60	6.59	.....
19349	Monarch	Station Agent from E. Manchester & Sons, Winsted	6.86	6.88	$56.00
19387	Monarch. C.P. 120614	Rockville Grain & Coal Co., Rockville	6.95	6.88	55.75
19388	Monarch. So. 402019	Rockville Grain & Coal Co., Rockville	7.02	6.88	55.75
19389	Monarch. 103732	Rockville Grain & Coal Co., Rockville	7.02	6.88	55.75
19393	Monarch. 101879	American Sumatra Tobacco Co., Bloomfield	6.88	6.88	.....
18645	Paramount. So. 355566	The Coles Co., Middletown	5.68	5.76	50.00
18973	Paramount. A.C.L. 46180.	Spencer Bros., Inc., Suffield	5.63	5.76	46.00
19192	Paramount.	Station Agent from F. C. Morse, Guilford	5.77	5.76	50.00
19319	Paramount. L.N. 48205	Spencer Bros., Inc., Suffield	6.00	5.76	54.00
19443	Paramount. P.R.R. 537067	The Coles Co., Middletown	5.74	5.76	56.00
19023	Paramount. So. 411242	Spencer Bros., Inc., Suffield	5.69	5.76	46.00
	Apothecaries Hall Co., Waterbury.				
18696	14373	Hatheway & Steane, Hartford.	7.23	...	.....
18697	255158	Hatheway & Steane, Hartford.	6.80	...	.....
	Cameron-Daniel Co., Atlanta, Ga.				
18644	137727	The Coles Co., Middletown	5.81	5.76	50.00
18924	Good	Station Agent from Goodsell Bros., Bristol	6.22	5.76	49.00
18928	A.C.L. 41281	The Coles Co., Middletown	5.78	5.76	54.00
	The Green-Miller Co., Atlanta, Ga.				
19048	A.C.L. 34027	Geo. S. Phelps Co., Thompsonville	5.58	5.76	49.50

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.				
18631	Bull, 10604	L. B. Haas & Co., Hartford	6.60	6.87	$48.75
18632	Bull, 25052	L. B. Haas & Co., Hartford	6.90	6.87	47.50
18633	Bull, 28465	L. B Haas & Co., Hartford	6.98	6.87	47.50
18634	Bull, 29788	L. B. Haas & Co., Hartford	7.11	6.87	47.50
18635	Bull, 36078	L. B. Haas & Co., Hartford	7.00	6.87	47.50
18636	Bull, 110742	L. B. Haas & Co., Hartford	6.68	6.87	47.50
18710	Bull, L. & N. 8461	Huntington Bros., Windsor	6.99	6.87	47.50
18711	Bull, So. 122487	Huntington Bros., Windsor	6.96	6.87	47.50
18712	Bull, So. 410023	Huntington Bros., Windsor	6.96	6.87	47.50
18713	Bull, A.C.L. 36951	Huntington Bros., Windsor	7.25	6.87	47.50
19057	Bull	Station Agent from Fassler & Silberman, Hartford	6.81	6.87	49.50
19062	Bull, C. Ga. 25060	Geo. S. Phelps & Co., Thompsonville	7.11	6.87	52.50
18656	Bull, Sou. 153070	The Coles Co., Middletown	6.03	6.87	48.00
18657	Danish, D.L.W. 44107	The Coles Co., Middletown	5.89	5.75	50.00
18511	Dixie, 170939	Griffin Tobacco Co., Bloomfield	6.65	6.56	.....
18512	Dixie, 47890	Griffin Tobacco Co., Bloomfield	6.66	6.56	.....
18513	Dixie, 52141	Griffin Tobacco Co., Bloomfield	6.63	6.56	.....
18514	Dixie, 170181	Griffin Tobacco Co., Bloomfield	6.77	6.56	.....
18534	Dixie, 42592	American Sumatra Tobacco Co., Bloomfield	6.86	6.56	.....
18535	Dixie, 46767	American Sumatra Tobacco Co., Bloomfield	6.66	6.56	.....
18536	Dixie, 27802	American Sumatra Tobacco Co., Bloomfield	6.71	6.56	.....
18537	Dixie, 216380	American Sumatra Tobacco Co., Bloomfield	6.72	6.56	.....
18538	Dixie, 48861	American Sumatra Tobacco Co., Bloomfield	6.78	6.56	.....
18539	Dixie, 37640	American Sumatra Tobacco Co., Bloomfield	6.88	6.56	.....
18622	Dixie, 132913	American Sumatra Tobacco Co., Bloomfield	6.49	6.56	.....
18623	Dixie, 4470	American Sumatra Tobacco Co., Bloomfield	6.42	6.56	.....
18624	Dixie, 7556	American Sumatra Tobacco Co., Bloomfield	6.54	6.56	.....
18625	Dixie, 7868	American Sumatra Tobacco Co., Bloomfield	6.59	6.56	.....
18626	Dixie, 60024	American Sumatra Tobacco Co., Bloomfield	7.02	6.56	.....
18627	Dixie, 251699	American Sumatra Tobacco Co., Bloomfield	6.53	6.56	.....
18648	Dixie, 173931	American Sumatra Tobacco Co., Bloomfield	6.68	6.56	.....

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.				
18649	Dixie, 173901	American Sumatra Tobacco Co., Bloomfield	6.71	6.56	.....
18650	Dixie, 43913	American Sumatra Tobacco Co., Bloomfield	6.74	6.56	.....
18651	Dixie, 61344	American Sumatra Tobacco Co., Bloomfield	6.82	6.56	.....
18652	Dixie, 35024	American Sumatra Tobacco Co., Bloomfield	6.68	6.56	.....
18665	Dixie, 23255	American Sumatra Tobacco Co., Bloomfield	6.71	6.56	.....
18670	Dixie, 103187	American Sumatra Tobacco Co., Bloomfield	6.64	6.56	.....
18671	Dixie, 38128	American Sumatra Tobacco Co., Bloomfield	6.49	6.56	.....
18672	Dixie 137499	American Sumatra Tobacco Co., Bloomfield	6.35	6.56	.....
18673	Dixie, 126758	American Sumatra Tobacco Co., Blooomfield	6.58	6.56	.....
18674	Dixie, 40394	American Sumatra Tobacco Co., Bloomfield	6.80	6.56	.....
18676	Dixie, S.A.L. 24428	Steane, Hartman & Co., Hartford	6.59	6.56	.....
18677	Dixie, C.C.C. & St. L. 46095	Steane, Hartman & Co., Hartford	6.87	6.56	.....
18678	Dixie, N. C. & St. L. 14245	Steane, Hartman & Co., Hartford	6.70	6.56	.....
18679	Dixie, I. C. 48766	Steane, Hartman & Co., Hartford	6.55	6.56	.....
18680	Dixie, S. A. L. 19208	Steane, Hartman & Co., Hartford	6.94	6.56	.....
18681	Dixie, A. C. L. 26118	Steane, Hartman & Co., Hartford	6.83	6.56	.....
18682	Dixie, 7401	Steane, Hartman & Co., Hartford	6.58	6.56	.....
18683	Dixie, N. C. St. L. 11990	Steane, Hartman & Co., Hartford	6.75	6.56	.....
18684	Dixie, A. C. L. 41430	Steane, Hartman & Co., Hartford	6.44	6.56	.....
18685	Dixie I. C. 170018	Steane, Hartman & Co., Hartford	6.52	6.56	.....
18686	Dixie, L. & A. 2652	Steane, Hartman & Co., Hartford	6.36	6.56	.....
18687	Dixie, 31537	Steane, Hartman & Co., Hartford	6.30	6.56	.....
18688	Dixie, 8648	Steane, Hartman & Co., Hartford	5.66	6.56	.....
18689	Dixie, C. S. M. & O. 11234	Steane, Hartman & Co., Hartford	6.90	6.56	.....

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.				
18690	Dixie, 245801	Hatheway & Steane, Hartford.	6.70	6.56	.....
28691	Dixie, 255944	Hatheway & Steane, Hartford.	6.67	6.56	.....
28692	Dixie, 7841	Hatheway & Steane, Hartford.	6.94	6.56	.....
18693	Dixie, 7227	Hatheway & Steane, Hartford.	6.90	6.56	.....
18694	Dixie, 36302	Hatheway & Steane, Hartford.	6.67	6.56	.....
18695	Dixie, 130931	Hatheway & Steane, Hartford.	6.47	6.56	.....
18729	Dixie (old stock)	American Sumatra Tobacco Co., Bloomfield	7.26	6.56	.....
18743	Dixie, 136020	Hatheway & Steane, Hartford.	6.98	6.56	$48.65
18744	Dixie, 172739	Hatheway & Steane, Hartford.	6.42	6.56	48.65
18745	Dixie, 37332	Hatheway & Steane, Hartford.	6.78	6.56	48.65
18746	Dixie, 7774	Hatheway & Steane, Hartford.	6.96	6.56	48.65
18747	Dixie, 6715	Hatheway & Steane, Hartford.	6.53	6.56	48.65
18841	Dixie, 7448	Hatheway & Steane, Hartford.	6.30	6.56	48.65
18842	Dixie, 90276	Hatheway & Steane, Hartford.	6.90	6.56	48.65
18860	Dixie, 26655	Steane, Hartman Co., Hartford	6.62	6.56	.....
18861	Dixie, 4564	Steane, Hartman Co., Hartford	6.75	6.56	.....
18862	Dixie, 22450	Steane, Hartman Co., Hartford	6.67	6.56	.....
18929	Dixie, 15676	John B. Parker, Poquonock	6.29	6.56	49.15
18987	Dixie, 609197	American Sumatra Tobacco Co., Bloomfield	7.00	6.56	.....
18988	Dixie, 17729	American Sumatra Tobacco Co., Bloomfield	6.88	6.56	.....
19218	Dixie, 25905	Hatheway & Steane, Hartford	6.14	6.56	48.65
19223	Dixie, 31203	Hatheway & Steane, Hartford	6.41	6.56	48.65
19226	Dixie, 15676	Hatheway & Steane, Hartford	6.47	6.56	48.65
19229	Dixie, 20138	Hatheway & Steane, Hartford	6.92	6.56	48.65
19394	Dixie, 120757	American Sumatra Tobacco Co., Bloomfield	6.84	6.56	.....
19396	Dixie, 130842	American Sumatra Tobacco Co., Bloomfield	6.94	6.56	.....
19397	Dixie, 265455	American Sumatra Tobacco Co., Bloomfield	6.89	6.56	.....
19420	Dixie, L. & N. 101808	American Sumatra Tobacco Co., Bloomfield	6.27	6.56	.....
19509	Dixie	Station Agent from E. Manchester & Sons, Winsted	6.36	6.56	54.00
18515	90458	Griffin Tobacco Co., North Bloomfield	6.54	...	.....
18516	501660	Griffin Tobacco Co., North Bloomfield	6.74	...	.....
18517	5179	Griffin Tobacco Co., North Bloomfield	6.92	...	.....

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. —Continued.				
18518	7833	Griffin Tobacco Co., North Bloomfield	7.05	...	.....
18519	34437	Griffin Tobacco Co., North Bloomfield	7.14	...	.....
18593	3825	American Sumatra Tobacco Co., Bloomfield	6.22	...	.....
18594	171148	American Sumatra Tobacco Bloomfield	6.86	...	.....
	L. B. Lovitt & Co., Memphis, Tenn.				
18970	Lovit, N.Y.C. & St. L. N.K.P. 28292	Spencer Bros., Inc., Suffield	6.60	6.58	.....
18971	Lovit, A. C. L. 43853	Spencer Bros., Inc., Suffield	6.63	6.58	$53.50
18972	Lovit, G. S. & F. 4684	Spencer Bros., Inc., Suffield	6.71	6.58	.....
19355	Lovit	Station Agent from G. E. Ackley, New Milford	6.77	6.58	56.00
18830	Neal's Choice, Wabash 79333	Spencer Bros., Inc., Suffield	7.18	6.88	55.50
19024	Neal's Choice, C. Ga. 3471	Spencer Bros., Inc., Suffield	6.96	6.88	55.50
19078	Neal's Choice, B. & O. 168940	Spencer Bros., Inc., Suffield	7.00	6.88	55.50
19512	Neal's Choice	Station Agent from J. H. Dodd, New Milford	7.02	6.88	56.00
19542	Neal's Choice, 42142	American Sumatra Tobacco Co., Bloomfield	7.02	6.88	.....
19543	Neal's Choice, 64913	American Sumatra Tobacco Co., Bloomfield	6.52	6.88	.....
19544	Neal's Choice, 35934	American Sumatra Tobacco Co., Bloomfield	7.00	6.88	.....
19545	Neal's Choice, 174594	American Sumatra Tobacco Co., Bloomfield	6.99	6.88	.....
19239	Thirty Six	Station Agent from A. D. Bridge's Sons, Hazardville	5.82	5.75	52.00
18831	R. I. 156833	Spencer Bros., Inc., Suffield	7.17	6.88	55.50
18832	A. C. L. 42141	Spencer Bros., Inc., Suffield	6.97	6.88	55.50
	Lyle & Lyle, Huntsville, Ala.				
19510	Economy	Station Agent from E. Manchester & Sons, Winsted	5.74	5.76	40.00
19756	Economy N. Y. C. 28927.	The Coles Co., Middletown	5.58	5.76	56.00
	W. C. Nothern, Little Rock, Ark.				
19027	Standard	A. E. Plant Sons Co., Branford	5.74	5.76	.....

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.
	Olds & Whipple, Hartford.				
18989	1	Clark Bros., Poquonock	6.72	6.56	$48.65
18990	2	Clark Bros., Poquonock	6.64	6.56	48.65
18991	3	Clark Bros., Poquonock	6.58	6.56	48.65
18992	4	Clark Bros., Poquonock	6.60	6.56	48.65
	The Rogers & Hubbard Co., Portland.				
19147	N. C. & St. L. 15680	Station Agent from A. N. Shepard & Son, Hartford	6.40	5.75	.....
19149	C. & W. C. 1150	Station Agent from A. N. Shepard & Son, Hartford	5.96	5.75	.....
17959	Lot 1	L. J. Prior, East Hartford	6.93	...	.....
17960	Lot 2	L. J. Prior, East Hartford	7.04	...	.....

CASTOR POMACE.

GUARANTIES.

Of the 61 samples examined, 50 had a guaranty of 4.50 per cent nitrogen, and most of them far exceeded their guaranty, the average nitrogen in them being 5.30 per cent. Nine had a guaranty of 5 per cent nitrogen; their average content was 5.25 per cent, and one fell below the guaranty. Two were guaranteed 5.75 or higher, and one of these, No. **19454,** stated to be sold by the Eastern States Exchange, was below guaranty by 1.32 per cent, while the price quoted was far above the average price.

COST.

The average cost per ton, chiefly in car lots, has been about $31.46, and the average cost of nitrogen per pound 29.9 cents per pound.

TABLE IV. ANALYSES OF CASTOR POMACE.

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent Nitrogen. Guaranteed.	Per cent Nitrogen. Found.	Cost per ton.	Nitrogen costs cents per pound.
	The American Agricultural Chemical Co., New York City.					
19447		A. B. & R. W. Hitchcock, Warehouse Point	4.53	5.50	.....	...
19448		A. B. & R. W. Hitchcock, Warehouse Point	4.53	5.24	.....	...
19385		Station Agent from Joseph Rostek, Melrose	4.53	5.57	$34.00	30.5
19080	Erie 74592	Spencer Bros., Inc., Suffield.	4.53	5.12	34.00	33.2
19287		Station Agent from F. O. Williams, Silver Lane	4.53	5.06	32.00	31.6
	Apothecaries Hall Co., Waterbury.					
18993		Clark Bros., Poquonock	4.52	5.22	29.50	28.3
19213	195354	Hatheway & Steane, Hartford	4.52	5.04	28.50	28.3
19214	62465	Hatheway & Steane, Hartford	4.52	5.01	28.50	28.4
19222		Hatheway & Steane, Hartford	4.52	4.66	28.50	30.6
19233	189210	Hatheway & Steane, Hartford	4.52	5.93	28.50	24.0
18778	C. C. & St. L. 52366	Spencer Bros., Inc., Suffield.	4.52	5.53	32.00	28.9
18779	N. Y. C. 246234	Spencer Bros., Inc., Suffield.	4.52	6.24	32.00	25.6
18780	N. Y. C. 244479	Spencer Bros., Inc., Suffield.	4.52	6.00	32.00	26.7
18969		Station Agent from Spencer Bros., Inc., Suffield	4.52	5.78	30.00	25.9
19104	N. Y. C. 115313	Spencer Bros., Inc., Suffield.	4.52	4.94	.....	...
19236	N. Y. C. 217334	Spencer Bros., Inc., Suffield.	4.52	4.84	32.00	33.0
19237	N. Y. C. 218674	Spencer Bros., Inc., Suffield.	4.52	5.08	34.00	33.5
19320	N. Y. C. 255508	Spencer Bros., Inc., Suffield.	4.52	4.76	32.00	33.6
19321	N. Y. C. 212684	Spencer Bros., Inc., Suffield.	4.52	4.92	32.00	32.5
	Armour Fertilizer Works, New York City.					
19459		Station Agent from J. H. McAllister, Middletown Grain Assoc., Cromwell	5.75	5.78	33.00	28.6
	Baker Castor Oil Co., New York City.					
18540	89166	American Sumatra Tobacco Co., Bloomfield	4.50	6.04	.....	...
18541	35716	American Sumatra Tobacco Co., Bloomfield	4.50	5.61	.....	...
18653	27149	American Sumatra Tobacco Co., Bloomfield	4.50	5.80	.....	...
18662	97750	American Sumatra Tobacco Co., Bloomfield	4.50	4.89	.....	...

TABLE IV. ANALYSES OF CASTOR POMACE—*Continued.*

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent Nitrogen. Guaranteed.	Per cent Nitrogen. Found.	Cost per ton.	Nitrogen costs cents per pound.
	Baker Castor Oil Co. —Continued.					
18663	560620	American Sumatra Tobacco Co., Bloomfield	4.50	5.20	.....	...
18664	16379	American Sumatra Tobacco Co., Bloomfield	4.50	6.25	.....	...
18762	4726	American Sumatra Tobacco Co., Bloomfield	4.50	5.38	.....	...
18763	94558	American Sumatra Tobacco Co., Bloomfield	4.50	5.43	.....	...
18764	67326	American Sumatra Tobacco Co., Bloomfield	4.50	4.81	.....	...
18818	76091	American Sumatra Tobacco Co., Bloomfield	4.50	5.11	.....	...
18819	560566	American Sumatra Tobacco Co., Bloomfield	4.50	4.70	.....	...
18820	42976	American Sumatra Tobacco Co., Bloomfield	4.50	5.08	.....	...
18821	N. Y. C. 221066	American Sumatra Tobacco Co., Bloomfield	4.50	4.90	.....	...
18949	94485	American Sumatra Tobacco Co., Bloomfield	4.50	5.32	.....	...
19204	47750	American Sumatra Tobacco Co., Bloomfield	4.50	5.62	.....	...
19205	16761	American Sumatra Tobacco Co., Bloomfield	4.50	5.36	.....	...
19206	32505	American Sumatra Tobacco Co., Bloomfield	4.50	4.68	.....	...
19207	32134	American Sumatra Tobacco Co., Bloomfield	4.50	5.44	.....	...
19208	19105	American Sumatra Tobacco Co., Bloomfield	4.50	5.44	.....	...
19209	94343	American Sumatra Tobacco Co., Bloomfield	4.50	5.45	.....	...
19210	40691	American Sumatra Tobacco Co., Bloomfield	4.50	4.99	.....	...
19060	.....	Station Agent from Fassler & Silberman, Hartford....	4.50	5.48	$32.00	29.2
18520	562628	Griffin Tobacco Co., North Bloomfield	4.50	5.20	.....	...
18521	26204	Griffin Tobacco Co., North Bloomfield	4.50	6.03	.....	...
19212	206709	Hatheway & Steane, Hartford	4.50	5.15	28.50	27.7
18715	.....	Huntington Bros., Windsor.	4.94	5.43	31.00	28.5
18959	.....	Station Agent from Olds & Whipple, Inc., Hartford...	4.50	5.03	31.00	30.8
19271	.....	H. E. Wells, East Windsor Hill	4.50	5.64	32.00	28.4

TABLE IV. ANALYSES OF CASTOR POMACE—*Concluded.*

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent Nitrogen. Guaranteed.	Per cent Nitrogen. Found.	Cost per ton.	Nitrogen costs cents per pound.
	Berkshire Fertilizer Co., Bridgeport.					
19045	.....	Station Agent from factory.	5.00	5.77	.....	...
19422	80989	J. E. Shepard, South Windsor	5.00	4.65	$28.00	30.1
	E. D. Chittenden Co., Bridgeport.					
19653	.....	Station Agent from F. J. Meskill, Broad Brook	4.93	5.04	.....	...
	Eastern States Farmers' Exchange, Springfield, Mass.					
19454	.....	Station Agent from C. M. Beeman, Granby Co-operative Assoc., Granby	6.18	4.86	39.50	40.6
	L. T. Frisbie Co., New Haven, Conn.					
18965	.....	Station Agent from factory.	4.51	5.80	.....	...
19105	.....	J. E. Shepard, South Windsor	4.51	4.70	28.00	29.8
19294	.....	Station Agent from J. E. Shepard, South Windsor..	4.51	4.96	28.00	28.2
	Olds & Whipple, Inc., Hartford.					
18979	P. & R. 5828	L. Wetstone, Hartford	4.94	5.20	31.00	29.8
18980	P. & R. 74867	L. Wetstone, Hartford	4.94	5.44	31.00	28.5
	The Rogers & Hubbard Co., Portland.					
18932	.....	Edward D. Douglas, Suffield	5.35	5.44	32.30	29.7
19435	.....	Station Agent from A. R. Fairbanks, Windsor	5.00	5.18	35.00	33.8
19612	.....	A. R. Fairbanks, Windsor...	5.00	5.11	35.00	34.2
	Sanderson Fertilizer & Chemical Co., New Haven.					
18905	.....	Station Agent from the factory	4.53	5.18	32.00	30.9

II. RAW MATERIALS CHIEFLY VALUABLE FOR PHOSPHORIC ACID.

RAW ROCK PHOSPHATE.

Two samples were analyzed as follows:

19735. Ground Rock Phosphate. Sold by Robin Jones Phosphate Co., Nashville, Tenn. Stock of T. H. Eldredge, Norwich.

19005. Ground Raw Rock Phosphate Flour. Sold by W. L. Mitchell, New Haven. Sent by W. A. Simpson, Wallingford.

TABLE V. ANALYSES OF RAW ROCK PHOSPHATE.

Station No.	19735	19005
Total phosphoric acid:		
Found	28.00	30.50
Guaranteed	28.00	30.00
Cost per ton	$18.00	$19.50
Phosphoric acid costs cents per pound	3.2	3.2

PRECIPITATED BONE PHOSPHATE.

In Table VI are analyses of 13 samples.

TABLE VI. ANALYSES OF PRECIPITATED BONE PHOSPHATE.

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total.	Phosphoric Acid. "Available" Found.	Phosphoric Acid. "Available" Guaranteed.	Cost per ton or per unit of Phosphoric Acid.
	Sampled by Station:		%	%	%	%	
19605	Apothecaries Hall Co., Waterbury	Sampled at factory	1.65	39.55	37.90	35.00	.....
19620	Armour Fertilizer Works, New York	Middletown Grain Assoc., J. H. McAllister, Cromwell	0.15	37.65	37.50	36.00	$60.40
19059	Olds & Whipple, Hartford	Fassler & Silberman, Hartford	0.92	39.36	38.44	40.00	1.15
	Sampled by Purchaser:						
18595	American Glue Co., Boston, Mass.	American Sumatra Tobacco Co., Bloomfield	0.38	39.70	39.32	....	.....
18654	American Glue Co., Boston, Mass.	American Sumatra Tobacco Co., Bloomfield	0.18	39.86	39.68	....	.....
18655	American Glue Co., Boston, Mass.	American Sumatra Tobacco Co., Bloomfield	0.95	38.12	37.17	....	.....
18675	American Glue Co., Boston, Mass.	American Sumatra Tobacco Co., Bloomfield	0.63	37.22	36.59	....	.....
18727	American Glue Co., Boston, Mass.	American Sumatra Tobacco Co., Bloomfield	none	38.76	38.76	....	.....
18765	American Glue Co., Boston, Mass.	American Sumatra Tobacco Co., Bloomfield	none	38.84	38.84	....	.....
18777	American Glue Co., Boston, Mass.	American Sumatra Tobacco Co., Bloomfield	none	38.68	38.68	....	.....
18950	American Glue Co., Boston, Mass.	American Sumatra Tobacco Co., Bloomfield	none	38.65	38.65	....	.....
18951	American Glue Co., Boston, Mass.	American Sumatra Tobacco Co., Bloomfield	0.05	37.20	37.15	....	.....
18913	.....	Huntington Bros., Windsor	0.55	40.15	39.60	....	.....

The complete analysis of one sample, No. **18913**, shows the average percentage composition of this material:

Lime	33.24
Magnesia	0.32
Phosphoric acid	40.15
Sulphuric acid	1.19
Chlorine	0.70
Water (free and combined)	24.40
	100.00

This consists largely of the dicalcic phosphate not readily soluble in water, but very easily soluble in ammonium citrate as used for determining "reverted" phosphoric acid.

All of the samples examined have been of good quality, and the average cost of available phosphoric acid has been about 8.5 cents per pound.

DISSOLVED ROCK PHOSPHATE OR ACID PHOSPHATE.

Thirty-three analyses are given in Table VII.

Guaranties of Available Phosphoric Acid.

With one exception, all of the samples had a guaranty of 16 per cent available.

Only three of the number failed to meet their guaranty.

No. **19334**, sold by the Coe-Mortimer Co., was deficient by 1.02 per cent. No. **19530**, sold by the Levering Fertilizer Co., by 0.48 per cent. No. **19699**, sold by the American Agricultural Chemical Co., by 0.28 per cent.

Composition and Cost.

The average content of phosphoric acid was 17.3 per cent, of which 16.6 per cent was available.

Cost. The reported costs show wide differences, ranging from $38.25 to $18.00. Early in the year the wholesale prices fell considerably and "forced sales" and "resales" resulted in much lower prices than had previously prevailed.

The average cost of available phosphoric acid in all the samples was about 6.9 cents per pound, but leaving out the three highest prices, the average price per ton was $21.59, which would make the cost of available phosphoric acid about 6.5 cents.

Table VII. Analyses of Acid Phosphate.

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total.	Phosphoric Acid. "Available" Found.	Phosphoric Acid. "Available" Guaranteed.	Cost per ton.	"Available" phosphoric acid costs cents per pound.	Station No.
	Sampled by Station:		%	%	%	%	$		
19297	American Agricultural Chemical Co., New York	F. W. Martin, Clark's Corner	1.63	17.56	15.93	16	25.00	7.8	19297
19067	American Agricultural Chemical Co., New York	Spencer Bros., Suffield	0.86	17.08	16.22	16	21.00	6.5	19067
18867	Apothecaries Hall Co., Waterbury	R. W. Hine, Cheshire	0.45	16.48	16.03	16	....	..	18867
19037	Armour Fertilizer Works, New York	J. D. Kelsey & Son, Madison	0.64	16.73	16.09	16	22.00	6.8	19037
18879	Berkshire Fertilizer Co., Bridgeport	Sampled at factory	0.15	18.14	17.99	16	19.00	5.3	18879
19143	Berkshire Fertilizer Co., Bridgeport	John Dorsey, Farmers' Exchange, Putnam	0.13	17.05	16.92	16	18.41	5.4	19143
19163	Bowker Fertilizer Co., New York	P. Schwartz, New London	1.40	17.60	16.20	16	23.00	7.1	19163
19112	Bowker Fertilizer Co., New York	Goodsell Bros., Bristol	0.90	17.58	16.68	16	23.00	6.9	19112
18789	Everett B. Clark Seed Co., Milford	Sampled at factory	0.22	17.01	16.79	16	24.00	7.1	18789
19466	E. D. Chittenden Co., Bridgeport.	E. J. Bantle, Glastonbury	0.15	17.05	16.90	16	23.75	7.0	19466
19334	The Coe-Mortimer Co., New York	J. B. McArdle, Greenwich	0.85	15.83	14.98	16	30.00	10.0	19334
19015	Consolidated Rendering Co., Boston, Mass.	Fred Farwell, Vegetable Growers' Assoc., Danbury	0.50	16.98	16.48	16	18.00	5.5	19015
18801	Consolidated Rendering Co., Boston, Mass.	L. T. Frisbie Co., New Haven	0.56	17.42	16.86	16	....	..	18801
19043	Eastern States Farmers' Exchange, Springfield, Mass.	J. D. Kelsey & Son, Madison	0.58	17.18	16.60	16	21.40	6.4	19043
19485	International Agricultural Corp., Boston, Mass.	Harvey Beaumont, Wallingford	0.53	16.94	16.41	16	26.00	7.9	19485
19530	Levering Fertilizer Co., Baltimore, Md.	F. O. Brown, Colchester	1.16	16.68	15.52	16	20.00	6.4	19530

TABLE VII. ANALYSES OF ACID PHOSPHATE— *Concluded.*

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Phosphoric Acid.				Cost per ton.	"Available" phosphoric acid costs cents per pound.	Station No.
			Citrate-insoluble.	Total.	"Available" Found.	"Available" Guaranteed.			
19496	W. L. Mitchell, New Haven	Ansonia Flour & Grain Co.	1.88	17.05	15.17	*	25.00	8.2	19496
18870	Olds & Whipple, Inc., Hartford..	Sampled at factory	0.46	16.94	16.48	16	22.50	6.8	18870
19246	The Rogers & Hubbard Co., Portland	Willimantic Grain Co., Willimantic..	0.06	16.39	16.33	16	24.00	7.3	19246
19502	F. S. Royster Guano Co., Baltimore, Md.	Rockville Coal & Grain Co., Rockville	1.73	18.00	16.27	16	25.00	7.7	19502
18795	Sanderson Fertilizer & Chemical Co., New Haven	Sampled at factory	0.96	17.77	16.81	16	....	..	18795
19629	Virginia-Carolina Chemical Co., New York	F. A. Waters, Middlebury	0.40	17.45	17.05	16	33.00	9.7	19629
19506	Wilcox Fertilizer Co., Mystic.....	Sampled at factory	0.15	17.65	17.50	16	....	..	19506
	Sampled by Purchaser:								
19699	American Agricultural Chemical Co., New York	E. N. Austin, Suffield	0.86	16.58	15.72	16	24.00	7.6	19699
18750	Apothecaries Hall Co., Waterbury	Hatheway & Steane, Hartford	0.28	16.45	16.17	16	38.25	11.8	18750
18855	Apothecaries Hall Co., Waterbury	Hatheway & Steane, Hartford	none	17.13	17.13	16	19.00	5.5	18855
18856	Apothecaries Hall Co., Waterbury	Hatheway & Steane, Hartford	none	16.58	16.58	16	19.00	5.7	18856
18857	Apothecaries Hall Co., Waterbury	Hatheway & Steane, Hartford	0.64	17.04	16.40	16	19.00	5.8	18857
19221	Apothecaries Hall Co., Waterbury	Hatheway & Steane, Hartford	0.25	18.83	18.58	16	19.00	5.1	19221
19231	Apothecaries Hall Co., Waterbury	Hatheway & Steane, Hartford	0.75	17.60	16.85	16	19.00	5.6	19231
19025	Consolidated Rendering Co., Boston, Mass.	A. E. Plant Sons Co., Branford	0.63	18.05	17.42	16	....	..	19025
18628	Olds & Whipple, Inc., Hartford..	American Sumatra Tobacco Co., Bloomfield	0.14	18.73	18.59	16	....	..	18628
19538	Sanderson Fertilizer Co., New Haven	H. F. Johnson, Norwich, Conn.	0.65	18.50	17.85	16	18.25	5.1	19538

* Guaranteed 16% total Phosphoric Acid.

III. RAW MATERIALS CONTAINING POTASH AS THE CHIEF ACTIVE INGREDIENT.

Here are given analyses of 56 samples. Forty-nine of them are in Table VIII.

CARBONATE OF POTASH.

Two or three of the samples are of rather lower grade than the others.

The potash in the two samples whose prices are quoted cost 8 cents per pound.

MURIATE OF POTASH.

GUARANTIES.

All of the 16 samples contain as much or more potash than is guaranteed, except one, No. **19744**, which has 0.6 per cent less.

COST.

The average content of potash has been 50.80 per cent. The prices have ranged all the way from $60.50 to $45.00. The average of those here given is $51.60, which would make the cost of potash about 5.1 cents per pound.

HIGH-GRADE SULPHATE OF POTASH.

Seventeen samples have been analyzed, seven of which were drawn by the Station agent.

Four of these do not meet their guaranties.

No. **19411** contained some phosphates and a large amount of matter insoluble in water. The seller took steps to pay a rebate of $1.24 per unit of potash.

The average per cent of potash in these samples is 48.69 and the average cost per pound of potash is 5.7 cents, ranging from 7.9 to 4.9 cents.

DOUBLE SULPHATE OF POTASH AND MAGNESIA, SOMETIMES CALLED "DOUBLE MANURE SALTS."

Five samples have been analyzed, two of them carrying less than the guaranteed potash. The analyses appear in the table, but more complete analyses of some of them are as follows:

ANALYSES OF DOUBLE SULPHATE OF POTASH AND MAGNESIA.

	18873	18796	18839	19698	18915
Potash	26.38	27.44	27.32	25.53	27.36
Lime	2.39	....	1.18	....	6.47
Magnesia	8.34	11.25	10.89	9.03	6.04
Chlorine	2.34	4.18	2.24	2.65	2.38
Sulphuric acid	36.98	46.67	41.50	....	46.60

MANURE SALTS.

This is a material very different from the double sulphate of potash and magnesia or "double manure salts" mentioned above. Seven analyses were made, as follows: **18659,** stock of Apothecaries Hall Co., Waterbury. Samples **19280** to **19284** represent five different car lots sent by J. E. Shepard, South Windsor, and bought through the L. T. Frisbie Co., New Haven. **19697** sampled and sent by E. N. Austin, Suffield.

The analyses are as follows:

ANALYSES OF CRUDE POTASH SALTS.

	18659	19280	19281	19282	19283	19284	19697
Potash	20.34	25.44	24.13	27.99	26.60	26.10	22.20
Lime	3.16	....	....	....	....	....	....
Magnesia	0.46	....	....	....	....	....	1.93
Chlorine	48.83	47.58	49.60	48.84	48.24	49.70	37.14
Sulphuric acid	1.86	....	....	....	....	....	....
Insoluble in acid	2.08	....	....	....	....	....	....

The average per cent of potash is 24.70, and the cost $25 per ton, making the cost of potash 5.1 cents per pound.

It will be seen that in the double sulphate of potash and magnesia the potash is nearly all in form of sulphate, the amount of magnesia is considerable and that of chlorine is small.

But in the "Potash Salts" almost all the potash is in form of muriate. The amount of magnesia is small and that of chlorine very large.

This salt is quite unfit for a tobacco fertilizer, though the quantity of potash is not much smaller than in the double sulphate, which is an excellent source of potash for tobacco.

TABLE VIII. ANALYSES OF POTASH SALTS.

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Potash. Found.	Potash. Guaranteed.	Cost per ton.	Potash costs cents per pound.	Station No.
	CARBONATE OF POTASH.						
	Sampled by Purchaser:						
18542	A. Klipstein, New York	American Sumatra Tobacco Co., Bloomfield	% 60.84	%	$	....	18542
18725	A. Klipstein, New York	American Sumatra Tobacco Co., Bloomfield	63.00	....	....	....	18725
18726	A. Klipstein, New York	American Sumatra Tobacco Co., Bloomfield	60.04	....	....	....	18726
18759	A. Klipstein, New York	American Sumatra Tobacco Co., Bloomfield	60.12	....	....	....	18759
18760	A. Klipstein, New York	American Sumatra Tobacco Co., Bloomfield	60.24	....	....	....	18760
18761	A. Klipstein, New York	American Sumatra Tobacco Co., Bloomfield	62.00	....	....	....	18761
18822	A. Klipstein, New York	American Sumatra Tobacco Co., Bloomfield	62.68	....	....	....	18822
18948	A. Klipstein, New York	American Sumatra Tobacco Co., Bloomfield	58.50	....	....	....	18948
18851	Olds & Whipple, Inc., Hartford	Hatheway & Steane, Hartford	52.80	....	85.00	8.0	18851
18852	Olds & Whipple, Inc., Hartford	Hatheway & Steane, Hartford	53.08	....	85.00	8.0	18852
	MURIATE OF POTASH.						
	Sampled by Station:						
19181	American Agricultural Chemical Co., New York	P. Schwartz & Co., New London	50.67	48.00	....	....	19181
18868	Apothecaries Hall Co., Waterbury	J. R. Reinhard, West Cheshire	51.06	50.00	....	....	18868
19289	Armour Fertilizer Works, New York	J. O. Fox & Co., Putnam	50.06	48.00	55.00	5.5	19289
18877	Berkshire Fertilizer Co., Bridgeport	Sampled at factory	50.28	50.00	45.00	4.5	18877

TABLE VIII. ANALYSES OF POTASH SALTS—*Continued.*

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Potash. Found.	Potash. Guaranteed.	Cost per ton.	Potash costs cents per pound.	Station No.
			%	%	$		
19145	Berkshire Fertilizer Co., Bridgeport	John Dorsey, Farmers' Exchange, Putnam	52.02	50.00	46.00	4.4	19145
19016	Consolidated Rendering Co., Boston	Fred Farwell, Vegetable Growers' Assoc., Danbury	50.40	50.00	55.00	5.5	19016
18803	Consolidated Rendering Co., Boston	L. T. Frisbie Co., New Haven	50.98	50.00	....	....	18803
19744	Consolidated Rendering Co., Boston	Knowles-Lombard Co., Guilford	49.40	50.00	48.00	4.9	19744
19450	Eastern States Farmers' Exchange, Springfield, Mass.	C. K. Andrews, West Woods Farmers' Co-op. Assoc., Mt. Carmel	50.20	50.00	49.60	4.9	19450
19531	Levering Fertilizer Co., Baltimore, Md.	F. O. Brown, Colchester	52.56	50.00	50.00	4.8	19531
18872	Olds & Whipple, Inc., Hartford	Sampled at factory	52.56	50.40	53.00	5.0	18872
19065	Wilcox Fertilizer Co., Mystic	Spencer Bros., Suffield	50.70	50.00	50.00	4.9	19065
	Sampled by Purchaser:						
19028	Consolidated Rendering Co., Boston	A. E. Plant Sons Co., Branford	50.16	50.00	48.00	4.8	19028
19444	National Fertilizer Co., New York	A. B. & R. W. Hitchcock, Warehouse Point	50.60	48.00	60.50	6.0	19444
19445	National Fertilizer Co., New York	A. B. & R. W. Hitchcock, Warehouse Point	50.02	48.00	60.50	6.0	19445
19345	Worcester Rendering Co., Auburn, Mass.	E. C. Rogers, Putnam	51.10	50.00	50.00	4.9	19345

TABLE VIII. ANALYSES OF POTASH SALTS—*Continued.*

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Potash. Found.	Potash. Guaranteed.	Cost per ton.	Potash costs cents per pound.	Station No.
	HIGH-GRADE SULPHATE OF POTASH.						
	Sampled by Station:		%	%	$		
19301	American Agricultural Chemical Co., New York	C. F. Allen, Warehouse Point	50.44	48.00	58.50	5.8	19301
19449	Apothecaries Hall Co., Waterbury	Sampled at factory	49.28	48.00	....	....	19449
19527	Armour Fertilizer Works, New York	J. H. McAllister, Middletown Grain Assoc., Cromwell	48.32	48.00	58.50	6.1	19527
18378	Berkshire Fertilizer Co., Bridgeport	Sampled at factory	50.20	48.00	55.00	5.5	18378
18799	Consolidated Rendering Co., Boston	L. T. Frisbie Co., New Haven	49.08	48.00	....	....	18799
19411	Eastern States Farmers' Exchange, Springfield, Mass.	C. M. Beeman, Granby Co-op. Assoc., Granby	39.12	48.00	61.45	7.9	19411
18871	Olds & Whipple, Inc., Hartford	Sampled at factory	49.08	48.60	61.00	6.2	18871
	Sampled by Purchaser:						
19424	L. T. Frisbie Co., New Haven	J. E. Shepard, South Windsor	49.32	48.00	48.50	4.9	19424
18716	Olds & Whipple, Inc., Hartford	Huntington Bros., Windsor	49.88	48.60	50.27	5.0	18716
18848	Olds & Whipple, Inc., Hartford	Hatheway & Steane, Hartford	50.94	48.60	52.87	5.2	18848
18849	Olds & Whipple, Inc., Hartford	Hatheway & Steane, Hartford	50.94	48.60	51.87	5.1	18849
18850	Olds & Whipple, Inc., Hartford	Hatheway & Steane, Hartford	50.44	48.60	51.87	5.1	18850
19219	Olds & Whipple, Inc., Hartford	Hatheway & Steane, Hartford	48.14	48.60	51.20	5.3	19219
19230	Olds & Whipple, Inc., Hartford	Hatheway & Steane, Hartford	50.36	48.60	51.20	5.1	19230
19611	The Rogers & Hubbard Co., Portland	A. R. Fairbanks, Windsor	49.53	46.00	60.00	6.1	19611
18934	The Rogers & Hubbard Co., Portland	Edward O. Douglass, Suffield	46.10	48.00	57.50	6.2	18934

TABLE VIII. ANALYSES OF POTASH SALTS—*Concluded.*

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Potash. Found.	Potash. Guaranteed.	Cost per ton.	Potash costs cents per pound.	Station No.
			%	%	$		
19541	Sanderson Fertilizer Co., New Haven	Preston Co-operative Exchange, Preston	46.64	48.00	....	....	19541
	DOUBLE MANURE SALTS. *Sampled by Station:*						
18873	Olds & Whipple, Inc., Hartford..	Sampled at factory	26.38	25.90	....	....	18873
18796	Sanderson Fertilizer & Chemical Co., New Haven	Sampled at factory	27.44	26.00	....	....	18796
	Sampled by Purchaser:						
18839	American Agricultural Chemical Co., New York	Ernest N. Austin, Suffield	27.32	20.00	23.00	4.2	18839
19698	American Agricultural Chemical Co., New York	Ernest N. Austin, Suffield	25.53	26.00	40.00	7.8	19698
18915	....	Huntington Bros., Windsor	27.36	28.00	....	....	18915
	UNNAMED POTASH MATERIAL. *Sampled by Purchaser:*						
19716	L. T. Frisbie Co., New Haven	Knowles-Lombard Co., Guilford	48.33	51.29	....	....	19716

IV. MATERIALS CONTAINING NITROGEN AND PHOSPHORIC ACID.

FISH MANURES.

Twenty-six analyses are given in Table IX. All of the samples but one meet their guaranties. The average per cent of nitrogen in them was 8.74, the phosphoric acid 7.23, and average cost $54.99.

Allowing 8 cents per pound for available phosphoric acid, nitrogen has cost about 24.8 cents per pound in fish manures.

It will be noticed that "herring meal" contains half as much phosphoric acid and somewhat less nitrogen than "fish scrap," which is made from menhaden or white fish.

TABLE IX. ANALYSES OF

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.
	Sampled by Station:	
19179	American Agricultural Chemical Co., New York	F. O. Williams, Silver Lane
19008	Apothecaries Hall Co., Waterbury.	Sampled at factory
19528	Armour Fertilizer Works, New York	J. H. McAllister, Middletown Grain Assoc., Cromwell
19044	Berkshire Fertilizer Co., Bridgeport	Sampled at factory
19652	E. D. Chittenden Co., Bridgeport	F. J. Meskill, Broad Brook
19764	Consolidated Rendering Co., Boston	T. J. Coleman, Warehouse Point
19476	Eastern States Farmers' Exchange, Springfield	C. M. Beeman, Granby Co-operative Assoc., Granby
18966	L. T. Frisbie Co., New Haven	Sampled at factory
19058	Olds & Whipple, Inc., Hartford	Fassler & Silberman, Hartford
19688	Sanderson Fertilizer & Chemical Co., New Haven	C. S. Smith, East Haven
19238	Wilcox Fertilizer Co., Mystic	Spencer Bros., Suffield
	Sampled by Purchaser:	
18840	American Agricultural Chemical Co., New York	Ernest Austin, Suffield
19006*	American Agricultural Chemical Co., New York	Ernest Austin, Suffield
19701*	American Agricultural Chemical Co., New York	Ernest Austin, Suffield
19083	Berkshire Fertilizer Co., Bridgeport	J. E. Shepard, South Windsor
19029	L. T. Frisbie Co., New Haven	A. E. Plant Sons Co., Branford
18543	Olds & Whipple, Inc., Hartford	American Sumatra Tobacco Co., Bloomfield
18596	Olds & Whipple, Inc., Hartford	American Sumatra Tobacco Co., Bloomfield
18728	Olds & Whipple, Inc., Hartford	American Sumatra Tobacco Co., Bloomfield
18845	Olds & Whipple, Inc., Hartford	Hatheway & Steane, Hartford
18846	Olds & Whipple, Inc., Hartford	Hatheway & Steane, Hartford
18847	Olds & Whipple, Inc., Hartford	Hatheway & Steane, Hartford
19224	Olds & Whipple, Inc., Hartford	Hatheway & Steane, Hartford
18714	Olds & Whipple, Inc., Hartford	Huntington Bros., Windsor
18930	Rogers & Hubbard Co., Portland	Edward O. Douglass, Suffield
17961		L. J. Prior, East Hartford

* "Herring meal."

FISH MANURE.

Nitrogen.				Phosphoric Acid.					
As ammonia.	As organic.	Total found.	Total guaranteed.	Citrate-insoluble.	Total found.	Total guaranteed.	Cost per ton.	Nitrogen costs cents per pound.†	Station No.
%	%	%	%	%	%	%			
0.10	8.35	8.45	8.23	....	6.80	6.00	$60.00	....	19179
0.37	8.80	9.17	8.20	1.17	7.03	5.50	60.00	27.6	19008
1.06	9.36	10.42	9.87	0.15	5.98	....	50.00	19.5	19528
0.88	7.71	8.59	8.23	0.75	7.55	6.00	....	....	19044
1.35	7.19	8.54	8.00	0.70	7.28	6.00	....	....	19652
0.11	8.30	8.41	8.20	....	7.30	6.66	....	....	19764
1.24	8.72	9.96	9.04	....	6.43	....	57.45	....	19476
0.20	8.31	8.51	8.20	1.63	7.25	6.66	....	....	18966
0.18	8.24	8.42	8.23	1.48	7.20	5.00	51.50	23.8	19058
0.09	8.94	9.03	8.23	1.80	7.68	6.00	....	....	19688
0.16	9.62	9.78	9.04	1.58	7.08	6.00	59.00	24.6	19238
0.14	8.26	8.40	8.23	1.33	6.81	6.00	56.00	26.8	18840
0.10	8.54	8.64	8.23	0.30	3.25	6.00	60.00	32.0	19006
....	....	8.19	8.23	0.25	3.50	....	55.00	30.4	19701
0.66	7.56	8.22	....	1.03	9.33	....	....	....	19083
0.20	8.22	8.42	8.20	....	7.23	6.66	....	....	19029
0.14	8.54	8.68	8.23	1.11	7.42	5.00	....	....	18543
0.14	8.69	8.83	8.23	0.95	7.89	5.00	....	....	18596
0.26	8.49	8.75	8.23	1.83	8.14	5.00	....	....	18728
0.24	8.40	8.64	8.23	1.65	8.06	5.00	51.50	23.9	18845
0.18	8.49	8.67	8.23	1.78	7.70	5.00	51.50	24.2	18846
0.24	8.32	8.56	8.23	1.91	7.85	5.00	51.50	24.2	18847
0.14	8.40	8.54	8.23	1.45	7.65	5.00	51.50	24.3	19224
0.16	8.57	8.73	8.23	1.57	7.58	5.00	....	....	18714
0.30	7.90	8.20	8.23	4.45	13.80	12.00	55.00	24.4	18930
0.10	8.38	8.48	....	0.20	4.19	....	....	....	17961

† Allowing 8 cents per pound for available phosphoric acid.

TABLE X. ANALYSES OF SLAUGHTER HOUSE TANKAGE.

Station No.	Manufacturer.	Dealer or Purchaser.	Nitrogen. As ammonia.	Nitrogen. As organic.	Nitrogen. Total found.	Nitrogen. Total guaranteed.	Phosphoric Acid. Found.	Phosphoric Acid. Guaranteed.	Mechanical Analysis. Finer than 1-50 inch.	Mechanical Analysis. Coarser than 1-50 inch.	Cost per ton	Station No.
	Sampled by Station Agent:											
18911	Apothecaries Hall Co., Waterbury.	E. W. Smith, Mt. Carmel	0.16	7.53	7.69	7.41	8.33	7.00	62	38	$50.00	18911
19515	Armour Fertilizer Works, New York	J. H. McAllister, Middletown Grain Assoc., Cromwell	0.15	4.59	4.74	4.93	14.00	13.73	68	32	41.50	19515
19659	Armour Fertilizer Works, New York	J. H. McAllister, Middletown Grain Assoc., Cromwell	0.05	7.24	7.29	7.40	8.65	6.87	34	66	41.50	19659
18804	Conn. Fat Rendering & Fertilizing Corp., West Haven, Conn.	Sampled at factory	0.06	3.94	4.00	3.25	21.26	20.00	53	47	35.00	18804
19244	Consolidated Rendering Co., Boston	M. E. Cooke, Wallingford	0.21	5.10	5.31	4.92	16.40	14.00	46	54	40.00	19244
18798	Consolidated Rendering Co., Boston	L. T. Frisbie Co., New Haven	0.18	7.04	7.22	7.41	12.10	10.00	36	64	....	18798
19412	Eastern States Farmers' Exchange, Springfield, Mass.	H. H. McKnight, Ellington	0.28	5.91	6.19	5.75	9.98	6.85	28	72	....	19412
19505	Wilcox Fertilizer Co., Mystic	Sampled at factory	0.12	8.12	8.24	6.50	5.85	(*)	56	44	....	19505
19523	Worcester Rendering Co., Auburn, Mass.	Meech & Stoddard, Middletown	0.19	7.93	8.12	5.74	10.88	25.00	43	57	62.00	19523
	Sampled by Purchaser:											
18769	Consolidated Rendering Co., Boston	Chas. A. Lyman, Middlefield	0.20	5.48	5.68	4.92	12.91	14.00	26	74	....	18769
18180	Middlesex Fertilizer Corp., Middletown	H. B. Cornwall, Meriden	0.14	6.04	6.18	....	11.12	....	36	64	....	18180
19539	Sanderson Fertilizer Co., New Haven	H. F. Johnson, Norwich	0.27	8.09	8.36	4.94	11.08	13.70	31	69	....	19539
19344	Worcester Rendering Co., Auburn, Mass.	E. C. Rogers, Putnam	0.17	7.69	7.86	5.74	11.70	25.00	32	68	35.00	19344

* Guaranteed 4% available.

SLAUGHTER HOUSE TANKAGE.

Of the 13 samples analyzed three did not meet their guaranty. Two, **19515** and **19659,** were from the Armour Fertilizer Works, New York, and one, **18798,** from the Consolidated Rendering Co., Boston.

As will be seen from Table X, tankage, as well as bone, ranges widely in composition, depending on the relative amount of bone, meat, etc., which goes into it.

Here the nitrogen in these samples ranges from 8.36 to 4.00 and the phosphoric acid from 21.26 to 5.85. The agricultural value of tankage depends on its fineness as well as on its composition.

When only a quarter or a third of the weight of the tankage is finer than one fiftieth inch it will not be nearly as quick in its action in the soil as tankage, two-thirds of which is finer than one-fiftieth inch.

BONE MANURES.

In Table XI are analyses of 33 brands. The nitrogen in the various samples ranges from 5.13 to 1.68; phosphoric acid from 30.47 to 18.80.

Seventy-eight per cent of fine material is found in one sample, in another only 37 per cent.

Sample **18605** is a factory waste not on the market.

Thirteen samples have a guaranty of 2.47 per cent nitrogen, but the percentage in them range from 3.76 to 1.68.

Ten others have a guaranty of 3.29 per cent, but the samples range from 4.73 to 3.31 per cent. An average of such figures is of very limited value. The average figures of the 23 samples drawn by the Station are:

Nitrogen	3.13 per cent
Phosphoric acid	24.64 per cent
Cost per ton	$47.90

The following samples failed to meet their guaranty:

In respect of nitrogen:

19618	Consolidated Rendering Co.	0.78%
19619	Wilcox Fertilizer Co.	.17

In respect of phosphoric acid:

19603	Berkshire Fertilizer Co.	1.20
19598	Rogers & Hubbard Co.	0.50

TABLE XI. ANALYSES OF

Station No.	Manufacturer.	Dealer or Purchaser.
	Sampled by Station:	
19596	American Agricultural Chemical Co., New York	W. C. Mansfield, North Haven
19601	Apothecaries Hall Co., Waterbury	Cheshire Reformatory, Cheshire.
19600	Apothecaries Hall Co., Waterbury	C. F. Curtiss, Milldale
19621	Armour Fertilizer Works, New York	J. H. McAllister, Middletown
		Grain Assoc., Cromwell
19603	Berkshire Fertilizer Co., Bridgeport	Sampled at factory
19613	Consolidated Rendering Co., Boston	August Grulich Estate, Meriden
19618	Consolidated Rendering Co., Boston	Rockville Milling Co., Rockville
19615	Eastern States Farmers' Exchange, Springfield, Mass.	C. K. Andrews, West Woods Farmers' Assoc., Mt. Carmel
19595	L. T. Frisbie Co., New Haven	Lightbourn & Pond, New Haven.
19007	L. T. Frisbie Co., New Haven	Sampled at factory
19606	International Agricultural Corp., Boston.	Wm. Myers, Tariffville
19622	Levering Fertilizer Co., Baltimore, Md.	F. O. Brown, Colchester
19599	Mapes Fertilizer & Peruvian Guano Co., New York City	J. F. Ravens Hardware Co., Meriden
19597	Olds & Whipple, Inc., Hartford	Sampled at factory
19598	The Rogers & Hubbard Co., Portland	Cadwell & Jones, Hartford
19604	The Rogers & Hubbard Co., Portland	R. H. Hall Estate, East Hampton
19602	F. S. Royster Guano Co., Baltimore, Md.	Plumb Bros., Waterbury
19614	Sanderson Fertilizer & Chemical Co., New Haven	Fred C. Morse Guilford
19354	M. L. Shoemaker & Co., Philadelphia, Pa.	G. T. Soule, New Milford
19616	Virginia-Carolina Chem. Co., New York.	Silliman Hardware Co., New Canaan
19689	What Cheer Chemical Co., Pawtucket, R. I.	Lyon & Ewald, New London
19619	Wilcox Fertilizer Co., Mystic	M. E. Thompson, Ellington
19617	Worcester Rendering Co., Auburn, Mass.	J. O. Fox & Co., Putnam
	Sampled by Purchaser:	
18748	Apothecaries Hall Co., Waterbury	Hatheway & Steane, Hartford
18749	Apothecaries Hall Co., Waterbury	Hatheway & Steane, Hartford
18853	Apothecaries Hall Co., Waterbury	Hatheway & Steane, Hartford
18854	Apothecaries Hall Co., Waterbury	Hatheway & Steane, Hartford
19220	Apothecaries Hall Co., Waterbury	Hatheway & Steane, Hartford
19232	Apothecaries Hall Co., Waterbury	Hatheway & Steane, Hartford
19423	Berkshire Fertilizer Co., Bridgeport	J. E. Shepard, South Windsor
19326	Berkshire Fertilizer Co., Bridgeport	J. E. Shepard, South Windsor
18931	The Rogers & Hubbard Co., Portland	Edward O. Douglass, Suffield
18605	Winchester Repeating Arms Co., New Haven	Joseph A. Smith, New Haven

BONE MANURES.

Nitrogen.		Phosphoric Acid.		Mechanical Analysis.			
Found.	Guaranteed.	Found.	Guaranteed.	Finer than 1-50 inch.	Coarser than 1-50 inch.	Cost per ton.	Station No.
2.84	2.47	24.95	22.88	58	42	$45.00	19596
2.65	2.26	25.80	22.88	78	22	47.00	19601
3.46	3.29	20.00	20.00	52	48	....	19600
2.84	2.47	25.55	22.00	70	30	38.50	19621
4.34	3.29	18.80	20.00	54	46	....	19603
2.28	2.05	27.50	26.00	63	37	56.00	19613
1.68	2.46	29.65	24.00	68	32	52.00	19618
2.56	2.46	23.75	23.00	61	39	40.70	19615
2.60	2.46	26.70	24.00	57	43	50.00	19595
4.10	3.28	22.63	22.00	37	63	....	19007
2.54	2.50	26.65	22.00	62	38	44.00	19606
2.44	2.47	27.35	22.90	56	44	45.00	19622
4.00	3.71	24.60	20.00	55	45	55.00	19599
2.81	2.47	23.60	22.00	60	40	....	19597
3.89	3.82	24.20	24.70	69	31	60.00	19598
3.31	3.29	23.30	20.50	71	29	55.00	19604
3.14	2.47	25.65	22.90	50	50	52.50	19602
3.38	2.47	23.40	22.88	71	29	40.00	19614
5.13	4.53	23.55	20.00	56	44	55.00	19354
3.76	2.47	22.25	22.00	50	50	42.50	19616
3.65	1.80	24.30	20.00	50	50	50.00	19689
1.88	2.05	28.40	25.17	65	35	40.00	19619
2.65	2.46	25.05	25.00	65	35	42.00	19617
3.77	3.29	24.50	20.00	49	51	38.25	18748
3.75	3.29	22.08	20.00	46	54	38.25	18749
3.74	3.29	24.46	20.00	54	46	38.25	18853
3.77	3.29	24.36	20.00	52	48	38.25	18854
4.73	3.29	20.15	20.00	48	52	38.25	19220
3.36	3.29	25.18	20.00	54	46	38.25	19232
2.96	2.50	26.05	25.00	54	46	....	19423
1.83	3.29	30.47	20.00	76	24	36.00	19326
4.97	4.11	20.12	23.00	74	26	36.00	18931
4.00	...	25.59	....	29	71	....	18605

MIXED BONE AND MEAT TANKAGE.

19176. Made by Apothecaries Hall Co., Waterbury. Sampled at factory.

18791. Sent by Frank Hofmann, Cromwell. Very coarse material.

ANALYSES OF MIXED BONE AND TANKAGE.

Station No.	19176	18791
Nitrogen:		
In ammonia	0.06	0.31
Total found	4.12	7.47
Total guaranteed	3.29	....
Phosphoric acid:		
Found	22.10	11.64
Guaranteed	20.00	....

GARBAGE TANKAGE.

18999. Sent by Frank Strasburger, Stratford. From the Bridgeport garbage reduction plant.

19137. Sent by S. D. Woodruff & Sons, Orange.

ANALYSES OF GARBAGE TANKAGE.

Station No.	18999	19137
Nitrogen:		
In ammonia	2.43	0.06
Total	2.43	2.92
Phosphoric acid:		
Total	3.58	4.38

A REVIEW OF THE ANALYSES OF RAW MATERIALS

used as fertilizers indicates the following facts:

The average cost of plant food in raw materials has been lower this year than last, with the exception of nitrogen in cotton seed meal.

The average figures calculated from the analyses made here are:

	Cents per pound.
Cost of nitrogen in sulphate of ammonia	15.6
Cost of nitrogen in nitrate of soda	19.7
Cost of nitrogen in cotton seed meal 36% protein	44.6†
Cost of nitrogen in cotton seed meal 41% protein	37.3†
Cost of nitrogen in cotton seed meal 43% protein	37.3†
Cost of nitrogen in castor pomace	29.9
Cost of nitrogen in fish*	24.8
Insoluble phosphoric acid in phosphate rock	3.2
Available phosphoric acid in precipitated bone	8.5
Available phosphoric acid in acid phosphate	6.5-6.9
Potash in form of H. G. Sulphate	5.7
Potash in form of muriate	5.1
Potash in form of crude salts	5.1

† Mostly in car lots. If allowance is made for the phosphoric acid and potash the price will be reduced by four or five cents.

* Allowing 8c. per lb. for available phosphoric acid.

These figures show that sulphate of ammonia and nitrate of soda have been the cheapest forms of available nitrogen; that cotton seed with 41 per cent protein has been a much cheaper source of nitrogen than the 36 per cent meal.

The reason is plain. A thirty-ton car lot of 36 per cent meal carries the same freight charge as a car of 41 per cent meal, but carries 500 pounds less of *nitrogen*.

The market for fertilizer chemicals has been very fluctuating during the fertilizer season, and extravagantly high and unusually low prices have been paid in individual instances, but the average prices of fertilizer chemicals have been considerably lower than in 1921.

A following table gives complete average analyses of the commonly used raw fertilizer materials which have been referred to on previous pages. Our routine analyses usually show only the three most important elements, nitrogen, phosphoric acid and potash, but we are frequently asked what makes up the rest of the material. For example, cotton seed meal contains 6.8 per cent of nitrogen, and usually that is all that the sender desires to know. But a complete analysis shows that it contains, as an average:

	Per cent.
Water and very small amounts of undetermined matter	10.5
Vegetable matter, exclusive of nitrogen	76.9
Nitrogen	6.8
Phosphoric acid	2.9
Potash	1.9
Lime	0.3
Magnesia	0.7
	100.0

TABLE XII. AVERAGE COMPOSITION OF VARIOUS FERTILIZER MATERIALS.

Materials.	Water and Undetermined	Organic Matter.	Nitrogen.	Phosphoric Acid.	Potash.	Lime.	Magnesia.	Oxide Iron.	Sulphuric Acid.	Soda.	Chlorine.	Sand.
Nitrate of Soda	50.0a	....	15.4	...	...	...	...	...	...	34.1	0.5	...
Nitrate of Potash	44.1b	....	12.5	...	43.4	...	...	...	...	...	...	...
Sulphate of Ammonia	24.1c	....	20.5	...	...	...	...	...	55.4	...	...	...
Calcium Cyanamide	16.9	....	16.8	...	...	63.2	...	2.1	...	...	...	1.0
Cottonseed Meal	10.5	83.7*	6.8	2.9	1.9	0.3	0.7	...	...	...	...	...
Castor Pomace	11.6	82.9*	5.4	2.2	1.5	0.9	0.8	...	...	...	0.1	...
Dry Fish Scrap	1.9	73.7*	8.7	7.6	1.1	8.7	0.4	...	5.2	...	0.1	1.3
Acid Phosphate	....	....	...	17.2	...	...	...	...	...	...	...	...
Precipitated Bone	24.4†	....	...	40.15	...	33.24	0.32	...	1.19	...	0.7	...
German H. G. Sulf. Pot.	2.4	....	...	...	49.9	0.2	1.3	...	43.6	0.7	1.6	0.3
French H. G. Sulf. Pot.	8.7	....	...	...	49.9	...	...	...	39.0	...	2.4	...
Double Sulf. Pot. and Mag.	8.5	....	...	...	27.4	...	11.3	...	46.7	1.3	4.2	0.6
Double Carb. Pot. and Mag.	57.5d	....	...	...	18.1	1.2	19.3	2.2	...	1.5	0.2	...
Carbonate of Potash	39.0e	....	...	...	61.0	...	...	...	...	...	...	...
Kainit#	9.4	....	...	...	12.8	0.8	7.4	...	20.4	18.3	30.3	0.8
Manure Salts#	23.2f	....	...	...	20.3	3.2	0.5	...	1.9	...	48.8	2.1
Vegetable Ash	31.3	....	...	0.6	25.1	21.7	10.1	...	5.3	...	2.6	3.3
Cotton Hull Ash	32.5g	....	...	9.8	27.9	5.2	11.2	...	2.4	1.3	0.2	9.5
Wood Ashes	29.1h	....	...	2.1	6.6	36.6	5.7	2.4	1.2	1.0	0.5	14.8
N. Y. Horse Manure	66.0	31.9*	0.7	0.4	0.6	0.5	0.2	0.2	0.1	...	0.1	...
Cow Manure	71.8	18.2*	0.4	0.3	0.5	0.2	0.1	0.8	0.1	...	0.1	7.9
‡Sheep Manure	10.2	71.3*	2.1	1.8	2.4	...	...	...	...	...	...	...
Tobacco Stems	20.8	63.9*	2.1	0.6	7.5	3.8	0.5	0.1	0.5	0.2	0.5	1.6

NOT USED FOR TOBACCO. (a) Of this 44 per cent is oxygen, (b) of this 37.4 per cent is oxygen, (c) of this 11.7 per cent is chiefly oxygen, (d) of this 32.6 per cent is carbonic acid, (e) mostly carbonic acid, (f) mostly soda, (g) mostly water and carbonic acid, (h) of this 23.2 per cent is carbonic acid. * The nitrogen given in next column is included here, it being principally in organic form. † Free and combined. ‡ A partial analysis.

V. MIXED FERTILIZERS.

MIXED FERTILIZER CONTAINING PHOSPHORIC ACID AND POTASH.

19526. Olds & Whipple's Potash Compound. Sampled by Station agent at the factory.

ANALYSIS.

Available phosphoric acid	5.40
Insoluble phosphoric acid	0.18
Total phosphoric acid	5.58
Potash calculated as muriate	3.81
Potash calculated as sulphate	11.58
Total potash	15.39
Chlorine	2.87
Cost per ton	$43.88

NITROGENOUS SUPERPHOSPHATES WITHOUT POTASH.

In Table XIII are given the analyses of 12 samples which contain no potash.

Sample **19377** shows 1.72 per cent of nitrogen as ammonia. We are advised by the manufacturer that ammonia salts are not used in this brand. While the analysis corresponds well with the guaranty, it appears likely that there has been a mistake in the brand name. It has not been possible to get another sample.

Two brands failed to meet their guaranty: Royster's Landmark, **19433**, and Sanderson's Tobacco Grower, **19437**.

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:				
	American Agricultural Chemical Co., New York City.				
19504	National 5-4 Tobacco Manure	Somers	$54.00	0.10	0.94
	Berkshire Fertilizer Co., Bridgeport.				
19335	Tobacco Starter	New Milford	52.40	1.71	1.21
	F. T. Blish Hardware Co., South Manchester.				
19522	Top Dressing for Grass.....	South Manchester	44.00	2.44	0.08
	Bowker Fertilizer Co., New York City.				
19377	Tobacco Grower	Avon	50.75	0.10	1.72
	Olds & Whipple, Inc., Hartford.				
19092	High Grade Tobacco Starter	Silver Lane	62.00	3.25	0.23
19493	Top Dressing for Grass	Factory	44.00	2.31	0.13
	F. S. Royster Guano Co., Baltimore, Md.				
19433	Landmark	Waterbury	52.00	0.16	1.96
19122	Prime Fish Brand	Ansonia	37.00	0.08	1.00
	Sanderson Fertilizer & Chemical Co., New Haven.				
19499	High Grade Ammoniated Phosphate	Factory	....	0.98	0.30
19508	Phosphate without Potash	Seymour	45.00	0.69	0.03
19437	Tobacco Grower	New Milford	....	0.16	0.08
	M. L. Shoemaker & Co., Philadelphia, Pa.				
18960	Swift-Sure Superphosphate Tobacco Starter	Hartford	45.00	0.90	0.08

WITHOUT POTASH.

Nitrogen.				Phosphoric Acid.					Station No.
Organic water-soluble.	Organic water-insoluble.	Total.		Citrate-insoluble.	Total.		So-called "Available."		
		Found.	Guaranteed.		Found.	Guaranteed.	Found.	Guaranteed.	
0.36	2.82	4.22	4.11	0.23	5.08	5.00	4.85	4.00	19504
0.05	1.95	4.92	5.00	0.13	5.18	5.00	5.05	4.00	19335
0.71	2.59	5.82	5.76	0.90	6.45	4.00	5.55	4.00	19522
0.38	3.00	5.20	4.11	0.28	4.98	5.00	4.70	4.00	19377
0.27	4.61	8.36	8.23	0.58	4.75	3.00	4.17	3.00	19092
0.19	3.19	5.82	5.76	0.60	6.25	4.00	5.65	4.00	19493
0.16	1.09	3.37	3.29	0.80	10.50	10.50	9.70	10.00	19433
0.08	0.53	1.69	1.65	1.15	10.75	8.50	9.60	8.00	19122
0.76	1.18	3.22	3.29	1.20	11.70	11.00	10.50	10.00	19499
0.03	0.95	1.70	1.65	0.70	11.48	11.00	10.78	10.00	19508
0.42	2.83	3.49	4.11	0.28	4.60	5.00	4.32	4.00	19437
0.5	1.84	3.32	3.30	3.28	13.63	12.00	10.35	10.00	18960

NITROGENOUS SUPERPHOSPHATES CONTAINING POTASH.

In Table XIV are analyses of 279 samples drawn by the Station agent and 4 samples drawn by other individuals.

Guaranties.

Of the samples examined 97, or about 34 per cent, did not meet their guaranties in all respects. Forty-four were deficient in potash, 40 in nitrogen. Seventy nine were lacking in one ingredient, 16 in two, and two samples in all three ingredients.

In all but twenty cases, however, the deficiency in one ingredient was fully made up in money value by an overrun in the other two.

The following did not make up the deficiency, if nitrogen is reckoned at 40 cents, available phosphoric acid at 8 cents and potash at 5½ cents per pound.

Number.	Name.	Deficiency.
19291	A. A. C. Co.'s Wheeler's Potato Manure	$1.20
19010	Armour's Big Crop, 3-8-4	1.42
19375	Bowker's Stockbridge Top Dressing and Forcing Manure	3.21
19381	Chittenden's Complete Tobacco and Onion Grower, 4% Potash	1.59
19194	Coe-Mortimer's Red Brand Excelsior Guano	1.12
19488	International Agric. Corp'n Buffalo Crop Grower	6.52
19529	Levering Fertz'r Co.'s General Fertilizer	3.42
19151	Levering Fertz'r Co.'s Market Garden	1.37
19483	Lowell Fertz'r Co.'s 5-8-7 for Potatoes and Vegetables	2.14
19358	Mitchell's 5-8-7	6.52
19196	New England Fertz'r Co. 5-8-7 for Potatoes and Market Gardens	1.37
19625	Parmenter & Polsey's 5-8-7 for Potatoes and Market Gardens	1.61
19248	Rogers & Hubbard Co. Hubbard's Bone Base Fertilizer for Seeding Down	3.87
19623	Rogers & Hubbard Co. Hubbard's Bone Base Fertilizer for Seeding Down	2.63
19356	Royster Guano Co. Arrow Head Tobacco Formula.	1.36
19642	Royster Guano Co. Quality Trucker	1.65
19507	Sanderson Fertilizer & Chemical Co. Top Dressing for Grass and Grain	1.92
19664	What Cheer Chemical Co. Superior Brand	1.41
19663	Worcester Rendering Co. Prosperity Brand Complete Dressing	2.34

Composition.

Of the 283 samples analyzed:

17	have a guaranty of 0.82 per cent nitrogen
54	have a guaranty of 1.65 per cent nitrogen
54	have a guaranty of 2.47 per cent nitrogen
73	have a guaranty of 3.29 per cent nitrogen
65	have a guaranty of 4.11 per cent nitrogen
11	have a guaranty of 4.94 per cent nitrogen
9	not included above
283	

There has been an increase in the percentage of high nitrogen brands this year, as the following statement shows:

	1921.	1922.
Guaranty of .82 nitrogen	10.0	6.0
Guaranty of 1.65 nitrogen	20.4	19.1
Guaranty of 2.47 nitrogen	23.2	19.1
Guaranty of 3.29 nitrogen	20.4	25.9
Guaranty of 4.11 nitrogen	21.4	23.0
Guaranty of 4.94 nitrogen	4.6	6.9
	100.0	100.0

As will be noted in the following paragraphs, nitrogen, the most expensive element in fertilizers, costs very much more in the lower than in the higher nitrogen brands.

Cost of Nitrogen.

As nitrogen costs four or five times as much per pound as either phosphoric acid or potash, its cost in the different grades of mixed goods is of special importance.

In the following statement are given the guaranteed composition of the brands sold in the state, their number, average cost per ton as quoted by the dealers and the average cost of nitrogen per pound in the different brands. Available phosphoric acid is valued at 8 cents per pound and potash at 5½ cents. The sum of these values is subtracted from the cost price. This remainder, divided by the number of pounds of nitrogen, gives the cost per pound of nitrogen.

For example, the formula .82-8-2 carries in one ton 16.4 pounds of nitrogen, 160 of available phosphoric acid and 40 of potash. The calculation is:

160 lbs. phosphoric acid at 8c.	$12.80
40 lb. potash at 5½c.	2.20
Valuation of both	$15.00

The average cost of this fertilizer per ton is $36.19.

36.19—15.00=$21.19, which is what the 16.4 lbs of nitrogen cost.

$\frac{21.19}{16.4}$=$1.29, which is the cost of a pound of nitrogen in this class of goods.

Formulas.	No. of brands.	Average cost per ton.	Nitrogen cost per lb.	Average
.82-8-2	9	$36.19	$1.29	$1.29
1.65-8-2	22	40.10	.76	.81
1.65-8-3	16	44.88	.87	
2.47-8-3	7	44.87	.58	.52
2.47-8-4	19	44.86	.49	
3.29-8-4	29	44.65	.35	.41
3.29-8-6	11	44.45	.53	
3.29-8-7	9	48.87	.43	
4.11-8-7	12	51.35	.37	.46
4.11-8-6	3	50.50	.38	
4.11-4-3	6	54.66	.55	
4.11-4-5	15	54.29	.52	

To the last column of this statement special attention is invited. In the lowest grade—and lowest priced—goods the nitrogen costs two to three times as much per pound as in higher grade—and higher priced—brands.

Manufacturers are endeavoring to drop the sale of the lowest grades, and buyers waste their money when they buy them.

ANALYSES REQUIRING SPECIAL NOTICE.

Bradley's Complete Potato and Vegetable, **19073,** was below guaranty in nitrogen. A second sample, **19646,** met the nitrogen guaranty but was below in potash.

Packer's Union Potato Manure was below guarantee in potash. A second sample, **19688,** met its guaranty.

National XXX Fish and Potash, **18918,** was below its available phosphoric acid guaranty, but a second sample, **19184,** fully met the guaranty.

Apothecaries Hall Co.'s Liberty Top Dressing, **18910,** was slightly below guaranty of nitrogen. A second sample, **19054,** fully met the guaranty.

Armour's Big Crop, 4-8-7, **18903,** was below guaranty in potash. A second sample, **19183,** fully met this guaranty.

19358, Mitchell's 5-8-7. Below guaranty in all particulars.

Mr. Mitchell states that only a little more than one carload was sold in the state. The parties who made this brand for him have given him a rebate as agreed in their contract, which has been paid to buyers.

Royster's Quality Trucker, **19124,** was below guaranty in potash. A second sample, **19642,** showed similar deficiency.

AVAILABILITY OF THE ORGANIC NITROGEN.

Nine samples showed that less than 50 per cent of their insoluble organic nitrogen was soluble by the alkaline permanganate test and less than 80 per cent by the neutral permanganate test.

These two tests confirm the presence of inferior forms of nitrogen. In one case the percentage of insolubility is so near the limits named that the difference may be disregarded.

In six cases the excess of total nitrogen over guaranty is enough to compensate for the inactive nitrogen.

Mapes Corn Manure, **19157,** and Virginia-Carolina Champion Brand, **18920,** were somewhat below guaranty in nitrogen, and in these two brands there was no such compensation as in the other six cases.

POTASH DETERMINATIONS.

In a considerable number of cases the manufacturer repeated this Station's determination of potash, on the samples which the Station had analyzed and had forwarded to them. They were the following:

From the American Agricultural Chemical Co.:

No.		Per cent of potash found by Station.	Manufacturers.
19071	Packer's Union	2.84	2.98
19180	Quinnipiac	6.84	6.98
19308	Bradley	1.85	2.02
19291	Wheeler	2.71	2.60
19245	National	3.75	3.84
19307	Williams & Clark	3.58	3.76
19295	Williams & Clark	6.64	6.76
19093	Williams & Clark	2.85	2.97
19165	Bowker	9.64	9.78
19111	Stockbridge	3.76	3.77
19375	Stockbridge	3.67	3.54
19158	Coe-Mortimer	3.76	4.00
19194	Coe-Mortimer	6.78	7.00
19127	Sanderson	3.73	3.92
	Average	**4.46**	**4.57**
From the Consolidated Rendering Co.:			
19187	Lowell	3.88	3.98
19195	New England	5.87	5.89
19198	Essex	3.86	4.81
	Average	**4.54**	**4.63**

While most of the differences are inconsiderable, it is sufficient to bring the percentage of potash in some of them in agreement with the guarantee if the higher figure is taken, while the lower figure does not meet the guarantee.

TABLE XIV. ANALYSES OF

Station No.	Manufacturer and Brand.		Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station:			
	American Agricultural Chemical Co., New York.			
19068	Double A Tobacco Fertilizer	4.1-4-5	Manchester	.....
18907	Fish and Potash	2.5-10-3	North Haven	$45.00
19113	Grass and Lawn Top Dressing.....	4.9-6-4	Manchester	.....
18908	Monarch Potato Manure	3.3-8-4	North Haven	48.00
18906	7% Potash Fertilizer	3.3-8-7	New Haven	.....
19290	7% Potash Fertilizer	3.3-8-7	Riverton	50.50
19072	Universal Phosphate	0.8-8-2	New London	42.00
19418	Bradley's Complete Manure for Top Dressing Grass and Grain.....	4.9-6-4	Stafford Springs...	57.00
19073*	Bradley's Complete Manure for Top tatoes and Vegetables	3.3-8-7	Groton	54.00
19646*	Bradley's Complete Manure for Potatoes and Vegetables	3.3-8-7	Granby	50.00
19304	Bradley's Complete Tobacco Manure	4.1-4-5	Glastonbury	.....
18925	Bradley's Corn Phosphate	1.7-8-2	Bristol	43.00
19013	Bradley's New Method Fertilizer..	0.8-8-2	Norwalk	42.00
19070	Bradley's Potato Fertilizer	1.7-8-3	East River	43.00
18958	Bradley's Potato Manure	2.5-8-4	Bristol	46.00
19309	Bradley's Valley Tobacco Fertilizer	4.1-4-3	Simsbury	62.00
18927	Bradley's XL Superphosphate of Lime	2.5-9-2	Bristol	44.00
19308†	Bradley's XL Superphosphate of Lime	2.5-9-2	Unionville	50.00
19630	Great Eastern General	0.8-8-2	Thomaston	44.75
19667	Great Eastern Northern Corn Special	1.7-8-2	Woodbury	43.00
19651	Lister's Celebrated Tobacco Fertilizer	4.1-4-3	West Suffield	50.00
19303	Lister's Complete Tobacco Manure	4.1-4-5	Warehouse Point ..	52.00
19089	Lister's Corn and Potato Fertilizer	1.7-8-3	Yalesville	45.00
19286	Lister's Eastern Pride Fertilizer....	2.5-8-4	Yalesville	55.00
19110	Lister's Standard Pure Superphosphate of Lime	2.5-9-2	Yalesville	44.00
19088	Lister's Success Fertilizer	1.7-8-2	Yalesville	40.00
19382	Packer's Union Animal Corn Fertilizer	2.5-9-2	North Haven	42.50
19071*	Packer's Union Potato Manure	1.7-8-3	Waterford	43.00
19668*	Packer's Union Potato Manure	1.7-8-3	Portland	.....
19471	Packers' Union Universal Fertilizer	0.8-8-2	Riverton	34.00
18909	Quinnipiac Climax Phosphate	0.8-8-2	North Haven	35.00
19090	Quinnipiac Corn Manure	1.7-8-2	Manchester	.....
19180	Quinnipiac Market Garden Manure	3.3-8-7	Manchester	.....
19085	Quinnipiac Potato Manure	2.5-8-4	North Haven	45.00
19106	Quinnipiac Potato Phosphate	1.7-8-3	North Haven	42.00

* See note, page 110.
† See note, page 111.

NITROGENOUS SUPERPHOSPHATES WITH POTASH.

Nitrogen.						Phosphoric Acid.					Potash.			Station No.
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Total. Found.	Total. Guaranteed.	Citrate-insoluble.	Total. Found	Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	As muriate.	Total. Found.	Total. Guaranteed.	
0.97	none	0.07	3.16	4.20	4.11	0.28	4.77	5.00	4.49	4.00	0.25	5.01	5.00	19068
trace	0.79	0.49	0.99	2.27	2.47	1.20	12.03	11.00	10.83	10.00	3.01	3.01	3.00	18907
1.94	1.26	0.82	0.92	4.94	4.94	1.06	7.13	7.00	6.07	6.00	4.17	4.17	4.00	19113
0.80	1.50	0.09	0.88	3.27	3.29	0.85	9.08	9.00	8.23	8.00	3.88	3.88	4.00	18908
0.58	1.62	0.22	0.81	3.23	3.29	0.58	8.61	9.00	8.03	8.00	7.04	7.04	7.00	18906
0.65	1.46	0.41	0.72	3.24	3.29	0.78	8.71	9.00	7.93	8.00	7.06	7.06	7.00	19290
0.31	0.06	0.41	0.19	0.97	0.82	1.20	9.40	9.00	8.20	8.00	1.98	1.98	2.00	19072
2.90	1.24	0.27	0.53	4.94	4.94	0.80	7.68	7.00	6.88	6.00	3.87	3.87	4.00	19418
0.94	0.92	0.42	0.88	3.16	3.29	0.83	9.03	9.00	8.20	8.00	6.96	6.96	7.00	19073
0.43	1.91	0.26	0.67	3.27	3.29	0.49	8.62	9.00	8.13	8.00	6.69	6.69	7.00	19646
0.94	0.08	0.35	3.11	4.48	4.11	0.30	4.85	5.00	4.55	4.00	0.32	5.19	5.00	19304
0.08	0.83	0.20	0.61	1.72	1.65	0.70	8.95	9.00	8.25	8.00	2.01	2.01	2.00	18925
0.02	0.26	0.28	0.49	1.05	0.82	0.68	9.23	9.00	8.55	8.00	2.32	2.32	2.00	19013
0.40	0.44	0.10	0.97	1.91	1.65	1.23	9.73	9.00	8.50	8.00	3.00	3.00	3.00	19070
0.45	1.27	0.03	0.94	2.69	2.47	0.88	9.28	9.00	8.40	8.00	3.94	3.94	4.00	18958
1.06	0.04	0.42	2.94	4.46	4.11	0.40	5.00	5.00	4.60	4.00	0.32	3.41	3.00	19309
0.40	1.23	0.21	0.88	2.72	2.47	1.98	10.73	10.00	8.75	9.00	2.42	2.42	2.00	18927
0.37	0.81	0.37	1.01	2.56	2.47	0.85	10.10	10.00	9.25	9.00	1.85	1.85	2.00	19308
0.06	0.21	0.22	0.50	0.99	0.82	0.68	9.00	9.00	8.32	8.00	2.12	2.12	2.00	19630
0.11	0.43	0.28	0.83	1.65	1.65	0.65	9.00	9.00	8.35	8.00	2.18	2.18	2.00	19667
0.04	0.73	0.40	2.73	3.90	4.11	0.15	4.75	5.00	4.60	4.00	0.11	3.34	3.00	19651
0.05	1.00	0.27	2.97	4.29	4.11	0.33	4.93	5.00	4.60	4.00	0.36	5.17	5.00	19303
0.44	0.45	0.12	0.93	1.94	1.65	1.25	9.60	9.00	8.35	8.00	3.46	3.46	3.00	19089
0.47	0.76	0.29	0.95	2.47	2.47	0.68	9.05	9.00	8.37	8.00	3.90	3.90	4.00	19286
0.36	0.64	0.36	0.94	2.30	2.47	0.84	10.82	10.00	9.98	9.00	2.32	2.32	2.00	19110
0.10	0.46	0.41	0.84	1.81	1.65	0.65	9.19	9.00	8.54	8.00	2.27	2.27	2.00	19088
0.32	0.50	0.28	1.20	2.30	2.47	0.75	10.90	10.00	10.15	9.00	2.06	2.06	2.00	19382
0.53	0.74	0.17	0.38	1.82	1.65	0.55	8.88	9.00	8.33	8.00	2.84	2.84	3.00	19071
0.39	0 48	0.02	0.88	1.77	1.65	1.20	9.43	9.00	8.23	8.00	3.08	3.08	3.00	19668
0.01	0.15	0.21	0.49	0.86	0.82	0.78	8.89	9.00	8.11	8.00	1.82	1.82	2.00	19471
0.04	0.11	0.29	0.47	0.91	0.82	0.63	9.20	9.00	8.57	8.00	2.06	2.06	2.00	18909
0.08	0.43	0.34	0.85	1.70	1.65	0.70	9.10	9.00	8.40	8.00	2.06	2.06	2.00	19090
0.58	1.78	0.21	0.80	3.37	3.29	0.65	9.02	9.00	8.37	8.00	6.84	6.84	7.00	19180
0.68	1.64	0.02	0.86	3.20	2.47	0.75	9.03	9.00	8.28	8.00	4.47	4.47	4.00	19085
0.52	1.26	none	0.87	2.65	1.65	0.85	9.18	9.00	8.33	8.00	3.90	3.90	3.00	19106

TABLE XIV. ANALYSES OF

Station No.	Manufacturer and Brand.		Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station:			
	American Agricultural Chemical Co., New York (Continued).			
19376	Wheeler's Corn Fertilizer	1.7-8-2	Riverton	$40.00
19291*	Wheeler's Potato Manure	1.7-8-3	Riverton	40.00
19296	Williams & Clark's Americus Ammoniated Bone Superphosphate..	2.5-9-2	Clark's Corner	44.00
19691	Williams & Clark's Americus Ammoniated Bone Superphosphate..	2.5-9-2	South Manchester.	46.00
19094	Williams & Clark's Corn Phosphate	1.7-8-2	New London	46.00
19295*	Williams & Clark's Americus High Grade Special for Potatoes and Vegetables	3.3-8-7	Clark's Corner	50.00
19093*	Wiliams & Clark's Americus Potato Manure	1.7-8-3	New London	46.00
19307*	Williams & Clark's Potato Phosphate	2.5-8-4	New Britain	48.00
19302	Williams & Clark's Prolific Fertilizer	0.8-8-2	Milford	36.50
19690	Williams & Clark's Seed Leaf Tobacco Manure	4.1-4-3	Burnside	56.00
19056	National Complete Tobacco Fertilizer	4.1-4-5	Silver Lane	62.00
18919	National Eureka Potato Fertilizer.	3.3-8-4	West Cheshire	48.00
19245	National Market Garden Fertilizer.	2.5-8-4	Silver Lane	50.00
19055	National Potato Phosphate.....	1.7-8-3	Silver Lane	45.00
19660	National Special Tobacco Fertilizer	4.1-4-3	East Windsor Hill	.....
19199	National Universal Phosphate	0.8-8-2	Wallingford	32.00
18918†	National XXX Fish and Potash...	2.5-10-3	West Cheshire	42.00
19184†	National XXX Fish and Potash...	2.5-10-3	Wallingford	42.00
	Apothecaries Hall Co., Waterbury.			
19178	Liberty Corn, Fruit and All Crops..	1.6-8-2	Bristol	40.00
18826	Liberty Fish, Bone and Potash....	2.5-8-3	Meriden	32.75
18916	Liberty Fish, Bone and Potash....	2.5-8-3	Cheshire	45.00
18917	Liberty Market Gardeners' Special	3.3-8-4	West Cheshire	47.00
19338	Liberty Tobacco Special	4.1-4-5	Factory	55.60
18910†	Liberty Top Dresser for Grass and Grain	5.7-8-3	Mt. Carmel	50.00
19054†	Liberty Top Dresser for Grass and Grain	5.7-8-3	Bristol	60.00

* See note, pages 108 and 111.
† See note, page 110.

NITROGENOUS SUPERPHOSPHATES WITH POTASH—*Continued.*

Nitrogen.						Phosphoric Acid.					Potash.			Station No.
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Total. Found.	Total. Guaranteed.	Citrate-insoluble.	Total. Found	Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	As muriate.	Total. Found.	Total. Guaranteed.	
0.20	0.83	0.14	0.55	1.72	1.65	0.98	9.53	9.00	8.55	8.00	2.00	2.00	2.00	19376
0.02	0.76	0.21	0.52	1.51	1.65	0.85	9.00	9.00	8.15	8.00	2.71	2.71	3.00	19291
0.44	0.58	0.65	0.81	2.48	2.47	0.95	9.12	10.00	8.17	9.00	3.98	3.98	2.00	19296
0.26	0.74	0.71	1.24	2.95	2.47	1.35	10.78	10.00	9.43	9.00	2.38	2.38	2.00	19691
0.60	0.64	0.10	0.47	1.81	1.65	0.65	8.85	9.00	8.20	8.00	1.98	1.98	2.00	19094
0.81	1.45	0.38	0.80	3.44	3.29	1.00	9.45	9.00	8.45	8.00	6.64	6.64	7.00	19295
0.44	0.40	0.54	0.38	1.76	1.65	1.20	9.23	9.00	8.03	8.00	2.85	2.85	3.00	19093
0.48	0.68	0.31	0.89	2.36	2.47	0.65	9.25	9.00	8.60	8.00	3.58	3.58	4.00	19307
0.34	0.09	0.11	0.37	0.91	0.82	1.08	9.43	9.00	8.35	8.00	2.04	2.04	2.00	19302
1.00	0.04	0.06	3.34	4.44	4.11	0.25	4.66	5.00	4.41	4.00	0.19	3.11	3.00	19690
1.11	0.03	0.13	2.83	4.10	4.11	0.43	5.25	5.00	4.82	4.00	0.23	5.30	5.00	19056
0.58	1.70	0.46	0.70	3.44	3.29	1.00	9.10	9.00	8.10	8.00	4.14	4.14	4.00	18919
0.45	0.76	0.30	0.90	2.41	2.47	0.70	8.95	9.00	8.25	8.00	3.75	3.75	4.00	19245
0.42	0.48	0.11	0.79	1.80	1.65	1.28	9.35	9.00	8.07	8.00	3.24	3.24	3.00	19055
0.10	0.86	0.09	3.27	4.32	4.11	0.23	4.40	5.00	4.17	4.00	0.33	3.69	3.00	19660
0.03	0.12	0.26	0.58	0.99	0.82	1.60	10.25	9.00	8.65	8.00	2.01	2.01	2.00	19199
0.56	0.71	0.37	0.88	2.52	2.47	1.05	10.84	11.00	9.79	10.00	3.32	3.32	3.00	18918
0.07	0.80	0.45	1.08	2.40	2.47	1.15	11.33	11.00	10.18	10.00	3.00	3.00	3.00	19184
0.01	1.20	0.09	1.18	2.48	1.64	0.90	9.23	9.00	8.33	8.00	2.01	2.01	2.00	19178
none	1.82	1.20		3.02	2.47	0.79	9.52	9.00	8.73	8.00	3.17	3.17	3.00	18826
none	1.74	0.04	1.12	2.90	2.47	0.68	8.88	9.00	8.20	8.00	2.91	2.91	3.00	18916
0.97	1.68	0.08	0.97	3.70	3.29	0.55	8.94	9.00	8.39	8.00	4.25	4.25	4.00	18917
0.20	1.08	0.34	3.24	4.86	4.11	0.45	6.35	5.00	5.90	4.00	0.88	6.16	5.00	19338
none	4.91	0.03	0.70	5.64	5.76	0.50	9.25	9.00	8.75	8.00	3.13	3.13	3.00	18910
none	5.23	none	0.67	5.90	5.76	0.65	9.33	9.00	8.68	8.00	3.18	3.18	3.00	19054

TABLE XIV. ANALYSES OF

Station No.	Manufacturer and Brand.		Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station:			
	Armour Fertilizer Works, New York.			
19039	Corn Grower, 2-8-2	1.7-8-2	Madison	$36.00
19010†	Big Crop, 3-8-4	2.5-8-4	Madison	41.00
19182	Big Crop Fertilizer, 4-6-10	3.3-6-10	New London	48.00
19009	Big Crop Potato and Onion, 4-8-4	3.3-8-4	Guilford	48.00
18903*	Big Crop Fertilizer, 4-8-7	3.3-8-7	New Haven	52.00
19183*	Big Crop Fertilizer, 4-8-7	3.3-8-7	Putnam	46.50
19040	Big Crop, 5-8-5	4.1-8-5	Madison	48.00
19293	Big Crop Tobacco Special	4.1-4-5	Thompsonville	55.00
19108	General Crop, 1-7-1	0.8-7-1	New Canaan	25.00
	Atlantic Packing Co., New Haven.			
19379	3-8-3	2.5-8-3	Waterbury	49.00
19299	5-8-7	4.1-8-7	New Britain	52.43
19115	Grain Fertilizer, 2-8-2	1.7-8-2	New Britain	36.35
19114	Potato Phosphate, 3-8-4	2.5-8-4	New Britain	41.35
19288	Special Vegetable, 4-8-4	3.3-8-4	New Britain	46.80
19456	Tobacco Manure, 5-8-6	4.1-8-6	Glastonbury	45.00
	Berkshire Fertilizer Co., Bridgeport.			
19300	Ammoniated Bone Phosphate	0.8-10-2	Waterbury	52.00
19329	Complete Fertilizer	2.5-8-3	Waterbury	63.00
19384	Complete Tobacco	4.1-4-4	Hazardville	53.50
19107	Grass Special	5.8-4-4	Factory	49.00
19201	Market Garden Fertilizer	3.3-8-4	Milldale	44.00
19474	Potato and Vegetable Phosphate	1.7-8-2	New Milford	38.00
19457	Tobacco Special	5.8-5-5	Rockville	60.00
	F. T. Blish Hardware Co., South Manchester.			
19350	Complete Tobacco Fertilizer	4.1-4-5	Factory	55.50
19524	Corn and Potato Phosphate	1.7-8-2	Factory	36.25
19347	Market Garden Fertilizer	3.3-8-4	Factory	42.25

* See note, page 110.
† See note, page 108.

NITROGENOUS SUPERPHOSPHATES WITH POTASH—*Continued.*

Nitrogen.						Phosphoric Acid.					Potash.			Station No.
				Total.			Total.		So-called "Available."			Total.		
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Citrate-insoluble.	Found	Guaranteed.	Found.	Guaranteed.	As muriate.	Found.	Guaranteed.	
0.16	0.93	0.05	0.49	1.63	1.65	0.35	8.63	8.50	8.28	8.00	1.78	1.78	2.00	19039
0.04	1.69	0.06	0.53	2.32	2.47	0.28	7.98	8.50	7.70	8.00	4.24	4.24	4.00	19010
1.13	1.04	0.34	0.81	3.32	3.29	0.28	6.80	6.50	6.52	6.00	9.86	9.86	10.00	19182
0.04	2.42	0.14	0.68	3.28	3.29	0.18	8.18	8.50	8.00	8.00	3.90	3.90	4.00	19009
0.09	2.45	0.02	0.67	3.23	3.29	0.10	8.66	8.50	8.56	8.00	6.70	6.70	7.00	18903
0.05	2.10	0.42	0.67	3.24	3.29	0.33	8.60	8.50	8.27	8.00	6.98	6.98	7.00	19183
0.06	2.92	0.13	0.81	3.92	4.11	0.12	8.03	8.50	7.91	8.00	5.04	5.04	5.00	19040
0.59	0.05	0.01	3.35	4.00	4.11	0.68	4.85	4.50	4.17	4.00	0.54	5.01	5.00	19293
0.09	0.27	none	0.56	0.92	0.82	0.42	7.37	7.50	6.95	7.00	1.16	1.16	1.00	19108
0.65	0.81	0.52	0.63	2.61	2.46	0.55	9.18	9.00	8.63	8.00	3.08	3.08	3.00	19379
0.82	1.06	1.08	1.04	4.00	4.10	1.03	10.28	9.00	9.25	8.00	7.05	7.05	7.00	19299
0.51	0.09	0.62	0.54	1.76	1.64	0.78	8.90	9.00	8.12	8.00	2.22	2.22	2.00	19115
0.66	0.66	0.57	0.65	2.54	2.46	1.15	9.55	9.00	8.40	8.00	3.99	3.99	4.00	19114
1.34	0.43	0.81	0.78	3.36	3.28	1.20	9.55	9.00	8.35	8.00	4.15	4.15	4.00	19288
1.42	0.04	0.67	1.93	4.06	4.10	0.45	9.55	9.00	9.10	8.00	0.96	6.26	6.00	19456
0.52	0.04	0.20	0.24	1.00	0.80	0.30	11.68	11.00	11.38	10.00	1.99	1.99	2.00	19300
0.08	1.40	0.36	0.61	2.45	2.50	0.23	9.03	9.00	8.80	8.00	3.48	3.48	3.00	19329
1.51	0.18	0.44	2.31	4.44	4.11	0.13	5.15	4.00	5.02	4.00	1.13	5.44	4.00	19384
5.19	0.03	0.36	0.94	6.52	5.75	1.95	5.90	5.00	3.95	4.00	4.02	4.02	4.00	19107
0.28	2.08	0.45	0.61	3.42	3.30	0.65	9.13	9.00	8.48	8.00	4.42	4.42	4.00	19201
0.05	0.96	0.04	1.15	2.20	1.70	0.40	8.88	9.00	8.48	8.00	2.71	2.71	2.00	19474
1.79	0.32	0.56	3.21	5.88	5.75	0.30	6.38	5.00	6.08	5.00	1.24	6.09	5.00	19457
0.87	0.06	0.57	2.98	4.48	4.11	0.55	5.70	4.00	5.15	4.00	0.56	5.10	5.00	19350
0.72	0.02	0.10	0.94	1.78	1.65	2.30	11.03	8.00	8.73	8.00	2.27	2.27	2.00	19524
1.65	0.03	0.07	1.67	3.42	3.30	1.60	10.05	8.00	8.45	8.00	4.53	4.53	4.00	19[illegible]

TABLE XIV. ANALYSES OF

Station No.	Manufacturer and Brand.		Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station:			
	F. E. Boardman, Middletown.			
19336	Fertilizer for Potatoes and General Crops	3.3-7-4	Factory	$40.00
19475	Tobacco Fertilizer	3.3-7-4	Portland	41.00
	Bowker Fertilizer Co., New York.			
19116	All-Round Fertilizer	2.5-8-4	Yalesville	53.75
19643	Connecticut Valley Tobacco Fertilizer	4.1-4-3	Talcottville	53.00
19451	Corn, Grain and Grass Phosphate	1.7-8-2	Willimantic	38.50
19202	Early Potato Manure	3.3-8-7	Milldale	.....
18923	Fisherman's Brand Fish and Potash	2.5-10-3	Plainville	47.00
19469	Hill and Drill Phosphate	2.5-9-2	Willimantic	43.00
19383	Lawn and Garden Dressing Revised	2.5-9-2	Hartford	‡
19330	Potato and Vegetable Phosphate	1.7-8-3	Thomaston	46.50
19162	Square Brand Farm and Garden Phosphate	1.7-8-2	Yalesville	47.20
19197	Sure Crop Phosphate	0.8-8-2	Willimantic	35.00
19164	Maryland Corn Phosphate	1.7-8-2	New London	30.00
19165	Maryland High Potash Fertilizer	3.3-6-10	New London	50.00
19117	Maryland Truck Garden Fertilizer.	3.3-8-4	New London	40.00
19111	Stockbridge Early Crop Manure	4.1-8-7	North Haven	53.25
18922	Stockbridge Market Garden Manure	3.3-8-4	Plainville	54.00
19161	Stockbridge Potato and Vegetable Manure	3.3-6-10	Bristol	49.00
19332	Stockbridge Tobacco Manure	4.1-4-5	Avon	56.00
19375*	Stockbridge Top Dressing and Forcing Manure	4.9-6-4	Thomaston	60.00
	Amos D. Bridge's Sons, Inc., Hazardville.			
19333	Corn, Onion and General Purpose Fertilizer	3.3-8-4	Factory	48.50
19525	Tobacco Fertilizer Special	4.1-4-5	Factory	60.00
	E. D. Chittenden Co., Bridgeport.			
19468	Complete Grain Fertilizer with 3% Potash	1.6-8-3	Abington	41.00
19381†	Complete Tobacco and Onion Grower, 4% Potash	3.3-8-4	Simsbury	47.50
19645	Complete Tobacco and Onion Grower, 6% Potash	3.3-8-6	Glastonbury	49.50
19470	Potato Special with 4% Potash	3.3-8-4	Torrington	53.00
19465	Potato Special with 6% Potash	3.3-8-6	Glastonbury	49.50
19472	Tobacco Special with 5% Potash	4.1-4-5	Poquonock	51.00

* See note, pages 108 and 111.
† See note, page 108.
‡ Ninety-eight cents for 10-pound package.

NITROGENOUS SUPERPHOSPHATES WITH POTASH—*Continued.*

Nitrogen.						Phosphoric Acid.					Potash.			
				Total.			Total.		So-called "Available."			Total.		
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Citrate-insoluble.	Found	Guaranteed.	Found.	Guaranteed.	As muriate.	Found.	Guaranteed.	Station No.
1.12	1.08	0.28	0.84	3.32	3.29	0.20	7.80	....	7.60	7.00	3.95	3.95	4.00	19336
1.14	0.91	0.41	1.36	3.82	3.29	0.38	7.33	....	6.95	7.00	0.48	6.00	4.00	19475
0.30	0.90	0.19	1.15	2.54	2.47	1.20	9.16	9.00	7.96	8.00	1.93	3.72	4.00	19116
0.83	0.04	0.26	3.05	4.18	4.11	0.18	4.58	5.00	4.40	4.00	0.33	3.56	3.00	19643
0.58	0.16	0.48	0.40	1.62	1.65	1.05	9.15	9.00	8.10	8.00	1.99	1.99	2.00	19451
0.44	1.92	0.36	0.68	3.40	3.29	0.72	8.50	9.00	7.78	8.00	7.00	7.00	7.00	19202
0.13	0.80	0.30	1.09	2.32	2.47	1.08	11.93	11.00	10.85	10.00	2.90	2.90	3.00	18923
0.50	1.32	0.10	0.60	2.52	2.47	1.00	9.98	10.00	8.98	9.00	2.13	2.13	2.00	19469
0.86	0.17	0.19	1.56	2.78	2.47	3.03	12.40	10.00	9.37	9.00	2.28	2.28	2.00	19383
0.10	0.77	0.24	0.60	1.71	1.65	0.65	9.10	9.00	8.45	8.00	2.94	2.94	3.00	19330
0.15	0.78	0.13	0.66	1.72	1.65	1.38	9.45	9.00	8.07	8.00	1.97	1.97	2.00	19162
0.27	0.06	0.42	0.19	0.94	0.82	1.38	9.58	9.00	8.20	8.00	2.10	2.10	2.00	19197
0.60	0.40	0.34	0.42	1.76	1.65	0.90	9.00	9.00	8.10	8.00	1.92	1.92	2.00	19164
0.95	1.75	0.25	0.59	3.54	3.29	0.75	7.00	7.00	6.25	6.00	9.64	9.64	10.00	19165
0.89	1.15	0.49	0.83	3.36	3.29	0.85	8.88	9.00	8.03	8.00	3.93	3.93	4.00	19117
2.24	0.64	0.38	0.50	3.76	4.11	0.80	9.03	9.00	8.23	8.00	8.15	8.15	7.00	19111
0.77	1.59	0.11	0.93	3.40	3.29	0.90	9.15	9.00	8.25	8.00	3.96	3.96	4.00	18922
0.67	1.48	0.45	0.98	3.58	3.29	0.53	6.93	7.00	6.40	6.00	10.02	10.02	10.00	19161
0.11	1.08	none	3.49	4.68	4.11	0.23	5.00	5.00	4.77	4.00	0.32	4.86	5.00	19332
1.41	2.34	0.18	0.66	4.59	4.94	0.35	6.32	7.00	5.97	6.00	3.67	3.67	4.00	19375
1.01	0.07	0.72	1.81	3.61	3.30	1.40	9.88	8.00	8.48	8.00	4.48	4.48	4.00	19333
0.93	0.05	0.52	2.96	4.46	4.11	0.68	5.58	4.00	4.90	4.00	1.57	5.09	5.00	19525
0.15	0.80	0.34	0.58	1.87	1.64	1.28	8.76	9.00	7.48	8.00	3.38	3.38	3.00	19468
1.78	0.12	0.50	0.76	3.16	3.29	1.98	9.63	9.00	7.65	8.00	0.94	4.01	4.00	19381
0.80	1.30	0.26	0.95	3.31	3.29	1.00	9.50	9.00	8.50	8.00	6.78	6.78	6.00	19645
0.14	2.46	0.06	0.44	3.10	3.29	0.40	9.23	9.00	8.83	8.00	4.82	4.82	4.00	19470
0.06	1.61	0.60	0.98	3.25	3.29	1.90	10.75	9.00	8.85	8.00	5.48	5.48	6.00	19465
0.03	2.21	0.39	1.65	4.28	4.11	0.35	5.90	5.00	5.55	4.00	0.57	5.65	5.00	19472

TABLE XIV. ANALYSES OF

NITROGENOUS SUPERPHOSPHATES WITH POTASH—*Continued.*

Station No.	Manufacturer and Brand.		Place of Sampling.	Dealer's cash price per ton.	Nitrogen. In nitrates.	Nitrogen. In ammonia.	Nitrogen. Organic, water-soluble.	Nitrogen. Organic, water-insoluble.	Nitrogen. Total. Found.	Nitrogen. Total. Guaranteed.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. So-called "Available." Found.	Phosphoric Acid. So-called "Available." Guaranteed.	Potash. As muriate.	Potash. Total. Found.	Potash. Total. Guaranteed.	Station No.
	Sampled by Station:																			
	Everett B. Clark Seed Co., Milford.																			
19327	Special Mixture Corn Starter with 2% Potash	2.5-8-2	Factory	$38.00	1.46	0.72	0.13	0.69	3.00	2.46	1.33	9.60	8.25	8.27	8.00	2.86	2.86	2.00	19327
19046	Special Mixture for General Use, 4% Potash	3.3-10-4	Southport	36.60	0.99	1.32	0.25	0.88	3.44	3.28	1.20	12.10	10.25	10.90	10.00	3.18	4.12	4.00	19046
18963	Special Mixture with 6% Potash	3.3-8-6	Factory	45.00	0.61	1.50	0.25	0.98	3.34	3.28	0.93	9.85	8.25	8.92	8.00	6.58	6.58	6.00	18963
19328	Special Mixture Tip Top Brand	4.1-8-5	Southport	38.50	0.13	2.70	0.33	1.14	4.30	4.10	0.90	10.03	8.25	9.13	8.00	5.27	5.27	5.00	19328
	Coe-Mortimer Co., New York.																			
19159	Celebrated Special Potato Fertilizer	3.3-8-4	New Canaan	.....	0.57	1.22	0.36	1.22	3.37	3.29	1.28	9.28	9.00	8.00	8.00	2.21	3.66	4.00	19159
19473	Columbian Corn and Potato Fertilizer	1.7-8-3	Greenwich	55.00	0.10	0.84	0.09	0.62	1.65	1.65	0.63	8.87	9.00	8.24	8.00	2.96	2.96	3.00	19473
19337	Connecticut Wrapper Grower	4.1-4-5	Simsbury	56.00	0.99	0.03	0.37	3.00	4.39	4.11	0.28	4.89	5.00	4.61	4.00	0.35	5.07	5.00	19337
19158*	Gold Brand Excelsior Guano	2.5-8-4	New Canaan	42.00	0.49	1.11	0.16	0.82	2.58	2.47	1.05	9.78	9.00	8.73	8.00	3.76	3.76	4.00	19158
19109	New Englander Special	0.8-8-2	New Canaan	25.00	0.05	0.16	0.32	0.47	1.00	0.82	1.40	9.44	9.00	8.04	8.00	0.78	1.90	2.00	19109
19194†	Red Brand Excelsior Guano	3.3-8-7	Abington	53.00	0.86	0.90	0.49	0.90	3.15	3.29	0.90	9.05	9.00	8.15	8.00	6.78	6.78	7.00	19194
19378	Special Grass Top Dressing	4.9-6-4	Milford	60.00	1.97	1.24	0.75	0.87	4.83	4.94	1.03	7.25	7.00	6.22	6.00	4.28	4.28	4.00	19378
	Eastern States Farmers' Exchange, Springfield, Mass.																			
19331	2-8-2	1.7-8-2	Litchfield	.....	0.09	0.78	0.16	0.45	1.48	1.65	1.60	10.80	....	9.20	8.00	2.36	2.36	2.00	19331
19038	3-8-4	3.3-8-4	Madison	35.82	0.66	1.50	1.04	0.10	3.30	2.46	1.90	10.10	....	8.20	8.00	3.94	3.94	4.00	19038
19130	4-8-4	3.3-8-4	Branford	40.00	0.36	1.30	0.91	0.59	3.16	3.29	1.28	9.78	....	8.50	8.00	3.63	3.63	4.00	19130
19310	4-8-4	3.3-8-4	Granby	39.30	0.07	1.93	0.26	0.78	3.04	3.29	1.70	10.40	....	8.70	8.00	4.30	4.30	4.00	19310
19042	4-8-7	3.3-8-7	Madison	41.86	0.84	1.35	0.58	0.78	3.55	3.29	1.94	9.80	....	7.86	8.00	7.02	7.02	7.00	19042
19410	5-8-5	4.1-8-5	Granby	43.64	0.34	2.50	0.61	0.96	4.41	4.11	0.80	9.48	....	8.68	8.00	4.88	4.88	5.00	19410
19409	Tobacco Special	4.1-4-5	Granby	48.40	0.71	1.38	0.14	1.83	4.06	4.11	0.18	5.48	....	5.30	4.00	0.37	4.24	5.00	19409
	Essex Fertilizer Co., Boston, Mass.																			
19408	1-10-1 for Grain and Grass	0.8-10-1	Wallingford	40.00	0.04	0.06	0.43	0.43	0.96	0.82	0.98	11.43	11.00	10.45	10.00	0.97	0.97	1.00	19408
19415	2-8-2 for Farm and Garden	1.6-8-2	Cromwell	48.00	0.13	0.30	0.55	0.70	1.68	1.64	0.55	8.55	9.00	8.00	8.00	2.04	2.04	2.00	19415
19198*	4-8-4 for Potatoes, Roots and Vegetables	3.3-8-4	Hartford	.....	0.50	1.23	0.78	0.91	3.42	3.29	1.05	9.48	9.00	8.43	8.00	3.86	3.86	4.00	19198
19126	Fish Fertilizer, 3-8-3, for All Crops.	2.5-8-3	Wallingford	45.00	0.50	0.94	0.53	0.69	2.66	2.46	0.65	9.15	9.00	8.50	8.00	3.18	3.18	3.00	19126
19479	Market Garden, 3-8-4, for Vegetables and Grass	2.5-8-4	Wallingford	47.00	0.56	0.91	0.49	0.65	2.61	2.46	1.10	9.40	9.00	8.30	8.00	4.33	4.33	4.00	19479
19650	Essex Special Tobacco Grower, 5-5-5	4.1-5-5	East Granby	57.00	1.50	0.14	0.48	1.98	4.10	4.10	0.88	7.23	6.00	6.35	5.00	0.96	5.09	5.00	19650
19649	Tobacco, 5-4-3	4.1-4-3	West Suffield	.....	1.67	0.05	0.83	1.73	4.28	4.11	1.33	6.23	5.00	4.90	4.00	0.62	3.22	3.00	19649

* See note, page 111.
† See note, pages 108 and 111.

TABLE XIV. ANALYSES OF

Station No.	Manufacturer and Brand.		Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station:			
	L. T. Frisbie Co., New Haven.			
19011	5-8-7	4.1-8-7	Highwood	$44.00
19018	Corn and Grain Fertilizer	1.6-8-2	Danbury	34.00
19012	Market Garden, 4-8-6	3.3-8-6	Southport	37.50
19480	Special	2.5-8-4	North Haven	.....
19014	Superphosphate, 3-8-3	2.5-8-3	Danbury	33.25
19364	Tobacco Grower, 5-5-5	4.1-5-5	East Hartford	54.39
19455	Tobacco Manure, 5-8-6	4.1-8-6	Glastonbury	52.50
19624	Top Dresser, 7-5-4, for Grass and Market Gardens	5.8-5-4	Wethersfield	53.00
19017	Vegetable and Potato Grower	3.3-8-4	Danbury	42.00
	A. W. Higgins, Inc., South Deerfield, Mass.			
19724	Old Deerfield Fertilizer, 5-8-7	4.1-8-7	Suffield	.....
19725	Tobacco Fertilizer		Suffield	.....
	International Agricultural Corp., Boston, Mass.			
19369	Buffalo Complete Tobacco	3.3-4-4	West Suffield	.....
19488*	Buffalo Crop Grower	4.1-8-7	Pomfret Center	53.50
19484	Buffalo Economy	1.6-8-2	West Suffield	.....
19191	Buffalo Farmers' Choice	0.8-8-4	Ansonia	40.00
19036	Buffalo High-Grade Manure	3.3-6-10	East Haven	.....
19452	Buffalo New England Special	1.6-10-4	Litchfield	46.00
19486	Buffalo Tobacco Producer	4.5-5-5.5	Buckland	60.00
19458	Buffalo Top Dresser and Starter	5.8-6-5	West Suffield	.....
19035	Buffalo Vegetable and Potato	2.5-8-6	Ansonia	49.00
19413	Buffalo Vegetable and Potato	2.5-8-6	West Suffield	.....
	Levering Fertilizer Co., Baltimore, Md.			
19529*	General Fertilizer	3.3-8-4	Colchester	40.00
19151*	Market Garden	4.1-8-7	Middletown	50.00
19150	Potato Phosphate	2.5-8-4	Middletown	40.00
19167	Potato Special	3.3-8-6	Middletown	45.00
19166	Tobacco Special	4.1-5-5	Middletown	52.00

* See note, page 108.

NITROGENOUS SUPERPHOSPHATES WITH POTASH—*Continued.*

Nitrogen.						Phosphoric Acid.					Potash.			Station No.
				Total.			Total.		So-called "Available."			Total.		
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Citrate-insoluble.	Found	Guaranteed.	Found.	Guaranteed.	As muriate.	Found.	Guaranteed.	
0.82	1.08	1.06	1.07	4.03	4.10	1.05	10.05	9.00	9.00	8.00	7.18	7.18	7.00	19011
0.35	0.07	0.73	0.54	1.69	1.64	0.63	8.70	9.00	8.07	8.00	2.19	2.19	2.00	19018
0.83	1.07	0.63	0.79	3.32	3.28	1.08	9.35	9.00	8.27	8.00	5.99	5.99	6.00	19012
0.65	0.69	0.43	0.63	2.40	2.46	1.15	9.35	9.00	8.20	8.00	3.80	3.80	4.00	19480
0.47	0.82	0.59	0.64	2.52	2.46	0.95	9.40	9.00	8.45	8.00	3.26	3.26	3.00	19014
1.38	0.07	0.78	1.95	4.18	4.10	0.95	6.08	6.00	5.13	5.00	0.97	5.09	5.00	19364
1.99	0.07	1.10	1.32	4.48	4.10	0.75	9.10	9.00	8.35	8.00	1.08	6.12	6.00	19455
2.39	2.21	0.50	0.62	5.72	5.75	0.65	6.63	6.00	5.98	5.00	3.90	3.90	4.00	19624
1.25	0.67	0.66	0.76	3.34	3.28	1.28	9.50	9.00	8.22	8.00	4.32	4.32	4.00	19017
0.74	1.36	0.79	1.24	4.13	4.11	0.96	10.07	....	9.11	8.00	0.62	7.44	7.00	19724
0.16	1.04	0.69	3.93	5.82	...	0.26	6.41	....	6.15	....	0.85	5.91	....	19725
0.24	0.72	0.32	1.99	3.27	3.30	0.25	4.78	5.00	4.53	4.00	0.29	4.50	4.00	19369
1.43	0.34	0.55	0.75	3.07	4.10	0.47	7.20	9.00	6.73	8.00	8.96	8.96	7.00	19488
0.31	0.22	0.39	0.68	1.60	1.60	2.58	10.70	9.00	8.12	8.00	2.03	2.03	2.00	19484
0.04	0.44	0.15	0.34	0.97	0.80	1.15	9.73	9.00	8.58	8.00	3.87	3.87	4.00	19191
0.05	1.38	0.72	1.01	3.16	3.30	0.50	6.58	7.00	6.08	6.00	11.30	11.30	10.00	19036
0.56	0.22	0.17	0.68	1.63	1.60	0.85	11.25	11.00	10.40	10.00	3.78	3.78	4.00	19452
0.09	2.46	0.07	2.08	4.70	4.50	0.13	6.63	6.00	6.50	5.00	0.43	5.03	5.50	19486
0.88	2.64	0.41	1.77	5.70	5.80	0.10	6.38	7.00	6.28	6.00	0.77	5.00	5.00	19458
0.03	1.00	0.70	0.82	2.55	2.50	0.98	9.70	9.00	8.72	8.00	5.75	5.75	6.00	19035
0.26	0.83	0.75	0.79	2.63	2.50	0.68	8.90	9.00	8.22	8.00	6.47	6.47	6.00	19413
0.44	1.33	0.34	0.75	2.86	3.29	0.50	8.75	....	8.25	8.00	3.65	3.65	4.00	19529
0.34	2.54	0.35	0.66	3.89	4.12	1.08	9.28	....	8.20	8.00	7.14	7.14	7.00	19151
0.38	1.32	0.16	0.54	2.40	2.47	0.43	9.07	....	8.64	8.00	3.85	3.85	4.00	19150
0.41	1.77	0.27	0.66	3.11	3.29	0.48	9.20	....	8.72	8.00	5.41	5.41	6.00	19167
0.14	2.70	0.32	1.02	4.18	4.12	0.78	8.93	....	8.15	5.00	5.39	5.39	5.00	19166

TABLE XIV. ANALYSES OF

Station No.	Manufacturer and Brand.		Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station:			
	Lowell Fertilizer Co., Boston, Mass.			
19186	2-8-3 for Vegetables and Grain....	1.6-8-3	Cheshire	$33.60
19633	2-8-6 for Grain, Grass and Potatoes	1.6-8-6	Southford	44.00
19365	3-6-10 for Corn, Potatoes and Vegetables	2.5-6-10	Rockville	50.00
19185	4-6-10 for Potatoes and Vegetables	3.3-6-10	Cheshire	50.50
19187†	4-8-4 for Corn, Potatoes and Vegetables	3.3-8-4	Cheshire	47.00
18921	5-8-4 for Vegetables and Grass	4.1-8-4	Southington	57.00
19483*	5-8-7 for Potatoes and Vegetables.	4.1-8-7	South Manchester.	50.00
19053	Animal Brand 3-8-4 for All Crops..	2.5-8-4	Wallingford	45.00
19477	Bone Fertilizer, 2-8-2, for Corn, Grain, Grass and Vegetables.....	1.6-8-2	Southington	43.00
19050	Empress Brand, 1-10-1	0.8-10-1	Southington	40.00
19644	Tobacco, 5-5-5	4.1-5-5	South Manchester.	53.00
	Mapes Fertilizer and Peruvian Guano Co., New York.			
19414	Connecticut Valley Special	4.9-4-7	East Granby	60.00
19157	Corn Manure	2.5-8-3	Windsor Locks ...	46.00
19487	Cotton Seed Tobacco Manure	4.1-4-1	Melrose	49.00
19453	General Tobacco Manure	4.1-4-5	Hartford	56.00
19482	General Truck Manure	4.1-6-5	Hartford	51.00
19434	General Use Manure	2.5-6-4	Hartford	43.00
19359	Onion Manure	3.3-6-4	Hartford	47.00
19052	Potato Manure	3.3-7-5	Windsor Locks ...	49.00
19478	Tobacco Ash Constituents	0.8-4-15	Suffield	52.00
19367	Tobacco Manure Wrapper Brand..	6.2-2-10.5	South Windsor	73.00
19693	Tobacco Manure Wrapper Brand..	6.2-2-10.5	Burnside	.....
19156	Tobacco Starter Improved	4.1-6-1	Windsor Locks....	50.00
18967	Top Dresser	8.2-4-2	Windsor Locks....	66.00
	W. L. Mitchell, New Haven.			
19481	2-8-2	1.6-8-2	Ansonia	38.00
19358‡	5-8-7	4.1-8-7	Ansonia	51.00
19694	5-8-7	4.1-8-7	Somers	49.00

* See note, page 108.
† See note, page 111.
‡ See note, page 110.

NITROGENOUS SUPERPHOSPHATES WITH POTASH—*Continued.*

Nitrogen.						Phosphoric Acid.					Potash.			Station No.
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Total. Found.	Total. Guaranteed.	Citrate-insoluble.	Total. Found	Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	As muriate.	Total. Found.	Total. Guaranteed.	
0.02	0.82	0.36	0.59	1.79	1.64	0.65	8.76	9.00	8.11	8.00	2.83	2.83	3.00	19186
0.09	0.04	0.73	0.95	1.81	1.64	0.55	9.11	9.00	8.56	8.00	6.88	6.88	6.00	19633
0.89	0.03	0.68	0.90	2.50	2.46	0.40	6.53	7.00	6.13	6.00	10.46	10.46	10.00	19365
1.24	0.84	0.63	0.69	3.40	3.28	0.73	7.10	7.00	6.37	6.00	10.18	10.18	10.00	19185
0.56	1.21	0.75	0.91	3.43	3.28	1.03	9.45	9.00	8.42	8.00	3.88	3.88	4.00	19187
1.76	0.08	1.17	1.30	4.31	4.10	0.60	9.43	9.00	8.83	8.00	4.09	4.20	4.00	18921
1.38	0.54	0.72	1.17	3.81	4.10	0.68	8.80	9.00	8.12	8.00	6.99	6.99	7.00	19483
0.62	0.84	0.48	0.58	2.52	2.46	1.00	9.05	9.00	8.05	8.00	3.98	3.98	4.00	19053
0.07	0.60	0.46	0.60	1.73	1.64	0.53	9.30	9.00	8.77	8.00	1.93	1.93	2.00	19477
0.02	0.08	0.50	0.32	0.92	0.82	0.70	10.78	11.00	10.08	10.00	1.00	1.00	1.00	19050
1.60	0.12	0.63	1.95	4.30	4.10	0.83	6.65	6.00	5.82	5.00	5.01	5.01	5.00	19644
2.74	0.08	0.50	1.93	5.25	4.94	1.38	5.88	....	4.50	4.00	1.52	6.94	7.00	19414
0.87	0.80	0.15	0.45	2.27	2.47	2.35	10.27	10.00	7.92	8.00	3.95	3.95	3.00	19157
1.69	0.08	0.25	2.08	4.10	4.12	1.93	6.35	....	4.42	4.00	0.61	2.92	1.00	19487
2.28	0.05	0.12	1.97	4.42	4.12	1.50	5.65	....	4.15	4.00	1.05	5.24	5.00	19453
2.77	0.95	0.07	0.55	4.34	4.12	2.58	9.38	8.00	6.80	6.00	4.49	5.16	5.00	19482
1.77	0.55	0.04	0.40	2.76	2.47	2.65	8.95	8.00	6.30	6.00	2.95	4.17	4.00	19434
3.29	0.04	0.15	0.44	3.92	3.29	2.55	8.55	8.00	6.00	6.00	0.35	3.65	4.00	19359
1.59	1.49	0.04	0.38	3.50	3.29	1.93	9.05	8.00	7.12	7.00	5.01	5.01	5.00	19052
0.12	0.04	0.11	0.96	1.23	0.82	2.69	6.38	6.00	3.69	4.00	1.71	15.05	‡15.00	19478
4.19	0.03	0.68	1.69	6.59	6.18	1.05	5.10	4.50	4.05	2.00	1.14	9.01	10.50	19367
3.37	....	0.69	2.04	6.10	6.18	1.53	5.93	4.50	4.40	2.00	1.70	11.26	10.50	19693
3.71	0.09	0.24	0.78	4.82	4.12	1.70	8.08	8.00	6.38	6.00	0.70	.144	1.00	19156
2.86	4.82	0.10	0.46	8.24	8.22	1.48	6.50	6.00	5.02	4.00	2.02	2.55	2.00	18967
0.08	0.72	0.40	0.48	1.68	1.64	1.45	9.60	9.00	8.15	8.00	2.14	2.14	2.00	19481
1.16	1.16	0.30	0.80	3.42	4.10	1.24	8.92	9.00	7.68	8.00	6.48	6.48	7.00	19358
0.09	2.94	0.29	0.47	3.79	4.10	1.33	9.65	9.00	8.32	8.00	6.71	6.71	7.00	19694

‡ 6.53 as sulphate; 6.81 as carbonate.

TABLE XIV. ANALYSES OF

Station No.	Manufacturer and Brand.		Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station:			
	New England Fertilizer Co., Boston, Mass.			
19120	2-8-3 for Vegetables and Grain....	1.6-8-3	Meriden	$40.00
19692	2-8-3 for Vegetables and Grain....	1.6-8-3	East Woodstock ..	42.00
19125	3-8-4 Superphosphate for All Crops	2.5-8-4	East Wallingford..	45.00
19195†	4-8-6 for Potatoes and Vegetables..	3.3-8-6	Putnam	38.00
19196*	5-8-7 for Potatoes and Market Gardens	4.1-8-7	Putnam	43.00
19366	Corn Phosphate, 2-8-2, for Grain and Vegetables	1.6-8-2	Rockville	44.00
19666	Special Tobacco Grower, 5-4-3....	4.1-4-3	Warehouse Point..	.....
19363	Tobacco, 5-5-5	4.1-5-5	Unionville	57.00
19634	Tobacco Manure, 5-8-6	4.1-8-6	Warehouse Point..	54.00
	Olds & Whipple, Inc., Hartford.			
19091	Complete Corn, Onion and Potato Fertilizer	3.3-8-4	Silver Lane	45.00
19498	Complete Tobacco Fertilizer.....	4.1-4-5	South Windsor ...	51.30
19051	Grass Fertilizer	5-8-6	Factory	48.83
19416	High-Grade Potato Fertilizer.....	4.1-8-7	Wethersfield	56.00
19500	High-Grade Starter and Potash Compound	4.1-4-15	Factory	60.98
19501	Special Corn, Onion and Potato Fertilizer	2.5-8-2	Factory	36.23
	Parmeter & Polsey Fertilizer Co., Boston, Mass.			
19417	2-8-2 for Farm and Garden.....	1.6-8-2	South Manchester.	40.00
19200	4-8-4 for Potatoes, Corn and Vegetables	3.3-8-4	Wallingford	50.00
19631	Tobacco, 5-4-3	4.1-4-3	Gaylordsville	50.00
19632	5-5-5	4.1-5-5	Gaylordsville	54.00
19626	5-8-4 for Potatoes, Corn and Vegetables	4.1-8-4	Stafford Springs ..	.....
19625*	5-8-7 for Potatoes and Market Gardens	4.1-8-7	Stafford Springs ..	57.00
19362	Plymouth Rock Brand, 3-8-4, for All Crops	2.5-8-4	Plainville	43.00
	Frank S. Platt Co., New Haven.			
18901	Platco Special	3.3-8-6	Factory	47.00

* See note, page 108.
† See note, page 111.

NITROGENOUS SUPERPHOSPHATES WITH POTASH—*Continued.*

Nitrogen.						Phosphoric Acid.					Potash.			
				Total.			Total.		So-called "Available."			Total.		
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Citrate-insoluble.	Found	Guaranteed.	Found.	Guaranteed.	As muriate.	Found.	Guaranteed.	Station No.
0.14	0.70	0.43	0.49	1.76	1.64	0.60	8.66	9.00	8.06	8.00	2.44	2.44	3.00	19120
0.10	0.63	0.30	0.65	1.68	1.64	0.68	9.08	9.00	8.40	8.00	2.98	2.98	3.00	19692
0.60	0.91	0.48	0.61	2.60	2.46	1.08	9.13	9.00	8.05	8.00	4.17	4.17	4.00	19125
0.68	1.14	0.58	0.94	3.34	3.28	0.98	9.33	9.00	8.35	8.00	5.87	5.87	6.00	19195
1.35	0.59	0.79	1.07	3.80	4.10	0.75	9.30	9.00	8.55	8.00	7.14	7.14	7.00	19196
0.12	0.62	0.39	0.51	1.64	1.64	0.56	8.35	9.00	7.79	8.00	1.76	1.76	2.00	19366
1.53	0.05	0.75	1.96	4.29	4.10	0.80	5.60	5.00	4.80	4.00	0.45	3.48	3.00	19666
0.68	0.82	0.91	1.73	4.14	4.10	0.75	6.85	6.00	6.10	5.00	0.86	5.57	5.00	19363
1.50	0.06	1.05	1.39	4.00	4.10	0.75	9.45	9.00	8.70	8.00	0.89	6.39	6.00	19634
1.47	0.04	0.16	1.70	3.37	3.30	1.63	9.78	8.00	8.15	8.00	4.58	4.58	4.00	19091
0.82	0.06	0.46	3.02	4.36	4.11	0.80	5.85	4.00	5.05	4.00	0.64	5.10	5.00	19498
2.47	0.04	0.70	2.09	5.30	4.95	1.74	9.91	8.00	8.17	8.00	6.70	6.70	6.00	19051
1.61	0.04	none	2.77	4.42	4.11	2.10	10.45	8.00	8.35	8.00	4.90	7.50	7.00	19416
1.50	0.04	0.29	2.48	4.31	4.11	0.45	5.13	4.00	4.68	4.00	1.90	16.07	15.00	19500
1.16	0.02	0.24	1.25	2.67	2.45	1.35	9.95	8.00	8.60	8.00	2.50	2.50	2.00	19501
0.14	0.59	0.34	0.56	1.63	1.64	0.55	8.48	9.00	7.93	8.00	2.09	2.09	2.00	19417
0.49	1.19	0.75	0.91	3.34	3.28	1.05	9.45	9.00	8.40	8.00	4.02	4.02	4.00	19200
1.26	0.08	0.79	1.77	3.90	4.10	1.03	5.95	5.00	4.92	4.00	0.82	3.68	3.00	19631
1.38	0.07	0.85	1.80	4.10	4.10	0.80	6.85	6.00	6.05	5.00	0.82	5.61	5.00	19632
1.57	0.06	1.11	1.32	4.06	4.10	0.70	9.78	9.00	9.08	8.00	4.31	4.31	4.00	19626
1.28	0.56	0.88	1.08	3.80	4.10	0.75	9.18	9.00	8.43	8.00	7.09	7.09	7.00	19625
0.56	0.88	0.50	0.59	2.53	2.46	0.95	9.05	9.00	8.10	8.00	3.90	3.90	4.00	19362
1.90	0.05	0.75	0.77	3.47	3.29	0.55	9.25	9.00	8.70	8.00	5.72	5.72	6.00	18901

TABLE XIV. ANALYSES OF

Station No.	Manufacturer and Brand.		Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station:			
	The Rogers & Hubbard Co., Portland.			
19248*	Hubbard's Bone Base Fertilizer for Seeding Down	2.5-6-4	North Haven	$52.00
19623*	Hubbard's Bone Base Fertilizer for Seeding Down	2.5-6-4	Seymour	50.00
19095	Hubbard's Bone Base Fertilizer for Oats and Top Dressing	8.2-3-8	Norwich	68.00
19096	Hubbard's Bone Base Soluble Corn and General Crops Manure	2.5-8-6	Norwich	52.00
19380	Hubbard's Bone Base Soluble Potato Manure	5-8-5	East Hampton	73.50
18962	R. & H. 4-8-4 Phosphate	3.3-8-4	Hartford	54.00
19361	R. & H. Climax Tobacco Brand	4.1-4-4	Glastonbury	.....
19494	R. & H. Complete Phosphate	0.8-10-3	Norwich	40.00
19495	R. & H. Potato Phosphate	1.6-8-4	Norwich	43.00
19368	R. & H. Soluble Tobacco Manure	5-8-10	Thompsonville	66.50
19360	R. & H. Tobacco Grower, Vegetable Formula	5-4-4	Glastonbury	.....
18961	Garden Phosphate‡	1.6-8-4	Hartford	47.00
	F. S. Royster Guano Co., Baltimore, Md.			
19356*	Arrow Head Tobacco Formula	4.1-4-3	Granby	57.00
19240	Bully Guano	1.6-8-5	Ansonia	44.00
19503	Fish, Flesh and Fowl	1.6-8-3	Trumbull	40.00
19128	Fish and Potash	1.6-8-1	Plantsville	35.00
19124†	Quality Trucker	3.3-8-7	Guilford	42.00
19642†	Quality Trucker	3.3-8-7	Rockville	.....
18788	Trucker's Delight	3.3-8-4	Milford	47.00
19353	Valley Tobacco Formula	4.1-4-5	Glastonbury	52.00
	Sanderson Fertilizer & Chemical Co., New Haven.			
19123	Atlantic Coast Bone, Fish and Potash	1.6-8-3	Guilford	40.00
19306	Atlantic Coast Bone, Fish and Potash	1.6-8-3	West Cheshire	42.00
19497	Complete Tobacco Grower	4.1-4-5	Windsor Locks	.....
19348	Corn Superphosphate	1.6-8-2	Seymour	45.00
19086	Formula A	3.3-8-4	East Haven	.....
19087	Formula B	3.3-8-6	Highwood	.....
19127§	Potato Manure	2.5-8-4	West Cheshire	46.50
19305	Potato Manure	2.5-8-4	Hamden	48.00
19507*	Top Dressing for Grass and Grain	5-6-4	Seymour	57.00
19436	Kelsey's Bone, Fish and Potash	2.5-10-3	Factory	42.25

* See note, page 108.
† See note, pages 108 and 110.
‡ Potato Phosphate Formula.
§ See note, page 111.

NITROGENOUS SUPERPHOSPHATES WITH POTASH—*Continued.*

Nitrogen.						Phosphoric Acid.					Potash.			Station No.
				Total.			Total.		So-called "Available."			Total.		
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Citrate-insoluble.	Found	Guaranteed.	Found.	Guaranteed.	As muriate.	Found.	Guaranteed.	
none	0.75	0.41	0.89	2.05	2.46	9.13	14.57	15.00	5.44	6.00	4.27	4.27	4.00	19248
0.10	0.91	0.34	0.89	2.24	2.46	8.64	14.20	15.00	5.56	6.00	3.85	3.85	4.00	19623
5.01	2.99	0.06	0.31	8.37	8.22	1.75	7.70	8.00	5.95	3.00	7.87	7.87	8.00	19095
0.03	1.41	0.68	0.62	2.74	2.46	0.95	10.00	10.00	9.05	8.00	5.87	5.87	6.00	19096
0.91	2.19	1.11	0.99	5.20	5.00	1.20	9.28	10.00	8.08	8.00	1.06	5.22	5.00	19380
0.01	2.69	0.29	0.73	3.72	3.29	0.93	9.33	9.00	8.40	8.00	4.10	4.10	4.00	18962
0.17	1.06	0.37	2.80	4.40	4.11	0.20	5.30	5.00	5.10	4.00	0.85	4.40	4.00	19361
0.24	0.06	0.13	0.57	1.00	0.82	2.00	12.15	11.00	10.15	10.00	3.11	3.11	3.00	19494
0.05	0.87	0.33	0.57	1.82	1.64	1.70	10.05	9.00	8.35	8.00	4.26	4.26	4.00	19495
1.69	1.38	1.03	1.10	5.20	5.00	0.98	9.78	10.00	8.80	8.00	1.78	10.32	10.00	19368
1.30	0.11	0.74	3.05	5.20	4.93	1.03	5.58	5.00	4.55	4.00	0.58	4.20	4.00	19360
0.06	0.58	0.31	0.76	1.71	1.64	0.98	9.48	9.00	8.50	8.00	4.00	4.00	4.00	18961
0.24	0.76	0.30	2.44	3.74	4.11	0.38	5.20	4.50	4.82	4.00	0.29	3.26	3.00	19356
0.09	0.91	0.05	0.50	1.55	1.65	0.85	9.38	8.50	8.53	8.00	4.31	4.31	5.00	19240
0.05	1.00	0.10	0.44	1.59	1.65	0.78	8.75	8.50	7.97	8.00	3.12	3.12	3.00	19503
0.04	1.04	0.14	0.49	1.71	1.65	0.60	9.30	8.50	8.70	8.00	1.03	1.03	1.00	19128
0.11	2.04	0.22	0.92	3.29	3.29	1.23	8.96	8.50	7.73	8.00	6.66	6.66	7.00	19124
0.50	1.50	0.30	0.80	3.10	3.29	0.65	8.85	8.50	8.20	8.00	6.59	6.59	7.00	19642
none	2.12	1.17		3.29	3.29	0.93	8.99	8.50	8.06	8.00	4.12	4.12	4.00	18788
0.32	0.94	0.37	2.62	4.25	4.11	0.48	4.68	4.50	4.20	4.00	0.45	4.97	5.00	19353
0.45	0.28	0.21	0.90	1.84	1.65	1.08	9.48	9.00	8.40	8.00	2.99	2.99	3.00	19123
0.46	0.42	0.10	0.98	1.96	1.65	1.20	9.78	9.00	8.58	8.00	3.06	3.06	3.00	19306
1.01	0.07	0.40	2.68	4.16	4.11	0.28	4.55	5.00	4.27	4.00	0.52	5.06	5.00	19497
0.06	0.52	0.39	0.84	1.81	1.65	0.75	9.33	9.00	8.58	8.00	2.15	2.15	2.00	19348
0.70	1.58	0.49	0.73	3.50	3.29	1.02	9.36	9.00	8.34	8.00	3.89	4.07	4.00	19086
0.84	1.16	0.40	1.14	3.54	3.29	1.80	10.30	9.00	8.50	8.00	0.77	6.22	6.00	19087
0.31	0.80	0.48	0.96	2.55	2.47	0.63	9.03	9.00	8.40	8.00	3.73	3.73	4.00	19127
0.31	0.62	0.08	1.46	2.47	2.47	0.65	9.03	9.00	8.38	8.00	4.86	4.86	4.00	19305
1.88	1.06	0.87	0.86	4.67	4.94	0.90	7.20	7.00	6.30	6.00	3.78	3.78	4.00	19507
0.38	0.82	0.39	0.90	2.49	2.47	1.08	11.28	11.00	10.20	10.00	3.10	3.10	3.00	19436

TABLE XIV. ANALYSES OF

Station No.	Manufacturer and Brand.		Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station:			
	M. L. Shoemaker & Co., Philadelphia, Pa.			
19516	Swift-Sure Superphosphate Crop Grower	3.3-8-4	Hartford	$44.65
19648	Swift-Sure Superphosphate Potato No. 1	3.3-8-5	Granby	47.75
19129	Swift-Sure Superphosphate, Tobacco and General Use	2.5-10-3	Glastonbury	.....
	Springfield Rendering Co., Springfield, Mass.			
19441	4-8-6	3.3-8-6	Thompsonville	48.75
19511	Animal Brand, 3-8-4	2.5-8-4	Thompsonville	42.00
19351	Market Garden Grower and Top Dresser, 5-8-7	4.1-8-7	Hazardville	57.00
19628	Special Potato, Onion and Vegetable, 4-8-4	3.3-8-4	Suffield	44.00
19460	Tobacco Special, 5-5-5	4.1-5-5	Thompsonville	57.00
	Virginia-Carolina Chemical Co., New York.			
18920	Champion Brand	3.3-8-4	Plantsville	38.00
19241	Double Owl Brand	3.3-8-6	Guilford	40.50
19432	Eureka Brand	1.6-8-10	North Haven	44.65
19247	Fish, Phosphate and Potash Brand.	1.6-8-2	North Haven	38.00
19352	Indian Chief Brand	4.1-4-5	Hazardville	54.50
19131	Owl Brand	1.6-8-3	Groton	.....
19357	Perfection Brand	2.5-9-5	Broad Brook	41.00
19647	Perfection Brand	2.5-9-5	Granby	33.95
19121	Plow Brand	0.8-8-1	Plantsville	30.00
	What Cheer Chemical Co., Pawtucket, R. I.			
19664*	Superior Brand	3.3-8-4	New London	50.00
	Wilcox Fertilizer Co., Mystic.			
19069	4-8-4 Fertilizer	3.3-8-4	Branford	40.00
19627	4-8-4 Fertilizer	3.3-8-4	Ellington	43.00
19074	5-8-7 Fertilizer	4.1-8-7	Factory	.....
19513	Corn Special	2.5-8-4	Northford	37.50
19066	Fish and Potash	2.5-6-3	Suffield	39.00
19665	Fish and Potash	2.5-6-3	Branford	35.00
19249	Grain Fertilizer	1.6-8-2	Northford	.....
19075	Grass and Truck Fertilizer	4.1-8-4	Factory	.....
19431	Potato Fertilizer	1.6-8-3	Suffield	38.00
19438	Potato and Vegetable Phosphate	3.3-8-6	Ellington	44.00
19514	Tobacco Special	4.1-4-5	Ellington	49.00

* See note, page 108.

NITROGENOUS SUPERPHOSPHATES WITH POTASH—*Continued.*

Nitrogen.						Phosphoric Acid.					Potash.			Station No.
				Total.			Total.		So-called "Available."			Total.		
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Citrate-insoluble.	Found	Guaranteed.	Found.	Guaranteed.	As muriate.	Found.	Guaranteed.	
1.71	0.08	0.38	1.17	3.34	3.30	2.43	11.63	10.00	9.20	8.00	4.07	4.07	4.00	19516
1.35	0.08	0.29	1.35	3.07	3.30	2.28	11.10	11.00	8.82	8.00	5.41	5.41	5.00	19648
0.68	0.04	0.46	1.12	2.30	2.46	3.13	13.23	11.00	10.10	10.00	1.34	3.06	3.00	19129
0.66	0.84	1.02	0.70	3.22	3.28	0.50	9.03	9.00	8.53	8.00	6.12	6.12	6.00	19441
0.38	0.56	0.83	0.56	2.33	2.46	0.48	8.83	9.00	8.35	8.00	4.03	4.03	4.00	19511
1.18	1.00	1.03	0.79	4.00	4.10	0.68	9.08	9.00	8.40	8.00	7.14	7.14	7.00	19351
0.71	0.71	0.90	0.79	3.11	3.29	0.53	8.90	9.00	8.37	8.00	4.10	4.10	4.00	19628
0.95	0.43	0.88	1.88	4.14	4.10	0.83	6.90	6.00	6.07	5.00	0.98	5.14	5.00	19460
0.06	2.40	0.14	0.58	3.18	3.29	0.68	9.75	9.00	9.07	8.00	3.98	3.98	4.00	18920
none	3.02	0.15	0.42	3.59	3.29	0.83	9.25	9.00	8.42	8.00	5.96	5.96	6.00	19241
0.03	1.10	0.08	0.34	1.55	1.65	0.55	9.53	9.00	8.98	8.00	8.57	9.77	10.00	19432
0.06	0.84	0.20	0.77	1.87	1.65	1.10	9.78	9.00	8.68	8.00	1.96	1.96	2.00	19247
0.56	0.60	0.30	3.04	4.50	4.11	0.43	5.03	5.00	4.60	4.00	0.92	5.06	5.00	19352
0.08	1.10	0.15	0.39	1.72	1.65	0.73	9.63	9.00	8.90	8.00	2.70	2.70	3.00	19131
0.16	2.00	0.05	0.46	2.67	2.47	0.55	9.79	10.00	9.24	9.00	4.91	4.91	5.00	19357
0.16	1.88	none	0.65	2.69	2.47	0.43	9.88	10.00	9.45	9.00	5.67	5.67	5.00	19647
0.04	0.54	0.09	0.29	0.96	0.82	1.05	10.30	9.00	9.25	8.00	1.00	1.00	1.00	19121
0.98	0.26	0.53	1.41	3.18	3.28	1.00	8.62	9.00	7.62	8.00	3.99	3.99	4.00	19664
0.18	1.38	0.74	1.23	3.53	3.29	1.15	10.18	9.00	9.03	8.00	3.81	3.81	4.00	19069
0.58	1.36	0.60	1.06	3.60	3.29	1.16	9.30	9.00	8.14	8.00	3.69	3.69	4.00	19627
1.20	1.48	0.49	1.15	4.32	4.12	0.83	9.03	9.00	8.20	8.00	5.74	6.96	7.00	19074
0.56	0.78	0.19	0.97	2.50	2.46	0.90	9.19	9.00	8.29	8.00	3.85	3.85	4.00	19513
0.62	0.17	2.02		2.81	2.46	0.45	7.28	7.00	6.83	6.00	2.82	2.82	3.00	19066
0.45	0.26	0.56	1.30	2.57	2.46	0.75	7.28	7.00	6.53	6.00	3.22	3.22	3.00	19665
0.25	0.92	0.46	0.42	2.05	1.65	0.38	8.69	9.00	8.31	8.00	3.99	3.99	2.00	19249
0.71	1.85	0.69	1.05	4.30	4.12	1.38	9.48	9.00	8.10	8.00	3.80	3.80	4.00	19075
0.35	0.12	0.39	1.19	2.05	1.65	2.60	10.80	9.00	8.20	8.00	1.99	3.75	3.00	19431
0.58	1.20	1.00	0.94	3.72	3.29	0.75	8.47	9.00	7.72	8.00	5.75	5.75	6.00	19438
0.89	0.13	0.62	2.87	4.51	4.12	2.50	7.10	5.00	4.60	4.00	0.12	5.34	5.00	19514

TABLE XIV. ANALYSES OF

Station No.	Manufacturer and Brand.		Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station:			
	Witherbee, Sherman Co., New York.			
19440	Truck Grower	3.3-8-6	Higganum	$44.15
	S. D. Woodruff & Sons, Orange.			
19521	Home Mixed Fertilizer	3.3-8-4	Factory	46.00
	Worcester Rendering Co., Auburn, Mass.			
19663*	Prosperity Brand Complete Dressing	4.9-6-3	Norwich	42.00
19661	Prosperity Brand Corn and Grain, 2-8-2	1.6-8-2	Willimantic	38.00
19662	Prosperity Brand Market Garden, 4-6-8	3.3-6-8	Willimantic	46.00
19442	Prosperity Brand Potato and Vegetable, 4-8-4	3.3-8-4	Norwich	38.00
	Sampled by Purchaser:			
19446	American Agr. Chem. Co. National Complete Tobacco Fertilizer	4.1-4-5	Warehouse Point	56.00
19325	Atlantic, 4-8-6	3.3-8-6	Southbury	39.50
19491	Chittenden's Tobacco Special	4.1-4-5	Rockville	46.40
19270	Olds & Whipple's High-Grade Starter and Potash Compound	4.1-4-15	East Windsor Hill.	59.25

* See note, page 108.

NITROGENOUS SUPERPHOSPHATES WITH POTASH—*Concluded.*

Nitrogen.						Phosphoric Acid.					Potash.			Station No.
				Total.			Total.		So-called "Available."			Total.		
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Citrate-insoluble.	Found	Guaranteed.	Found.	Guaranteed.	As muriate.	Found.	Guaranteed.	
0.65	1.43	0.40	0.88	3.36	3.29	0.53	8.35	....	7.82	8.00	5.98	5.98	6.00	19440
1.31	0.06	0.05	3.20	4.62	3.29	0.59	7.22	....	6.63	8.00	4.69	4.69	4.00	19521
2.41	0.03	0.98	1.10	4.52	4.90	0.70	7.00	7.00	6.30	6.00	3.20	3.20	3.00	19663
0.81	0.04	0.32	0.48	1.65	1.64	0.20	8.28	9.00	8.08	8.00	2.13	2.13	2.00	19661
0.91	0.17	1.46	1.32	3.86	3.29	0.45	7.00	7.00	6.55	6.00	6.44	6.44	8.00	19662
1.66	0.08	0.83	0.92	3.49	3.28	0.35	8.35	9.00	8.00	8.00	4.07	4.07	4.00	19442
....	....	....	....	4.25	4.11	0.30	4.70	5.00	4.40	4.00	0.27	4.82	5.00	19446
....	....	....	....	3.46	3.28	0.75	9.80	9.00	9.05	8.00	6.11	6.11	6.00	19325
....	....	....	....	3.79	4.11	0.20	6.20	5.00	6.00	4.00	4.82	4.82	5.00	19491
....	....	....	....	4.38	4.11	0.45	5.10	4.00	4.65	4.00	2.02	15.34	15.00	19270

HOME MIXTURES AND SPECIAL MIXTURES.

The 53 samples whose analyses are given in Table XVI represent mixtures made by corporations or individuals for their own use from chemicals bought by them for the purpose. There are also included analyses of special mixtures, made by fertilizer manufacturers according to the formula ordered by the customer.

The formulas used in mixing were given in 17 cases, and appear in Table XV.

The actual cost of the materials used was given in only six cases, and is included in the table.

TABLE XV. FORMULAS OF SOME OF THE HOME MIXTURES IN TABLE XVI.

	Cotton Seed Meal.	Castor Pomace.	Fish.	Tankage.	Nitrate of Soda.	Sulphate of Ammonia.	Bone.	H. G. Sulphate of Potash.	Muriate of Potash.	Acid Phosphate.	Cost of Materials.
19669 and 19670	700	300	300	....	200	....	300	200	....	....	
18735	1200	....	....	....	....	....	500	300	....	....	
19177	....	....	....	750	100	....	....	200	200	750	
19141	....	....	400	....	200	....	....	....	200	1200	
19490	500	500	300	....	....	....	400	300	....	....	
19532	1050	400	....	....	100	....	150	200	....	100	
19250	800	200	300	....	....	....	400	300	....	....	
19251*	500	500	300	....	200	....	....	300	....	....	
19252*	....	1000	400	....	100	....	....	300	....	....	
19253	....	....	300	300	150	200	....	350	....	700	
19211†	950	300	300	....	50	....	200	....	....	....	$55.67
18770	1200	....	....	....	....	....	500	300	....	....	
19030	....	....	650	....	100	....	....	....	250	1000	35.33
19031	....	....	1000	....	200	....	....	....	....	800	39.72
19032	....	....	1000	....	100	....	....	....	....	900	37.81
19033	300	....	500	....	200	....	....	....	200	800	38.27

* Also precipitated bone 200 lbs.
† Also carbonate of potash 200 lbs.

TABLE XVI. ANALYSES OF

Station No.	Manufacturer.	Purchased, Sampled or Sent by.	Dealer's cash price per ton.
		Station Agent from	
19669	American Agricultural Chemical Co., New York	Arthur Manning, So. Manchester	$66.50
19670	American Agricultural Chemical Co., New York	Arthur Manning, So. Manchester	70.00
18735	Apothecaries Hall Co., Waterbury	F. R. & R. M. Goodrich, Portland	55.00
19177	Apothecaries Hall Co., Waterbury	Conn. School for Boys, Meriden	42.75
19140	Berkshire Fertilizer Co., Bridgeport	Farmers' Exchange, Putnam	....
19141	Berkshire Fertilizer Co., Bridgeport	Farmers' Exchange, Putnam	....
19490	L. T. Frisbie Co., New Haven	Levi Hickey, East Hartford	45.00
19461	Mapes Formula & Peruvian Guano Co., New York	W. C. Sanders, New Haven	....
19462	Mapes Formula & Peruvian Guano,Co. New York	W. C. Sanders, New Haven	....
19532	Olds & Whipple, Inc., Hartford	F. N. Buckland, Glastonbury	52.50
19292	Olds & Whipple, Inc., Hartford	L. W. Newbury, South Windsor	52.00
19101	Olds & Whipple, Inc., Hartford	H. Whitaker, Hazardville	63.50
19146	The Rogers & Hubbard Co., Portland	A. N. Shepard & Son, Rockville	....
19148	The Rogers & Hubbard Co., Portland	A. N. Shepard & Son, Rockville	....
19534	Sanderson Fertilizer Co., New Haven	Preston Co-op. Exchange, Norwich	34.25
19535	Sanderson Fertilizer Co., New Haven	Preston Co-op. Exchange, Norwich	41.25
19536	Sanderson Fertilizer Co., New Haven	Preston Co-op. Exchange, Norwich	26.75
19537	Sanderson Fertilizer Co., New Haven	Preston Co-op. Exchange, Norwich	36.25
19076	....	Allied Tobacco Co., Hartford	....
19077	....	Allied Tobacco Co., Hartford	....
18597	....	American Sumatra Tobacco Co., Bloomfield	....
18660	....	American Sumatra Tobacco Co., Bloomfield	....
18661	....	American Sumatra Tobacco Co., Bloomfield	....
18730	....	American Sumatra Tobacco Co., Bloomfield	....

SPECIAL MIXTURES AND HOME MIXTURES.

Nitrogen.						Phosphoric Acid.					Potash.			Station No.
				Total.			Total.		So-called "Available."			Total.		
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As muriate.	Found.	Guaranteed.	
....	....	....	....	5.83	....	0.70	5.05	....	4.35	....	....	6.81	....	19669
1.42	0.08	0.67	3.26	5.43	....	0.75	5.90	....	5.15	....	1.77	5.82	....	19670
....	0.12	....	....	5.06	....	1.65	7.04	....	5.39	....	0.22	8.20	....	18735
0.79	0.09	2.95		3.83	....	1.85	9.38	....	7.53	....	8.57	10.07	....	19177
1.42	0.34	2.24		4.00	....	1.65	12.00	....	10.35	....	5.70	5.70	....	19140
1.74	0.26	1.36		3.36	....	0.20	11.93	....	11.73	....	5.59	5.59	....	19141
....	....	....	....	4.60	....	1.78	7.80	....	6.02	....	....	8.75	....	19490
....	....	....	....	2.34	1.65	3.35	9.40	....	6.05	5.00	1.28	8.63	10.00	19461
....	....	....	....	1.98	1.65	1.80	7.15	....	5.35	5.00	0.47	5.98	5.00	19462
0.82	0.06	0.30	3.90	5.08	....	0.20	5.75	....	5.55	....	0.65	5.84	....	19532
1.70	none	4.05		5.75	....	0.30	6.40	....	6.10	....	0.64	8.28	....	19292
....	....	....	....	5.93	5.75	0.20	5.00	4.00	4.80	4.00	0.44	5.50	5.00	19101
0.20	1.40	3.42		5.02	....	0.10	6.24	....	6.14	....	1.42	11.94	....	19146
0.14	1.91	3.38		5.43	....	0.10	7.92	....	7.82	....	1.21	12.02	....	19148
....	....	....	....	3.34	3.29	1.65	9.83	9.00	8.18	8.00	....	4.31	4.00	19534
....	....	....	....	3.96	4.11	0.40	9.08	9.00	8.68	8.00	....	7.45	7.00	19535
....	....	....	....	1.70	1.65	0.68	9.45	9.00	8.77	8.00	....	2.31	2.00	19536
....	....	....	....	3.50	3.29	2.35	10.93	9.00	8.58	8.00	....	5.88	6.00	19537
0.75	0.08	4.72		5.55	....	0.73	5.70	....	4.97	....	0.58	6.14	....	19076
1.10	0.07	4.77		5.94	....	0.60	5.83	....	5.23	....	0.47	5.33	....	19077
none	0.04	4.52		4.56	....	0.15	8.35	....	8.20	....	0.62	8.94	....	18597
....	0.05	5.43		5.48	....	0.15	5.46	....	5.31	....	0.27	7.04	....	18660
....	0.05	3.65		3.70	....	0.23	10.77	....	10.54	....	0.35	8.66	....	18661
....	....	....	....	4.64	....	0.12	8.25	....	8.13	....	0.44	8.51	....	18730

TABLE XVI. ANALYSES OF

Station No.	Manufacturer.	Purchased, Sampled or Sent by.	Dealer's cash price per ton.
18731		American Sumatra Tobacco Co., Bloomfield	....
18732		American Sumatra Tobacco Co., Bloomfield	....
18766		American Sumatra Tobacco Co., Bloomfield	....
18767		American Sumatra Tobacco Co., Bloomfield	....
18768		American Sumatra Tobacco Co., Bloomfield	....
18771		American Sumatra Tobacco Co., Bloomfield	....
18772		American Sumatra Tobacco Co., Bloomfield	....
18773		American Sumatra Tobacco Co., Bloomfield	....
18774		American Sumatra Tobacco Co., Bloomfield	....
18775		American Sumatra Tobacco Co., Bloomfield	....
18776		American Sumatra Tobacco Co., Bloomfield	....
18823		American Sumatra Tobacco Co., Bloomfield	....
18824		American Sumatra Tobacco Co., Bloomfield	....
18825		American Sumatra Tobacco Co., Bloomfield	....
18952		American Sumatra Tobacco Co., Bloomfield	....
18953		American Sumatra Tobacco Co., Bloomfield	....
18954		American Sumatra Tobacco Co., Bloomfield	....
19250		Archie Evans, Hockanum	....
19251		Archie Evans, Hockanum	....
19252		Archie Evans, Hockanum	....
19253		Archie Evans, Hockanum	....
19254		Archie Evans, Hockanum	....
19211		Fassler & Silberman, Hartford	....
18770		John H. Fay, Middletown	....
19030		A. E. Plant Sons Co., Branford	....
19031		A. E. Plant Sons Co., Branford	....
19032		A. E. Plant Sons Co., Branford	....
19033		A. E. Plant Sons Co., Branford	....
18724		S. D. Woodruff & Sons, Orange	....

SPECIAL MIXTURES AND HOME MIXTURES—*Concluded.*

Nitrogen.						Phosphoric Acid.					Potash.			Station No.
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Total. Found.	Total. Guaranteed.	Citrate-insoluble.	Total. Found.	Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	As muriate.	Total. Found.	Total. Guaranteed.	
....	....	....	....	5.63	....	0.10	5.10	....	5.00	....	0.18	6.90	....	18731
....	....	....	....	5.59	....	0.13	5.09	....	4.96	....	0.22	6.79	....	18732
....	0.10	5.06		5.16	....	0.23	6.35	....	6.12	....	0.24	7.75	....	18766
....	0.10	4.96		5.06	....	0.18	6.22	....	6.04	....	0.23	7.84	....	18767
....	0.12	4.96		5.08	....	0.26	6.52	....	6.26	....	0.19	8.03	....	18768
....	0.06	5.21		5.27	....	0.13	4.96	....	4.83	....	0.13	7.09	....	18771
....	0.08	5.34		5.42	....	0.08	5.19	....	5.11	....	0.20	7.00	....	18772
....	0.04	5.34		5.38	....	0.12	5.30	....	5.18	....	0.23	6.60	....	18773
....	0.05	5.28		5.33	....	0.14	5.26	....	5.12	....	0.27	6.74	....	18774
....	0.07	5.24		5.31	....	0.13	5.31	....	5.18	....	0.23	6.54	....	18775
....	0.06	5.25		5.31	....	0.12	5.13	....	5.01	....	0.20	6.45	....	18776
....	....	....	....	5.07	....	....	6.18	....	....	....	....	7.24	....	18823
....	....	....	....	4.78	....	....	6.14	....	....	....	....	7.04	....	18824
....	....	....	....	4.78	....	....	6.00	....	....	....	....	7.48	....	18825
....	....	....	....	5.44	....	....	5.05	....	....	....	....	5.32	....	18952
....	....	....	....	5.42	....	....	5.03	....	....	....	....	5.44	....	18953
....	....	....	....	5.40	....	....	5.43	....	....	....	....	5.42	....	18954
....	....	....	....	4.89	....	....	7.28	....	....	....	....	8.78	....	19250
....	....	....	....	5.78	....	....	6.45	....	....	....	....	8.57	....	19251
....	....	....	....	5.14	....	....	6.53	....	....	....	....	8.72	....	19252
....	....	....	....	5.55	....	....	8.28	....	....	....	....	9.20	....	19253
....	....	....	....	4.40	....	....	5.90	....	....	....	....	6.57	....	19254
0.44	0.12	5.32		5.88	....	0.25	7.13	....	6.88	....	0.58	5.90	....	19211
....	0.13	4.95		5.08	....	1.97	7.13	....	5.16	....	0.08	7.17	....	18770
0.84	0.06	2.65		3.55	....	1.18	11.18	....	10.00	....	6.37	6.37	....	19030
1.64	0.10	3.94		5.68	....	1.40	10.68	....	9.28	....	....	....	....	19031
0.86	0.10	4.18		5.14	....	1.58	11.58	....	10.00	....	....	....	....	19032
1.81	0.06	2.77		4.64	....	0.73	8.73	....	8.00	....	5.63	5.63	....	19033
....	....	....	....	3.92	....	0.03	1.68	....	1.65	....	0.40	1.32	....	18724

VI. MISCELLANEOUS FERTILIZERS, AMENDMENTS AND WASTE PRODUCTS.

WOOD ASHES.

The following samples were submitted by Hatheway & Steane, Hartford; purchased from John Joynt, Lucknow, Canada:

18501, car No. 117922; **18502,** car No. 534106; **19215,** car No. 247466; **19216,** car No. 213388; **19227,** car No. 206079; **19635,** car No. 90928.

Other samples were:

19234. Sent by A. N. Farnham, Westville.

19589. Sent by H. V. Worth, East Berlin. This is the ashes from a brick kiln. As our previous analyses of this material have shown, this is of very small value as a commercial fertilizer. Where it can be used with only a short haul and in large amount, it has given excellent results on grass growing on a light, sandy soil.

19421. Sent by S. R. McDonald, Wallingford. Bought of George Stevens, Peterborough, Canada.

The ashes had evidently been wet.

TABLE XVII. ANALYSES OF WOOD ASHES.

Station Number	18501	18502	19215	19216	19227	19635	19234	19589	19421
	%	%	%	%	%	%	%	%	%
Phosphoric acid	2.43	2.52	2.28	2.53	2.15	1.93	1.83	1.00	1.83
Water-soluble Potash	6.56	6.75	7.09	7.54	7.28	4.59	6.78	0.64	2.37
Insoluble material	8.91	9.56	10.37	14.26	9.77	9.82	7.46	60.46	9.15
Cost per ton	$36.08	$37.12	....	....	....	....	....	....	....

SHEEP MANURE, ETC.

Analyses of eleven samples of sheep manure, etc., are given in Table XVIII. All were sampled by the Station agent except 19695, which was submitted by the manufacturer.

18926. Sold by American Agricultural Chemical Co. Sampled from stock of Bristol Grain & Supply Co., Bristol.

18912. Sold by Apothecaries Hall Co., Waterbury. Sampled from stock of R. W. Hine, Cheshire.

18968. Sold by Armour Fertilizer Works, N. Y. Sampled from stock of Spencer Bros., Suffield.

18964. Sold by Berkshire Fertilizer Co., Bridgeport. Sampled at the factory.

19160. Sheepshead Pulverized Sheep Manure. Sold by Natural Guano Co., Aurora, Ill. Sampled from stock of F. C. Benjamin, Danbury.

18902. Master Brand. Sold by Proto-Feed & Guano Co., Chicago, Ill. Sampled from the stock of Lightbourn & Pond Co., New Haven.

19193. Wizard Brand. Sold by Pulverized Manure Co., Chicago, Ill. Sampled from stock of G. R. Stannard, Branford.

18904. South American Sheep and Goat Manure. Sold by Sanderson Fertilizer Co., New Haven. Sampled at the factory.

19242. Sold by Virginia-Carolina Chemical Co., New York. Sampled from the stock of Silliman Hardware Co., New Canaan.

19695. Wizard Brand. Sold by Pulverized Manure Co., Chicago, Ill. Manufacturer's sample.

There is included a single analysis of poultry manure.

19243. Premier Brand Pulverized Poultry Manure, sold by Poultry Feed Co., Chicago, Ill. Sampled from stock of Quality Seed & Fertilizer Co., Stamford.

TABLE XVIII. ANALYSES OF

Station Number	18926	18912	18968
	%	%	%
Nitrogen as nitrates	....	....	....
" as ammonia	0.20	0.16	0.12
" organic	2.38	1.24	1.38
" total found	2.58	1.40	1.50
" guaranteed	2.06	1.84	1.23
Phosphoric acid, citrate-insoluble	0.20	0.10	0.43
" " total found	1.45	0.95	1.70
" " guaranteed	1.25	1.25	1.00
Potash, water-soluble, found	2.08	3.24	3.21
" guaranteed	1.00	3.00	2.50
Cost per ton	$48.00	....	$45.00

Sample **18912** falls below the guaranty in both nitrogen and phosphoric acid. The Apothecaries Hall Co. states that the guarantee is the one given by the party from whom the manure was bought.

On receiving our analysis, the guaranty on the packages was changed to conform to the analysis.

The ten samples vary greatly in their composition. The average of the ten is:

Nitrogen	1.93%
Phosphoric acid	1.54%
Water-soluble potash	2.80%
Cost per ton	$45.96

18522, sent by E. Barnwater, Stratford, was stated to have been bought for sheep manure. It contained:

Nitrogen	2.80%
Phosphoric acid	0.73%
Potash	1.50%
Insoluble matter	11.00%
Water	12.61%

TOBACCO STEMS.

No. **18900,** sent by J. E. Luddy, Windsor, was a sample offered by the Imperial Tobacco Co., Montreal. It contained 1.17 per cent of nitrogen and 2.57 per cent of potash. It is therefore of very inferior quality.

REFUSE GLUE.

18751, from J. H. Stannard, Ivoryton, contained 12.04 per cent nitrogen and 0.15 phosphoric acid.

SHEEP MANURE, ETC.

18964	19160	18902	19193	18904	19242	19695	19243
%	%	%	%	%	%	%	%
0.08	0.04	....	....	....	....	....	....
0.38	0.24	0.12	....	0.12	....	0.04	0.62
1.80	2.21	1.86	....	1.45	....	1.60	3.61
2.26	2.49	1.98	1.96	1.57	1.91	1.64	4.23
1.70	2.25	2.05	2.00	1.23	1.72	1.80	4.10
0.13	0.18	0.10	0.13	0.13	0.25	0.10	0.15
1.05	1.73	1.60	1.55	1.63	2.45	1.30	2.75
1.00	1.25	1.00	....	1.00	....	1.00	2.70
2.91	2.15	3.71	3.07	3.25	1.56	2.85	1.28
1.00	1.50	2.50	2.00	3.00	1.50	1.00	1.30
$40.00	$50.00	$49.00	$49.00	$42.00	$44.70	....	$45.00

TOBACCO FERTILIZER.

19489 was a tobacco fertilizer salvaged from a burned tobacco barn. Sent by Foran Bros., East Hartford.

It contained 3.73 per cent nitrogen, 8.05 of available phosphoric acid and 5.96 of potash and was not very seriously damaged.

PEAT OR MUCK.

Four samples have been examined:

17876 from C. L. Bill, 1184 Main St., Bridgeport.

18290 from M. H. Nolan, Stratford.

18881 from D. J. Smith, Southington.

19406 from Richard Starr, Darien.

These analyses are here given on a water-free basis:

Per cent of	Organic Matter.	Mineral Matter.	Nitrogen.
17876	28.66	71.34	0.95
18290	25.87	74.13	1.14
18881	78.73	21.27	4.00
19406	69.91	20.09	1.30

The first two in the table are of very moderate value because sand and earth make nearly three-quarters of their weight. The others in their dry or partially dry state would be excellent absorbents of liquid manure or would be suitable for composing with stable manure.

The amount of nitrogen in **18881** is exceptionally large.

LIME AND LIMESTONE.

A number of samples of these materials have been analyzed and will be printed in another bulletin including analyses not yet completed.

SOILS.

The tests of acidity made in samples of soil are of no general value and are therefore not reported here.

POTASH-MARL.

This material is sold by Potash-Marl, Inc., 15 East 40th St., New York City, and is a prepared green sand marl which occurs in New Jersey, and has been used locally as a fertilizer where it could be obtained abundantly and cheaply.

It contains considerable potash, sometimes 6 per cent or more, which is not, however, water-soluble. The Company only guarantees the amount of phosphoric acid.

Four samples have been examined as follows:

No. **19407,** from stock of Silliman Hardware Co., New Canaan, Conn.

No. **19726,** stock of Lightbourn & Pond, New Haven, Conn.

Both the above were sent by the Station agent.

No. 1 and No. 2 were sent by the Potash-Marl Co.

Analyses.

	19407	19726	No. 1	No. 2
Available phosphoric acid found.....	0.33	0.24	....	....
Available phosphoric acid guaranteed.	1.75	1.75	....	....
Insoluble phosphoric acid	0.55	0.64	....	....
Total phosphoric acid found	0.88	0.88	0.99	1.24
Total phosphoric acid guaranteed....	2.14	2.14	....	....
Price per ton	$45.00	$45.00	....	....

The samples Nos. 1 and 2 were noticeably finer than the others.

CORRECTIONS.

The following corrections should be made in Bulletin 238 (being the Report of this Station on Commercial Feeding Stuffs for 1921), page 337, Table II:

Item under *Wheat Feed* (*Mixed Feed*) should read: 15722 Wirthmore, St. Albans Grain Co., St. Albans, Vt. 0.30

Item under *Poultry Feeds* should read: 18008 Chick-Chuck, Russia Cement Co., Gloucester, Mass. 5.75 0.38 .....

CONNECTICUT
AGRICULTURAL EXPERIMENT STATION
NEW HAVEN, CONN.

BULLETIN 242 NOVEMBER, 1922

BEING A

Report on Commercial Insecticides and Fungicides

1922

I. The Examination of Some Materials Sold as Insecticides and Fungicides. By E. M. Bailey and R. E. Andrew.

II. Recent Developments in the Use of Insecticides. By W. E. Britton.

CONTENTS

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

November, 1922.

BOARD OF CONTROL.

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

James H. Webb, *Vice-President*.....Hamden
George A. Hopson, *Secretary*.....Mount Carmel
E. H. Jenkins, *Director and Treasurer*.....New Haven
Joseph W. Alsop.....Avon
Charles R. Treat.....Orange
Elijah Rogers.....Southington
Edward C. Schneider.....Middletown

STAFF.

Administration.
E. H. Jenkins, Ph.D., *Director and Treasurer.*
W. L. Slate, Jr., B.Sc., *Vice-Director.*
Miss L. M. Brautlecht, *Bookkeeper and Librarian.*
Miss J. V. Berger, *Stenographer and Bookkeeper.*
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
Owen L. Nolan
Harry J. Fisher, A.B.
Assistant Chemists.
Frank Sheldon, *Laboratory Assistant.*
V. L. Churchill, *Sampling Agent.*
Mrs. B. P. Storrs, *Clerk.*

Biochemical Laboratory.
T. B. Osborne, Ph.D., D.Sc., *Chemist in Charge.*

Botany.
G. P. Clinton, Sc.D., *Botanist.*
E. M. Stoddard, B.S., *Pomologist.*
Miss Florence A. McCormick, Ph.D., *Pathologist.*
G. E. Graham, *General Assistant.*
Mrs. W. W. Kelsey, *Secretary.*

Entomology.
W. E. Britton, Ph.D., *Entomologist; 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 Gypsy Moth Work.*
Samuel T. Sealy, *Deputy in Charge of Mosquito Control.*
Miss Gladys M. Finley, *Stenographer.*

Forestry.
Walter O. Filley, *Forester.*
A. E. Moss, M.F., *Assistant.*
H. W. Hicock, M.F., *Assistant.*
Miss Pauline A. Merchant, *Stenographer.*

Plant Breeding.
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.

I. The Examination of Some Materials Sold as Insecticides and Fungicides.

By E. M. Bailey and R. E. Andrew.

No laws have been enacted in this State to control the manufacture, sale or distribution of insecticides and fungicides. An Act concerning the testing and labeling of disinfectants was passed by the legislature in 1917, and it is probable that such materials can be controlled also by the provisions of our food and drug law under the definition of the term "drug"; but the law cannot be interpreted to include insecticides and fungicides. The terms of the Federal Insecticide Act of 1910 amply provide for the control in interstate commerce of materials to be used for insecticidal or fungicidal purposes, but do not operate for the control of such materials as are now, or may be, made and sold within this state.

The general and increasing use of spraying materials for the control of insect pests and fungus diseases makes the question of the composition of such materials of interest and importance. A bulletin[1] on this subject was issued by this Station in 1907, but no systematic survey has been made since that time. Occasional samples of substances used for spraying or dusting purposes have been examined for individuals interested, but these have been published in regular reports from this laboratory, together with other miscellaneous materials. Such scattering analyses, so far as they are of interest, have been collected and are presented here in addition to the results of new analyses.

MATERIALS EXAMINED.

A classification of the materials examined is as follows:

Samples Collected in 1922.

Paris Green	8
Lead Arsenate	16
Calcium Arsenate	1
Copper-Calcium Arsenate	2
Bordeaux Mixture	3
Bordeaux Mixture—Paris Green	2
Bordeaux Mixture—Lead Arsenate	3
Bordeaux Mixture—Zinc Arsenate	1
Nicotine Products and Tobacco	14
Hellebore	5
Miscellaneous	25

[1] Conn. Agr. Sta., Bull. 157, Sept., 1907.

Cited from Earlier Reports of This Station, But Subsequent to 1907.

Paris Green, Lead Arsenate and Miscellaneous	15
Total from all sources	95

Of samples secured this year, 49 were collected by our Station agent, Mr. Churchill, and the remainder were submitted by purchasers or others interested. A considerable number have been referred to us by the department of entomology of this Station.

METHODS OF ANALYSIS.

The methods used for the analysis of these preparations are those authorized by the Association of Official Agricultural Chemists unless otherwise stated.

RESULTS OF EXAMINATION.

For the sake of uniformity where like materials are tabulated together, dissimilar chemical terms used in statements of guaranty have been reduced to a common basis. Where products are treated individually the composition found by analysis has been stated in terms conforming to those used in the guaranties.

TABLE I. ANALYSES OF PARIS GREEN.

Station No.	Date.	Brand, Manufacturer or Distributor.	Arsenious Oxide, As_2O_3. Total. Found.	Arsenious Oxide, As_2O_3. Total. Guaranteed not less than.	Arsenious Oxide, As_2O_3. Water-soluble. Found.	Arsenious Oxide, As_2O_3. Water-soluble. Guaranteed not more than.	Copper Oxide, CuO. Found.	Copper Oxide, CuO. Guaranteed not less than.	Station No.
		Sampled by Station Agent:	%	%	%	%	%	%	
18445	1922	James A. Blanchard Co., New York. Lion Brand	57.92	50.00	1.98	3.50	28.85	....	18445
18091	1922	Bob-White Chemical Corp., New York. Bob-White	59.40	50.00	2.57	3.50	29.65	....	18091
18458	1922	Devoe & Raynolds Co., Inc., New York. Devoe.	55.94	50.00	1.98	3.50	29.65	....	18458
18099	1922	The Glidden Co., Cleveland. Glidden	55.69	50.00	1.58	3.50	29.45	....	18099
18100	1922	Morris Herrmann & Co., Chicago. Hi-Grade	56.18	50.00	1.19	3.50	29.45	....	18100
18443	1922	Interstate Chem. Co., Jersey City. Hillside	55.69	50.00	1.98	3.50	30.25	....	18443
18090	1922	Leggett & Brother, New York. Anchor Brand	54.95	50.00	2.37	3.50	28.85	29.00	18090
18455	1922	The Sherwin-Williams Co., Cleveland	55.69	50.00	2.57	3.50	29.65	....	18455
		Sampled by Purchaser:							
17320	1921	Leggett's	56.00	....	...	...	26.80	....	17320
19319	1921	Raynold's	56.50	....	...	...	26.60	....	19319

PARIS GREEN.

Chemically, Paris green is the aceto-arsenite of copper, and, under the provisions of the Federal Insecticide Act and the laws of many states where numerical standards for insecticides are fixed, this product is deemed to be adulterated: first, if it does not contain at least fifty per cent of arsenious oxide; second, if it contains arsenic in water-soluble forms equivalent to more than three and one-half per cent of arsenious oxide; third, if any substance has been mixed and packed with it so as to reduce or lower or injuriously affect its quality or strength.

From the tabulated analyses given in Table I it is evident that the guaranties conform to the federal numerical standards and are met with a liberal margin of safety in all cases. The ratio of copper oxide to arsenious oxide in pure copper aceto-arsenite is 1 : 1.87. For the products examined this year this ratio is closely approximated except in samples **18445** and **18091**, where it is about 1 : 2; in the two samples examined in 1921 the ratio of 1 : 2 is considerably exceeded.

ARSENATE OF LEAD.

Chemically, commercial arsenate of lead consists of products derived from arsenic acid by replacing one or more hydrogen atoms by lead. The Federal Insecticide Act deems arsenate of lead to be adulterated: first, if it contains more than fifty per cent of water; second, if it contains total arsenic equivalent to less than twelve and one-half per cent of arsenic oxide (As_2O_5); third, if it contains arsenic in water-soluble forms equivalent to more than seventy-five one-hundredths per cent of arsenic oxide (As_2O_5); fourth, if any substances have been mixed and packed with it so as to reduce, lower, or injuriously affect its quality or strength; *provided, however,* that extra water may be added to lead arsenate (as described in this paragraph), if the resulting mixture is labeled lead arsenate and water, the percentage of extra water being plainly and correctly stated on the label.

Most of the samples examined this year were in powder form. From the analyses given in Table II it appears that all samples meet the requirements of their guaranties with respect to the active ingredient. One sample contains a slight excess of water.

The method of stating guaranties is not uniform as regards the chemical terms used. The arsenic content is sometimes stated in terms of the metal and in other cases in terms of the oxide; and it is not always clear which form is indicated in stating the limit of water-soluble arsenic. Uniform practice in this respect would enable purchasers to compare statements of composition more readily and save the analyst some uncertainty.

TABLE II. ANALYSES OF ARSENATE OF LEAD.

Station No.	Date.	Brand, Manufacturer or Distributor.	Water. Found.	Water. Guaranteed not more than.	Arsenic Oxide, As_2O_5. Total. Found.	Arsenic Oxide, As_2O_5. Total. Guaranteed not less than.	Arsenic Oxide, As_2O_5. Water-soluble. Found.	Arsenic Oxide, As_2O_5. Water-soluble. Guaranteed not more than.	Lead Oxide, PbO. Found.	Lead Oxide, PbO. Guaranteed not less than.	Station No.
		Sampled by Station Agent:	%	%	%	%	%	%	%	%	
18452	1922	Acme White Lead & Color Works, Detroit. Acme.	....	....	33.12	30.00	0.14	1.00	63.65	....	18452
18451	1922	Bowker Insecticide Co., Boston. Bowker's	....	....	30.59	30.00	0.38	0.77	66.31	....	18451
18456	1922	Corona Chemical Co., Milwaukee. Corona Dry	....	....	32.20	30.00	0.18	0.77	64.25	....	18456
18454	1922	Detroit White Lead Works, Detroit. Rogers	....	....	31.51	30.00	0.18	1.00	63.23	....	18454
18088	1922	Devoe & Raynolds Co., Inc., New York. Devoe	....	....	32.66	31.00	0.97	1.00	63.65	63.00	18088
18094	1922	General Chemical Co., New York. Orchard	....	....	31.74	30.00	0.18	1.50	65.07	....	18094
18102	1922	The Glidden Co., Cleveland. Glidden	....	....	31.97	31.00	0.44	0.77	63.46	....	18102
18459	1922	The Grasselli Chemical Co., Cleveland. Paste	43.73	50.00	17.80	15.00	0.29	0.50	36.47	....	18459
18441	1922	Interstate Chemical Co., Jersey City. Key-Dry	....	....	31.74	30.00	0.28	0.75	61.86	....	18441
18105	1922	Leggett & Brother, New York	44.23	50.00	18.03	14.00	0.11	0.75	36.43	30.00	18105
18106	1922	Leggett & Brother, New York	....	....	32.66	30.00	0.28	1.00	64.50	61.00	18106
18449	1922	Merrimac Chemical Co., Boston. Swift's	50.43	50.00	14.61	12.50	0.26	0.75	33.48	31.50	18449
18089	1922	Nitrate Agencies Co., New York. Naco	....	....	30.59	30.00	1.10	1.53	65.50	62.00	18089
18110	1922	Powers-Weightman-Rosengarten Co., Philadelphia.	....	....	32.78	30.00	0.77	2.30	64.59	....	18110
18447	1922	The Sherwin-Williams Co., Cleveland	....	....	31.06	30.00	0.28	1.00	63.95	....	18447
		Sampled by Purchaser:									
20920[1]	1908–9	Disparene	36.61	....	18.80	....	...	...	42.05	....	20920
20564[1]	1908–9	Grasselli Chemical Co.	40.70	....	15.24	....	...	...	....	....	20564
22163[1]	1908–9	Grasselli Chemical Co.	45.57	....	15.38	....	...	...	37.25	....	22163
22382[1]	1908–9	Thomsen Chemical Co.	51.73	....	13.81	....	...	...	32.04	....	22382
22701[1]	1908–9	Thomsen Chemical Co.	45.76	....	16.10	....	...	...	35.71	....	22701
.....[2]	1913	Merrimac Chemical Co., Boston. Swift's	42.20	....	17.67	....	...	...	37.81	....	.....
19373	1922	Brand and Mfr. not known. Sent by County Agent, Middletown	....	....	32.18	....	...	...	64.45	....	19373

[1] Conn. Exp. Sta. Report 1911, p. 218.
[2] Conn. Exp. Sta. Report 1913, p. 305.

INSECTICIDES AND FUNGICIDES OTHER THAN PARIS GREEN AND LEAD ARSENATE.

The federal Act holds an insecticide or fungicide other than Paris green and lead arsenate to be adulterated: first, if its strength or purity falls below the professed standard or quality under which it is sold; second, if any substance has been substituted wholly or in part for the article; third, if any valuable constituent of the article has been wholly or in part abstracted; fourth, if it is intended for use on vegetation and shall contain any substance or substances which, although preventing, destroying, repelling, or mitigating insects shall be injurious to such vegetation when used.

The Act further requires such of these preparations as contain arsenic to declare on the label in terms of metallic arsenic the total amount thereof and the amount in water-soluble forms; it also requires to be stated the name and amount of each and every inert ingredient or, in lieu of this, the name and amount of each active ingredient, together with the total percentage of inert ingredients. Under the laws of some states an insecticide or fungicide, other than Paris green or lead arsenate, is misbranded if it does not declare the name and percentage of each and every active ingredient.

Calcium Arsenate.

18101. The Glidden Co., Cleveland, O.

This sample was found by analysis to be arsenate of lead instead of arsenate of calcium, evidently a mistake in labeling or packing.

Copper-Calcium Arsenate.

19136. *Copper-Calcium Arsenate* dust, 13-8-79. Dosch Chemical Co., Louisville, Ky. Stock of the department of entomology of this Station.

Analysis:

	Found.	Guaranteed.
	%	%
Copper, metallic	5.20	4.40 (not less than)
Arsenic oxide, total	1.39	3.00 (not less than)
Arsenic, metallic, water-soluble	...	0.50 (not more than)

19428. *Niagara Potato Dust Mixture.* Labeled as containing monohydrated copper sulphate, 19.5 per cent; tricalcium arsenate, 17.5 per cent, and inert ingredients, 63 per cent.

Analysis:

	Found.	Guaranteed.
	%	%
Copper, metallic	7.97	6.95
Arsenic, metallic	5.28	6.25
Arsenic, water soluble, metallic	...	0.50

Bordeaux Mixtures.

18104. *Anchor Brand.* Leggett and Brother, New York.

18108. The Grasselli Chemical Co., Cleveland, O.

18448. *Sterlingworth.* Sterling Chemical Co., Cambridge, Mass.

Table III. Analyses of Bordeaux Mixtures.

Station No.	Condition.	Water.	Copper, Metallic.	
			Found.	Guaranteed not less than.
		%	%	%
18104	Paste	58.03	4.79	4.50
18108	Dry	....	14.78	13.00
18448	Dry	....	11.96	10.00

Bordeaux Mixture—Paris Green.

18107. Leggett and Brother, New York.

18093. *Naco.* Nitrate Agencies Co., New York.

Table IV. Analyses of Bordeaux—Paris Green.

Station No.	Copper Oxide, CuO.		Arsenious Oxide, As_2O_3.			
			Total.		Water-soluble.	
	Found.	Guaranteed not less than.	Found.	Guaranteed not less than.	Found.	Guaranteed not more than.
	%	%	%	%	%	%
18107	17.37	17.50	17.69	16.50	2.72	2.64[1]
18093	16.23	18.00	17.32	17.00	0.82	2.00

[1] Calculated from amount guaranteed as metallic arsenic.

Bordeaux Mixture—Lead Arsenate.

18111 and **18442.** *Key Brand Bordo-Lead.* Interstate Chemical Co., Jersey City, N. J.

18096. *Glidden Bordo-Arsenate.* The Glidden Co., Cleveland, O.

TABLE V. ANALYSES OF BORDEAUX—LEAD ARSENATE.

Station No.	Condition.	Water.	Arsenic Oxide, As_2O_5. Total. Found.	Arsenic Oxide, As_2O_5. Total. Guaranteed not less than.	Arsenic Oxide, As_2O_5. Water-soluble. Found.	Arsenic Oxide, As_2O_5. Water-soluble. Guaranteed not more than.	Copper Oxide, CuO.	Lead Oxide, PbO.
		%	%	%	%	%	%	%
18111	Paste	60.85	6.65	4.45[1]	0.60	0.77[1]	7.57	13.76
18442	Paste	60.83	7.82	7.67[1]	0.09	0.77[1]	3.74	....
18096	Dry	....	17.54	15.50	0.20	0.50[1]	11.66	31.71

[1] Calculated from amount guaranteed as metallic arsenic.

BORDEAUX MIXTURE—ZINC ARSENITE.

19729. *Zinc Bordeaux, Orchard Brand,* General Chemical Co., New York.

Analysis:

	Found. %	Guaranteed. %
Arsenic, total, metallic	10.22	10.16 (not less than)
water-soluble, metallic	0.25	1.00 (not more than)
Copper, metallic	16.07	15.70 (not less than)
Zinc, metallic	14.41	13.31[1] (not less than)

[1] Guaranteed zinc arsenite 30.00.

NICOTINE PRODUCTS AND TOBACCO.

19748. *Black Leaf 40.* Tobacco By-Products and Chemical Corporation, Inc., Louisville, Ky. Sampled by Station agent.

Nicotine found 40 per cent; guaranteed 40 per cent.

19370. *Black Leaf 40.* Sample submitted by department of entomology of this Station.

Nicotine found 40.70 per cent; guaranteed 40 per cent.

19608. *Jebl.* Made by J. H. Rice, Ashtabula, O.

This is an emulsion guaranteed to contain nicotine 0.80 per cent and inert ingredients 99.20 per cent.

Partial analysis showed the following composition:

Water and volatile at 100° C.	79.29%
Solids	20.71
Ash	7.85
Nicotine (as alkaloid)	1.08

19152. *Garden Dust.* Dosch Chemical Co., Louisville, Ky. The sample was submitted by the Station department of entomology. It is a mixture of lead arsenate, sulphur and nicotine, but

was examined only for nicotine. Nicotine found 2.24 per cent; guaranteed 2.00 per cent.

19427. *Niagara Nicotine Contact Mixture.* Niagara Sprayer Co., Middleport, N. Y. Sampled by the Station agent. Nicotine found, 2.38 per cent; guaranteed, 2.20 per cent.

19658. *Tobacco Dust.* Hall Tobacco Chemical Co., St. Louis, Mo. The sample was submitted by E. M. Ives, Meriden. Sixty per cent passed a 200 mesh sieve. Nicotine content found, 1.30 per cent.

19742. *Tobacco Dust.* Sample submitted to the Station entomologist by Lewis Cheeseman, Hatfield, Mass.

The sample was examined as follows:

Total ash	39.60%
Ash insoluble in dil. acid (sand, etc.)	15.30
Nitrogen	1.99
Nicotine (as alkaloid)	1.72

19099 and **19100.** *Tobacco Dust.* Submitted by Prof. G. H. Lamson, Storrs. The samples contained 1.09 and 0.50 per cent of nicotine respectively.

19188. *Low Grade Leaf Tobacco.* Supplied by L. B. Hass Co., Hartford.

Partial analysis showed the following composition:

Moisture	5.63%
Ash, crude	20.13
Nitrogen, in nitrates	1.17
in ammonia	0.77
in nicotine	0.55
in other organic matter	1.89
Ether extract	3.98
Nicotine	3.10

Analysis of the crude ash showed the following composition:

Sand, silica, etc.	22.67%
Iron and aluminum (Fe_2O_3 and Al_2O_3)	1.86
Manganese (Mn_3O_4)	0.62
Magnesium (MgO)	4.69
Calcium (CaO)	20.74
Potassium (K_2O)	22.44
Sodium (Na_2O)	0.80
Sulphuric acid (SO_3)	6.09
Chlorine (Cl)	0.71
Phosphoric acid (P_2O_5)	3.62
Carbonic acid (CO_2)	14.50
Undetermined including moisture	1.26
Deduct oxygen=chlorine	0.16
Total	100.00

Cigarettes.

In connection with a study of methods for the determination of nicotine in tobacco and other products a number of brands of cigarettes were examined.

Table VI. Analyses of Cigarettes.

Station No.	Brand.	Loss at 100° C.	Ash.	Nitrogen.	Nicotine.
		%	%	%	%
19298	Lucky Strike	7.63	16.54	2.23	1.83
19311	Melachrino	7.34	17.74	2.58	1.43
19316	Camel	7.98	15.30	2.24	1.80
19317	Fatima	8.25	13.63	1.99	1.72
19318	Murad	7.33	17.14	2.72	1.46

Hellebore.

19730. *White Hellebore Root.* J. L. Hopkins & Co., New York.

19736. *Key Brand Hellebore.* Interstate Chemical Co., Jersey City, N. J.

18109. *Anchor Brand Hellebore.* Leggett & Brother, New York.

18098. *Hellebore Root.* S. B. Penick & Co., New York.

19731. *Hellebore Root Powder.* S. B. Penick & Co., New York.

Table VII. Analyses of Hellebore.

Station No.	Ash.		Total alkaloids.		Total nitrogen.
	Total.	Insol. in acid.	Found.	Guaranteed not less than.	
	%	%	%	%	%
19730	11.83	6.97	1.07	0.79	1.21
19736	10.56	5.03	1.43	0.25	1.29
18109	7.50	3.23	1.26	0.20	1.59
18098	9.25	5.40	1.27	1.14	...
19731	4.46	1.05	2.70	1.00	1.48

The method used for the determination of alkaloids of *Veratrum* (hellebore), was as described by Viehoover and Clevenger[1].

Miscellaneous Insecticides and Fungicides.

The following spray materials were made by the Niagara Sprayer Co., Middleport, N. Y. and were sampled by the Station agent from the stock of H. D. Peters, Highwood.

[1] Jour. Am. Phar. Assoc., **11**, 3, 169, March 1922.

19425. *Niagara Potato Dust Mixture,* without poison. Labeled monohydrated copper sulphate, 19.5; inert ingredients, 80.5.

Analysis:

	Found.	Guaranteed.
Copper, metallic	7.56%	6.50%

19426. *Niagara "All in One."* Labeled sulphur, 19; nicotine, 1.1; lead arsenate, 9.5; Bordeaux, 19; inert ingredients, 51.4.

Analysis:

	Found.	Guaranteed.
	%	%
Copper, metallic	6.30	4.00
Arsenic, metallic	1.82	1.80
Arsenic, water-soluble	...	0.50
Nicotine	1.11	1.10

19429. *Niagara 80-10-10 Mixture.* Labeled sulphur, 78; lead arsenate, 9.8; inert ingredients, 12.2.

Analysis:

	Found.	Guaranteed.
	%	%
Arsenic, metallic	2.26	1.95
Arsenic, water-soluble	...	0.50

19430. *Niagara 85-15 Dusting Mixture.* Labeled sulphur 83; lead arsenate, 14.70; inert ingredients, 2.30.

Analysis:

	Found.	Guaranteed.
	%	%
Arsenic, metallic	3.02	2.92
Arsenic, water-soluble	...	0.50

Other miscellaneous materials sampled by the Station agent are as follows:

18453. *Pyrox.* Bowker Insecticide Co., Boston.

18446. *Naco Kalibor.* Nitrate Agencies Co., New York.

18086. *Hexpo.* H. J. Smith & Co., Utica, N. Y.

19739. *Key-Cide.* Interstate Chemical Co., Jersey City.

TABLE VIII. ANALYSES OF MISCELLANEOUS MATERIALS.

Station No.	Condition.	Water.	Arsenic, Metallic. Total. Found.	Arsenic, Metallic. Total. Guaranteed not less than.	Arsenic, Metallic. Water-soluble. Found.	Arsenic, Metallic. Water-soluble. Guaranteed not more than.	Copper, Metallic. Found.	Copper, Metallic. Guaranteed.	Lead, PbO. Found.	Lead, PbO. Guaranteed.
		%	%	%	%	%	%	%	%	%
18453	Paste	68.40	4.53	3.42	0.06	0.75	3.02	1.50	....	12.00
18446	Dry	....	17.25	18.20	0.19	0.75	5.13	3.50	....	....
18086	Dry	....	4.78	4.50	0.37	0.33	19.27	15.40	14.33	....
19739	Dry	....	3.75	2.75	0.12	....	10.06	10.00	9.90	....

18450. *Slug Shot.* Hammond's Slug Shot Works, Beacon, N. Y.

Analysis:

	Found.	Guaranteed.
	%	%
Sulphur	...	6.00
Arsenic, metallic	0.89	0.79
Water-soluble arsenic, metallic	0.12	trace
Copper, metallic	1.01	0.91[1]
Nicotine	0.04	trace
Carbolic acid, crude	present	0.40

18087. *Bug Death.* Danforth Chemical Co., Leominster, Mass.

Analysis:

	Found.	Guaranteed.
	%	%
Zinc oxide	54.15	47.00
Lead oxide	14.11	5.00

18092. *Sterlingworth Cut Worm Killer.* Sterling Chemical Co., Cambridge, Mass.

Analysis:

	Found.	Guaranteed.
Arsenious oxide	1.99	1.00 (not less than)
Water-soluble arsenic, metal	1.40	0.07 (not more than)

The arsenic in this sample is largely in water-soluble form.

18444. *He-Bo.* Sterling Chemical Co., Cambridge, Mass.

Analysis:

	Found.	Guaranteed.
	%	%
Barium carbonate	34.41	36.00
Arsenic, metallic	1.35	2.00
Arsenic, water-soluble, metal	0.12	0.30

18103. *Mag-O-Tite.* Randall-McLaughlin, Seattle, Wash.

Analysis:

	Found.	Guaranteed.
	%	%
Arsenic, metallic	...	0.06
Arsenic, water-soluble, metal	0.06	0.002
Napthalene	6.35	4.39

Napthalene was determined by extracting the material with ether, dissolving the ether extract in boiling 95 per cent alcohol and precipitating the napthalene by means of a saturated solu-

[1] Calculated from copper-sulphate and copper arsenite guaranteed.

tion of picric acid. The naphthalene picrate was dried at 50° C. and weighed[1].

18457. *Sulfocide.* B. G. Pratt Co., New York.

This is a liquid fungicide guaranteed to contain 30 per cent of sulphur combined as sodium polysulphide and sodium thiosulphate.

Analysis showed the following distribution of sulphur[2]:

Sulphur, total	29.25%
as thiosulphate	1.84
as sulphate	0.10
as sulphide, by diff.	27.31

The following miscellaneous materials were submitted from various sources:

19173. *Nickel Carbonate.* Submitted by the Station entomologist.

It was found to contain 44.64 per cent of nickel, which is equivalent to 90.28 per cent of nickel carbonate. The material contained also a trace of sulphates. Nickel was determined by the dimethylglyoxime method[3].

17257. *Borecide.* Mason Drug and Chemical Co., Hancock, Md.

According to descriptive literature concerning this insecticide, the vapors which it gives off are toxic to borers and other tree pests.

Partial analysis was made as follows:

Ash	58.14%
Loss on ignition	41.86
Insoluble in boiling water	65.35
M. P. of sublimate	31.0° C.

The material has the odor of naphthalene and the sublimate combined with picric acid. The melting point, however, was not correct for naphthalene, but approximated that of the methyl derivative.

19732. *Mechlings P. T. B.* Mechling Bros. Mfg. Co., Camden, N. J.

This is a preparation of paradichlorobenzine, the vapors of which are destructive to peach tree borers and other tree pests. The melting point of the compound was observed to be 56° C.

19683 and **19684.** *Fish Oil Soap.* Made by the General Chemical Co., New York, and submitted by the Station entomologist. Differentiated by the sodum cobaltinitrite and potas-

[1] Allen Comm. Org. Analysis, **3**, p. 243 et seq.
Mulliken. Identification of Pure Organic Compounds, **1**, p. 201.
[2] Analysis by H. J. Fisher.
[3] Griffin, Technical Methods of Analysis, p. 121.

sium pyroantimonate tests, **19683** was indicated to be a soda soap, while **19684** was indicated to be largely a potash soap.

18898. A *paste* made by the Garden Chemical Co., New York, and examined for the Station entomologist. It appeared to be composed largely of an emulsion of soap and pyridine.

Dusting Powder, made by the Niagara Sprayer Co., Middleport, N. Y., was submitted by E. M. Ives, Meriden. By the U. S. P. assay it contained 99.09 per cent of sulphur; 98.2 per cent of the powder passed a 200 mesh sieve.

19404. *Bordeaux mixture,* thought to have decomposed or to have been mixed with other material. The sample, which was a black powder, contained 24.02 per cent of calcium oxide and 21.23 per cent of copper, largely in the form of cupric oxide.

19339. *Bees* and **19340,** *Soil,* submitted by O. N. Whitehead, Wallingford. The bees were thought to have been killed by arsenical spray on blossoms of peach trees. No conspicuous amounts of arsenic were found in either the bees or the soil.

18095. *Kayso.* California Central Creameries, San Francisco. A prepared casein spreader to be used with spraying mixtures. The material contained 25.26 per cent of casein (calculated from nitrogen by the factor 6.38), and 73.78 per cent of ash, which consisted chiefly of calcium.

19492. *Ace-Hy.* General Chemical Co., New York. The active ingredient is not stated, but the inert ingredient is stated to be water, of which there is not more than 40 per cent. The preparation is an emulsion in which a cyanide, equivalent to 2.29 grams CN per 100 cc. is the chief active ingredient detected. The ash, 3.58 per cent, consisted chiefly of iron and copper oxides. Water and volatile matter (at 100° C.), made up 77.3 per cent of the material.

Salairacine. Made by J. D. McGregor, Stamford.

A sample, **17745,** submitted by a purchaser in 1921, and one, **19740,** supplied by the Station entomologist, have been examined as follows:

	17745 %	19740 %
Moisture	0.90	....
Insoluble in dilute acid	0.56	....
Nitrogen (in nitrates)	none	1.95
Lead oxide (PbO)	24.21	....
Arsenic oxide (As_2O_5)	11.73	10.54
Oxides of iron and aluminum (Fe_2O_3 and Al_2O_3)	0.50	....
Calcium (CaO)	25.64	17.67
Magnesium (MgO)	17.33	....
Carbon dioxide (CO_2), by difference	19.13	....

The analysis made in 1921 indicated that the material was composed essentially of lead arsenate and dolomitic lime. The sample analyzed in 1922 showed a considerable amount of nitrogen in nitrates, indicating a change in the formula. Advertising literature submitted with the first sample states: "Salairacine destroys the insects in the soil and gives new life to young and old trees. It has been used with great success on trees which were absolutely riddled with borers." It is directed to loosen the soil two inches deep around trees and dust salairacine into the soil; or sprinkle on the surface of turf and water thoroughly.

There is nothing shown by our analyses to indicate any insecticidal value in this product not supplied by lead arsenate as well; or any fertilizing value not equally well supplied by nitrate of soda and lime.

The following were submitted by the Station entomologist during 1921 and are cited from Bulletin 233 of this laboratory, p. 109:

16420. *"Sulco-V. B."* Contained 3.97 per cent of phenol.

16740. *Niagara Contact Special Dusting Mixture* was found to contain 1.62 per cent nicotine.

Four *nicotine mixtures* were found to contain 0.29, 0.30, 0.84 and 0.71 per cent of nicotine.

16946. *Formaldehyde solution* submitted by the Station botanist, was found to contain 33.7 per cent of formaldehyde by weight.

II. Recent Developments in the Use of Insecticides.

By W. E. Britton, *Entomologist.*

In connection with the analyses reported in the preceding pages, it might be well to call attention to some tendencies of the present day in the use of insecticides and fungicides. In 1907, when Bulletin 157 was published, no arsenical poisons were used except paste lead arsenate and Paris green. At the present time to kill chewing insects, most Connecticut orchardists and vegetable growers prefer and use lead arsenate in its dry or powdered form, which is easier to handle and seems to be just as effective. As an insecticide, Paris green has largely been replaced by lead arsenate. Moreover, several other poisons are now on the market, such as calcium arsenate, copper-calcium arsenate, and zinc arsenite which are sometimes, though probably not extensively, used.

In 1907, nicotine sulphate preparations were little used, whereas now they have come into almost universal use to kill sucking insects. Casein spreaders were then unknown and are now coming into rather general use. Dusting in orchards is a recent practice in Connecticut, which will probably not wholly supplant spraying; and there are many proprietary insecticides and fungicides now on the market, and many possible and advantageous combinations of standard materials, unheard of fifteen years ago. Likewise in those days the lime-sulphur mixture was used only as a dormant spray to kill San José scale, but now this mixture diluted as a summer spray is the most common fungicide used on the foliage in Connecticut apple orchards.

Arsenical Poisons.

Arsenical insecticides are commonly employed as stomach poisons to kill chewing insects, such as grasshoppers, caterpillars and leaf-beetles. The poison is placed upon the food plant, and must be swallowed by the insect in order to be effective as an insecticide. Lead arsenate is by far the most common one now in use, is generally non-injurious to the plant, and may be applied as a dust or in liquid form at the rate of one ounce of paste or one-half ounce of the powder in a gallon of water. This is nearly equivalent to three pounds of the paste or one and one-half pounds of the powder in a barrel holding fifty gallons.

Paris green contains a sufficient amount of water-soluble arsenic to be generally unsafe for vegetation except in the presence of lime. Lime should also be added to a mixture of calcium arsenate when used on most kinds of foliage, but both Paris green and

calcium arsenate may be used in combination with Bordeaux mixture on potatoes without fear of injury. Several times in our Station tests calcium arsenate has injured apple foliage even where lime was added. Zinc arsenite was used as a poison on ten rows of potatoes at the Station Farm at Mount Carmel in 1914, in comparison with lead arsenate. Both killed the larvae of the Colorado potato beetle, and there was no injury to the foliage. Magnesium and barium arsenates have not been used in Station tests.

Hellebore.

Hellebore is the powdered rootstock of an herbaceous plant, *Veratrum*. It acts as a stomach poison and has slight value as a repellant. Its virtue depends upon a volatile alkaloid; hence only fresh material should be used. The larvae of the sawflies, like the currant worm, are particularly susceptible to death from eating it. It may be applied dry and undiluted or mixed with water at the rate of one ounce in two gallons.

Nicotine Preparations.

Though nicotine is a stomach poison if taken in sufficient amounts, it is chiefly employed to kill sucking insects by contact. It is often used in the form of tobacco dust, finely ground, but as tobaccos vary widely in their nicotine content and few manufacturers have attempted to place a uniform product on the market, nicotine is generally purchased as a liquid in the form of nicotine sulphate containing 40 per cent nicotine. There are several commercial preparations on the market sold under trade names, "Black Leaf 40" being one of those best known in Connecticut. When diluted at the rate of one teaspoonful per gallon, or one-half pint per barrel, and applied as a spray, it will kill most soft-bodied aphids, but this quantity may need to be doubled to kill some other sucking insects. Even in stronger applications it does not injure most kinds of foliage. When used alone it is more effective if common laundry soap, one-half ounce per gallon, or two pounds per barrel, is dissolved and added, but this is unnecessary when used with calcium caseinate or with lime-sulphur.

Combinations of Insecticides and Fungicides.

Though each different material may be recommended and used to control some particular pest, the grower cannot conveniently make a separate application for this purpose, and has practiced applying them in combination to control those chewing and sucking insects and fungi which may simultaneously attack his crops. For instance, he can combine lead arsenate, nicotine solution and

Bordeaux mixture to form the best general application for potatoes. Calcium arsenate may be substituted for lead arsenate at a saving in cost, but by such a combination thoroughly applied, the grower may effect a reasonable degree of control over the Colorado beetle, aphids, leafhoppers, and the blight. Bordeaux mixture is still the most effective fungicide on the potato.

In Connecticut apple orchards, Bordeaux mixture is not employed to the same extent as was the case a few years ago on account of its effect in russeting the fruit. Liquid lime-sulphur (diluted 1 to 40) is now generally used in its place on the foliage. Some trouble results from an indiscriminate mixing of lime-sulphur with lead arsenate and nicotine, but this may be avoided in large measure by mixing in the proper order and by the use of a calcium caseinate spreader. The best results are obtained when these materials are placed in the spray tank in the following order:

1. Clean water.
2. Nicotine sulphate.
3. Calcium caseinate (if used).
4. Lead arsenate.
5. Lime-sulphur.

There is usually some discoloration when lime-sulphur and lead arsenate are put together, and this sometimes approaches a brown color due to lead sulphide being formed. If the nicotine is then thrown into this mixture it will often be precipitated in masses of brown sludge, which will clog the pump and coat the tank. When mixed in the order shown above, particularly with the calcium caseinate spreader, little or no discoloration follows, and a clear yellow mixture results. The spreader is also of material assistance in coating the whole surface with a thin film of the spray mixture; otherwise, it is apt to collect in drops. The spreader, therefore, insures better protection to the foliage, makes the mixture go further, and prevents chemical changes from occurring when the different ingredients are mixed together.

CONNECTICUT
AGRICULTURAL EXPERIMENT STATION
NEW HAVEN, CONN.

BULLETIN 243 NOVEMBER, 1922

Report of the Director

FOR THE YEAR ENDING OCTOBER 31, 1922

By E. H. JENKINS

CONTENTS

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

OFFICERS AND STAFF

October, 1922.

BOARD OF CONTROL.

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

James H. Webb, *Vice-President*.....Hamden
George A. Hopson, *Secretary*.....Mount Carmel
E. H. Jenkins, *Director and Treasurer*.....New Haven
Joseph W. Alsop.....Avon
Charles R. Treat.....Orange
Elijah Rogers.....Southington
Edward C. Schneider.....Middletown

STAFF.

Administration.
E. H. Jenkins, Ph.D., *Director and Treasurer.*
W. L. Slate, Jr., B.Sc., *Vice-Director.*
Miss L. M. Brautlecht, *Bookkeeper and Librarian.*
Miss J. V. Berger, *Stenographer and Bookkeeper.*
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
Owen L. Nolan
Harry J. Fisher, A.B.
Assistant Chemists.
Frank Sheldon, *Laboratory Assistant.*
V. L. Churchill, *Sampling Agent.*
Mrs. Alta Moss Storrs, *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, *Assistant.*
Mrs. W. W. Kelsey, *Secretary.*

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., *Assistant.*
H. W. Hicock, M.F., *Assistant.*
Miss Pauline A. Merchant, *Stenographer.*

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.

Report of the Director

For the Year Ending October 31st, 1922.

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

Following are the facts concerning the work done by the Station staff during the year which may not be so conveniently gathered from the detailed papers included in the Station bulletins and reports. The Station work is divided between seven departments as follows:

BOTANICAL DEPARTMENT.

Dr. G. P. Clinton in charge.

The work of this department is chiefly a study of plant pathology: that is of the diseases which injure plants and of the proposed remedies.

One of the chief studies of the year has been a comparison of sprays *vs.* dusts on fruit and vegetables, carried on by Mr. Stoddard in co-operation with the entomological department. This is further described under the entomological department.

Sweet corn seed selection, now in its third year, is an attempt by careful tests to secure perfect germination and freedom from disease in the stock seed of Connecticut growers, and by this means to get commercial crops of seed which will have superior quality. The results thus far are encouraging, and in connection with the work of the plant breeding department on sweet corn promise to be of great value to seed growers.

The study of the wildfire disease of tobacco has made it possible to very greatly control the ravages of this bacterial trouble, if not to entirely suppress it.

Dr. Clinton is also preparing a general description and discussion of all tobacco diseases. He continues a plant disease survey of the state, with special reports to the United States Department of Agriculture.

Dr. Clinton also determines the species of smuts referred to him from all parts of the country, and in connection with Dr. Stevens of Illinois, he has prepared an article on the smuts of Hawaii.

Further work on the white pine blister rust by Drs. Clinton and McCormick is about ready for publication.

Various studies of miscellaneous fungi, the Thielavia root rot of tobacco, species of Pythium, heteroecious rusts, etc., and of mosaic diseases, are in progress.

The study of peach yellows in connection with orchard fertilization is continued.

The incidental office and laboratory work has included the writing of over 600 letters, identifying 225 specimens of fungi, weeds, seeds and varieties of fruit, testing the germination of 742 samples of seed for various persons, besides a very large number of corn samples in connection with the selection work.

Three hundred and thirteen named specimens have been added to the herbarium and several hundred more of this year's collection wait for study and determination.

Twelve lectures and addresses on botanical subjects have been delivered.

A public meeting was held in New Milford in conjunction with the Farm Bureau Agents of Litchfield and Fairfield Counties to give information regarding the control of the wildfire disease of tobacco, which has appeared for the first time in the Housatonic Valley.

The publications of the department have been:

Dr. Clinton. New Facts Regarding Diseases of Vegetables and Their Control. Connecticut Vegetable Growers' Association, 1921, 7-20.

Drs. Clinton and McCormick. Wildfire of Tobacco in Connecticut. Bulletin 239, 58 pp.

Mr. Stoddard. Report on Fungous Troubles of Fruit, Season of 1921. Connecticut Pomological Society, 24, 74-77.

Mr. Stoddard has also collaborated in publications listed under the entomological department.

BIOCHEMICAL DEPARTMENT.

Dr. T. B. Osborne in charge.

The study of protein chemistry is in charge of Dr. Osborne. In the study of problems of nutrition he is favored by the collaboration of Dr. Lafayette B. Mendel of Yale University. The work of this department is in part supported by a grant from the Carnegie Institution of Washington. This is at present concerned with:

1. A study of the constitution of the proteins and also of the chemical makeup of green forage plants, by methods recently devised in this laboratory.

2. Study of some fundamental facts of nutrition (by methods devised here), with special reference to the nutritive function and relative nutritive value of the chemical factors involved.

3. In collaboration with Dr. Park and his associates in the Medical School of Yale University, the influence of diet as a factor in the development of rickets and other organic changes is being studied.

4. The studies of the relation of vitamines to nutrition are being continued.

5. An elaborate study of the chemical constituents of the living alfalfa plant has developed much of interest and value regarding the chemistry of the living plant, but the results are not yet ready for popular discussion.

By using the method here devised of feeding animals, it has been made clear that some of the traditions concerning the needed relative proportions of protein and other nutrients must be in part modified or abandoned.

Thus rats have been grown here to adult size without more than traces of carbohydrates in their food, others without more than traces of fat in their food, and, most surprising of all, rats have been often grown nearly to maturity on rations containing 90 per cent of protein, but without more than traces of carbohydrates or fat, and on such a ration the energy requirement was well met by protein, for the rats ate no more of this diet than they would eat of a mixed diet having the same calorific value.

7. It has been noticed here, as elsewhere, that animals fed on rations consisting of purified nutrients, including vitamines and mineral salts, rations which are wholly adequate to enable animals to grow to full maturity and to maintain themselves in apparently normal condition, may be incapable of reproduction.

Examinations of such animals made in collaboration with workers in Professor Harrison's laboratories of Yale University show extreme abnormalities in the reproductive systems of both sexes. It is noted that small additions of egg yolk, and probably of some other naturally occurring foods, avert this sterility. An extensive study of these abnormalities has been undertaken.

8. Work in collaboration with Professor H. G. Wells of the University of Chicago has proved, by means of the anaphylaxis reaction, that the four proteins of cow's milk are chemically distinct, and that one of them, the lacto-globulin, is chemically indistinguishable from the serum globulin of beef blood.

The recent experiments in this department indicate that the amount of the water-soluble B. vitamine requirement bears a fairly definite relation to the mass of active tissue of the animal, that is, the larger and heavier the animal the larger the amount of vitamine required.

The study of the proteins, begun by Dr. Osborne about thirty years ago, has been most fruitful in establishing the nature and structure of these very complicated bodies and their relative value in nutrition: facts which have profoundly modified current theories regarding their rôle in nutrition. The results of the work

of this department are published in technical journals. Following is a list of the papers published during the present year:

Feeding Experiments with Mixtures of Foodstuffs in Unusual Proportions. Thomas B. Osborne and Lafayette B. Mendel. Proc. Nat. Acad. Sc. (1921) VII, 157-162.

The Proteins of the Alfalfa Plant. Thomas B. Osborne, Alfred J. Wakeman and Charles S. Leavenworth. Jour. Biol. Chem. (1921) XLIX, 63-91.

Vitamin A in Oranges. Thomas B. Osborne and Lafayette B. Mendel. Proc. Soc. Exper. Biol. and Med. (1922) XIX, 187-188.

Quelques caracteristiques d' ordre chimique de l'alimentation. Thomas B. Osborne and Lafayette B. Mendel. Bull. Soc. Sc. d'Hyg. Alimentaire (1922) X, 5-11.

Nutritive Factors in Plant Tissues. V. Further Observations on the Occurrence of Vitamin-B. Thomas B. Osborne and Lafayette B. Mendel. Jour. Am. Med. Assn. (1922) LXXVIII, 1121-1122.

Mas observaciones sobre la distribucion de la vitamina B en algunos alimentos vegetales. Thomas B. Osborne and Lafayette B. Mendel. Jour. Am. Med. Assn. Edicion Espanol (1922) VII, 656-657.

Milk as a Source of Water-Soluble Vitamin, III. Thomas Burr Osborne and Lafayette Benedict Mendel. Biochem. Jour. (1922) XVI, 363-367.

The Water-Soluble Constituents of the Alfalfa Plant. Thomas B. Osborne, Alfred J. Wakeman and Charles S. Leavenworth. Jour. Biol. Chem. (1922) LIII, 411-429.

CHEMICAL DEPARTMENT.

Dr. E. M. Bailey in charge.

This department is charged by statute with much control work, which has been required of this Station because it could be better and more economically done here than elsewhere.

Thus some 900 fertilizers have been analyzed and the results reported to the manufacturers and buyers of them. They have also been tabulated with appropriate discussion and are now being printed for distribution.

The same has been done with 535 samples of commercial feed and fodder materials.

Over 2400 samples of foods and drugs have been examined, many of them for the Dairy and Food Commissioner, and expert evidence has been furnished in prosecutions for adulteration or misbranding.

Over 1900 pieces of glassware used by milk dealers for the Babcock test have been examined and certified when correct.

The foregoing work is required by special statutes. The research and other work of the department may be summarized as follows:

The discovery of the vitamines and of their importance in nutrition has been quickly noted by manufacturers and the facts commercialized. A considerable number of so-called vitamine preparations are made and sold, with large advertising claims for them. A chemical and biochemical study of these proprietary vitamine preparations (many of which do not at all meet their advertising claims) has been made and a report on them is ready for publication.

Analyses have been made of the insecticides and fungicides in the Connecticut market.

Further work includes: Studies of methods for the examination of teas; for the determination of crude fiber and for the determination of nicotine in tobacco products, and further studies on the cryoscopy of milk.

Co-operative work with other organizations has included:

Analytical work with the American Oil Chemical Society to secure greater uniformity in the analyses of cotton seed meal and other fertilizers.

The published studies of diabetic preparations made by this department are in great demand by physicians and patients in all parts of the country, and Dr. Bailey collaborates with the Council of Pharmacy and Chemistry of the American Medical Association on matters relating to diabetic and other special foods.

He is also a member of the Joint Committee of Definitions and Standards, which includes three members each from the Bureau of Chemistry of the United States Department of Agriculture, the Association of Food and Drug Commissioners and the Association of Official Agricultural Chemists. The definitions and standards of food and drug products established by the committee are generally accepted as decisive as to the name and quality of such products.

The department has issued the following bulletins and reports:

Bulletin 233. The Fertilizer Report for 1921. 90 pp.
Bulletin 236. Report on Food Products and Drugs for 1921, 73 pp.
Bulletin 238. Report on Feeding Stuffs, 1921, 34 pp.
Cryscopy of Milk. Report of Associate Referee. J. Assoc. Offic. Agr. Chemists 1922, 5, 494. Report of Referee on Tea, J. Assoc. Offic. Agr. Chemists 1922, 6, 107.

ENTOMOLOGICAL DEPARTMENT.

Dr. W. E. Britton in charge.

Dr. Britton is the state as well as the Station Entomologist, and the following paragraphs cover his work in both capacities.

An extensive wind-spread invasion of the gipsy moth was brought to light by the scouting work of last winter, done in co-operation with the Federal authorities, who have charge of most of such work on the borders of areas known to be infested. All of Tolland and Hartford Counties are scatteringly infested, also

the northern and eastern borders of Litchfield County, two northern towns in New Haven County, two northern towns in Middlesex and all of New London County except four towns.

Windham County has been infested for several years and is now more thickly infested than any other part of the state.

Following the Federal quarantine, a state quarantine, No. 4, has been published, with a map, in Bulletin of Immediate Information No. 18.

This new infestation makes the area to be treated three times as large as before and makes the present appropriation entirely inadequate to do the work required. Between 20 and 25 state men have been employed in this work throughout the year.

In discharge of other work required by special statutes, 106 official nursery inspections have been made, and all stock infested with dangerous pests destroyed before certificates were given permitting the shipment of stock.

Thirty shipments, 159 cases, of imported nursery stock were inspected and 56.6 per cent of them found infested with insects or fungi, which had to be destroyed before release.

Apiary inspection involved examination of 797 apiaries containing 8,007 colonies. Thirty-three apiaries and 68 colonies had European foul brood, 11 apiaries and 22 colonies had American foul brood.

Mr. Sealy has had charge of the maintenance of drainage for mosquito elimination, besides making several preliminary surveys and giving advice as to the best means of getting rid of the mosquito nuisance.

Aside from the foregoing work, which is required by statute, the following comparisons of sprays *vs.* dusts have been the joint work of Mr. Stoddard of the botanical and Mr. Zappe of the entomological department:

On apples: Sulphur dust *vs.* liquid L. & S., in two orchards; Saunders dust and sulphur dust *vs.* liquid L. & S., and liquid L. & S. *vs.* 3-6-50 Bordeaux, each in one orchard; Saunders dust *vs.* sulphur dust and liquid L. & S. in one orchard.

On peaches: Sulphur dust *vs.* atomic sulphur, and Henry's Summo spray, in one orchard; Atomic sulphur *vs.* sulphur dust in another orchard.

The entomological department has also made the following comparisons:

On cherries: Liquid L. & S. 1 to 40 *vs.* 2-6-50 Bordeaux, both with Kayso spreader.

On potatoes, 4-4-50 Bordeaux *vs.* Saunders dust, in two places.

On onions, 4-4-50 Bordeaux with and without Kayso spreader.

All the tests included check plots, and comparison was made between three and four applications. They involved individual examination and scoring of about 384 barrels of apples and 600 baskets of peaches. The results are being prepared for publication.

Besides these, tests of various dormant sprays to kill the San José scale have been made, and dusting experiments on potatoes, turnips and cabbages have been conducted. Field tests have also been made to control the cabbage maggot, and of paradichlorobenzene to kill the peach borer.

Special studies have been made of the raspberry fruit worm, *Byturus unicolor*, the spruce mite, a pest of spruce trees in ornamental plantings, and of the European red mite, *Paratetranychus pilosus*, a pest of apple orchards. Various sprays for its control have been tested.

The life history of another species of spittle-bug or frog-hopper, found on alders, has been established.

Further observations have been made on the life history, spread and injury done by the apple and thorn skeletonizer, *Hemerophila pariana*, first found in Connecticut at Greenwich in 1920, and now distributed throughout the state. Nearly all unsprayed apple trees in Fairfield and New Haven Counties and the southern part of Hartford County were brown in late summer from its attacks.

A paper by Dr. Garman on the Dragonflies of Connecticut is nearly finished and will be published by the State Geological and Natural History Survey.

Dr. Britton and fifteen other specialists have prepared a monograph on the Hemiptera of Connecticut, containing 1100 typewritten pages, 20 plates and 169 text figures, which is now in the printer's hands, to be issued as a bulletin of the State Natural History Survey.

The office routine has included the writing of 2,350 letters, 656 circulars and postals, 54 reports to the Federal Horticultural Board, and 15 lectures and addresses at farmers' gatherings.

There have been moderate additions to the library and insect collections.

The publications of the department have been:

By W. E. Britton:

Twenty-first Report, State Entomologist of Connecticut (Bull. 234), 94 pp., 6 figs., 16 plates.

Control of Ant Invasions, Bull. of Immediate Information No. 17, 6 pp.

The Gipsy Moth Quarantine, Bull. of Immediate Information, No. 18, 4 pp.

Report of Committee on Injurious Insects. Proceedings 31st Annual Meeting, Conn. Pomol. Soc., 1922, p. 71.

New Facts Regarding Insects attacking Vegetables and their Remedies. Proceedings 9th Annual Meeting Conn. Veg. Growers Ass'n, 1922, p. 44.

Tobacco Plants Injured by Seed Corn Maggot. Jour. Economic Entomology, Vol. 15, 1922, p. 275.

Preparedness for Insect Control. Market Growers Journal, June 15, 1921, p. 12.

Notes in New Haven County Farm Bureau News on Potato Spraying and Skeletonizers on Apple and Birch Trees.

By W. E. Britton, M. P. Zappe and E. M. Stoddard:

Experiments in Dusting *versus* Spraying on Apples and Peaches in Connecticut in 1921. (Bull. 235, 20 pp., 5 figs., 6 plates.)

Results on Apples and Peaches in Connecticut. Bull. 2, Crop Protection Digest, Feb. 1922, p. 7.

By W. E. Britton and S. T. Sealy:

Mosquito Work in Connecticut in 1920. Eighth Rept. N. J. Mosquito Extermination Ass'n, p. 64, 1922.

By Philip Garman:

The Grass Feeding Frog-Hopper or Spittle Bug, Guide to Nature, Vol. XIV, 1922, p. 165 (2 pp., 3 illustrations).

By M. P. Zappe and E. M. Stoddard:

Results of Dusting *vs.* Spraying on Apples and Peaches in Connecticut. Proceedings 31st Annual Meeting Conn. Pomol. Soc. 1922, p. 77.

FORESTRY DEPARTMENT.

Mr. W. O. Filley in charge.

The transfer of the records of the state forester, including the fire warden service, to the newly appointed state forester has involved considerable labor, but will leave more time for experimental forestry work.

The call for forest planting stock has been very large this year, but the supply consisted simply of five-year red pine transplants and two-year white pine seedlings. A commercial nursery held this stock for delivery at wholesale rates on orders placed through this department. By this arrangement forest planters made a considerable saving. The supply was less than the demand. About 211,000 trees were thus secured and planted by fifty applicants. Three thousand black walnut seedlings were obtained from Ohio and distributed at cost.

The experimental plantings at Rainbow have made good growth, but two small fires ruined a plantation of six acres. Descriptive signs have been put up to make it possible for visitors without a guide to learn some of the important lessons of the experiment.

The work of controlling the white pine blister rust has been carried on in Litchfield County by Mr. Hicock, who spent four months in camp with eradication crews. The disease was found to be spreading in Cornwall, Salisbury, North Canaan and Canaan.

As the state appropriation is inadequate, help has been sought from the towns and private owners. Through the Litchfield

County Farm Bureau a meeting was held in Cornwall. A committee was appointed to raise $2,000 by subscription, the state to spend an equal amount. Eradication work was carried on from May 16 to September 16. Over 5,000 acres were covered and nearly 100,000 wild currant and gooseberry bushes were removed.

A number of land owners in Salisbury met the expense of eradication work, the wages of a foreman and director being paid by the state. A local crew of five covered nearly 2,000 acres, removing about 37,000 wild currant and gooseberry plants. At a meeting in August, it was decided to endeavor to raise $3,500, for two years' work, if the state will contribute an equal amount.

By a co-operative agreement between the Bureau of Plant Industry, the State Relations Service, the Extension Service of the Agricultural College, and this Station, an effort is being made to show the public the seriousness of this rust, how to recognize it, and how to protect their property against it. The Bureau of Plant Industry will appoint and maintain educational agents in counties or groups of counties who will work under the supervision of this Station. One agent was assigned to Litchfield County in May; a second to Tolland, Hartford and Windham Counties in August, and a third to the remaining counties in October.

The sample forest plots at Woodbury, established in 1912, have been remeasured, the small wood lot at Mt. Carmel is being changed from a culled stand of hardwoods to a stand of mixed conifers, and a further survey is being made of the larger wood-using industries of the state.

The forester, together with the entomologist and botanist, act as a Tree Protection Examining Board to test the qualifications of those who do commercial work in the treatment of ornamental and orchard trees and to give certificates to those who are qualified.

The routine work of the office has involved the writing of 984 letters, 439 form letters, and the sending of 2,936 mail and express packages. Fourteen addresses have been given on forestry subjects, and examinations of forest land have been made for seventeen owners, to whom advice was given.

PLANT BREEDING DEPARTMENT.

Dr. D. F. Jones in charge.

After years of strict inbreeding of different strains of corn, the method of combining these strains by crossing, to secure increased vigor and yield, is being made of practical use in what is called the double-crossed Burr-Leaming.

This is the result of crossing four inbred strains in pairs and again crossing the two resulting hybrids.

It is not a fixed variety, and will not continue to give high yields if the seed from the hybrid plants is used for planting. The only seed recommended is the first generation of crossed seed.

The double-crossed Burr-Leaming, as a silage corn, has proved superior in yield to many other varieties in numerous trials in Fairfield, New Haven, Middlesex and Hartford Counties, and is being tested for silage in Massachusetts, Vermont and New York. In southern Connecticut, it is also a high yielding husking corn.

It requires a season of from 120 to 130 days to ripen sufficiently for putting in the shock. It is a large growing variety, requiring generous fertility and not too close planting.

At the trial field at Mt. Carmel this variety has outyielded every other in three years out of four. Only in 1920, when all yields were very low, did a single variety yield two bushels per acre more than this.

The average yields of the four best varieties and of the Burr-Leaming were, in bushels per acre:

	1918	1919	1920	1921
Four best varieties	87	68	45	82
Burr-Leaming hybrid	116	88	55	95

In our experience, this hybrid stands up better than most others, making it easier to cut with machinery, and the leaves on the whole plant stay green until the kernels are glazed.

This hybrid has been developed as a sort of by-product of the studies on inbreeding and cross-breeding undertaken to develop the fundamental principles of inheritance and which have been in progress for some fifteen years.

Work is also under way in improving the types of Evergreen and Golden Bantam sweet corn for canning purposes. The aim is to get even size and shape and especially uniform ripening.

Several methods for utilizing inbred strains are being studied to simplify the process of crossing, and, if possible, to do away with crossing entirely, while getting the best results in vigor, yield of grain and freedom from disease.

Studies on attaining complete homozygosity in naturally cross-fertilized species and studies on linkage of hereditary factors and inheritance of abnormalities with particular reference to sterility are at present only of interest to investigators.

Further studies of the best methods of growing and curing the Round Tip tobacco, which was originated by this department, and of certain new hybrid strains, will be reported with the work of the Tobacco Station after fermentation and testing are completed.

The ten-year test of corn varieties (eight years in co-operation with the Storrs Station) has been completed, and a report on the subject is in preparation.

The publications in scientific journals during the year, from this department, have been:

The Indeterminate Growth Factor in Tobacco and Its Effect upon Development. Genetics, 6:433-444, 1921. Jones

Collins' Remarks on the Vigor of First Generation Hybrids, Amer. Naturalist, 55:457-461, 1921. Jones

Indirect Evidence from Duplex Hybrids Bearing upon the Number and Distribution of Growth Factors in the Chromosomes. Amer. Naturalist, 56:166-173, 1922. Jones

Selective Fertilization as an Indicator of Germinal Differences. Science, 55:~~59-60~~, 1922. 348-349. Jones

The Productiveness of Single and Double First Generation Corn Hybrids. Jour. Amer. Soc. Agronomy, 14: 242-252, 1922. Jones

Dr. Jones has delivered two addresses at the Farmers' Week of the Ohio State University on "Breeding Out the Nubbins" and on "Inbreeding and Hybrid Vigor," and one address on "New Methods of Corn Breeding," at Berlin, Connecticut.

THE TOBACCO EXPERIMENT STATION.

Dr. G. H. Chapman in charge.

During the last winter a plan for the experimental field work was prepared. This included a test of the effect on yield and quality of supplying half the nitrogen and all the nitrogen in mineral forms, also of supplying half the nitrogen in fish or in tankage, the effect of small, moderate and large amounts of phosphoric acid, and tests of the effect of magnesia, sulphur and chlorine.

On a plot nearly ruined by wildfire last year, and where the infected leaves and stalks were plowed under, healthy broadleaf and Havana plants were set to determine whether the organism lived over winter and would attack the next year's crop. No evidence of such effects appeared.

The effect of close and open planting on the growth of Round Tip tobacco and the best time for harvesting were studied on another plot.

Fifteen strains of a Cuban- Broadleaf cross made by Dr. Jones are tested to decide which are worth further selection.

A number of so-called good and poor domestic strains are to be compared under uniform treatment to learn, if possible, the truth or falsity of the statement that our strains of Havana and broadleaf are deteriorating.

Various strains of domestic and imported Cuban seed have been tested under shade to determine the type most suitable for yield and quality.

The United States Department of Agriculture is co-operating in studies of brown-rot of tobacco and in the experiments with magnesia, etc., noted above.

It is hoped that within a few months the fermentation of the experimental crops will be finished and a report on them prepared.

Bulletin No. 1 of this department has been issued. Condensed Recommendations for the Control of Wildfire, 4pp.

PHYSICAL EQUIPMENT.

The Station equipment includes a working library of over 10,000 bound volumes and about 500 volumes not owned by the Station but deposited here as a loan, an herbarium of about 48,800 specimens and an insect collection of about 56,000 specimens.

The valuation of the Station land and buildings is..	$295,275
Of the contents of the buildings	102,645
	$397,920

An exhibition illustrating the various departments of the Station work was made at the Exposition in Hartford, January 23 to 27.

The Station field day was held at Mt. Carmel on September 2.

The routine work of the Station may be briefly summarized as follows:

Fertilizers analyzed	900
Feeds analyzed	535
Foods and drugs analyzed	2,400
Pieces of glass ware tested and certified	1,973
Samples of seeds tested	742
Specimens identified	491
Nursery, orchard, apiary and other inspections	933
Addresses at farmers' meetings	44
Publications in scientific journals	13
Entomological monographs prepared	2
Letters written (more than)	9,000
Post and express packages sent	3,038
Form letters sent (more than)	1,500

Respectfully submitted,

E. H. JENKINS,
Director.

Connecticut Agricultural Experiment Station

E. H. JENKINS, Director

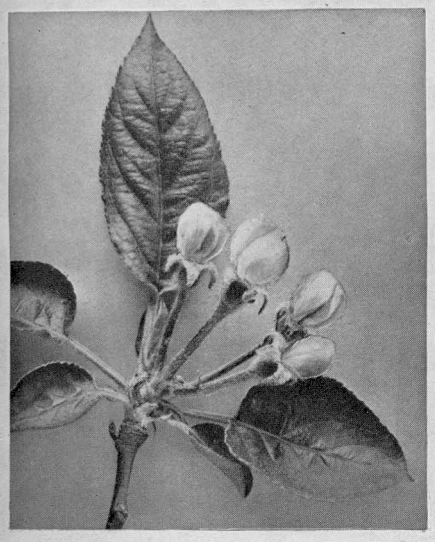
NEW HAVEN, CONN.

Spray Calendar

W. E. BRITTON, Entomologist

Bulletin 244

G. P. CLINTON, Botanist

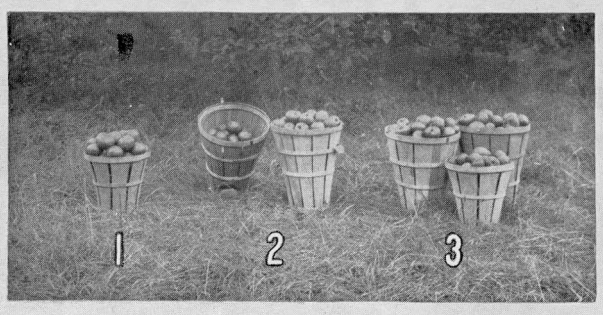


RIGHT TIME FOR PINK SPRAY

SPRAYED

82% 14.2% 2.8%

NO TREATMENT



11.1% 33.3% 55.6%

RIGHT TIME FOR CALYX SPRAY

CONNECTICUT

AGRICULTURAL EXPERIMENT STATION

NEW HAVEN, CONN.

BULLETIN 244 JANUARY, 1923

Spray Calendar

By

W. E. BRITTON, *Entomologist.*

AND

G. P. CLINTON, *Botanist.*

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.

DIRECTIONS FOR PREPARING INSECTICIDES AND FUNGICIDES.

FORMULAS FOR INSECTICIDES.

LEAD ARSENATE.

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

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

PARIS GREEN.

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

Spray upon foliage to kill chewing insects. Commonly used with Bordeaux mixture on potatoes, largely superseded by lead arsenate.

CALCIUM ARSENATE.

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

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

POISONED BRAN MASH.

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

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

FRESH HELLEBORE.

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

LIQUID LIME-SULPHUR.

Winter Spray.

1 part Lime-Sulphur. 9 parts Water.

Summer Spray.

1¼ to 1½ parts Lime-Sulphur. 50 parts Water.

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

CORROSIVE SUBLIMATE.

1 ounce in 10 gals. water, poured around cabbage plants to prevent injury from cabbage root maggot.

DUST MIXTURES.

Sulphur 75%, hydrated or air-slaked lime 15%, lead arsenate 10% (or sulphur 90%, lead arsenate 10%), is used to dust apple orchards for fungous diseases and chewing insects. To kill sucking insects add 2% of nicotine. Copper hydrate 15%, hydrated lime 80%, and calcium arsenate 5%, is used successfully in some localities. Plain sulphur is used in peach orchards. These dusts can be purchased, mixed ready for use.

NICOTINE SOLUTION.

½ pint of a 40% nicotine solution in 50 gals. water. Dissolve and add 2 lbs. Laundry Soap or 1 lb. Calcium Caseinate for a spreader.

Excellent for killing aphids and other sucking insects.

KEROSENE EMULSION.

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

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

MISCIBLE OILS.

Mix 1 part of "Scalecide", "Jarvis Compound", "Target Scale Destroyer" or other miscible oils with 15 parts of water, to kill San José scale, especially on old apple trees.

COMMON LAUNDRY SOAP.

Spray 1 lb. dissolved in 8 gals. water upon foliage to kill red spider, aphids, and other sucking insects. Soap flakes may be used in half this quantity.

CARBON DISULPHIDE.

To kill insects infesting stored grain, in tight bins, use 1 lb. for about 100 cubic feet of space. Expose for about 36 hours at 60° F. or higher.

PARADICHLOROBENZENE.

A granular solid chemical which gives off fumes fatal to insect life. Has recently been used successfully to control the peach borer. Also called "Krystal gas," "Paradichloride," "P. C. Benzene," etc.

NAPHTHALENE.

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

CALCIUM CASEINATE SPREADERS.

1 lb. in 50 gals. acts as a spreader and prevents chemical reactions, where different materials are mixed together.

FORMALIN FLY POISON.

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

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

ANT POISON.

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

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

HYDROCYANIC ACID GAS.

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

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

FORMULAS FOR COMMON FUNGICIDES.

LIQUID LIME-SULPHUR.

Winter Spray.

1 part Lime-Sulphur. 9 parts Water.

Summer Spray.

1¼ to 1½ parts Lime-Sulphur. 50 parts Water.

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

DRY LIME-SULPHUR.

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

SELF-BOILED LIME-SULPHUR.

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

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

A very excellent substitute for this fungicide on peaches is the commercial article called "Atomic Sulphur," without lead arsenate, used at the rate of 5 lbs. to 50 gallons water.

SULPHUR DUST.

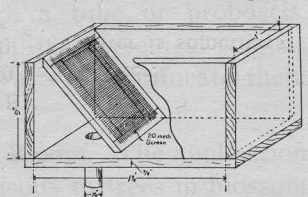
Dusting with special grades of very fine sulphur, about 90 parts thoroughly mixed with 10 parts lead arsenate for apples and 80 parts sulphur and 20 parts air-slaked lime for peaches, or with special material prepared by manufacturers, has attained some prominence as a combined fungicidal and insecticidal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

BORDEAUX MIXTURE.

5 lbs. Copper Sulphate (Blue Vitriol). 6 lbs. Fresh Lime. 50 gals. Water.

For small acreage. Dissolve the copper sulphate in hot water. Slake the lime and strain through coarse cheese-cloth. Dilute each separately to 25 gallons. Pour together slowly through a strainer into the spray barrel.

For large acreage. Make stock solutions of copper sulphate and lime as follows: Dissolve 50 pounds of copper sulphate in 50 gallons of water, by suspending in a bran sack. One gallon of stock solution thus contains one pound of copper sulphate. Slake 60 pounds of lime, strain into a barrel and make up to 50 gallons. A gallon of this solution contains one pound of lime. The excess takes care of waste in slaking. Put two 50-gallon dilution barrels on a platform so that the sprayer can be backed under them. For a 100-gallon sprayer put 10 gallons of stock lime mixture into the lime barrel and 10 gallons of stock copper sulphate solution into the copper sulphate barrel. Dilute each to 50 gallons. By using a molasses spigot for each barrel, the two streams may be run together through a trough into the sprayer. A large, fine wire strainer should be set in the sprayer opening. Lead arsenate, Paris green, or nicotine solution may be added if needed. Hydrated lime is handy to use, but Bordeaux made with it is said by some not to adhere so well and more likely to injure apple foliage.



TYPE OF STRAINER RECOMMENDED FOR SPRAY MATERIALS

Some growers get good results with the following method: Start filling the sprayer with water, washing in at same time 10 gallons of the stock lime mixture through the strainer. When half full, add the 10 gallons of stock copper sulphate solution with the remaining water, stirring meanwhile. When short handed, this method saves time. Half these amounts are used for a 50-gallon sprayer.

FORMALIN.

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

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

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

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

CORROSIVE SUBLIMATE.

4 ozs. Corrosive Sublimate. 30 gallons Water.

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

FORMULAS FOR LESS-USED FUNGICIDES.

OTHER BORDEAUX MIXTURES.

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

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

SPREADERS.

Certain commercial forms of casein are now on the market and can be used in Bordeaux mixture as a spreader instead of the preceding.

COPPER SULPHATE.

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

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

POTASSIUM SULPHIDE.

3 ozs. Potassium Sulphide. 10 gals. Water.

Used chiefly in greenhouses, or for powdery mildews.

FORMALIN FUMES.

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

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

GENERAL INFORMATION.

What are Insects and Fungi? Insects are animals having six legs. Spiders, mites, sow-bugs and millipedes are animals but not insects. Spraying kills the insects after they have attacked their food plants. Fungi are lower forms of plants, and get their sustenance from plant or animal tissues. Those growing upon living plants or animals are called parasitic fungi; those growing upon decaying tissues are saprophytic fungi. Spraying is an insurance, and prevents fungi from getting a foothold, but is not a cure after they have begun to cause injury.

Chewing and Sucking Insects. Some insects bite and chew their food, like the higher animals and can be killed by arsenical poisons placed upon their food. Their jaws or mandibles move horizontally. Other kinds puncture the tissues and suck the plant juices from inside through a tube or proboscis. Sucking insects cannot be killed by applying arsenical poisons to the food, but dusts and contact sprays will suffocate them and corrode their tissues.

Do Not Spray Fruit Trees When in Bloom. The application of lead arsenate or other arsenical poisons to trees in blossom may do much harm (1) by injuring the essential organs of the flowers, so that fruit will not set, and (2) by killing many of the bees which carry pollen from one tree to another. If all honey bees and native wild bees were killed, there would be little or no set of fruit.

Spraying Versus Dusting. Three years' experiments in Connecticut show that in apple orchards, spraying gives a larger percentage of good fruit than dusting and is less expensive. Dusting gives fairly good control of insect pests but does not hold some fungous diseases in check like spraying. Dusting has given as good results as spraying in controlling scab and brown rot on peaches. It is probable that dusts can be used to advantage on low growing vegetable crops, where spraying is impracticable.

Safe Combinations of Sprays. It is safe to mix lead arsenate with lime-sulphur, Bordeaux and nicotine, but none of these should be combined with miscible or other oils. It is also unsafe to use soap with lead arsenate. In making the usual orchard spray the ingredients should be put together in the following order:

1. Clean water.
2. Nicotine sulphate.
3. Calcium caseinate.
4. Lead arsenate.
5. Lime-sulphur.

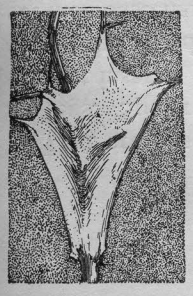
INSECT AND FUNGOUS PESTS OF CULTIVATED PLANTS.

APPLE.

Insects, etc.

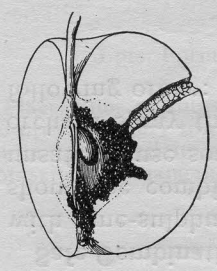
Bud-Moths: Case Bearers: Leaf Crumpler:—Small overwintering caterpillars feed upon the unfolding leaves. Spray with lead arsenate as soon as leaf buds begin to open. Repeat a few days later, if necessary. Rept. 1909, p. 353.

Canker-Worms—Small loopers devour the leaves in May and spin down on threads when disturbed. Spray with lead arsenate before blossoms open, and again soon after they fall. In unsprayed orchards place sticky bands around trunks of trees in October, keep sticky until January 1st, and again keep sticky during April and May. Rept. 1908, p. 777.



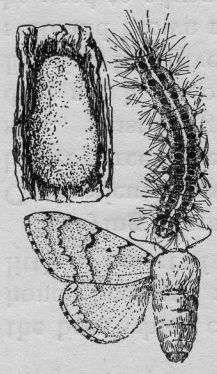
Tent-Caterpillar—During May the caterpillars form nests at the forks of the branches, and devour the leaves. Clip off and burn egg-masses on twigs in winter. Remove nests with caterpillar brush. Spray with lead arsenate once before blossoms open and again soon after they fall. Bull. 177, and Rept. 1913, p. 226.

Lesser Apple-Worm—Larva feeds on exterior of nearly mature fruit, and often causes injury in storage. Spray twice as for codling-moth. Keep foliage and fruit covered until fruit is nearly grown. Rept. 1910, p. 595.



Codling-Moth or **Apple-Worm**—Pink caterpillar tunnels inside the fruit, especially around the core. Spray with lead arsenate as soon as the blossoms fall. Repeat three and six weeks later. Rept. 1910, p. 594.

Brown-Tail Moth: Fall Web-Worm—See Pear.



Gipsy Moth—Brownish hairy caterpillars defoliate trees in May and June. Band trees with tanglefoot and spray foliage with lead arsenate. From August to May soak egg-masses with creosote. Bull. 186; Repts. 1905, p. 246; 1906, p. 235; 1907, p. 300.

Curculios—Grubs of both apple and plum curculios infest the fruit, making it gnarled and ill-shaped. Spray with lead arsenate as soon as blossoms fall, and repeat a week later. Remove infested fruit in thinning. Keep fence rows clear of trash. Rept. 1904, p. 219.

Apple and Thorn Skeletonizer—Small spotted larvae feeding in web skeletonize upper surface of leaves. White pointed cocoons formed on leaves. Purplish moths fly about and rest

on flowers. Three broods each season. Unsprayed apple trees brown in June and August. Spray with lead arsenate middle of May, first of July and middle of August. Rept. 1920, p. 190; 1921, p. 186; Bull. 246.

Green Fruit Worms: Palmer Worm: Leaf Roller—Caterpillars all feed upon foliage and immature fruit. Spray with lead arsenate, as for codling-moth.

Tussock Moths—Tufted caterpillars of several species feed upon the leaves in mid-summer. Spray with lead arsenate as for codling-moth. Rept. 1905, p. 230; 1907, p. 332; 1916, p. 105; 1917, p. 325.

Yellow-necked Caterpillar: Red-humped Caterpillar—Feed in clusters and often strip young trees in fall. Hand-picking is easy method of control. Spray leaves with lead arsenate. Rept. 1901, p. 274; 1917, pp. 328, 329.

Maggot or **Railroad Worm**—Maggots tunnel through the pulp of the ripening fruit of sweet and sub-acid varieties, especially those ripening early in the season. Destroy all infested fruit. Spray as late as July 15 with lead arsenate to kill adult flies. Rept. 1910, p. 593.

Round-Headed Borer: Flat-Headed Borer—Grubs burrow in wood at base of trunks. Watch trees and dig out borers wherever sawdust appears. Paint trunk with lead arsenate and lime-sulphur. Rept. 1907, p. 333.

Leafhoppers—Whitish insects sucking sap from underside the leaves. Spray with nicotine solution, as for aphids.

Tarnished Plant Bug—Injures developing fruit by sucking sap, forming dimples. Spray or dust with nicotine as for aphids.

Red Spider: Clover Mite: European Red Mite—Cause much injury to leaves, especially in dry seasons. Overwintering eggs killed by winter spray of miscible oils or delayed dormant of lime-sulphur. Spray in May and June with lime-sulphur or strong soaps.

Leaf-Blister Mite—See Pear.

Green and **Rosy Aphids**—Green aphids suck sap from the leaves and terminal shoots, causing leaves to curl and checking growth. Rosy aphids infest fruit clusters, checking development. Use delayed dormant spray with nicotine solution (½ pint in 50 gallons water), either separately or with lead arsenate, lime-sulphur or Bordeaux mixture. Dust with nicotine. Repts. 1903, p. 259; 1909, p. 343.

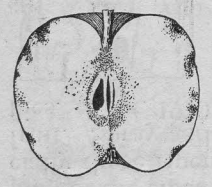
San José Scale—See Peach. Spray dormant trees with lime-sulphur or miscible oil. Bull. 165; Rept. 1904, p. 221.

Red Bugs—Two species of red leaf bugs suck the sap, causing leaves and fruit to become distorted. Spray with nicotine solution, as for aphids, or dust with 2% nicotine. Rept. 1917, pls. II-III.

Wooly Apple Aphis—A bluish-white, cottony plant louse in colonies on bark, forming galls or swellings on twigs of small trees, and preventing wounds from healing; also on roots, forming galls, and destroying small feeding roots. Plant only clean or fumigated stock. Soak soil with carbon disulphide, ½ ounce in 4 gals. water. Spray above ground with kerosene emulsion.

Oyster-Shell Scale: Scurfy Scale—Scale insects with elongated or pear-shaped shells, on bark, suck sap from the twigs; the former about the same color as the bark, the latter light gray or whitish. Spray with nicotine solution; soap and water; or kerosene emulsion, about the second week in June. Bull. 143; Rept. 1903, p. 225.

Fungi, etc.



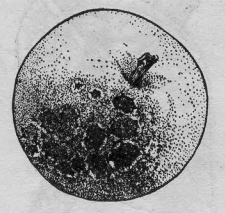
Baldwin Spot—Shows as small diseased masses of brownish tissue, usually a short distance beneath the skin; finally may appear at the surface as small, discolored, shrunken areas, then very similar in appearance to some of the fruit speck troubles. Not a fungous disease. Thought by some to be due to unusual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

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

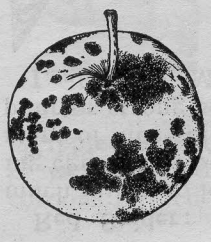
Black Rot—Causes mature fruit to turn brown, then black; forms small brown spots on leaves; does some damage through cankers on branches, which are eventually killed. Treat as for scab; prune and burn all dead limbs and twigs; cut out and paint over large cankers when found. Rept. 1909-10, p. 590.

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

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



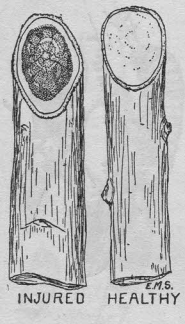
Scab—Produces "scabby spots" on fruit and leaves; rarely on twigs. Spray the unfolding leaves before the blossoms open, again after the petals fall, and follow with a third and fourth spraying at intervals of three weeks. For first treatment, use strong Bordeaux, for others, weak Bordeaux or lime-sulphur or the latter for all treatments. Rept. 1909-10, p. 591.



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

Blight—See Pear.

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



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

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

General Treatment for Apple Orchards.

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

(1) Winter treatment (spraying dormant trees) is necessary only in the presence of the San José scale, or leaf-blister mite, when commercial lime-sulphur, 1-9, or miscible oils, 1-15, may be used. "Delayed dormant" treatment just as the green leaves begin to show, will kill many aphids and lessens scab infection.

(2) At least three summer treatments with a fungicide are necessary to control fungous diseases, and the last two of these should contain an insecticide. These sprayings should be made as follows: 1st, just before the blossoms open (pink spray) on the young unfolding leaves; 2nd, as soon as all the blossoms have fallen (calyx spray); 3d, two to four weeks later (fruit spray). For sooty blotch and Brooks fruit spot and sometimes scab, a fourth treatment should follow the third at an interval of 2 or 3 weeks, while the first may be omitted except for scab.

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

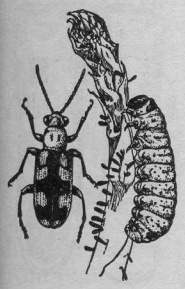
(4) For the insecticide in the above, use lead arsenate, if in the paste form at the rate of three pounds per fifty gallons of the mixture, or if in the powder form one and one-half pounds per fifty gallons.

(5) If canker worms, tent-caterpillars, bud-moths, or brown-tail moths are causing damage, add lead arsenate to the first

summer treatment, and if aphids are present nicotine solution should also be included. Nicotine solution may be added to any of the subsequent treatments to destroy aphids, red bugs, tarnished plant bugs, etc.

Insects.

ASPARAGUS.



Asparagus Beetles, Common and **12-spotted**—Adults and larvae devour the foliage. Cut everything clean during the cutting season; afterward spray with lead arsenate and calcium caseinate. Rept. 1921, p. 171.

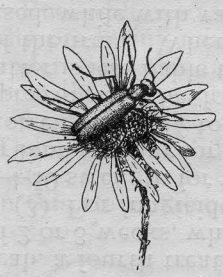
Asparagus Miner—Larvae tunnel under epidermis of stem near base, causing premature death of plant above ground. Burn infested stalks. Rept. 1906, p. 303.

Fungi, etc.

Rust—Produces small reddish or black elongated pustules scattered over stems. In fall, carefully gather and burn all stems from affected beds and escaped plants in vicinity. In gathering for market cut below the ground, as protruding stems offer opportunity for development of first stage of the fungus. Spraying with resin Bordeaux partially controls the disease, but is seldom practiced now. Begin spraying the latter part of July and repeat about every 10 days until the middle of September. Thorough cultivation and fertilization, with plenty of humus in the soil, are advocated as beneficial. Grow varieties most resistant to the disease or select seed for new stock from resistant individuals if found. This disease is not so serious as it was some years ago. Repts. 1896, p. 281; 1904, p. 313.

Insects.

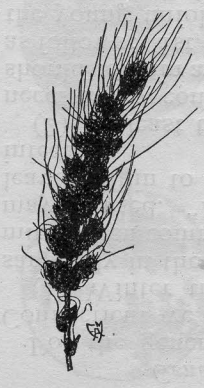
ASTER.



Blister Beetles—Three or four species feed upon the flowers, the black one being commonest. Hand-pick and cover choice plants with mosquito netting. Bull. 208, p. 110.

Fungi, etc.

Yellows—Shows in the yellowed and often imperfectly developed foliage and one-sided blossoms. A physiological trouble whose cause is not definitely known. Buy best seed; transplant only healthy plants; have soil conditions good; keep down aphids. Repts. 1903, p. 306; 1914, p. 413 (26).



Insects.

BARLEY.

Army Worm—See Grass.

Fungi.

Rusts—See Oats and Wheat.

Smuts—Are of two kinds, covered and loose, both largely destroying the infected spikes and changing them into black, sooty structures, in the latter kind easily dissipated. Treatment, see Oats. Rept. 1903, p. 306.

BEAN.

Insects.

Green Clover Worm—Occasionally green, wriggling caterpillars riddle the leaves in June and July. Dust string beans with air-slaked lime or other fine powder. Spray shell beans with lead arsenate. Repts. 1908, p. 828; 1919, p. 165.

Weevils—Adults lay eggs in the pods in the field and continue to breed in the dried seed, finally rendering it unfit for food or for planting. Fumigate the seed with carbon disulphide as soon as harvested, store in air-slaked lime, or heat in oven for 1 hour between 120° and 150° F. Bull. 195, p. 6.

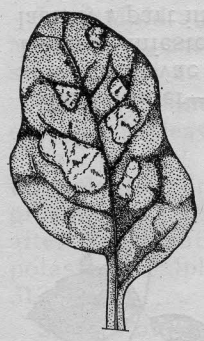
Fungi.

Anthracnose—Shows on leaves and pods as roundish discolored areas, often with a purplish border. Save seed from pods showing no spots and plant these by themselves, selecting each year seed from unspotted pods for the seed crop and using remainder for general crop. Destroy all infected seedlings. Where very troublesome spray with Bordeaux, beginning when plants are only a few inches high and repeating about every 10 to 14 days until pods are formed. Rotation and destruction of old vines may prove helpful in keeping the trouble in check.

Blight—Appears much like anthracnose, but with discolored areas having more of a translucent or watery character. Treat same as for anthracnose. Repts. 1898, p. 262; 1903, p. 307.

Downy Mildew—Forms dense, white, woolly growths on pods and less luxuriantly on young stems and leaves of the Lima bean. Serious only in years unusually moist after the middle of July. Plant on well-drained soil. Spray with Bordeaux beginning about the middle of July, and repeat every 10 to 14 days until the middle of September. Rept. 1905, p. 278.

Rust—Produces small, round, reddish or black, dusty outbreaks, usually on the leaves. Plant varieties not likely to rust. Burn the old infected plants in the fall, or rotate. Rept. 1903, p. 308.



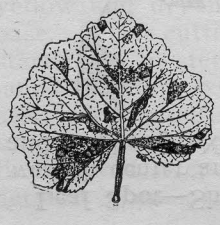
Insects.

BEET-CHARD.

Leaf-Miner—A small fly lays eggs in the leaves, and the larvae tunnel or mine between upper and lower surfaces. Practice clean cultivation. Destroy all infested leaves. Destroy all plants of the weed known as "lambs quarters" in which this insect breeds. Practice late fall plowing.

Fungi.

Leaf Blight—See Mangel. Rept. 1903, p. 309.



Eelworms.

BEGONIA.

Leaf-Blight Eelworm—Produces conspicuous dead areas on the leaves of Begonias (especially var. *Cincinnati*), ferns, etc. Spots vary in size and shape according to host and disposition of larger veins.

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

BIRCH.

Insects.

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

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

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

BLACKBERRY.

Insects.

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

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

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

Fungi, etc.

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

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

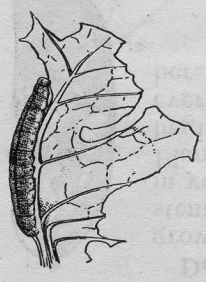
Orange Rust—Breaks out in spring or early summer as dusty masses of bright orange spores over the under side of the leaves. The fungus is perennial in the underground parts. Dig up and burn infected plants. Rept. 1903, p. 309.

BOX.

Insects.

Leaf-Miner—A small two-winged fly lays eggs in the leaf and the larvae tunnel between the upper and lower surfaces. Destroy infested leaves. Spray under side of leaves with molasses, 1 part in 3 parts water.

Oyster-Shell Scale—See Apple.

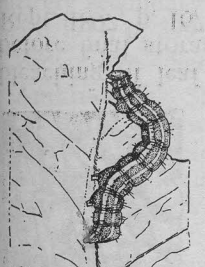


CABBAGE-CAULIFLOWER.

Insects.

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

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



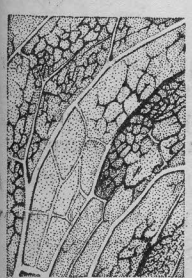
summer, and require same treatment. Bull. 190, p. 12; Rept. 1910, p. 706.

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

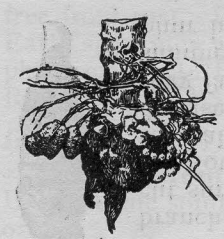
Cabbage Aphis—Sucks sap from the leaves. Spray or dust with nicotine. Bull. 190, p. 14.

Fungi, etc.

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



Club Root—Causes knob-like enlargements on the roots of cabbage and allied plants. The germ often becomes established in the soil; avoid such land and the use of refuse from old plants on the soil. Be especially careful that the seed bed is not infected. Infected land, if used, should be



treated in the fall with lime broadcast at the rate of 80 bushels per acre and worked in. Rept. 1903, p. 310.

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

CARNATION.

Insects.

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

Fungi.

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

Rust—Produces small dusty pustules, more or less confluent, on the leaves and stems. Select rust-resisting varieties. Spray in field with Bordeaux, adding spreader. Select for transplanting only hardy and rust-free specimens. Keep air of greenhouse dry. Give one or two sprayings with Bordeaux, after transplanting in greenhouse; for repeated sprayings use potassium sulphide or weak copper sulphate. Rept. 1903, p. 312.

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

Insects. **CEDAR.**

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

Fungi.

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

CELERY.

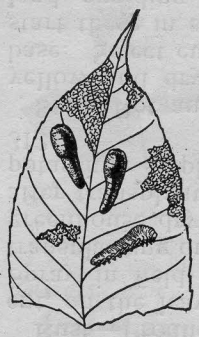
Insects.

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

Fungi.

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

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



Insects. **CHERRY.**

Cherry or **Pear Slug**—Larvae eat away the green tissue from upper side of leaf. Spray or dust with lead arsenate and sulphur. Rept. 1920, p. 199.

Canker-Worms—See Apple.

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

Plum Curculio—See Plum.

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

Fungi.

Black Knot—Forms knot-like growths on twigs and branches. Plant only trees free from this trouble; in the orchard, cut off and burn all infected branches in late fall or winter, painting over large cut surfaces. Cutting *out* knots is not advisable, as new outbreaks usually result. In cutting off, cut several inches below the knot, to insure removal of diseased tissues. Remove all knots each year until they fail to reappear. Spraying in spring and early summer with self-boiled lime-sulphur or atomic sulphur helps to keep new knots from fruiting, but is

entirely secondary in importance to the removal of the knots. Rept. 1911, p. 399.

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

Anthracnose—Shows as numerous, closely placed, purplish spots on leaves, which often have "shotholes." Spraying, if begun on young leaves early in May, is effective. Use self-boiled lime-sulphur or atomic sulphur. Give four or five sprayings at intervals of two weeks. Repts. 1895, p. 188; 1911, p. 401.

Powdery Mildew—Develops a cobweb-like growth over the leaves. Usually worst in young trees; controlled by spraying.

Insects. **CHRYSANTHEMUM.**

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

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

Leaf Mite—See Cyclamen.

Fungi.

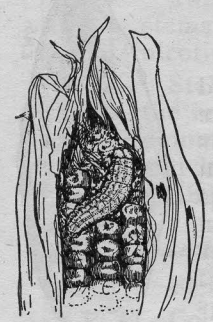
Powdery Mildew—Develops as a white mealy or cobweb coating on leaves. Air and water carefully, and if necessary spray from time to time with potassium sulphide or paint heating pipes with sulphur.

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

Insects. **CINERARIA.**

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

Insects. **CORN.**



Cut-Worms—See Tomato.

Army Worm—See Grass.

Stalk Borer—See Dahlia.

White Grubs—See Grass.

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

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

Fungi.

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

Root and **Ear Rots**—Injures roots and base of stalk with a reddish-brown rot. Stalks are easily broken off and often fail to produce ears. The ears show moldy, white or pinkish

growths. Plant only vigorous, disease-free seed, practice yearly rotation and do not let corn follow other grains. Bull. 222, p. 427.

Smut—Forms black dusty outbreaks on various parts of the plant. It is especially injurious to certain varieties of sweet corn. Seed treatment is ineffective.

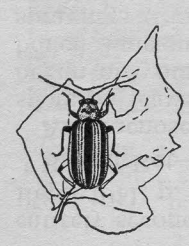
CRANBERRY.

Insects.

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

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

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



CUCUMBERS.

Insects.

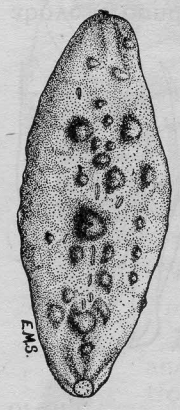
Striped Cucumber Beetle—Attacks young plants, eating the leaves. Larvae infest the main root or stem under ground, often killing the plant. Dust leaves with dry lead arsenate. Cover plants with screens. Bull. 216, p. 34; Rept. 1908, p. 807.

Melon Aphid—See Melon.

Fungi, etc.

Anthracnose—Produces prominent discolored spots, more or less merged, on leaves; occurs as rot on fruit. More serious on watermelon. Treatment is the same as for mildew.

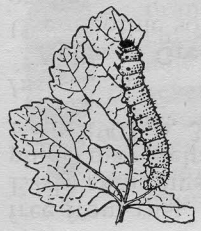
Downy Mildew—Forms discolored spots as in preceding, with fungous growth on lower side. Repeated sprayings with Bordeaux every 10 to 14 days during the season, beginning at least by middle of July, usually keeps this disease in check. Rept. 1904, p. 329.



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

Wilt—See Squash.

CURRANT.



Insects.

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

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

Currant Borers—The larvae of two species

of insects tunnel in the pith of the stems, causing the leaves to droop and wilt. Destroy infested canes during May.

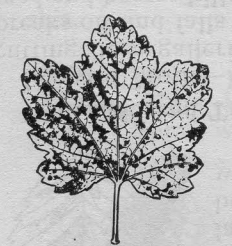
Currant Stem Girder—Adults cut or girdle tip of new shoots after laying eggs in them. Cut and burn these tips at any time of year. Rept. 1920, p. 201.

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

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

San José Scale—See Peach.

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



Fungi.

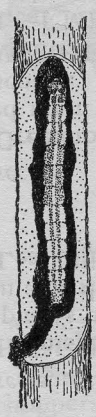
Anthracnose and **Leaf Spots**—Cause spots on the leaves and usually their premature shedding; the former also spots the fruit of certain varieties. Spray with Bordeaux as the leaves unfold, and repeat at intervals of 10 to 14 days until the fruit begins to ripen. If necessary continue spraying after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

Blister Rust—Shows first as dusty orange-colored outbreaks about size of pinhead on lower surface of leaves, and later as short hair-like growths. Worst on black currants, which should be destroyed if infected, near white pines, the alternate host. Report presence to the Experiment Station. See Pine. Rept. 1911-12, p. 347.

Insects.

CYCLAMEN.

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



Insects.

DAHLIA.

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

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

Insects.

EGG-PLANT.

Flea Beetle—See Potato.

Colorado Potato Beetle—See Potato.

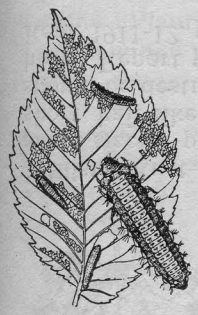
Fungi.

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

Insects.

ELM.

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



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

Canker-Worms—See Apple.

White-Marked Tussock Moth—See Horse Chestnut.

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

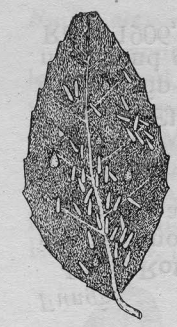
Elm Scale—A large brown soft scale, oval in shape with cottony marginal fringe, located especially in the cracks of the bark of trunk and lower branches, sucking the sap. Spray with kerosene emulsion. Bull. 151; Rept. 1905, p. 235.

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

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

Fungi.

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



EUONYMUS.

Insects.

Euonymus Scale—The various species of Euonymus are attacked and often injured by this scale, which has narrow white (male) or pear-shaped gray or brown (female) shells. Cut and burn infested twigs. Cover and fumigtae with hydrocyanic acid gas. Spray with nicotine solution or kerosene emulsion during June to kill young. Rept. 1921, p. 185.

FERN.

Insects, etc.

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

Leaf-Blight Eelworm—See Begonia.

GERANIUM.

Insects.

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

White Fly—See Tomato.

Leaf Mite—See Cyclamen.

Fungi.

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

Insects.

GOOSEBERRY.

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

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

Currant Fruit Fly—See Currant.

Fungi.

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

Blister Rust—Not common as yet on cultivated varieties. See Currant. The cluster cup rust is sometimes mistaken for this.

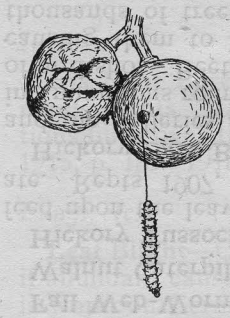
Insects.

GRAPE.

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

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

Grape Plume Moth—Small green spiny caterpillars web together the newly formed leaves at the tips of new shoots. Damage more apparent than real. Crushing by pinching these leaves is the best remedy. Rept. 1914, p. 190.



Grape Berry Moth—Larva feeds and develops inside the berries and is the cause of most wormy grapes. Spray with lead arsenate soon after the fruit sets, and repeat twice at intervals of about ten days. Bag the clusters soon after the fruit sets. Rept. 1920, p. 206.

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

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

Grape Leafhopper—Small, yellow and red-marked leafhoppers sucking sap from under side of leaves. Spray under surface with nicotine solution and soap.

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

Fungi.

Black Rot—Causes reddish-brown spots on leaves; more rarely on stems; rots the berries, which finally become hard, shrunken and black. This is one of the worst diseases of the grape and often difficult to control by spraying.

Begin spraying before blossoming time, about the last of May, with second application just after blossoming and subsequent sprayings at intervals of about 10 to 14 days. Usually 4 or 5 sprayings with Bordeaux are sufficient. Repts. 1889, p. 174; 1890, p. 100.

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

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

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

GRASS.

Insects.

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

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

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

HICKORY.

Insects.

Fall Web-Worm—See Pear.

Walnut Caterpillar—See Walnut.

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

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

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

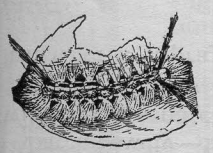
Hickory Gall Aphid—Curious galls on the leaf stems often cause the leaves to fall in midsummer. Galls contain large numbers of aphids. Spray with nicotine solution just as new growth starts in spring. Rept. 1916, p. 145.

HOLLYHOCK.

Fungi.

Rust—Appears as small, compact, reddish-brown pustules on both leaves and stems. In late fall, cut off the plants close to the ground, and destroy them. Spraying with Bordeaux is helpful in checking the rust; begin as plants push through the ground. Rept. 1895, p. 188.

HORSE CHESTNUT.



Insects.

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

Fungi.

Leaf Spot—Shows as extended reddish-brown areas on the leaves, resembling sun scorch, but showing the fruiting stage as minute black dots in the dead tissues. This trouble can be controlled by spraying with Bordeaux. The first application is made on the unfolding leaves and is followed by two or three at intervals of about 2 weeks.

HORSE RADISH.

Insects.

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

IRIS.

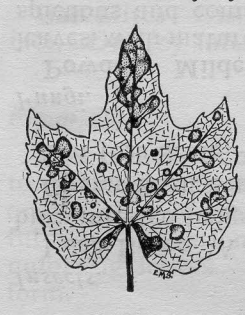
Insects.

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

Fungi, etc.

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

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



IVY, BOSTON.

Fungi.

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

Insects.

KALE.

Turnip Aphid—See Turnip.

Fungi.

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

Insects.

LARCH.

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

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

Insects.

LETTUCE.

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

Fungi.

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

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

Insects.

LILAC.

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

Oyster-Shell Scale—See Apple.

San José Scale—See Peach.

Fungi.

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

Insects.

LILY.

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

Stalk Borer—See Dahlia.

Insects.

LINDEN.

Canker-Worm—See Apple.

White-Marked Tussock Moth—See Horse Chestnut.

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

Insects.

LOCUST.

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

Insects.

MANGEL.

Leaf Miner—See Beet.

Fungi.

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

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

Insects.

MAPLE.

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

White-marked Tussock Moth—See Horse Chestnut.

Other Tussock Moths—See Apple.

Canker-Worms—See Apple.

Cottony Maple Scale—Large, oval, brown soft scales on bark of branches of silver and red maples. Each scale in early summer develops a large cotton-like tuft of wax, nearly half an inch long, and soon after the young appear. Spray with miscible oils. Rept. 1921, p. 179.

Woolly Maple Leaf Scale—Cottony or woolly masses of wax, containing the females, eggs and sometimes larvae, appear on the under side of the leaves in midsummer; leaves fall prematurely. Males and larvae enter crevices of bark of trunk and branches; latter pass the winter. Attacks only sugar maples. Spray dormant trees with nicotine solution and soap. Do not use miscible oils. Burn all infested leaves. Bull. 151; Repts. 1905, p. 226; 1911, p. 345.

Terrapin Scale—Small reddish-brown soft scales on small twigs of silver and red maples, sometimes killing the branches. Spray with kerosene emulsion. Rept. 1921, p. 183.

Oyster-Shell Scale—See Apple.

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

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

Fungi, etc.

Anthracnose—Causes dead areas in the leaves, often hard to distinguish from the leaf scorch. Its appearance depends on character of season. For this reason spraying is of doubtful value in the long run, but when given should start on the unfolding leaves. Repts. 1903, p. 329; 1915, p. 436, unusual form.

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

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

Stag-head—Kills trees at the top or large central branches gradualy die. Due to various agents or unfavorable environment such as parasitic or semiparasitic toadstools and shelf-fungi, escaping gas in soil, winter injury, etc. Cut off dead and dying branches; clean out decaying wood, treat with a wood preservative and fill cavities. Stimulate new growth by nitrogenous fertilizers.

MARGUERITE.

Insects.

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

MELON (MUSK).

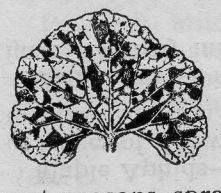
Insects.

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

Striped Cucumber Beetle—See Cucumber.

Fungi.

Anthracnose—Appears occasionally. See Cucumber.



Downy Mildew—Causes angular, eventually brown spots in the leaves, often killing vines; most prominent just before melons ripen, later ones not maturing or worthless. Begin spraying with Bordeaux mixture soon after the vines start to run, and keep them covered to the end of the season. In very wet seasons spraying is not entirely effective. Rept. 1904, p. 329.

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

Wilt—See Squash.

MILLET.

Insects.

Fall Army Worm—See Grass.

NASTURTIUM.

Insects.

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

OAK.

Insects.

Canker-Worms—See Apple.

Brown-Tail Moth—See Pear.

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

Fungi.

White Heart Rot—Forms hoof-shaped shelf-fungi on trunks. Gains entrance through wounded and dead branches; causes white rot of heart wood and slow death of sapwood and bark. Break off and burn fruiting bodies; cut out diseased bark and sapwood, and dig out dead heartwood and fill cavity with cement. Occurs in other deciduous trees. Bull. 222, p. 446.

OATS.

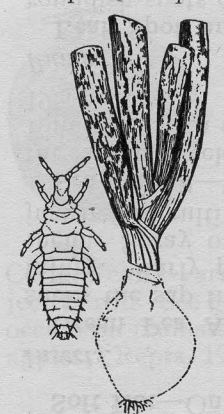
Insects.

Army Worm—See Grass.

Fungi.

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

Smut—Destroys the grain, turning it into a black dusty mass of spores. Seed treatment will prevent this smut. Either soak the seed 12 minutes in water at 133° F., and dry thoroughly, or sprinkle quickly with formalin (formula A), stirring the grain so that it is thoroughly wet, and leave in piles for several hours before drying out. A less cumbersome treatment coming into general use is that given under formula B. Buy seed from smut-free fields.



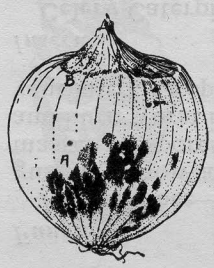
ONION.

Insects.

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

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

Fungi, etc.



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

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

Stem Rot—Starts rotting of bulbs at stem end, where they become soft and shrunken, sometimes showing beneath the layers a dense olive-brown growth. This fungus in a moist season occurs on various parts of the plant in the field (possibly responsible for "blast" of seed onions), but does not appear as a serious trouble with the bulbs until some time after they have been placed in the barn. Treat as for black spot. Late field spraying with Bordeaux shortly before pulling and again while lying in the field, combined with treatment by formalin fumes (See Fungicides) after storing, has given some indications of benefit. See Fig. (B) under anthracnose. Repts. 1903, p. 334; 1904, p. 321.

Insects. **PALMS.**

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

Fungi.

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

Insects. **PARSLEY-PARSNIP.**

Celery Caterpillar—On both hosts. See Celery.

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

Fungi.

Drop—On Parsley. See Lettuce.

Soft Rot—On Parsnip. See Salsify.

Insects. **PEA.**

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

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

Fungi.

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

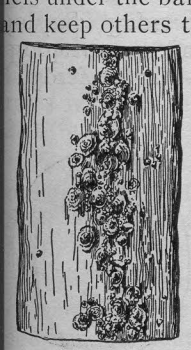
Root-Rot—Kills tops of roots and base of vines, causing parts above to turn yellow, wilt and die prematurely. Caused by various soil fungi. Practice rotation, use *well-rotted* manure; give frequent cultivation in wet years to hasten the drying of the top soil; plant most resistant varieties. Bull. 222,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

Insects. **PEACH.**

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

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

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

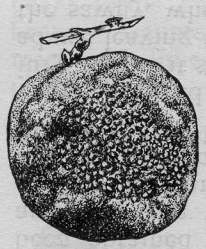


Plum Curculio—See Plum.

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

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

Fungi, etc.

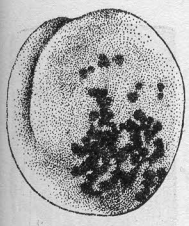


Brown Rot—Occurs on the young twigs, leaves and blossoms, but causes most serious injury to the fruit, rotting it about ripening time. The rotten areas become covered with numerous pustules of dusty brownish spores; eventually the diseased fruits form hard mummies. These carry the fungus over the winter,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

Crown Gall—See Plum.

Leaf Curl—Causes young yeaves to become irregularly curled and swollen and finally to drop off; rarely on fruit. In April as soon as buds begin to swell, spray the trees thoroughly with commercial lime-sulphur, 1-9. Same treatment takes care of San José scale. Repts. 1909-10, pp. 608, 612; 1911, p. 374; 1914, p. 19.

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



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

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

Winter Injury—Shows in various ways. In severe winters, especially when the ground is bare, the roots may be killed without injury to parts above the ground. In spring such trees put forth a scanty sickly foliage that soon drops. Often the injury occurs in the form of a "collar girdle" in the bark at the base of the tree. Sometimes it occurs above ground in the wood (shown by its blacker color), with or without injury to the bark. When the bark is not injured, severe pruning in spring will often save the trees. Nursery trees can sometimes be cut back to the snow line, below the injury, and an entirely new healthy trunk started. Avoid late applications of nitrogenous fertilizers and cultivation after middle of July. Mulch base of young trees in late fall with earth. Secure good drainage. Repts. 1903, p. 341; 1908, p. 872.

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

General Treatment for Peach Orchards.

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

(2) For the prevention of scab and rot of peaches, give three sprayings, as follows: 1st, shortly after the blossoms have fallen; 2nd, three or four weeks later; and 3d, one month later. Dusting with sulphur may replace spraying where more convenient.

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

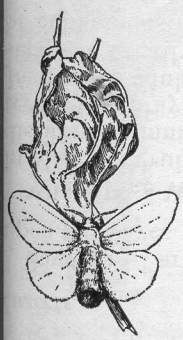
(4) As lead arsenate has done little to prevent curculio injury, and as it seems to increase the danger of spray injury, we advise leaving it out unless there is considerable danger from the sawfly, when it can be added in the second spraying the same as for apples.

Insects, etc.

PEAR.

Pear or **Cherry Slug**—See Cherry.

Codling-Moth—See Apple.



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

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

San José Scale—See Peach.

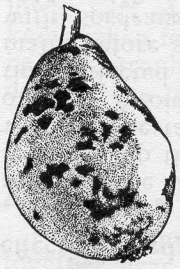
Pear Psylla—Small jumping plant lice suck sap from leaves and twigs, causing leaves to fall in midsummer. Spray with lime-sulphur in spring just before buds open. Spray infested trees with nicotine solution and soap in July. Rept. 1903, p. 262.

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

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

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

Fungi, etc..



Scab—Forms olive-black scabby spots on fruit and leaves, often causing the former to become distorted and cracked. The fungus lives over winter on the twigs. Certain varieties are not much injured, others, like Flemish Beauty, are very susceptible. Spray as for apple scab. Repts. 1894, p. 135; 1904, p. 323; 1911, p. 396.

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

Leaf Blight—See Quince.

PEONY.

Insects.

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

PHLOX.

Insects.

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

Fungi.

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

PINE.

Insects.

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

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

Pine Leaf Scale—Whitish pear-shaped shells on leaves; small trees sometimes killed. Spray with nicotine solution or kerosene emulsion about the second week in June. Rept. 1921, p. 181.

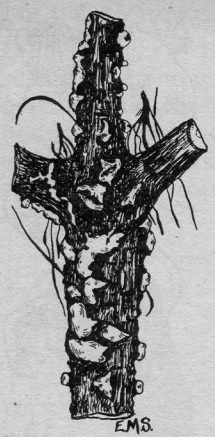
Pine Bark Aphid—White cottony or woolly objects on bark and sometimes on leaves, sucking out the sap. Spray with kerosene emulsion. Repts. 1911, p. 343; 1919, p. 155.

Fungi, etc.

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

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

Stem Rusts—Form on the swollen stems temporary, but conspicuous, white, blisterlike spore cups filled with a dusty orange-colored spore mass. The white pine blister rust, an imported species, spreads to the gooseberries and currants, and forms other less conspicuous leaf stages on these. A very similar native species on two and three needle pines spreads to the



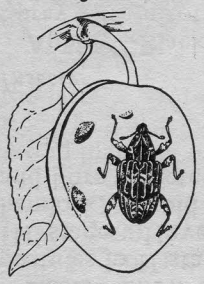
leaves of the sweet fern. In either case infected pines should be destroyed, and also the alternate hosts, if they occur in the neighborhood. Spray seed-beds with Bordeaux if liable to infection. In white pine plantations pull out all currant and gooseberries within 500 feet. Send any suspicious white pines or their alternate hosts to this Station for examination. Rept. 1912, p. 347; Bulls. 214, p. 428, 237, p. 305.

PLUM.

Insects.

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

San José Scale—See Peach.



Plum Curculio—Grub infests the growing fruit, causing it to fall. Jar the trees each morning for six weeks after blooming and catch the beetles on sheets and destroy them. Spraying with lead arsenate during the same period is also advised. Rept. 1910, p. 609; Bull. 235, p. 218.

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

Fungi.

Black Knot—See Cherry.

Brown Rot—Is the same as on peach. Thin fruit so it does not touch. Gather and destroy all mummies after harvest. Rather difficult to control by spraying, as spray does not readily adhere to the smooth fruit. First treatment with Atomic Sulphur or self-boiled lime-sulphur, should be made on half grown fruit, others at intervals of two weeks, and the last one 7 to 10 days before picking. Use a spreader in the spray.

Crown Gall—Shows hard roundish knots one-half inch or more in diameter, near crown or on roots, less frequently on lower part of trunk. Do not plant infected trees. Remove knots when found and paint over cut surface. This is said to be very troublesome in some states, but here, as yet, little damage has resulted from it.

POPLAR.

Insects.

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

Spiny Elm Caterpillar—See Elm.

Tussock Moths—See Apple, Hickory and Horse Chestnut.

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

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

Oyster-Shell Scale—See Apple.

Fungi.

European Canker—Forms sunken dead areas of varying extent in the bark. Importation from Europe; showing here

most commonly on Lombardy and white poplars. If trees are badly injured cut down and burn; otherwise cut out diseased areas going into the healthy bark, scraping and painting over exposed wood. Bull. 222, p. 461.

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

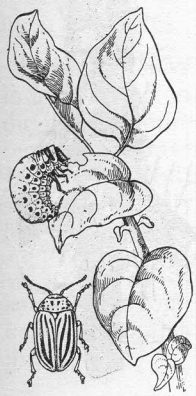
POPPY.

Insects.

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

POTATO.

Insects.



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

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

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

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

Leafhopper—Sucks sap from veins, causing leaves to curl and "burn." Known as "hopper burn." Spray or dust with nicotine to kill leafhoppers.

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

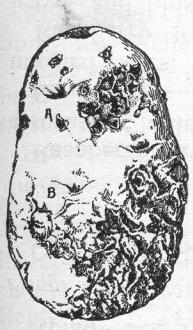
Fungi, etc.

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

Blight or **Downy Mildew**—Causes a sudden blackening of the leaves, and death of vines, from July to September in moist seasons; usually shows a slight whitish growth of fungus on the under side of the leaves; rots tubers. Spray with Bordeaux before the trouble appears, about July 1st, and keep vines *well covered* to the end of the season. Three to five sprayings by hand or five to seven by power sprayer are necessary. Use lead arsenate in the early sprayings for insects. After last cultivation thoroughly ridge up the rows to help keep the spores from washing down to the tubers. Early varieties usually escape blight by matur-

ing before its appearance. Repts. 1904, p. 363; 1905, p. 304; 1909-10, p. 739; 1915, p. 470; 1916, p. 355; Bull. 214, p. 411.

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



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

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

Fungi, etc.

PRIVET.

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

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

Insects.

QUINCE.

Round-Headed Borer—See Apple.

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

Aphid—See Apple.

Fungi, etc.

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

Blight—See Pear.

Leaf Blight—Appears as rounded, often confluent, reddish-brown spots with central black dots on leaves and as black sunken specks on fruit, the former often shedding prematurely and the latter cracking irregularly. Spray with Bordeaux just

before blossoms open, again soon after they fall, and follow with 1 or 2 additional treatments at intervals of about 2 weeks, according to the weather. This fungus also occurs on pear. Repts. 1890, p. 99; 1891, p. 150.

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

RADISH.

Insects.

Maggot—See Cabbage.

Aphid—See Turnip.

Fungi.

Club Root—See Cabbage.

RASPBERRY.

Insects.

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

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

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

Fungi, etc.

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

Crown Gall—See Blackberry.

Rust—See Blackberry.

Wilt—Forms cankered areas on the canes, causing the parts above to wilt. In the old canes and near the pruned ends, the fungus often develops a brownish coating of spores around each small imbedded fruiting receptacle. Spraying has not proved very satisfactory. Old and diseased canes should be removed and burned after the fruiting season and again early in spring. Rept. 1906, p. 321.

Yellows—Is now a general term for Mosaic (mottled leaves), leaf curl and blue stem, three physiological diseases causing serious trouble here. Plants gradually become worthless. Spraying, except for aphids, does not help these troubles. Dig out infected plants. Propagate only from perfectly healthy ones and most resistant varieties.

RHODODENDRON.

Insects.

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

Rhododendron Borer—Tunnels under bark of stems around crotches. Cut out borers and cover wounds with melted paraffin.

Fungi, etc.

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

ROSE.

Insects.

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

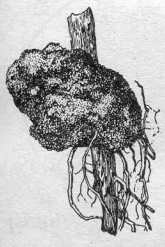
Rose Midge—Larvae distort young leaves and flower buds in greenhouses. Apply tobacco dust to the soil and fumigate nightly with tobacco stems or nicotine paper.

Rose Chafer—See Grape.

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

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

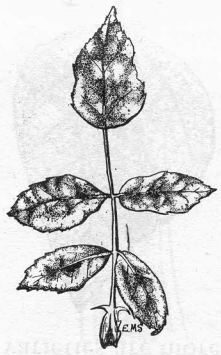
Aphid or **Green Fly**—Sucks sap from the leaves and stems. Spray with nicotine solution.



Fungi, etc.

Crown Gall—Occurs very frequently on rose roots, especially those of Manetti stock. Use cleaned tools in grafting and avoid infected plants. See Plum. Rept. 1911-12, p. 355.

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



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

RUTABAGA, See TURNIP.

RYE.

Insects.

Army Worm—See Grass.

Wheat Midge—See Wheat.

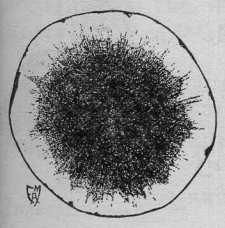
Fungi.

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

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

SALSIFY.

Fungi, etc.



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

SNAPDRAGON.

Insects, etc.

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

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

Fungi.

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

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

SNOWBALL.

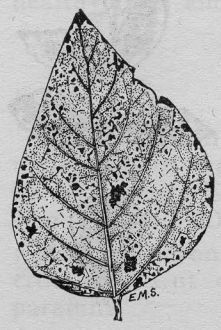
Insects.

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

SOY BEAN.

Fungi, etc.

Bacterial Leaf Spot—Appears as small, dark, reddish-brown angular spots frequently merging into larger areas. Certain varieties are more susceptible than others, Ito San being one of the worst. Grow least susceptible varieties and if possible purchase seed from uninfected fields.



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

SPINACH.

Insects.

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

SPIRAEA.

Insects.

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

SPRUCE.

Insects.

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

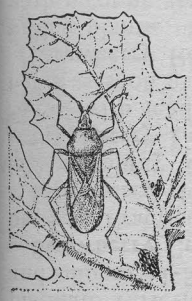
Spruce Bud Moth—Larva feeds on leaves of terminal shoots of the branches, causing much damage. Spray with lead arsenate. Rept. 1912, p. 291.

SQUASH-PUMPKIN.

Insects.

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

Striped Cucumber Beetle—See Cucumber.



Squash Bug or **"Stink Bug"**—A brown bug three-fourths of an inch in length sucks the sap from the under side of the leaves, which wilt and die. Spray with kerosene emulsion to kill the young. Bull. 216, p. 44; Rept. 1908, p. 811.

Squash-Vine Borer—Larva tunnels in the base of the stem, causing decay. Cut slits lengthwise in the stem and kill borers.

Cover the joints of the vine with earth so that new shoots may be formed to support the plant. Grow a few early plants for traps, and destroy them. The main crop should be planted rather late. Bull. 216, p. 39; Rept. 1908, p. 806.

Fungi.

Anthracnose—See Watermelon.

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

Wilts—Cause leaves of the plants to wilt and then dry up, sometimes all of the vine thus suddenly dying. If a cross section of the stem shows a slight milky and sticky exudation, it is caused by bacteria that clog up the water ducts. Fungi in the ducts or insects at the roots may cause similar injury. Heavy manuring often develops these troubles. Spraying is of little value except as it may keep off insects which inoculate the plants with the bacteria. Use enough seed to allow for loss by wilt and pull up and destroy all the wilted vines as they appear. Rept. 1903, p. 359.

STRAWBERRY.

Insects.

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

Strawberry Weevil—Small snout beetles; females cut off blossom buds of staminate varieties when ovipositing. Plant

pistillate varieties in part. Dust heavily with lead arsenate and sulphur (1-5).

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

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

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

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

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

White Grubs—See Grass.

Fungi.

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

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

SWEET PEA.

Insects.

Aphids—See Pea.

White Fly—See Tomato.

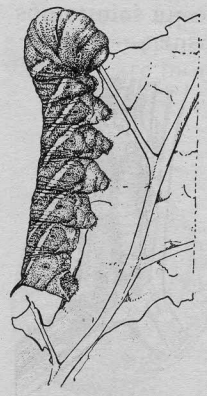
Fungi.

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

SYCAMORE.

Fungi.

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



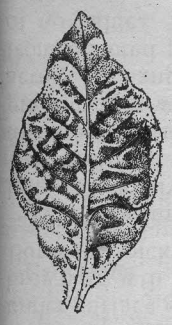
TOBACCO.

Insects.

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

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

Cut-Worms—See Tomato.



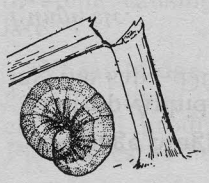
Fungi, etc.

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

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

Black Root Rot—Shows in seed beds by dwarfed "rosette" plants whose roots have been largely rotted off. Frequently it does damage in fields, especially where Havana has long been cultivated, but Round Tip is little injured; a short rotation is advisable in bad cases. Sterilize seed beds with steam or treat with formalin (formula D). Repts. 1906, p. 342; 1907, p. 363.

Wild Fire—Shows first in lower leaves as small, roundish, yellow spots. In time these grow larger, turn darker, and irregular dead areas appear more or less prominently. This disease is caused by bacteria and is favored by wet weather. It is carried on the seed and later may be readily transferred from infected places in the field by certain insects and the wind. Care should be used to select seed only from disease-free fields and sow this seed in sterilized seed bed. Where doubtful seed is used this should be soaked for 10 minutes in corrosive sublimate, rate of 1 to 1000 part water, stirring the seed during the treatment. Drain off the liquid, wash seed in pure water several times and dry before storing. Old cloth used previously on infected beds should be boiled in water before used again. Spray the beds, with Bordeaux mixture, shortly after the young plants have rooted, repeating every week until the setting season is over.



TOMATO.

Insects.

Cut-Worms—Eat off plant near ground or climb the plant and devour the leaves. Place around field poisoned bait or bran mash containing arsenic. Trap cut-worms with small piece of board. Rept. 1906, p. 264; Bulls. 190, p. 18; 208, p. 112; 216, p. 43.

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

Flea Beetle—See Potato or Tobacco.

Potato Aphid—See Potato.

Stalk Borer—See Dahlia.

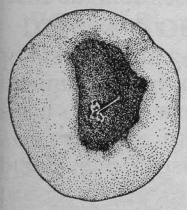
White Fly—Sucks the sap from under side of leaves. Spray under side of leaves with soap and water. Fumigate green-

houses with hydrocyanic acid gas (½ oz. to 1000 cubic ft.). Bulls. 140; 216, p. 50; Rept. 1902, p. 148.

Fungi, etc.

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

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



Point Rot—Causes the green fruit to rot at bloom end, showing a large, firm, dark-brown area. Claimed to be a physiological trouble. Frequently bad in very dry seasons. In greenhouses sub-irrigation is said to prevent it. Spraying is of little value. Considerable difference exists in varieties as to susceptibility.

Scab—Occurs most commonly in greenhouses, covering under surface of leaves more or less abundantly with an olive-brown growth which finally kills the tissue above. Spray with Bordeaux, picking ripe fruit before each of the later treatments.

Wilt—Occurs here chiefly in greenhouses; plants turn yellow and slowly wither up; fungus may finally show on dead stem and fruit as pinkish growth. Caused by fungus clogging ducts and cutting off water supply to leaves; in young stage presence shown by blackened bundles where stems are cut across. Change soil if appearing yearly; do not sow seeds from infected plants, as they can carry the disease. Spraying of no value. Rept. 1903, p. 366.

TULIP TREE.

Insects.

Tulip Tree Scale—Large brown hemispherical soft scales on bark, sucking the sap, especially on lower branches. Spray with lime-sulphur when trees are dormant. Oils may cause injury. Rept. 1921, p. 176.

TURNIP-RUTABAGA.

Insects.

Cut-Worms—See Tomato.

Cabbage Maggot—See Cabbage.

Turnip Aphid—Green aphids on under side of leaves sucking the sap. Dust with nicotine. Rept. 1916, p. 98.

Fungi, etc.

Club Root—See Cabbage.

Soft Rot—Causes an interior soft decay of roots, etc., of a variety of vegetables, such as turnips, salsify, parsnips, carrots, celery. Very wet seasons and imperfect storage conditions are usually the starting point of these troubles. Store under best possible conditions for keeping down heat and moisture. Keep contaminated refuse out of manure pile. Rept. 1914, p. 25.

Phoma Rot—Appears usually after storage, causing conspicuous, dry, sunken, subcircular, black spots scattered over roots. Fruiting pustules show as black dots. Store roots in cool dry place and not too deeply in the piles. Practice yearly rotation and keep refuse from manure pile. If necessary, use only artificial fertilizers. Rept. 1912, p. 355.

VIOLET.

Insects, etc.

Violet Midge—Larvae in curled edges of new leaves. Fumigate every other night with hydrocyanic acid gas (½ oz. to 1000 cu. ft.).

Violet Sawfly—Larvae devour leaves. Spray with lead arsenate or hellebore.

Eelworms—Form galls on the roots. Plant in new soil or sterilize the old soil by steam. Add plenty of air-slaked lime to the soil. See Snapdragon.

Fungi.

Spot Disease—Shows as whitish round spots on the leaves. Spray field plants early in fall with Bordeaux. Select only best stock for greenhouse; remove *all* affected leaves before transplanting. When plants have become established, spray again with Bordeaux. Be careful about watering plants, and, by proper ventilation and heat during September to November, keep atmosphere of house from ever becoming too moist.

WALNUT.

Insects.

Walnut Caterpillar—Clusters of black caterpillars covered with whitish hairs strip the branches and finally the trees in August. Spray with lead arsenate. Clip off twigs when caterpillars are small, and kill by crushing. Repts. 1914, p. 191; 1917, p. 326.

Walnut Weevil or **Curculio**—Adults feed at base of leaf stems. Larvae tunnel in new shoots and infest the fruit of Persian and Japanese walnuts. Spray with lead arsenate. Rept. 1912, p. 240.

Walnut Bud Moth—Larvae feed upon tender leaves and shoots, webbing them together. Spray with lead arsenate. Rept. 1912, p. 253.

WHEAT.

Insects.

Army Worm—See Grass.

Hessian Fly—Maggots burrow in sheath of a leaf at base of stem, causing the stalks to turn yellow and die. Plant late.

Wheat Midge—The fly lays eggs on the chaff and the maggots feed upon the developing kernels, so that the heads ripen early and produce no grain. Burn stubble before plowing. Plow infested fields deeply in the fall. Rept. 1917, p. 366.

Green Bug or **Aphid**—Green aphids suck the sap from leaves. Destroy in early fall all volunteer wheat and oats. Practice crop rotation.

Fungi.

Black Stem Rust—See Oats.

Leaf Rusts—Form small, dusty, orange-colored outbreaks on leaves, etc., and later darker and firmer mature stage. Several closely related species on barley, rye, and wheat but quite distinct from black stem rust. Some varieties are more re-

sistant than others to these various grain rusts. No effective treatment.

Loose Smut—Destroys entire head, turning it into a dusty olive-black mass that is dissipated in time. Soak seed for 3 hours in hot water at temperature of 110° to 115° F., or use formalin (B) dry sprinkle. Dry thoroughly if stored.

Stinking Smut—Fills the apparently scarcely changed seeds with a dusty mass of spores. Spores often found more or less abundantly in middlings and other feeds containing wheat, and their presence in amount indicates poor quality, and may have some connection with complaints of injury to stock fed on these. Use formalin treatment. Rept. 1909-10, p. 736.

WILLOW.

Insects.

Fall Web Worm—See Pear.

Spiny Elm Caterpillar—See Elm.

Poplar Tent-Maker—See Poplar.

Poplar and **Willow Curculio**—See Poplar.

Sawflies—Larvae devour leaves. Spray with lead arsenate.

Aphids—Lage reddish aphids congregate on twigs in fall, and suck the sap. Spray with kerosene emulsion or nicotine solution and soap.

Oyster-Shell Scale—See Apple.

Fungi.

Rusts—Occur on the leaves; similar in appearance and closely related to those on poplar. The alternate host for one species is the larch and apparently there is another whose alternate host is not yet determined. Rept. 1915, p. 450.

MANUFACTURERS AND DEALERS IN SPRAY APPARATUS AND SUPPLIES.

Prospective purchasers should write to these firms for catalogues and prices.

MANUFACTURERS OF SPRAYING MACHINES.

Aspinwall Manufacturing Co., Jackson, Mich. (Hand and power potato sprayers.)
Barnes Mfg. Co., Mansfield, Ohio. (Hand and power sprayers.)
Bateman Mfg. Co., Grenloch, N. J. (Iron Age sprayers for hand and power.)
Bean Spray Pump Co., Lansing, Mich. (Hand and power outfits.)
Brackett, Shaw & Lunt Co., Somersworth, N. H., 62 No. Washington St., Boston, Mass. (Hand and power outfits.)
Brown Co., E. C., Rochester, N. Y. (Compressed air, hand and power outfits.)
Church, Stephen B., Seymour, Conn., 64 Pearl St., Boston. Mass. (Power and hand sprayers.)
Crestline Mfg. Co., Crestline, Ohio. (Sprayers.)
Cushman Sprayer Co., St. Joseph, Mo. (Power outfits.)
Dayton Manufacturing Co., 2240 East Third St., Dayton, Ohio. (Hand sprayers.)
Deloro Chemical Co., Ltd., Deloro, Ontario, Canada. (Hand and power dusting and spraying machinery.)
Deming Co., Salem, Ohio. (Hand and power outfits.)
Douglas, W. & B., Middletown, Conn. (Hand and power pumps.)
Field Force Pump Co., Elmira, N. Y. (Hand and power pumps.)
Fitzhenry-Guptill Co., 135 First St., Cambridge, Mass. (Power sprayers.)
Friend Mfg. Co., Gasport, N. Y. (Power and hand pumps.)
Goulds Mfg. Co., 58 Pearl St., Boston, Mass.; 16 Murray St., New York. (Hand and power sprayers.)
Hardie Mfg. Co., Hudson. Mich.; Hagerstown, Md. (Hand and power pumps.)
Hayes Pump and Planter Co., Galva, Ill. (Spray pumps.)
Humphryes Mfg. Co., Mansfield, Ohio. (Hand and power pumps.)
Hurst Mfg. Co., H. L., Greenwich, Ohio.
Leggett & Brother, 301 Pearl St., New York. (Hand and power dusting machines.)
Myers & Brother, F. E., Ashland, Ohio. (Hand and power pumps.)
Niagara Sprayer Co., Middleport, N. Y. (Dusting machines.)
Rumsey Pump Co., Ltd.. 49 Federal St., Boston, Mass. (Hand and power pumps.)
Spramotor Co., 107-109 Erie St., Buffalo, N. Y. (Hand and power outfits.)
Ward-Love Pump Corporation, Rockford, Ill. (Pumps for all purposes.)

MANUFACTURERS OF INSECTICIDES AND FUNGICIDES.

Blanchard Co., Jas. A., Hudson Terminal Bldg., 30 Church St., New York. (Insecticides and fungicides.)
Bowker Insecticide Co., 49 Chambers St., New York, N. Y. (Insecticides and fungicides.)
California Central Creameries, Inc., 175 Franklin St., New York, N. Y. (Calcium caseinate spreaders.)
Deloro Chemical Co., Ltd., Deloro, Ontario, Canada. (Insecticides and fungicides, especially dusts.)
Frost Insecticide Co., 20 Mill St., Arlington, Mass. (Spray chemicals and apparatus.)
Fruit Growers' Supply Co., Inc., 65 Barclay St., New York, N. Y. (Spray machinery and supplies.)
General Chemical Co., 40 Rector St., New York. (General insecticides and fungicides, paradichlorobenzene, Atomic Sulphur and B. T. S.)
Glidden Co., Cleveland, Ohio. (Insecticides and fungicides.)
Grasselli Chemical Co., 80 Maiden Lane, New York. (Insecticides and fungicides.)
Hall Tobacco Chemical Co., 212 Fifth Ave., New York, N. Y. (Nicotine preparation.)
Heil Chemical Co., Henry, St. Louis, Mo. (Spray chemicals.)
Hemingway & Co., Inc., Bound Brook, N. J. (Arsenical poisons.)

Interstate Chemical Co., 12-20 Bay View Ave., Jersey City, N. J. (Insecticides and fungicides.)
Kil-Tone Co., The, Vineland, N. J. (Insecticides and fungicides.)
Lavanburg Co., Fred L., 100 William St., New York. (Arsenical poisons.)
Leggett & Brother, 301 Pearl St., New York. (Insecticides and fungicides.)
Mechling Bros. Mfg. Co., Line St., Camden, N. J. (Insecticides and fungicides.)
National Color and Chemical Works, Selling Agents for Taylor Chemical Co., 59th St. & 11th Ave., New York. (Carbon disulphide.)
Niagara Sprayer Co., Middleport, N. Y. (Dusting materials.)
Nicotine Production Corporation, Clarksville, Tenn. (Nicotine sulphate.)
Nitrate Agencies Co., 85 Water St., New York. (Arsenical poisons.)
Pratt Co., B. G., 50 Church St., New York. (Miscible oils.)
Riches, Piver & Co., 30 Church St., New York. (Arsenical poisons.)
Robertson Co., The J. T., 147 Richmond Ave., Syracuse, N. Y. (Miscible oils.)
Roessler & Hasslacher Chemical Co., 100 William St., New York. (Cyanide.)
Sherwin-Williams Co., 601 Canal Road, Cleveland, Ohio. (Lime-sulphur and arsenical poisons.)
Smith & Co., D. B., Utica, N. Y. (Pumps, insecticides and fungicides.)
Thum Co., O. & W., Grand Rapids, Mich., 15 India St., Boston, Mass. (Tanglefoot.)
Tobacco By-Products & Chemical Corporation, Inc., Louisville, Ky. (Nicotine solution.)
Standard Chemical Works., Inc., Womelsdorf, Pa.
Vreeland Chemical Mfg. Co., 16-18 East 40th St., New York. (Insecticides and fungicides.)

CONNECTICUT DEALERS IN SPRAYING SUPPLIES.

Dealers in spraying materials can usually be found in each town. Some of the larger firms are mentioned below.

Apothecaries Hall Co., 24 Benedict St., Waterbury. (Wholesale druggists.)
Barnes Bros., Yalesville. (Insecticides and fungicides.)
Cadwell & Jones, 1084 Main St., Hartford. (Pumps, insecticides and fungicides.)
Grasselli Chemical Co., River St., New Haven. (Insecticides and fungicides.)
Henry & Son, W. A., Blue Hills Farm, Wallingford. (Insecticides and fungicides.)
Jewell, Harvey, Cromwell. (Agent for Hardie hand and power sprayers.)
Leete Co., The Chas. S., 299 State St., New Haven. (Wholesale druggists.)
Lightbourn & Pond Co., 39 Broadway, New Haven. (Pumps, insecticides and fungicides.)
Platt Co., The Frank S., 450 State St., New Haven. (Pumps, insecticides and fungicides.)
Sisson Drug Co., 729 Main St., Hartford. (Spraying machines and insecticides.)
Whittlesey Co., The Chas. W., 259-271 State St., New Haven. (Wholesale druggists.)

CONNECTICUT
AGRICULTURAL EXPERIMENT STATION

NEW HAVEN, CONN.

BULLETIN 245 FEBRUARY, 1923

Results of Dusting Versus Spraying in Connecticut Apple and Peach Orchards in 1922

By M. P. Zappe and E. M. Stoddard.

CONTENTS

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.

Results of Dusting Versus Spraying in Connecticut Apple and Peach Orchards in 1922.

By M. P. Zappe and E. M. Stoddard.

This series of experiments with dust in comparison with liquid sprays for controlling the common insect and fungous pests of apple orchards in Connecticut was begun in 1920. The results of that year's work were printed in the Station Report for 1920, pages 168-177. In 1921 the project was enlarged to include peaches. Four apple and two peach orchards were used and the results of the work published in Bulletin 235 of the Station, and in Crop Protection Digest No. 2, page 7. In 1922 the same orchards were used as in preceding years.

APPLE ORCHARDS.

Orchard No. I.	Young orchard, Station Farm, Mount Carmel	96 trees
Orchard No. II.	Orchard of W. F. Platt, Orange	62 trees
Orchard No. III.	Orchard of F. N. Platt, Milford	285 trees
Orchard No. IV.	Old orchard, Station Farm, Mount Carmel	40 trees
		483 trees

A portion of the dusting materials was furnished gratis to Dr. W. E. Britton, Entomologist of this Station, on behalf of the Crop Protection Institute by the Dosch Chemical Company of Louisville, Kentucky, and we hereby express our appreciation and thanks for this favor.

We also desire to express our appreciation and thanks to Messrs. W. F. Platt and F. N. Platt for the use of their orchards and spray outfits, also for their co-operation in this work. We also wish to thank Dr. B. A. Porter, in charge of the Wallingford Field Station of the Bureau of Entomology, for the use of the dusting machine and for his assistance in scoring the fruit. Mr. G. E. Graham of the Botanical Department of this Station assisted in applying the treatments and scoring fruit. Messrs. W. E. Britton, B. H. Walden and P. Garman of the Entomological Department, and Messrs. F. D. Luddington and J. L. Rogers, temporary employees, assisted in gathering and scoring the fruit. The owners of the or-

chards furnished spray outfits with team and driver for each of the spray applications in orchards II and III.

MATERIALS USED.

SPRAYS.

The liquid spray for all treatments in all orchards was as follows:

Commercial Lime-Sulphur	3 gallons
Lead Arsenate (Dry)	3 pounds
Nicotine Sulphate	¾ pint
Water	100 gallons

DUSTS.

Sanders or Copper Dust.

Dehydrated Lime	79 per cent.
Dehydrated Copper Sulphate	13 per cent.
Calcium Arsenate	8 per cent.

Sulphur-Nicotine-Arsenate Dust.

Superfine Dusting Sulphur	65 per cent.
Lead Arsenate	10 per cent.
Nicotine Sulphate	5 per cent.
Carrier	20 per cent.

90-10 Sulphur-Arsenate Dust.

Dusting Sulphur	90 per cent.
Lead Arsenate	10 per cent.

APPARATUS USED.

The dusting machine used in all the orchards was a Niagara duster owned by the Bureau of Entomology and used at its Field Station at Wallingford, Connecticut. The machine was designed 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 orchards. The Ford truck had no trouble in carrying this outfit through the orchards. When the machine was not in use it could easily be unloaded from the truck and stored in a shed. In orchard No. I, an Arlington X. L. power sprayer with a 100 gallon tank was used. Two lines of hose were used with a nozzle at each rod. In orchards No. II and III, Friend power sprayers with 200 gallon tanks were used. In orchard No. II, spray rods were used, one man spraying from the tower and the other from the ground. The pressure was about 200 pounds. In orchard No. III, a single line of hose with a "spray gun" carrying 175 pounds pressure was used, spraying from the ground.

METHOD OF RECORDING DATA.

Certain trees promising a crop 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. 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 the trees that were not intended to be so treated. With the liquid spray there is less 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 twice before the ripe fruit was picked. 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 181,036 individual apples, equivalent to about 402 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 the count 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. The other method of scoring is of value in showing just where certain treatments fail.

ORCHARD NO. I.

Orchard No. I was the eleven year old Experiment Station orchard located at Mount Carmel. This orchard is just begining 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 Pip-

pin, 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 sulphur dust. The remaining plot in the center of the orchard was used as a check.

The green dropped fruit was gathered, counted and scored twice during the summer. At harvest time all the picked fruit was scored. All trees that bore fruit were used as count trees in this orchard.

NUMBER AND DATES OF APPLICATIONS.

The first application of spray and dust was given this orchard on April 29, when the blossom buds began to show pink. The second application was the calyx spray, made on May 22, just after all the petals had fallen. The next treatment was given on June 14. To test the value of later applications of spray and dust, the plots were each divided into two equal parts. One half of each original plot received two more applications of spray and dust while the other half had no further treatment. The two later applications were made on June 30 and July 20. The spray and dust were always applied on the same day. The dust was put on first, very early in the morning before the wind began to blow and often while the trees were still wet with dew. Later in the day, or as soon as the dusting operations were finished, the liquid spray was applied. As there were no sucking insects present, nicotine sulphate was omitted from the last two sprayings.

TABLE NO. I.

RESULTS OF TREATMENT. ALL VARIETIES.

Treatment.	Good Per Cent.	Aphis Per Cent.	Red Bug Per Cent.	Codling Moth Per Cent.	Curculio Per Cent.	Other Insects Per Cent.	Scab Per Cent.	Other Fungi Per Cent.
Spray, 5 applications ...	15.2	18.85	0	1.1	71.9	1.9	14.59	2.8
Sul.-Nic.-Ars. Dust, 5 applications ...	15.2	12.49	.054	2.8	80.4	2.9	2.06	5.3
Check	1.49	17.7	.199	20.4	95.	6.5	8.9	55.1
Spray, 3 applications	17.7	11.3	0	2.6	70.5	2.9	10.1	5.4
Sul.-Nic.-Ars. Dust, 3 applications ...	11.05	17.6	.047	4.3	81.7	3.3	5.68	10.3

DISCUSSION OF RESULTS.

In this orchard there were many varieties, some of which were represented by only a few trees, so that each variety could not be

included in each plot. For instance, the McIntosh variety was included only in the sprayed plots; none in the dust plots. There were no varieties that scab badly in either of the dust plots; therefore the percentage of scab in the sprayed plot is naturally higher than in the dusted plots. The percentage of good fruit in this orchard was very low on account of the great abundance of curculio injury. In nearly every case the liquid spray was a little better than the dust treatment. The plot receiving the dust treatment was much better than the check or untreated plot. In the column called "other insects" are included chewing insects which are normally controlled by arsenate of lead. The "other fungi" column includes sooty blotch, fruit speck, bitter rot and cedar rust. The injury from red bugs in this orchard was negligible.

FIVE TREATMENTS VERSUS THREE TREATMENTS.

In most cases the spray or dust plots having five applications gave a lower percentage of insect and fungous injury than the plots having but three applications, exceptions being the case of curculio injury in the spray plots, the good fruit in the sprayed plots, the scab results in both spray and dust plots, and aphis results in both sprayed and dusted plots. In the case of scab results the difference is easily explained. The scab susceptible varieties were not equally represented in the various plots, there being more varieties that scab easily in the sprayed than in the dusted plots. The spray plot having the extra treatments was on the northern edge of the orchard and it is a common occurrence for the trees along the border of an orchard to show greater curculio injury than trees further back from the margin. The curculio injury is caused early in the season, soon after the young fruit has set, so that the later treatments would have no effect on this insect. The extra treatments showed a little better codling moth control, evidently on the second brood worms. The "other insects" being later feeders on the surface of fruit, would naturally be better controlled by later treatments of spray or dust. The same is true of the fungi which make their appearance later in the season, with the exception of scab.

ORCHARD NO. II.

This orchard is owned by Mr. W. F. Platt, located in the town of Orange, near the Milford line. It is twenty-eight years old and has been kept in very good condition. There were three experimental plots in this orchard; the spray plot, consisting of 33 trees; the dust plot of 25 trees, and the check plot of four trees.

The varieties in the experimental plots in this orchard were Fall Pippin, McIntosh and Greening. Each variety was represented in the spray, dust and check plots, except that there were

no Fall Pippins in the check plot. Count trees were selected soon after blooming and trees that gave promise of having a good crop were selected. Two trees of each variety were selected in each plot, one receiving the five treatments and the other the three treatments.

The number and dates of application were the same as those in orchard No. 1. The owner of the orchard put on the regular delayed dormant spray over all the plots, also the pre-pink spray on all Fall Pippin and McIntosh trees. The regular spraying and dusting operations began with the pink treatment on April 28, followed by the calyx application on May 19. The first treatment after the calyx was applied on June 13. After this treatment the spray and dust plots were divided into two parts, one part of which received two further applications of spray and dust, while the other had no further treatment.

In this orchard the liquid spray was put on with a Friend power sprayer, using two lines of hose with two nozzles at each rod. One man sprayed the tops of the trees from a tower on the spray outfit while the other sprayed the lower part of the tree from the ground. The regular lime-sulphur arsenate of lead spray with the addition of Black Leaf 40 was used.

The dust was applied with the same duster used in the other orchard. Only one kind of dust was used in this orchard, namely, the sulphur-nicotine dust. About three or four pounds of dust were used per tree.

TABLE No. II.

RESULTS OF TREATMENT. GREENING.

Treatment.	Good Per Cent.	Aphis Per Cent.	Red Bug Per Cent.	Codling Moth Per Cent.	Curculio Per Cent.	Other Insects Per Cent.	Scab Per Cent.	Other Fungi Per Cent.
Spray, 5 applications	51.2	13.7	1.7	.14	15.1	1.76	28.1	6.45
Sul.-Nic.-Ars. Dust, 5 applications ...	7.8	7.77	.34	.42	7.5	2.36	46.2	97.
Checks	0	26.7	16.4	21.2	76.	6.62	89.5	113.
Spray, 3 applications	60.5	9.02	.05	.48	6.2	.97	16.5	12.9
Sul.-Nic.-Ars. Dust, 3 applications ...	6.4	11.04	.68	.76	15.	6.5	54.2	108.4

DISCUSSION OF RESULTS.

From Table II it is very evident that the liquid spray both in five and three applications gave a much higher percentage of good fruit than the dust treatment. The difference in control of apple scab and other fungous diseases is marked. In the control of in-

sect pests, the difference is not as great, although still a little in favor of the liquid spray. The value of five over three applications in both dust and liquid spray is again shown, especially in the case of other insects and other fungi, which appear later in the summer and are controlled with later applications.

TABLE No. III.

RESULTS OF TREATMENT. McINTOSH.

Treatment.	Good Per Cent.	Aphis Per Cent.	Red Bug Per Cent.	Codling Moth Per Cent.	Curculio Per Cent.	Other Insects Per Cent.	Scab Per Cent.	Other Fungi Per Cent.
Spray, 5 applications	40.	5.27	.44	.34	2.8	.54	54.5	4.38
Sul.-Nic.-Ars. Dust, 5 applications	6.39	9.54	.09	.18	3.56	.647	86.4	.55
Checks	.121	2.9	.78	4.4	35.3	3.14	98.4	9.11
Spray, 3 applications ...	44.4	.026	.227	.06	2.26	1.74	54.7	.166
Sul.-Nic.-Ars. Dust, 3 applications	5.06	3.58	.117	.311	4.66	1.55	96.	3.62

DISCUSSION OF RESULTS.

Here the liquid spray is again better than the dust treatments, particularly in the control of scab. The percentage of good fruit is very much greater in the sprayed plots both for the three and five treatments than in dusted plots. In control of other pests, the difference is not so marked. The difference noted in control of fungi on Greenings is more evident than in the case of McIntosh, probably because the McIntosh does not seem to be so susceptible to these diseases, as the check plot shows only nine per cent. of injury in this column.

TABLE No. IV.

RESULTS OF TREATMENT. FALL PIPPIN.

Treatment.	Good Per Cent.	Aphis Per Cent.	Red Bug Per Cent.	Codling Moth Per Cent.	Curculio Per Cent.	Other Insects Per Cent.	Scab Per Cent.	Other Fungi Per Cent.
Spray, 5 applications	24.9	14.1	.31	.387	2.56	1.35	64.4	6.
Sul.-Nic.-Ars. Dust, 5 applications	2.61	6.28	.23	.326	5.62	1.44	94.5	23.
Spray, 3 applications	19.09	12.9	.6	.247	3.99	.846	79.5	6.6
Sul.-Nic.-Ars. Dust, 3 applications	.95	11.	.08	.52	6.4	1.95	94.9	48.6
No checks.								

DISCUSSION OF RESULTS.

The results in the Fall Pippin plot are similar to those obtained in the other plots, the liquid spray again giving a higher percentage of good fruit and a very much lower percentage of scabby fruit also a much lower percentage of fruit showing the injury of sooty blotch and fruit speck. The differences in control of insect pests are not so evident as in the case of fungous diseases. There were no check trees left in the Fall Pippin plots, but in preceding years the fruit was absolutely worthless, showing nearly 100 per cent. of scab.

ORCHARD NO. III.

This orchard is located two miles north of the village of Milford and is bounded on the east side by a highway running north and south. The trees are 18 years old, and are located on a fairly level piece of land with woods on the west and open fields on north and south sides. The trees had dense crowns, making it rather difficult to reach the centers with spray or dust.

The varieties used in the experimental work in this orchard were Baldwin, Greening, Gravenstein and McIntosh. This orchard was divided into four plots, one for liquid spray, two for dust and one for check. Two kinds of dust were used, Sanders or copper dust, and sulphur-nicotine-arsenate dust. Count trees were selected soon after blossoming, and the green dropped fruit from them gathered, counted and scored twice during the summer. At harvest time the fruit remaining on these trees was gathered and scored.

The applications of spray and dust were put on at approximately the same dates as those of Orchard No. II. This orchard had no delayed dormant treatment nor any pre-pink spray, the first being applied when the blossom clusters had separated and were showing pink. As in the other two orchards the spray and dust plots were divided after the third application, one-half of each receiving two more treatments, while the other had no further applications.

The spray outfit used here was also a Friend machine, but a spray gun was used instead of spray rod as in orchard No. II. The same duster was used here as in the other orchards. The dusting was always done on the same day and usually before the spray was applied. One day the wind was too strong for dusting, so that it had to be put off until the evening of that day.

TABLE NO. V.

RESULTS OF TREATMENT. BALDWIN.

Treatment.	Good Per Cent.	Aphis Per Cent.	Red Bug Per Cent.	Codling Moth Per Cent.	Curculio Per Cent.	Other Insects Per Cent.	Scab Per Cent.	Other Fungi Per Cent.
Spray, 5 applications	39.2	28.2	1.53	.338	20.77	1.6	.73	9.96
Sul.-Nic.-Ars. Dust, 5 applications	11.5	8.1	.675	.725	24.87	3.	.948	117.2
Sanders Dust, 5 applications	21.5	11.6	2.55	1.03	40.64	6.73	.222	52.2
Checks	0	51.72	7.16	24.88	93.6	24.8	.127	177.5
Spray, 3 applications	25.8	15.1	4.1	1.15	36.22	3.73	.823	58.68
Sul.-Nic.-Ars. Dust, 3 applications	2.48	10.7	1.8	1.11	47.63	4.71	1.07	146.5
Sanders Dust, 3 applications	5.9	19.95	1.39	.856	51.55	6.66	.45	149.8

DISCUSSION OF RESULTS.

In each case the liquid spray produced a higher percentage of good fruit; Sanders dust came next and sulphur-nicotine-arsenate dust last, with the exception of the check plot, which had no good fruit at all. In the case of fungi, spray was best, Sanders dust averaged second best, while sulphur-nicotine-arsenate dust was third. In control of aphis and red bug, either of the dusts were better than the liquid spray and the sulphur-nicotine-arsenate dust was better than the Sanders dust.

In controlling curculio, codling moth and other chewing insects, liquid spray was a little better than either dust. There was little difference between the two dusts for the control of other insects.

TABLE NO. VI.

RESULTS OF TREATMENT. GREENING.

Treatment.	Good Per Cent.	Aphis Per Cent.	Red Bug Per Cent.	Codling Moth Per Cent.	Curculio Per Cent.	Other Insects Per Cent.	Scab Per Cent.	Other Fungi Per Cent.
Spray, 5 applications	39.6	38.2	2.14	.279	14.02	1.02	12.31	10.38
Sul.-Nic.-Ars. Dust, 5 applications	11.85	22.	.44	2.2	27.2	1.97	39.1	86.5
Sanders Dust, 5 applications	16.8	14.5	3.89	6.73	45.22	8.42	33.35	36.1
Checks	0	16.85	50.5	22.79	99.	28.75	45.6	184.
Spray, 3 applications	18.3	29.8	1.9	1.737	25.34	2.56	30.95	63.1
Sul.-Nic.-Ars. Dust, 3 applications	1.35	17.9	.579	1.35	39.55	4.81	39.1	140.7
Sanders Dust, 3 applications	.586	25.7	14.35	6.23	53.8	9.75	30.65	180.87

DISCUSSION OF RESULTS.

In the Greening plots the liquid spray is again better than either of the dusts. The three treatments of spray gave a higher percentage of good fruit than five applications of either dust. For some reason the three treatment Sanders dust plot made the poorest showing both in the percentage of good fruit and percentage of other fungi. The sulphur-nicotine-arsenate dust appeared to be more effective in controlling aphis and red bug than either spray or Sanders dust.

TABLE No. VII.

RESULTS OF TREATMENT. GRAVENSTEIN.

Treatment.	Good Per Cent.	Aphis Per Cent.	Red Bug Per Cent.	Codling Moth Per Cent.	Curculio Per Cent.	Other Insects Per Cent.	Scab Per Cent.	Other Fungi Per Cent.
Spray, 5 applications	46.4	25.3	1.82	.032	10.73	1.4	17.98	6.65
Sul.-Nic.-Ars. Dust, 5 applications	8.4	18.2	1.51	.331	32.43	2.97	56.6	51.55
Sanders Dust, 5 applications	14.1	28.7	3.55	.935	39.59	5.32	42.35	10.8
Checks	.04	27.9	6.55	.63	56.25	3.95	28.34	54.2
Spray, 3 applications	31.2	34.	2.69	.018	10.32	1.95	25.77	19.64
Sul.-Nic.-Ars. Dust, 3 applications	6.77	12.9	.415	.192	30.79	3.7	64.6	135.5
Sanders Dust, 3 applications	10.9	19.1	1.28	.39	43.94	5.03	42.8	29.4

DISCUSSION OF RESULTS.

It will be seen from Table VII that the liquid spray gave better control of scab and other fungous diseases than did either of the dusts. The Sanders or copper dust gave a higher percentage of good fruit and a lower percentage of scab and other fungi than the sulphur-nicotine-arsenate dust. As might be expected, the nicotine dust gave better control of sucking insects such as aphids and red bugs than the Sanders dust. It was also a little better in controlling curculio and other chewing insects.

TABLE No. VIII.

RESULTS OF TREATMENT. McINTOSH.

Treatment.	Good Per Cent.	Aphis Per Cent.	Red Bug Per Cent.	Codling Moth Per Cent.	Curculio Per Cent.	Other Insects Per Cent.	Scab Per Cent.	Other Fungi Per Cent.
Spray, 5 applications	28.2	2.56	1.94	.085	14.21	1.44	66.2	1.46
Sul.-Nic.-Ars. Dust, 5 applications	1.85	9.71	3.62	.362	9.2	1.49	97.2	5.
Sanders Dust, 5 applications	.238	11.2	18.3	.315	27.45	3.42	96.3	3.74
Checks	.601	10.75	13.4	1.35	9.34	.975	98.9	2.29
Spray, 3 applications	4.73	9.1	5.61	.391	11.53	1.07	93.4	5.48
Sul.-Nic.-Ars. Dust. 3 applications	.11	13.3	5.71	.33	13.52	1.65	99.8	5.27
Sanders Dust, 3 applications	.364	8.65	13.	.5	25.34	3.28	99.1	8.7

DISCUSSION OF RESULTS.

The results of the treatments are similar to those obtained in the other varieties, the liquid spray again giving the best results and the Sanders dust being a little better for control of fungous diseases than the sulphur-nicotine-arsenate dust. The check tree of this variety was located in the spray plot and was partly sprayed twice. This probably accounts for the low percentage of injury when compared with the other treatments.

TABLE No. IX.

RESULTS OF TREATMENT. COMMERCIAL GRADING.

Treatment	Grade No. I Per Cent.	Grade No. II Per Cent.	Culls Per Cent.
BALDWIN.			
Spray	41.05	40.95	18.
Sulphur-nicotine-arsenate dust	37.1	45.25	17.65
Sanders dust	34.65	46.4	18.95
Check	0	0	100.
GREENING.			
Spray	59.45	20.8	19.75
Sulphur-nicotine-arsenate dust	48.1	38.1	13.8
Sanders dust	34.45	35.	30.55
Check	0	0	100.
GRAVENSTEIN.			
Spray	85.1	10.9	4.
Sulphur-nicotine-arsenate dust	67.6	26.8	5.6
Sanders dust	78.	19.95	2.05
Check	0	57.	43.

McIntosh.

Spray	63.75	27.50	8.75
Sulphur-nicotine-arsenate dust		Not graded.	
Sanders dust	19.	42.	39.
Check		Not graded.	

DISCUSSION OF RESULTS OF COMMERCIAL GRADING.

This method of obtaining data shows that the liquid spray is superior to either of the dusts used in orchard No. III. This is true of each of the four varieties in the experimental plots, in each case producing a higher percentage of No. I fruit. In the Baldwin and Greening plots the sulphur-nicotine-arsenate dust produced a greater percentage of No. I apples than the Sanders dust, though in the case of Gravensteins, the Sanders dust showed up the best. Due to an oversight the fruit from the McIntosh sulphur-nicotine-arsenate dust plot was not graded, so that no comparisons can be made.

ORCHARD NO. IV.

This is the old orchard on the Experiment Station Farm at Mount Carmel. This orchard is 46 years old and consists of about 40 Baldwin and Greening trees planted rather closely together. This orchard was divided into halves. The east half was used for the sulphur-nicotine-arsenate dust plot and the west half for Sanders dust. One row along the north end of the orchard was left for a check. Count trees in each plot were selected early in the season, but in this orchard the early dropped fruit was not gathered and scored. No scoring was done until harvest time, then all the fruit from two trees in each plot was picked, scored and then graded commercially into three grades, No. I, No. II and culls.

No liquid summer spray was used in this orchard and only two kinds of dust, namely: sulphur-nicotine-arsenate and Sanders or copper dust. The entire orchard was sprayed with the regular delayed dormant spray of commercial lime-sulphur, one part to nine of water. This was applied on April 11 and 12.

The first application was made on April 29, when the blossom buds began to show pink. The next treatment was the calyx application on May 22. This orchard received only one more application of dust and that was on June 14.

The dust at each treatment was applied early in the morning before the dew was off the leaves. There was very little fruit on the check trees at the time of harvest and none was scored or graded. The work in this orchard was simply a comparison of the two dusts used.

TABLE No. X.

RESULTS OF TREATMENT. BALDWIN.

Treatment.	Good Per Cent.	Aphis Per Cent.	Red Bug Per Cent.	Codling Moth Per Cent.	Curculio Per Cent.	Other Insects Per Cent.	Scab Per Cent.	Other Fungi Per Cent.
Sul.-Nic.-Ars. Dust.	30.2	20.5	0	1.03	29.54	4.09	.148	51.7
Sanders dust	31.8	18.1	.087	2.53	23.14	5.03	0	46.7

DISCUSSION OF RESULTS.

In this orchard there was very little difference between the two kinds of dust. The percentage of good fruit was very nearly the same, while in the control of fungi the Sanders dust gave slightly better results. The other differences are so slight that they are hardly worth mentioning.

TABLE No. XI.

RESULTS OF TREATMENT. GREENING.

Treatment.	Good Per Cent.	Aphis Per Cent.	Red Bug Per Cent.	Codling Moth Per Cent.	Curculio Per Cent.	Other Insects Per Cent.	Scab Per Cent.	Other Fungi Per Cent.
Sul.-Nic.-Ars. Dust.	18.05	20.	.056	3.77	45.2	3.71	2.08	85.72
Sanders dust	22.5	35.8	0	7.37	44.04	4.1	.504	48.27

DISCUSSION OF RESULTS.

The Sanders dust again gave better control of fungous diseases and consequently produced a higher percentage of good fruit. The sulphur-nicotine-arsenate dust gave better control of aphis and slightly better control of other chewing insects.

TABLE No. XII.

RESULTS OF TREATMENT. COMMERCIAL GRADING.

Treatment	Grade No. I Per Cent.	Grade No. II Per Cent.	Culls Per Cent.
BALDWIN.			
Sulphur-nicotine-arsenate dust	61.	26.1	13.1
Sanders dust	53.6	35.6	10.7
GREENINGS.			
Sulphur-nicotine-arsenate dust	55.5	29.7	14.8
Sanders dust	52.2	27.3	20.4

By the commercial grading method of taking results the sulphur-nicotine-arsenate dust gives the highest percentage of No. I fruit. The fungous troubles (best controlled by Sanders dust) were apparently light enough to permit fruit showing their char-

acteristic injury to be placed in a No. I grade and some of the fruit scored as "good" by the other method of taking results may have been too small to go into this grade.

PEACH ORCHARDS.

Dusting versus spraying to control peach scab and brown rot was continued in the same orchards and with the same number of trees as in 1921. Dusting sulphur without lead arsenate, and "Atomic Sulphur," at the rate of 10 pounds to 100 gallons of water were the materials applied in both orchards.

Orchard No. I. Peach orchard of M. L. Coleman, Cheshire ..... 113 trees
Orchard No. II. Station peach orchard Mount Carmel... 150 trees

263 trees

The dust was applied with a Niagara duster and the spray with an Arlington X. L. sprayer in both orchards. The picked fruit only was scored. This involved the counting and scoring of 41,980 peaches or about 600 baskets. Four applications were made on the following dates: May 29, June 22, July 11 and August 1. The results of the treatments are shown in Table No. XIII.

TABLE No. XIII.

RESULTS OF TREATMENT IN PEACH ORCHARD No. I.

		Good Per Cent.	Rot Per Cent.	Scab Per Cent.
Elberta	Spray	71	10	13
	Dust	66	17	13
	Check	20	20	62
Carman	Spray	69	5	18
	Dust	65	7	17
	Check	32	21	50

The last treatment was applied to only one-half of each plot and showed no advantage over the three treatments.

It will be seen from the table that the spray controlled the brown rot slightly better than the dust, and scab control was practically the same for both treatments.

TABLE No. XIV.

RESULTS OF TREATMENT IN PEACH ORCHARD No. II.

		Good Per Cent.	Rot Per Cent.
Elberta	Spray	97	3
	Dust	99	1
Champion	Spray	67	32
	Dust	88	11

In Orchard No. II the dust controlled the brown rot better than the spray on both Elberta and Champion varieties. There was no scab in this orchard either on treated or untreated trees. The data for the check trees are not given because these trees were adjacent to the treated trees and the dust was blown upon the checks, controlling the rot nearly as well as upon the trees dusted directly.

SUMMARY.

1. In all apple orchards and on all varieties used in these experiments, liquid spray gave better results than any kind of dust used.

2. By the commercial grading method of taking results, sulphur-nicotine-arsenate dust gave a higher percentage of No. I fruit than Sanders dust. By the other method of scoring each individual apple, Sanders dust usually gave a higher percentage of perfect fruit than sulphur-nicotine-arsenate dust.

3. Sulphur-nicotine-arsenate dust gave decidedly better results in controlling aphids and red bugs, and slightly better results in controlling curculio, codling moth and other chewing insects than Sanders dust.

4. Sanders dust gave very much better results in controlling apple scab and other fungous diseases than sulphur-nicotine-arsenate dust.

5. Liquid spray was best for controlling most pests except that sulphur-nicotine-arsenate dust was nearly as good for control of aphids and red bugs.

6. Where fungous diseases are not likely to be present a fair grade of commercial fruit may be secured by use of dusts, but where the highest grade of apples is desired, liquid spray may be relied upon to give best results.

7. The brown rot and scab of peaches were controlled just as well by sulphur dust as by a spray of "Atomic Sulphur."

CONNECTICUT
AGRICULTURAL EXPERIMENT STATION

NEW HAVEN, CONN.

BULLETIN 246 FEBRUARY, 1923

The Apple and Thorn Skeletonizer

By B. A. PORTER and PHILIP GARMAN.

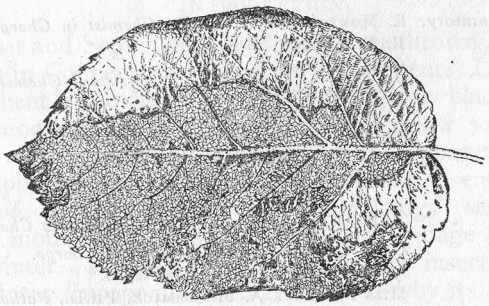


Figure 1. A skeletonized apple leaf.

CONTENTS.

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.

The Apple and Thorn Skeletonizer

Hemerophila pariana (Clerck)

BY

BENNET A. PORTER*, *Entomologist, Bureau of Entomology, United States Department of Agriculture,*

AND

PHILIP GARMAN, *Assistant Entomologist, Connecticut Agricultural Experiment Station.*

INTRODUCTION.

In August and September, 1922, numerous brown and defoliated apple trees in Connecticut caused much comment. Later, inquiries were frequent regarding the "little triangular black bugs" that were common everywhere, especially on window screens. These comments and inquiries were caused by the appearance of an insect, the apple and thorn skeletonizer, known to entomologists as *Hemerophila pariana* (Clerck), and the "bugs" seen on screens were tiny moths, the adult form, in which stage they probably pass the winter. Like many of our pests, the insect has found its way here from Europe and, being unchecked by its usual enemies, has multiplied abundantly.

In view of the importance of this new addition to our list of insect pests, the writers have made a study of its life history, and the information obtained, although incomplete in some respects, is here presented.

The work of the senior author was carried on at the field station maintained for the study of fruit insects by the U. S. Bureau of Entomology at Wallingford. This station is under the general direction of Dr. A. L. Quaintance of the Bureau, and work is con-

* Note: Dr. Porter, who has been in charge of the U. S. Bureau of Entomology Field Station at Wallingford, Conn., has studied this insect and has written the major portion of this paper. Dr. Garman of this Station has also made rearings and observations on this insect independently of Dr. Porter. At my suggestion they have put their notes together in the preparation of this bulletin. [W. E. BRITTON.]

ducted in co-operation with the Connecticut Agricultural Experiment Station at New Haven.*

History and Distribution.

This insect has been known to European entomologists for over 160 years, and frequent reference is made to it in Old World entomological literature. The species occurs throughout western Europe except the extreme southern part, and is recorded as far north as Norway, in many parts of eastern and southern European Russia, and in Turkestan in western Asia.

In August, 1917, Dr. E. P. Felt discovered that the insect was present in Westchester County, N. Y., in the lower Hudson River Valley. For the next two or three years the skeletonizer spread gradually to the northward and eastward. In the fall of 1920 it was found in Connecticut at Greenwich and Stamford, and was reported by Dr. Britton in his Annual Report for 1920 and in the Proceedings of the Connecticut Pomological Society for the same year.

Since 1920 the spread of the pest seems to have gained in momentum, and in Dr. Britton's 1921 Report it was mentioned as occurring in all parts of the State except Windham County. The infested area now includes the Hudson River Valley as far north as Albany, practically the entire State of Connecticut, and parts of western Massachusetts. During October large numbers of moths were noted at Amherst, Mass., and the insect will probably be found in southern New Hampshire and Vermont the coming year. The spread from the point where the skeletonizer was first noted has been almost wholly to the northward and eastward, since it does not seem to have extended its range very far into New Jersey.

In March of 1922 the insect was also reported in Northern Japan, where its life history is similar to that in Connecticut.

Importance.

Since its arrival, the skeletonizer has caused serious damage in many parts of Connecticut, especially in small home orchards and in orchards which were not carefully sprayed. Many unsprayed trees were seriously damaged before midsummer last year, and by late August all the leaves on many of them were brown and dry, falling early in September. Plate IV, a, shows a tree which was injured by an unusually severe infestation. Late in August nearly every leaf on this tree had been totally skeletonized, although most of the larvae were not more than two-thirds grown. With famine staring them in the face, many of the caterpillars left their depleted feeding ground in search of fresh food, spinning down on threads and crawling here and there. So many larvae laid threads over the same ground that the trunk of the tree became enclosed in a web similar to a huge tent caterpillar nest. Early in September most of the leaves on this tree were falling, and by the middle of the month it was bare. Similar injury was done in many parts of the State, especially on roadside trees and in smaller orchards. This injury to the foliage throughout the season, which in extreme cases means complete defoliation by September or even earlier, weakens the tree, lessens the amount of reserve food stored, and reduces the vitality of the blossom buds for the coming season.

Commercial growers will have little to fear from this insect, as the routine spray applications will ordinarily keep the pest from getting a start in the orchard. The future importance of the skeletonizer cannot be safely predicted, but it is to be hoped that before long it may be brought under control by climatic conditions or by its natural enemies, and will take its place among our native and long established pests. The infestation in southwestern Connecticut is reported by one observer as being less severe in 1922 than in 1921, which may be taken by the optimistic to indicate the future trend of the infestation.

*During the summer of 1922 the senior author was ably assisted in the life history studies by Mr. Stanley W. Bromley, then a Field Assistant in the Bureau, and now a graduate student at the Massachusetts Agricultural College. Thanks are here extended to Mr S. A. Rohwer, Mr. R. A. Cushman and Dr. J. M. Aldrich, of the Bureau of Entomology, for the identification of parasite material reared from the skeletonizer. Hearty thanks are also due Mr. B. H. Walden of the Station, for assistance in preparing the illustrations for publication.

Common Name.

In most American accounts the pest has been called the "apple and thorn skeletonizer". Although this common name is not entirely satisfactory, no attempt will be made here to suggest a new one. However, throughout this paper the insect is referred to for the most part simply as the "skeletonizer".

Food Plants.

In Europe the skeletonizer is recorded as feeding on apple, thorn, pear, mountain ash, birch, one species of plum, and possibly willow. Apple seems to be the preferred food plant, and many accounts speak of it solely as an apple pest and make no mention of other hosts.

In the United States it has been noted chiefly on apple, to a lesser extent on thorn and pear, and in one instance on sweet cherry, but it does not seem to have been found on any of the other host plants listed in Europe.

A similar injury occurred on gray and other birches in New England the past season, which was attributed by many persons to this insect. The cause of the injury to the birches, however, is a native insect, known as the "birch leaf skeletonizer." (*Bucculatrix canadensisella* Chambers). Outbreaks of this species have occurred at intervals of about ten years since 1892.

Synonymy.

This insect has been known to entomologists under a number of scientific names during the past century and a half. Among these are the following:

Phalaena (Tortrix) pariana Clerck
1759—Icones Insectorum, t. 10, f. 9.

Pyralis pariana (Clerck)
1794—Fab., Ent. Syst., III 2, p. 277, No. 148.

Hemerophila pariana (Clerck)
1806—Hübner, Tentamen.

Anthophila lutosa Haworth
1812—Lep. Britt., III, p. 472, No. 4.

Choreutis pariana (Clerck)
1826—Hübner, Verzeichniss Bekannten Schmetterlinge, p. 373.

Asopia parialis Treitschke
1829—Schmett. Europe, VII, p. 159.

Simaethis pariana (Clerck)
1829—Stephens, Catal., II, p. 161, No. 6782.

Hemerophila pariana (Clerck)
1900—Fernald, C. H., Can. Ent., 32, p. 236.

Xylopoda pariana (Clerck)
1903—Tutt, J. W., Ent. Rec. and Journ. of Var., 15, p. 242.

Descriptions.

The following brief outline will give a general idea of the appearance of the insect in its successive stages.

The form in which the skeletonizer does its damage to the apple foliage is that of a small caterpillar. When newly hatched it measures about one-twenty-fifth of an inch in length, and is a pale yellowish green. When full grown it has become nearly half an inch in length, and is yellowish green with numerous prominent black spots. After feeding is completed, a long narrow white cocoon about three-fourths of an inch to an inch in length is constructed in a fold of an apple leaf or elsewhere, and from this the adult emerges in due time. The moth is more or less triangular in shape when resting, brown or dark gray in color, usually with a purplish tinge. It has a very characteristic attitude, the wings usually being held in an oblique position, slanting upwards from the fore part of the body at an angle of about 30° with the surface on which it

is resting. The eggs are somewhat hemispherical, about one-sixtieth of an inch in diameter, and are pale yellowish green, with a brownish ring which usually develops before hatching.

More detailed descriptions of the different stages follow:

The Egg—

Sub-hemispherical in shape, often slightly longer than wide; measuring as follows: length—.39 mm. to .44 mm., average .41 mm.; width—.33 mm. to .44 mm., average .38 mm.; height—.19 mm. to .28 mm., average .23 mm. The partially flattened side is usually placed next the surface to which the egg is applied. It is soft, thin shelled, finely sculptured, with fine lines radiating from a point in the center of the rounded surface of the egg. When first laid the eggs are pale green; after a few days they take on a slight yellowish tinge, and many of them show a brownish ring which has a diameter about half or more of the diameter of the egg, and which varies in width, being sometimes narrow, and sometimes broad enough to occupy the greater part of the convex surface.

The Larva—

First Instar—Length, newly hatched—about .8 mm.; length, full fed—2.0 mm.; width of head—.17 mm. to .22 mm.; average, .18 mm. Body distinctly annular. Head, pale yellow brown, posterior lateral margin with a dark line. Thoracic legs and prolegs a translucent pale watery green.

Second Instar—General color pale yellowish green with dark tubercles. Length, full fed—3.5 mm.; width, head—.30 mm. to .33 mm.; average .33 mm. Head, light yellowish brown; ocelli and posterior lateral margin dark; tips of mouth parts, brown. Tubercles raised, dark, conspicuous. Legs and prolegs, pale, translucent.

Third Instar—Very similar to preceding instar, the dark tubercles becoming larger. Length, full fed—6.0 to 7.0 mm.; width, head—.52 mm. to .61 mm.; average, .55 mm. Head, light yellowish brown; ocelli and posterior lateral margin dark; tips of mouth parts, brown; upper part of head usually with two dusky spots. Legs, dusky distally; prolegs, slender, pale, translucent.

Fourth Instar (Full grown)—Length, full fed—10 mm. to 12 mm.; width, head—.88 mm. to .96 mm.; average, .90 mm. Yellowish green with prominent black tubercles. Head, pale brown; posterior lateral edge, ocelli, and a narrow line at edge of mouth parts, black; often a pair of dusky spots on upper front of head. The median dorsal area, also a round lateral area on each segment,

a more yellowish green; tubercles large, prominent, shining black, finely lined. Ventral surface paler; last two joints of thoracic legs dusky, the next to the last especially so, rest of legs about concolorous with body; prolegs pale, slender, tubular, with a complete circle of hooks at the tip of all except the posterior. See figure 2, a.

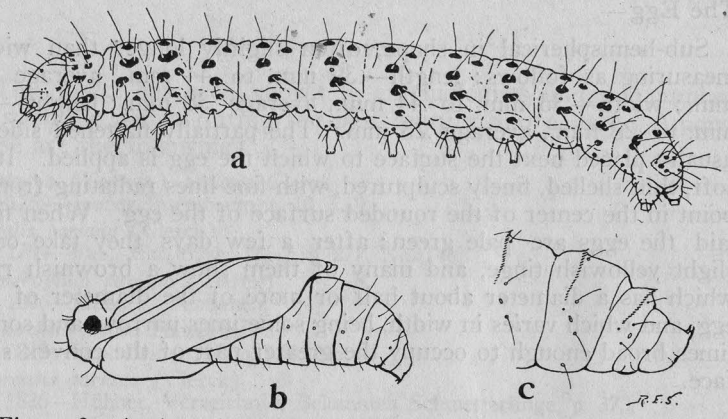


Figure 2. Apple and thorn skeletonizer. a. larva; b. female pupa; c. caudal extremity of male pupa, all greatly enlarged. Drawing lent by U. S. Bureau of Entomology.

The Pupa—

Length—5.0 mm. to 5.8 mm., average, 5.4 mm.; width at widest point—1.6 mm. to 1.9 mm.; average, 1.8 mm. Blunt at the ends. When newly formed is a light yellowish brown, with the outline of antennae, legs, wing pads, abdominal segments, and spiracles darker; eyes reddish. Later the entire pupa becomes darker, the head and abdominal segments 9-10 becoming nearly black; and the anterior portions of the meso-and metathorax, legs, and tips of antennae, more dusky than the rest of the pupa. On the anterior part of dorsal abdominal segments 3-8 in the male and 3-7 in the female is a single row of very fine, short spines, which in living specimens are often telescoped under the margin of each preceding segment. Segment 10 has two short, dorsal spines. Body with a few fine setae. The abdominal segments beyond the middle are very movable, and when disturbed the pupa moves the tip of the abdomen vigorously. See figure 2, b and c.

The Moth—

The moth is extremely variable. The predominant color, however, is dark reddish brown, often with a purplish tinge. Marginal scales of the wings nearly always dark brown, but the color

of the front wings is often relieved by an indefinite pale band (see Plate II, b and d), and wavy black lines. Frequently there are three or four white spots along the costal margin of the front wing, but the whole may be uniform brown or gray with spots or bands or stripes indistinct. Hind wings with a pale stripe on the costal margin which extends from the base of the wing slightly beyond the middle. The labial palpi consist of three segments, of which the third or terminal segment is three-fourths the length of the middle one. They are clothed with brown or white-tipped scales and extend beyond the head the length of the terminal segment. The wings below are mostly grayish in appearance, the costal margins of the front wings with conspicuous pale spots.

Body clothed with brown scales above except on sides of the abdomen where they are gray-tipped. Venter of abdomen and legs with gray-tipped scales, the tarsal segments with white scales at tip.

Length of body, 4.5 to 5 mm.; length of front wings, 5 mm.; wing-spread, 11-13 mm.

Observations in 1922.

While definite proof is lacking as to the stage in which the skeletonizer passes the winter, our observations indicate that, for the most part, hibernation occurs in the adult stage. Moths were noted in the field near Wallingford on April 16th and April 26th, and egg-laying evidently begins as early as the leaves appear, since larvae were found in various stages during May, and cocoons were spun as early as May 28th. A second generation followed soon after the first, larvae of this brood being present in the latter part of June, and some of them reaching maturity by the middle of July.

Oviposition.

From this point, our life history studies are more complete, due to the increasing abundance of the skeletonizers, and to the fact that moths were induced to lay eggs in captivity, providing abundant material in all stages. This was accomplished by placing fairly large numbers of moths (usually forty or more) in glass battery jars, supplying them with a dilute sugar solution in tufts of cotton, and providing apple foliage on which to place the eggs. On emergence, the moths are apparently not ready to oviposit, as no eggs were laid in any of the cages until the fifth day, and in one cage none were laid until the tenth day after the moths had left the cocoons. While a few are laid on the upper surface of the leaves, the majority of the minute, green, sub-hemispherical eggs are placed on the lower surface, usually next the midrib or a larger vein, often being tucked partly under it. Usually the flattened

side of the egg is placed next the surface on which it is laid, though occasionally the egg is placed on edge among a mass of leaf hairs. Ordinarily laid singly, the eggs when numerous may touch each other or overlap slightly. Not all are laid at one time, as with some species of insects, but they mature a few at a time over an extended period. After the moths commenced laying, eggs were deposited daily for two to three weeks. In the five jars used for second brood oviposition the average number of eggs recorded per moth in each jar was 52, 52, 76, 80, and 94, respectively, and no doubt some additional eggs were overlooked, tiny and inconspicuous as they are. Possibly more eggs are laid normally in the field than it was possible to obtain in captivity. Most of the moths lived at least two or three weeks, and most of them continued alive several weeks after egg-laying stopped, the maximum length of life recorded being forty-two days for a female, and forty-eight days for a male.

INCUBATION OF EGGS.

As the embryo larva develops, the egg turns from a pale green to a slightly yellowish green, and a brownish ring appears in the convex surface. As hatching time approaches, the form of the larva may be very faintly seen through the thin shell of the egg, and the ocelli show as dark red dots. During the summer, the eggs hatch about a week after being laid.

FEEDING HABITS.

On hatching, the tiny pale green larvae wander for a while over the lower surface of the leaf, feeding a little here and there, but soon settle down in one spot, sometimes several in company, and eat away small patches of the lower leaf surface. Over the feeding area is spun a loosely woven layer of silk, which soon becomes filled with dark bits of waste matter. The skeletonizer larvae pass rapidly through four stages or *instars,* shedding their skins at the close of each. After the first molt, numerous dark dots appear on the upper side of the body; these become more and more conspicuous with each succeeding instar. When about one-third grown, usually during the second instar, the larvae desert the original feeding areas on the lower surface of the leaves, and migrate to the upper side. There a light web of silk is spun across from opposite edges of the leaf, usually near the base or the tip, drawing the two edges of the leaf partly together. Under this web the larva feeds on the leaf tissue, consuming all except the opposite epidermis and the veins. Often several larvae of various sizes may be found under a single web, especially when they are abundant. In many cases a partially skeletonized leaf will be deserted for a fresh one nearby. When disturbed, the larvae

wriggle vigorously and drop on a fine silken thread. When nearly full grown, they often spin down in the same way, especially if the food supply is becoming depleted due to excessive numbers of the voracious caterpillars.

THE COCOONING PERIOD.

After feeding for three weeks or more, the larvae become full grown, and make preparations for their coming transformation. The cocoon is usually constructed in an angle or fold of a leaf, often along the midrib, sometimes in the last leaf fed upon, but more often in another. Besides apple leaves, numerous other places may be used for cocooning, such as cracks in buildings, leaves of various weeds, and so on. The cocoon is white, about three-fourths of an inch long and rather narrow. The cocoon proper is enclosed in an outer one, which consists of a double layer of silk, stretched between the opposite sides of the fold or curl of the leaf, with a smaller amount of silk woven next to the leaf itself. The inner cocoon is spindle shaped, pointed at the ends, a little shorter than the outer cocoon and considerably narrower, and, like the outer one, is composed of a double layer of silk. Both ends are open, and the last larval skin, cast off when the pupa was formed, is often pushed out into the space between the two parts of the cocoon. (Plate I, b.)

THE PUPA STAGE.

Within forty-eight hours after the cocoon is started, its construction is complete, and the larva has thrown off its skin to assume the form of the *pupa,* a less active stage in which no feeding is done, and in which the transformation to the moth form takes place.

The pupa is less than one-fourth of an inch in length, not more than one-third the length of the inner cocoon, is brownish in color and rather blunt at the ends. The rear half of the body is quite flexible, and when disturbed, the pupa wriggles back and forth the length of the cocoon. In summer the pupal stage is passed through rapidly. With the first and second generations the entire period from the spinning of the cocoon to the appearance of the moth averaged less than twelve days, while with the third generation the process was retarded by cooler weather, and the moths emerging late in November had spent more than six weeks in the cocoon. As time for emergence approaches, the pupa becomes darker. When the moth is about to emerge, the pupa wriggles its way through the cocoon, and forces almost its entire body out of one end. Then the skin bursts, and the moth appears.

HABITS OF THE MOTHS.

The moths seem to be inactive at night, but are very active in the daytime, especially if the weather is warm. They are great lovers of flowers, and when they are flying in great numbers, are to be found in abundance on flowers of all kinds. In the vicinity of Wallingford, the moths have been noted on the flowers of wild carrot, goldenrod, tansy, yarrow, cultivated zinnias, calliopsis and many others. After the flowers have been killed by the frost, the moths seem to pay no further attention to them. The moths became extremely abundant during the latter part of September. Moths alighting on window screens were noted everywhere, and as many as thirty-two were counted on one screen at one time.

DISSEMINATION OF THE MOTHS.

The most rapid dissemination seems to occur in the moth stage. During October immense numbers of moths were observed at Amherst, Mass., seemingly more than could have emerged nearby, judging from the infestation in the immediate vicinity. Presumably many of these moths had come from the more heavily infested areas in Connecticut at times when a strong wind was blowing from the south or southwest. This seems the simplest way of accounting for the rapid spread of the species across the States of Connecticut and Massachusetts within a period of not more than three years.

FOURTH GENERATION.

During a period of unusually warm weather the first few days in October, a few of the third brood moths laid eggs, both in insectary cages and in the field. After an incubation period of 10 to 12 days, these eggs hatched, but sharp freezes the 19th and 21st of October killed nearly all the apple foliage, cutting off the food supply before many of these larvae had passed the first instar.

HIBERNATION.

The stage in which the species passes the winter seems to be in doubt. Mention is made in English entomological literature of the collection of the moths from roof thatch in very late fall and in very early spring. In German publications the statement is found that probably both pupae and adults winter over. In Wallingford attempts to carry both stages through the winter of 1921-22 failed. In 1922, the emergence from pupae of the third generation was very nearly complete, although the last moths to emerge did not leave the cocoons until late November. An examination of 158 cocoons collected at random near the Wallingford station on November 24th yielded only one living pupa, while examination of

a large number at New Haven yielded no live examples. Evidently the greater part, if not all, of the insects will pass the winter of 1922-23 as adults. Probably the moths which were seen in such numbers on windows and screens in the fall were in search of satisfactory places to spend the winter. Of 104 moths which emerged from September 5th to 15th, and which were kept in glass cages, less than 20 per cent. had died by the latter part of November. Examination of these February 21, as well as those in other cages, showed that about 15 per cent. were still alive. It seems almost certain, therefore, that some of the moths will survive the winter.

Under different seasonal and weather conditions, the last brood of larvae might complete their feeding later in the fall, and pupation might occur so late that many individuals would pass the winter in the cocoons and emerge in the early spring. In November of 1922, however, moths emerged from cocoons spun as late as October 8th.

LIFE HISTORY DATA.

Table 1 gives in condensed form the information secured at the Wallingford station on the seasonal history of this insect during 1922. The records for the first two generations are incomplete, but estimates have been made of the dates when egg-laying and hatching probably occurred. With these two generations the information regarding cocooning, pupation, and emergence was secured from material in all larval stages collected in the field when the most advanced larvae were about to spin cocoons. Data for the third and fourth generations were obtained from material reared from eggs laid in the insectary.

The periods during which the different biological events occurred are represented graphically in Fig. 2. As a guide to effective application of control measures, the periods when larvae of the successive generations were present on the trees are shown in the lower part of the graph. The dates when the usual spray applications should have been made that particular season are also shown.

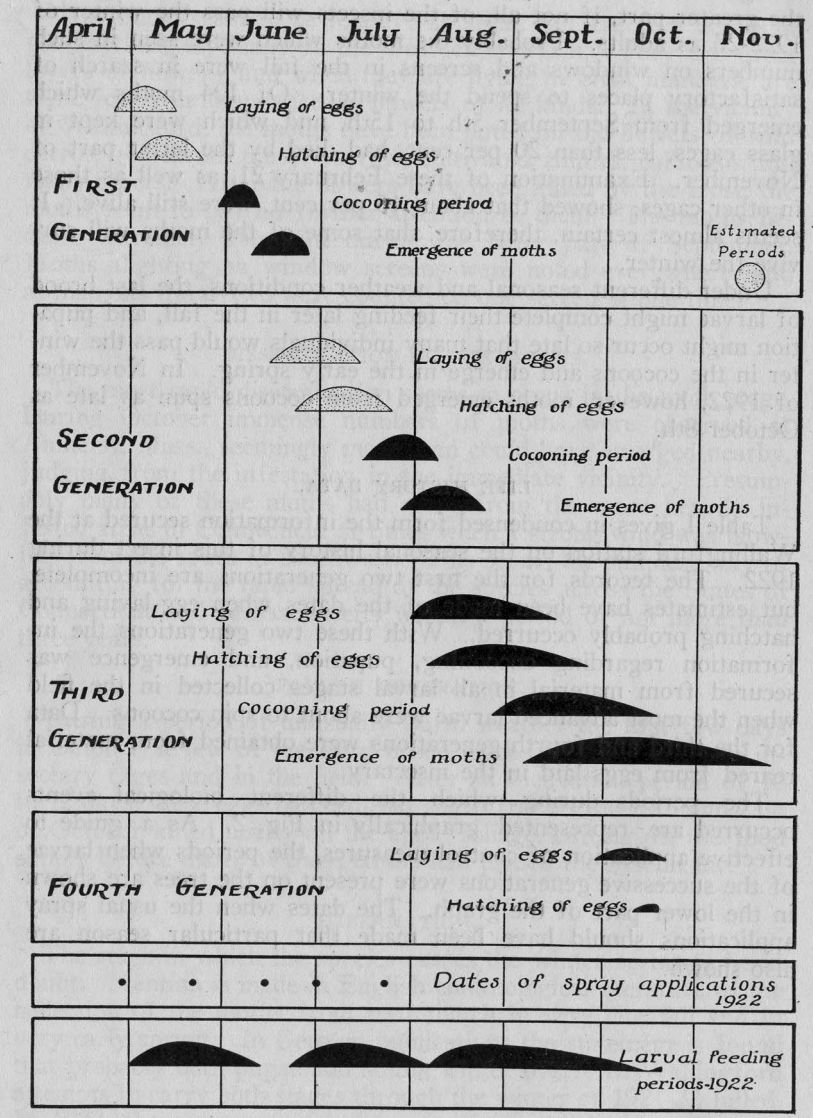


Figure 3. Chart of the life history of the apple and thorn skeletonizer. Stippled areas are estimated periods.

Table I. Condensed Seasonal History Notes. Wallingford, Conn., 1922.

Generation.	Stage.	Period When Present. First.	Period When Present. Maximum.	Period When Present. Last.	Duration of Stage—Days. Maximum.	Duration of Stage—Days. Minimum.	Duration of Stage—Days. Average.	Remarks.
1st	Egg	(April 25)*	(May 10)	(May 20)	..	..	...	
	Larva	(May 1)	May 28	June 11	..	..	...	
	Pupa	May 29	June 7	June 24	14	8	11.2†	
	Moth	June 7	(June 24)	(July 24)	..	..	...	
2nd	Egg	(June 14)	(July 7)	(July 20)	..	..	...	
	Larva	(June 20)	July 14	Aug. 7	..	..	...	
	Pupa	July 15	July 25	Aug. 20	16	8	11.8†	
	Moth	July 25	(Aug. 15)	Sept. 30	..	..	...	
3rd	Egg	(July 31)	(Aug. 20)	(Sept. 25)	9	5	6.9	
	Larva	Aug. 5	Aug. 30	Oct. 16	38	17	23.2	
	Pupa	Aug. 23	Sept. 5	? ?	{21 {45	9 14	13.5† 21.2	Early part 3rd generation Latter part 3rd generation
	Moth	Sept. 5	(Sept. 30)	....	..	..	...	
4th	Egg	Sept. 28	Oct. 9	Oct. 19	..	..	...	
	Larva	Oct. 9	Oct. 19	Oct. 19	..	..	...	Freeze killed foliage Oct. 19

* Approximate date. † Includes time spent as a larva within cocoon—approximately 1.5 days.

Natural Enemies.

A number of natural enemies have been observed preying on the skeletonizer. An encouraging feature of the work of parasites has been the wide variety of forms which seem to be adapting themselves to this new host, although most of them have been reared in small numbers. One Russian publication dealing with this insect (abstracted in Rev. Appl. Ent., I, p. 489) states that a high percentage of parasitism occurred in the region under discussion. It is to be hoped that a similar condition will be speedily reached in this country, although as yet the combined efforts of all enemies have not been sufficient to keep pace with the rapid multiplication of the host. A report from Fairfield County in 1922, however, indicates that the skeletonizer infestation has been somewhat less severe than in the preceding year, which we may hope is due to an increase of natural enemies.

Mr. Bromley noted a number of chipping sparrows which were apparently feeding on the skeletonizer larvae. He also observed a spider feeding on a moth, and another moth which had been captured by an ambush bug of the family *Phymatidae*. An immature Pentatomid, probably a species of *Podisus,* was observed sucking the juices from a small larva.

The following parasites have been reared in Connecticut*:

Habrobracon gelechiae (Ashmead). Parasitic on or in the larva which collapses before becoming full grown. Collected at Bantam.

Dioctes obliteratus (Cresson). Oviposition in the two-thirds to nearly full grown host larva; emergence from the host cocoon. Reared from Wallingford material, and has also been reared from the skeletonizer in New York State.

Sagaritis sp. Life history similar to that of *Dioctes*. Reared at Wallingford.

Exochus propinquus Cresson. Oviposition in nearly full grown larva; emergence from host cocoon. Wallingford.

Epiurus indagator (Cresson). Oviposition in full grown larva; emergence from host cocoon. Wallingford and Southington.

Dibrachys boucheanus (Ratzeburg). This omnivorous parasite oviposits in the host pupa in the cocoon. Wallingford.

Exorista pyste Walker. The pearly white eggs of this species are placed on the nearly full grown host larvae. Cocooning and pupation occur as usual, but the pupa is killed by the parasite maggot from which the fly later emerges. New Haven and Wallingford, and has also been reported from New York State as parasitizing the skeletonizer.

Phorocera tortricis Coquillett. Life history similar to that of *Exorista pyste*. Wallingford.

Nemorilla maculosa Meigen. A single individual emerged from a host pupa. Probably oviposition or larviposition occurs in or on host larva. Wallingford.

The following parasites have been recorded from Europe:

Angitia glabricola Holmgren; *Mesochorus pectoralis* Ragonot; *Microgaster* sp.; *Phygadeuon* sp.; *Thryptocera crassicornis* Meigen.

D. boucheanus determined by Mr. S. A. Rohwer; other Hymenopterous parasites determined by Mr. R. A. Cushman; all Dipterous parasites determined by Dr. J. M. Aldrich.

Control.

A review of the feeding habits of the skeletonizer larvae will show that the pest should be easily controlled by the use of arsenate of lead, the standard poison for leaf-chewing insects. For a week or more after hatching, the young larvae feed on the under sides of the leaves, but before they have become very large, and before extensive feeding has been done, they migrate to the upper surfaces, and complete their feeding there. Often one leaf will be deserted for another nearby. If the lower surfaces of the leaves are well coated with poison before the eggs hatch, the newly hatched larvae should be easily killed. If the upper sides of the leaves are thoroughly covered, the larvae on migrating there from their first feeding grounds will consume much of this poison.

These assumptions were confirmed by laboratory experiments carried on at the Wallingford station. On August 12th, 24 newly hatched larvae were placed on each of two apple branches sprayed with powdered arsenate of lead at the rate of one pound in 50 gallons of water, special care having been taken to cover the under sides. Twenty-four newly hatched larvae were similarly placed on each of two unsprayed branches. An examination of the foliage nine days later showed that 34 out of the 48 placed on the unsprayed twigs had survived, whereas none could be found on the sprayed. With third and fourth instar larvae, nearly one hundred per cent. kill was obtained with arsenate of lead at the rate of one pound of the powdered form in 50 gallons of water. Only one larva survived the treatment, this individual spinning its cocoon four days after being placed on the sprayed foliage. Equally good control was obtained with the use of only half this strength of the poison. From these experiments it is evident that a thorough application of arsenate of lead at the usual strength, and even at a lesser strength, will kill all but the nearly full grown larvae, which apparently may not consume enough poison before cocooning to kill them.

It is next necessary to consider the proper time for the applications. The periods during which the larvae are to be found feeding on the foliage are shown graphically in Fig. 3. A single application early in the feeding period of each generation should give satisfactory control. During 1922 these points were reached approximately as follows: 1st generation, about May 15th, during the latter part of the blooming period of the apple; 2nd generation, about July 4th, about seven weeks after apple blossom time; 3rd generation, about August 20th, approximately 14 weeks after apple blooming.

In practice, the commercial fruit grower will get fairly good control of the skeletonizer if he follows the usual spray schedule recommended for the control of other orchard insects. A majority of the first brood of skeletonizer larvae will be poisoned by the arsenate of lead in the so-called pink and calyx applications, and fairly good control should result from the latter application alone. The second brood should be well controlled by the first apple maggot spray early in July. Where this application is unnecessary, enough poison will probably remain from the spray for codling moth control (put on the middle of June or three or four weeks after the calyx spray) to kill at least the early part of the second generation of skeletonizer larvae. The later part of the same brood will be poisoned by the second brood codling moth spray, applied the latter part of July, approximately ten weeks after the calyx application. Enough of this last mentioned application will probably be still present during August, when the third brood of skeletonizer larvae appears. Fruit growers should be on the lookout for the third brood during August, and if an infestation threatens, due to a migration of moths into the orchard, it may be worth while to make a special application as soon as larvae are present in numbers. In 1922, this occurred soon after the middle of August. This probably is the only application which may be needed in addition to those included in the regular spray schedule. Young non-bearing orchards should have a fair amount of arsenical poison on the foliage during the early part of the feeding period of each larval brood; otherwise partial skeletonization if not complete defoliation may occur, and growth will be correspondingly retarded.

In an exceptionally warm and favorable season, or in regions further south, a fourth generation might become of importance, but this is not likely to occur in Connecticut. In 1922 the temperature at New Haven[1] for May was approximately 60° F.; June, 68° F.; July, 69° F.; August, 71° F.; September, 68° F.; and October, 62° F.

[1] This approximates a mean temperature, is based on records taken at eight o'clock P. M., and was computed on a system worked out by F. Z. Hartzell, Technical Bulletin No. 68, New York Agricultural Experiment Station, Geneva, N. Y., June, 1919.

Summary.

The apple and thorn skeletonizer, an insect well known in Europe for over one and one-half centuries, was discovered in the lower Hudson Valley in 1917, and in southwestern Connecticut in 1920. Since then it has spread up the Hudson to Albany, over nearly the entire State of Connecticut, and into western Massachusetts. Many neglected orchards, small home orchards, and roadside trees have been nearly defoliated by this insect in many parts of Connecticut.

In Connecticut the species passed through three generations during the season of 1922, larvae of the first generation being present on the trees during May and early June; those of the second from late June to early August; and those of the third from August to the middle of October. A very fractional fourth generation started during an unusually warm period in October, but a freeze ruined the food supply before any of the larvae had passed beyond the early instars. Hibernation in the winter of 1922-23 will occur almost entirely in the adult stage; under certain conditions some individuals may hibernate in the pupal stage.

A number of different parasites have been reared from the larvae and pupae of the skeletonizer, for the most part in small numbers. It is to be hoped that these and other natural enemies will increase in numbers and effectiveness, and will in the near future bring this new pest within more reasonable bounds.

The usual spray schedule will ordinarily keep the skeletonizer under control. The third generation will probably cause the most trouble in commercial orchards. In case this brood threatens serious damage, it can be easily controlled by an additional application of arsenate of lead at the rate of one pound of the dry form in 50 gallons of water, put on when the larvae are becoming numerous, the middle to the latter part of August.

Bibliography.

Clerck—
1759—Ic. Ins. t. 10, f. 9.
Original description.

Bower, B. A.
1890—*In* Ent. Mon. Mag., 26, p. 271.
Moths collected in thatch in fall and in early spring.

Fernald, C. H.
1900—*In* Can. Ent., 32, p. 236.
Synonymy cleared up, and the correct scientific name of the species shown to be *Hemerophila pariana* (Clerck).

Reh, L.
1913—Handbuch der Pflanzenkrankheiten, dritter Band, pp. 274-275.
Brief account of life history, food plants, and parasites in Europe.

Felt, E. P.
1917—*In* Journ. Econ. Ent., 10, p. 502.
Report of first discovery in the United States.

Felt, E. P.
1918—Cornell Extension Bulletin No. 27.
In Rep't Ont. Ent. Soc., 48, p. 44.
In Rep't N. Y. State Entomologist, 33, p. 33.
Illustrated account, giving habits, descriptions, partial life history, and bibliography.

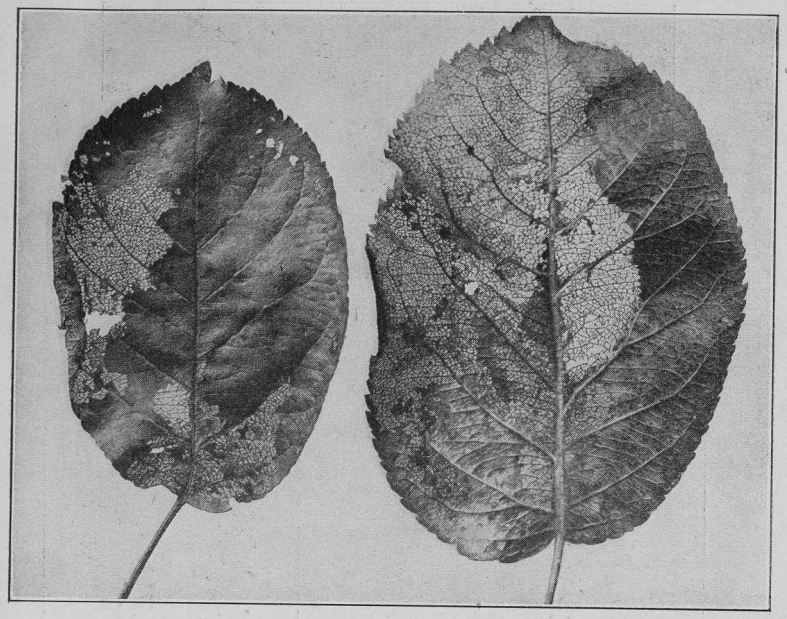
Britton, W. E.
1921—*In* 20th Rep't State Entomologist of Connecticut for 1920, pp. 190-193.
Records first discovery in Connecticut. General account.

Britton, W. E.
1922—*In* 21st Rep't State Entomologist of Connecticut for 1921, pp. 186-188.
Rapid spread of the insect over most of Connecticut recorded.
Rearing of parasite, *Exorista pyste,* Walker.

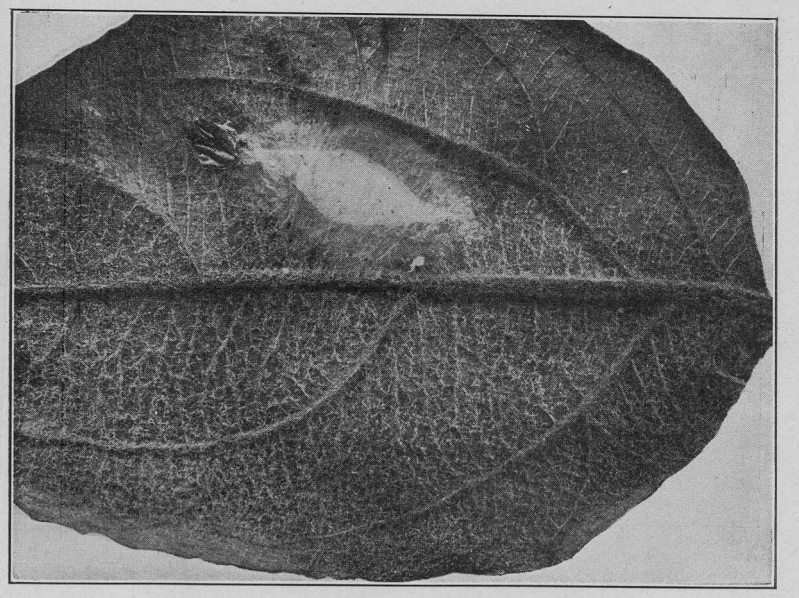
Felt, E. P.
1922—*In* The Insect Pest Survey Bulletin, II, p. 239.
Record of spread northward in Hudson Valley to Albany.

Fernald, H. T.
1922—*In* The Insect Pest Survey Bulletin, II, p. 267.
First record from western Massachusetts.

Kuwayama, S.
1922—*In* Journal of the Hokkaido Agric. Soc., Sapporo, Japan, XXII, No. 254-255, pp. 1-14. (Reviewed in Rev. Appl. Ent., X, p. 487).
Record of recent discovery in Sapporo and Aomori, in northern Japan.



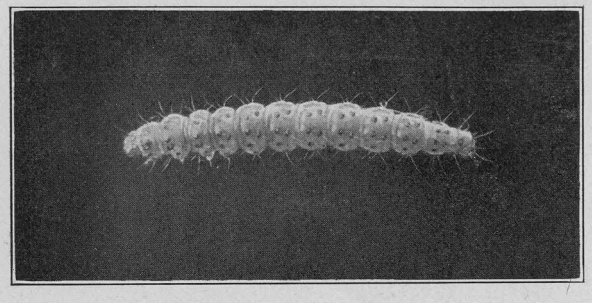
a. Characteristic injury of larvae on apple leaves, somewhat reduced.



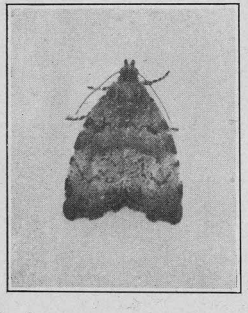
b. Cocoon on under surface of apple leaf, twice natural size.

APPLE AND THORN SKELETONIZER.

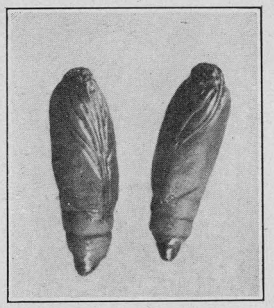
PLATE II.



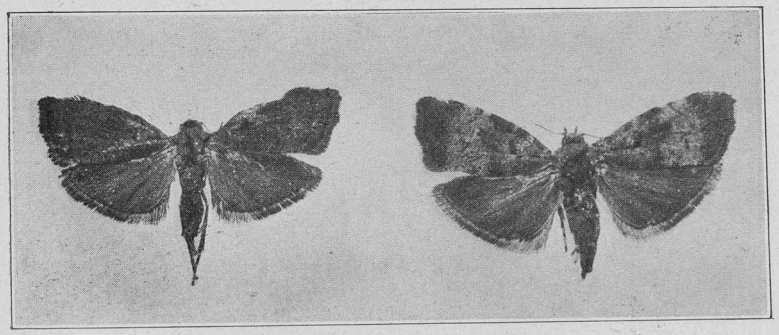
a. Larva, enlarged four times.



b. Moth resting, enlarged three and one-half times.



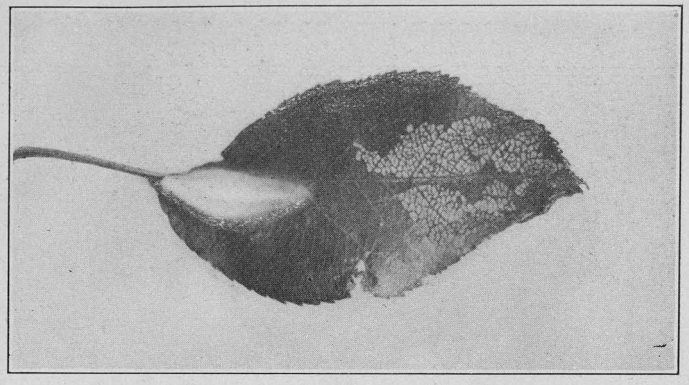
c. Pupae, enlarged about five times.



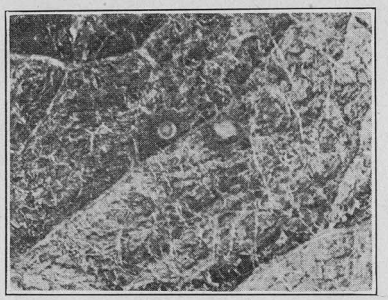
d. Adults, enlarged four times.

APPLE AND THORN SKELETONIZER.

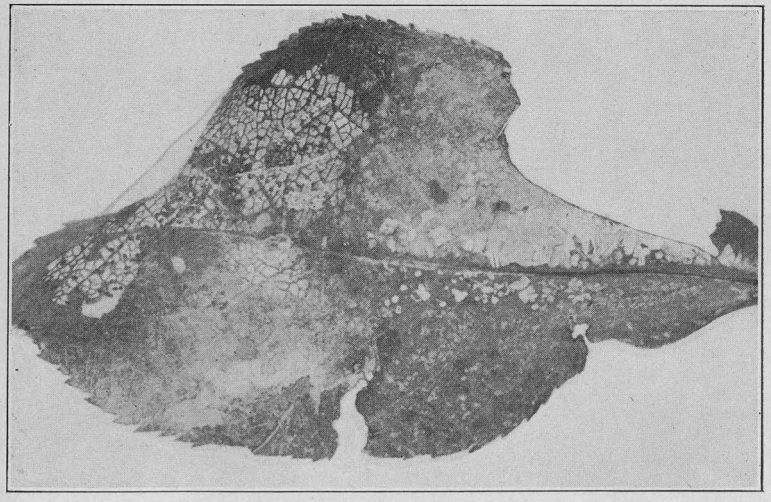
PLATE III.



a. Cocoon on leaf, showing double-walled construction, somewhat reduced.



b. Eggs on under surface of leaf, enlarged five times.

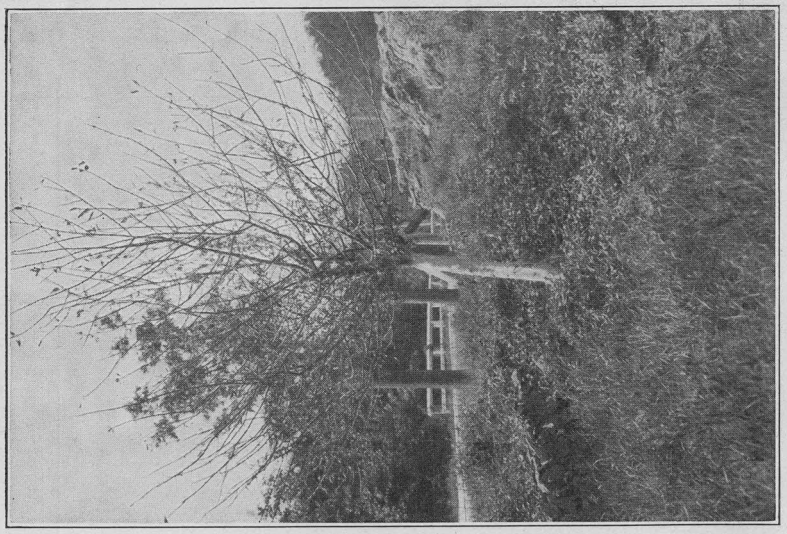


c. Larva on leaf, natural size.

APPLE AND THORN SKELETONIZER.

PLATE IV.

b. Apple tree showing unusual web spun by caterpillars leaving it in search of food.



a. Apple tree defoliated by the skeletonizer.

APPLE AND THORN SKELETONIZER.

TWENTY-SECOND REPORT

OF THE

STATE ENTOMOLOGIST

OF

CONNECTICUT

FOR THE YEAR 1922

(Being Bulletin 247, Connecticut Agricultural Experiment Station)

BY

W. E. BRITTON, PH.D.

State Entomologist

NEW HAVEN, CONN.

1923

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

OFFICERS AND STAFF

February, 1923

BOARD OF CONTROL.

His Excellency, Charles A. Templeton, *ex-officio, President.*

James H. Webb, *Vice President* ..... Hamden
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
Edward C. Schneider ..... Middletown

STAFF.

Administration.
E. H. Jenkins, Ph.D., *Director and Treasurer.*
W. L. Slate, B.Sc., *Vice Director.*
Miss L. M. Brautlecht, *Librarian and Bookkeeper.*
Miss J. V. Berger, *Stenographer and Bookkeeper.*
William Veitch, *In charge of Buildings and Grounds.*

Chemistry: Analytical Laboratory.
E. Monroe Bailey, Ph.D., *Chemist in Charge.*
R. E. Andrew, M.A.
C. E. Shepard,
Owen L. Nolan,
Harry J. Fisher, A.B.
} *Assistant Chemists.*
Frank Sheldon, *Laboratory Assistant.*
V. L. Churchill, *Sampling Agent.*
Mrs. B. P. Storrs, *Clerk.*

Biochemical Laboratory.
T. B. Osborne, Ph.D., D.Sc., *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, *Secretary.*

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., *Assistant.*
H. W. Hicock, M.F., *Assistant.*
Miss Pauline A. Merchant, *Stenographer.*

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

Tobacco Sub-Station at Windsor.
G. H. Chapman, Ph.D., *in Charge.*

CONTENTS

BULLETIN 247

TWENTY-SECOND REPORT

OF THE

State Entomologist of Connecticut

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

I transmit, herewith, my twenty-second annual report as State Entomologist of Connecticut. The financial statements cover the State fiscal year ending June 30, 1922, but in other respects this report deals with the activities of the department for the calendar year of 1922. One of its features is the remarkable wind-spread of the gipsy moth which we thought was well under control until the beginning of the year 1922. All regulatory matters, such as inspection of nurseries, imported nursery stock, and apiaries, mosquito elimination and gipsy moth control, are described in detail. Two important papers describing work done in part by this department have been published, as follows: Results of Dusting versus Spraying in Connecticut Apple and Peach Orchards in 1922, Bulletin 245: The Apple and Thorn Skeletonizer, Bulletin 246. These papers, though mentioned herein are not included as a part of this report. Other papers describe experiments of the staff on controlling cabbage root maggot, paradichlorobenzene for peach borers, dusting cabbages and turnips, European red mite, spruce mite, corn ear worm, San José scale, and observations and studies on the rhododendron borer, maple borer, maple sesian, bronze bich borer, European corn borer, ant invasions and many notes on miscellaneous insects, all of which vitally or indirectly concern the welfare or interest of the people.

Respectfully submitted,

W. E. Britton, *State Entomologist.*

Report of Receipts and Expenditures of the State Entomologist

From July 1, 1921, to June 30, 1922

RECEIPTS

From E. H. Jenkins, Treasurer	$12,500.00	
State Comptroller, Gipsy moth account	272.44	
Old automobile, exchanged	125.00	
Interest on Bank Deposits	24.21	
Various sources (Automobile Mileage)	54.10	
		$12,975.75

EXPENDITURES

For Salaries and Wages	$8,352.42	
Printing and Illustrations	28.15	
Postage	63.22	
Stationery	64.78	
Furniture and Fixtures	91.28	
Library (Books and Periodicals)	55.50	
" (Binding)	34.45	
Laboratory Supplies	74.52	
Spraying Supplies	334.81	
Machinery, Tools and Supplies	44.40	
Scientific Apparatus	32.83	
Express, Freight and Cartage	113.04	
Automobiles, New	1,644.55	
" Insurance	84.72	
" Supplies and Equipment	149.16	
" Repairs	140.21	
" Gasoline	191.85	
" Oil	11.71	
Traveling Expenses	374.62	
Balance, Cash on Hand	1,089.53	
		$12,975.75

Memorandum:—This account has been audited by the State Auditors of Public Accounts. The item of $272.44 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

266 samples of insects received for identification.
106 nurseries inspected.
104 regular certificates granted.
82 duplicate certificates furnished to be filed in other states.
48 parcels of nursery stock inspected and certified.
49 orchards and gardens examined.
30 shipments, containing 159 cases, 1,997,595 plants, imported nursery stock inspected.
17 shipments or 56.6 per cent. found infested with insects or fungi.
797 apiaries, containing 8,007 colonies inspected.
33 apiaries and 68 colonies found infested with European foul brood.

11 apiaries and 22 colonies found infested with American foul brood.
2,220 letters written on official work.
195 circular letters.
461 post cards.
54 reports to Federal Horticultural Board.
1,614 bulletins, etc., mailed on request or to answer inquiries.
102 packages sent by mail or express.
15 lectures and addresses at institutes, granges and other meetings.

Publications of Entomological Department, 1922

By W. E. BRITTON:

Twenty-first Report State Entomologist of Connecticut (Bulletin 234), 94 pages, 6 figures, XVI plates; 10,500 copies distributed in April,, 1922.

Control of Ant Invasions, Bulletin of Immediate Information No. 17, 6 pages, 1,000 copies, July, 1922.

The Gipsy Moth Quarantine, Bulletin of Immediate Information No. 18, 4 pages, 1,000 copies, August, 1922.

Report of Committee on Injurious Insects, Proceedings 31st Annual Meeting Connecticut Pomological Society (3 pages), page 71, 1922.

New Facts Regarding Insects Attacking Vegetables and their Remedies, Proceedings 9th Annual Meeting Connecticut Vegetable Growers' Association (7 pages), page 44, 1922.

Preparedness for Insect Control, Market Grower's Journal, page 12, June 15, 1921.

Potato Spraying, New Haven County Farm Bureau News, June, 1922.

Tobacco Plants Injured by the Seed Corn Maggot, Journal of Economic Entomology, Vol. 15, page 275, 1922.

Skeletonizers on Apple and Birch Trees, New Haven County Farm Bureau News, page 2, October, 1922.

By W. E. BRITTON, M. P. ZAPPE and E. M. STODDARD:

Experiments in Dusting *versus* Spraying on Apples and Peaches in Connecticut in 1921, Bulletin 235, 20 pages, 5 figures, 6 plates, 10,500 copies distributed in April, 1922.

Results on Apples and Peaches in Connecticut, Bulletin No. 2, Crop Protection Digest, page 7, February, 1922.

By W. E. BRITTON and S. T. SEALY:

Mosquito Work in Connecticut in 1920, Eighth Report New Jersey Mosquito Extermination Association, page 64, 1922.

By M. P. ZAPPE and E. M. STODDARD:

Results of Dusting *vs.* Spraying on Apples and Peaches in Connecticut, Proceedings 31st Annual Meeting Connecticut Pomological Society, page 77, 1922.

By PHILIP GARMAN:

The Grass-Feeding Frog-Hopper or Spittle-Bug, Guide to Nature, Vol. XIV, page 165, May, 1922 (2 pages, 3 illustrations).

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, }

There have been no changes in the personnel of the Department during the year. Messrs. Frank D. Luddington and J. Leslie Rogers were employed between July 1 and October 1 to aid in the inspection of nurseries.

Mr. Walden has continued his investigations of the American raspberry beetle, *Byturus unicolor,* but as certain points in its life history need to be settled and control measures tested further, another season's work will be devoted to it before publishing the results. Mr. Walden is also making a general survey of the insects attacking small fruit crops in Connecticut.

Mr. Zappe, in co-operation with Mr. Stoddard of the Botanical Department, has carried out a series of tests of copper-arsenate and sulphur-arsenate dusts with and without nicotine on apple orchards in comparison with spraying for the control of the common insect and fungous diseases. Similar tests with sulphur dusts versus atomic sulphur sprays were made on peach orchards. The results of this work have been published in Bulletin No. 245 of this Station.

Copper dusts were compared with spray on potatoes, nicotine dusts were given a trial in killing aphids on turnips and arsenate dusts in killing the green worms on cabbages.

Mr. Zappe has conducted small-sized experiments in controlling the cabbage root maggot, and in the use of paradichlorobenzene to kill peach borers. He has also had charge of inspecting the nurseries, and of inspecting the imported nursery stock consigned to points in Connecticut.

Messrs. Zappe, Walden and Stoddard applied various materials to a dormant apple orchard in Mount Carmel to control the San José scale.

Dr. Garman has continued his investigations on the life histories of our native spittle bugs (family Cercopidæ) and read a paper before the meeting of the Entomological Society of America in Boston, December 26, on the "Life History of the Alder Spittle Bug, *Clastoptera obtusa*", which will probably be published in the *Annals* of that Society or some other entomological journal.

Dr. Garman has further investigated the European red mite, *Paratetranychus pilosus* and tested a number of materials in controlling it; he has also studied the spruce mite, *Paratetranychus ununguis,* and has found several species of mites new to Connecticut.

Dr. Garman has devoted some time to the life history of the apple and thorn skeletonizer, *Hemerophila pariana,* and has collaborated with Dr. B. A. Porter of the Wallingford field station of the Bureau of Entomology in the preparation of an account of this insect which has been published as Bulletin No. 246 of this Station.

Dr. Garman has nearly completed the manuscript of a Bulletin on the Odonata or Dragonflies of Connecticut to be published some time in the future by the Connecticut Geological and Natural History Survey.

The apiary inspection work has been done as in past years by Messrs. H. W. Coley and A. W. Yates on a *per diem* basis.

Mr. Sealy has continued to serve as Deputy to the Director in Charge of Mosquito Elimination; very little new work has been done, but the ditches have been maintained and a number of preliminary surveys made.

Mr. Ashworth, Deputy in Charge of Gipsy Moth Control Work, and his Field Assistant, Mr. J. A. McEvoy, have been unusually busy on account of the increased territory to be covered because of the recent spread of this insect by winds. This work has been done in co-operation with the Federal Bureau of Entomology and a full account of it appears in this Report.

The Entomologist has attended to the executive work of the Department, has continued to aid the Federal Bureau of Entomology in gathering data and submitting reports for the Insect Pest Survey, and has spent much time in reading proof on the Hemiptera of Connecticut, which is now in press and soon to appear as Bulletin No. 34 of the Connecticut Geological and Natural History Survey. He has also devoted some time to the work of the Tree Protection Examining Board.

Substantial additions to the insect collection of the Station have been made during the year, particularly by Mr. Zappe in the Coleoptera, Mr. Walden in the Hemiptera and Dr. Garman in the Odonata. Messrs. Britton, Walden, Zappe and Garman have also done more or less general collecting, the total resulting in the addition of many new records and several species not before represented by Connecticut material in the collection.

The more important activities of the Department not prepared for publication elsewhere are described in the following pages of this Report.

ENTOMOLOGICAL FEATURES OF 1922.

The summer of 1922 was somewhat abnormal. It was characterized by cool, dry weather until June 1, then an abundance of rain until September 1. There were several hard frosts in April and one May 1st, just before the fruit trees blossomed. In some apple orchards, the buds were so seriously injured that whole clusters dropped off without opening; in some other cases, particularly with the McIntosh variety, the pistils were injured so that little or no fruit set. At harvest time it was rather common to find apples with well defined russet rings, a result of frost injury.

Perhaps the two most outstanding entomological features of the season were the rapid spread of the apple and thorn skeletonizer, *Hemerophila pariana* Clerck, and the discovery of an extensive wind-spread of the gipsy moth, *Porthetria dispar* Linn., which occurred in 1921.

The apple and thorn skeletonizer is a European pest discovered in this country in Westchester County, New York, in 1917, and was first found in Connecticut at Greenwich and Stamford in November, 1920. In 1921, specimens of the work of this insect were received from, or observed in, all parts of the State except Windham County. Some of the unsprayed trees in Fairfield County were brown. In 1922, the insect was observed in Windham and all other Counties of Connecticut, and it has spread northward into Massachusetts as far as Amherst. Nearly all unsprayed apple trees around New Haven were brown in late summer, and this condition prevailed along the turnpike leading from New Haven to Hartford. On the other hand, it was reported that in Greenwich and Stamford the injury was less severe than in 1921. Sprayed orchards were not injured. For a more complete account of this insect, the reader is referred to Bulletin No. 246 of this Station, which is included (pages 245-264) in the Annual Report for 1922.

The gipsy moth wind-spread increased the territory to be covered in control work from 27 towns having an area of 634,790 acres or 991 square miles in 1920-1921, to 90 towns infested in 1922. These towns have an area of 1,869,733 acres or 2,921 square miles, or nearly three times the area of two years ago.

The infested region quarantined by the Federal Horticultural Board effective July 1, 1922, and by the State of Connecticut effective July 20, 1922, includes 95 towns. Full details of the gipsy moth conditions will be found on page 290 of this Report.

The brown-tail moth has apparently disappeared from the State, as the only winter nests seen in Connecticut during the year were some which were intercepted on apple seedlings imported from France.

Fruit Insects

The tent caterpillar, *Malacosoma americana* Fabr., is slowly increasing, and the nests were more abundant in 1922 than in 1921.

The Oriental peach moth, *Laspeyresia molesta* Busck, was found in peach twigs at New Canaan in September.

The bud moth, *Tmetocera ocellana* Schiff., was rather less abundant in 1922 than usual.

The fall canker worm, *Alsophila pometaria* Harris, was locally abundant as usual, and caused a moderate amount of damage in unsprayed orchards.

The apple maggot, *Rhagoletis pomonella* Walsh, was somewhat less abundant than usual, yet caused much injury in certain orchards.

The apple twig miner, *Marmara elotella* Busck, which makes the serpentine mines underneath the outer bark of apple twigs, was very abundant in one orchard in Branford. This insect does not cause serious damage.

The plum curculio, *Conotrachelus nenuphar* Herbst, was very abundant and caused much injury to apples, plums and cherries in all parts of the State. It is really a serious apple pest and some better means of controlling it are needed. Of course, cleaning up the rubbish in and around the orchard and removing hedgerows, stone heaps and walls where the beetles are supposed to hibernate will aid considerably in reducing the injury caused by the attacks of this insect.

The buffalo tree hopper, *Ceresa bubalus* Fabr., has been very abundant in the region of North Haven, Branford and North Branford. In one orchard of small trees, all the branches were covered with scars caused by the females in laying eggs.

There was very serious injury in May and June by the rosy apple aphid, *Anuraphis roseus* Baker, in all sections of the State. On some trees where no treatment was given the entire crop of apples was ruined except for cider. The green apple aphid, *Aphis pomi* DeGeer, was also abundant, one correspondent stating that the attack was the worst that he had ever seen, yet the green apple aphid never causes as much injury to the season's crop as the rosy apple aphid. Its attack affects the foliage and new growth rather than the fruit.

The European red mite, *Paratetranychus pilosus* Can. & Fanz., was present and caused considerable injury in apple orchards in Branford, North Branford, Greenwich, Milford, and doubtless in other portions of the State.

The light or false apple red bug, *Lygidea mendax* Reuter, caused injury in orchards in many sections of the State.

The pear psylla, *Psylla pyricola* Foerster, was exceedingly abundant in one orchard early in the season and the twigs were thickly covered with eggs. Late sprays of lime-sulphur will kill the eggs, but summer sprays of nicotine with a spreader are often necessary to control this insect.

The rose chafer, *Macrodactylus subspinosus* Fabr., was noticeably less abundant generally than usual, though injury was reported from some localities, particularly northern Litchfield County and around Hartford. Spraying heavily with self-boiled lime-sulphur seems to act as a repellent..

The San José Scale, *Aspidiotus perniciosus* Comst., is on the increase in Connecticut, and a number of orchards where the dormant spray was omitted showed scale-marked fruit at harvest time. Owners should not neglect this treatment, but should apply a mixture of lime-sulphur or miscible oil in March or April.

In a few plantations, injury by the raspberry cane borer, *Oberea bimaculata* Oliv, was observed. Cutting out and burning the infested canes is the only remedy.

Vegetable Insects

The corn ear worm, *Chloridea obsoleta* Fabr., was much less prevalent than in 1921, though it appeared late in the season in some plantations.

The stalk borer, *Papaipema nitela* Guen., was present as usual and caused some injury to corn, potatoes, tobacco, tomatoes and other crops. Specimens were received at the Station from Andover, Bloomfield, Bristol, Harwinton, New Milford and Salisbury.

The Colorado potato beetle, *Leptinotarsa decemlineata* Say, was less abundant than usual.

The margined blister beetle, *Epicauta marginata* Fabr., caused some injury in a potato field in New Haven.

The pea aphid, *Macrosiphum pisi* Kalt., damaged many fields of peas in various portions of the State. Dusting with a two per cent. nicotine mixture gave good results, but this should be done early before the aphids have seriously injured the vines.

The potato aphid, *Macrosiphum solanifolii* Ashmead, appeared in small numbers, but there were no reports of serious injury.

The turnip aphid, *Aphis pseudobrassicae* Davis, killed and injured the turnip plants in many fields during 1922. Dusting seems to be more effective than spraying to control this pest.

Cutworms were very serious around Danbury, and caused much injury to early cabbages.

The striped cucumber beetle, *Diabrotica vittata* Fabr., was abundant and caused the average amount of injury. It was particularly serious at Burnside.

One of the most important discoveries of the year is the presence in Connecticut of an imported beetle, *Anomala orientalis* Waterhouse. The beetles were first collected in a nursery in New Haven in 1920 and again in the same spot in 1921, but we were unable to get them identified until May. This is an Asiatic species which has injured sugar cane in Hawaii, and no one can foretell what its status may be in this country.

Shade Tree and Forest Insects

The elm leaf beetle, *Galerucella luteola* Müll, was reported as being more abundant around Stamford and Greenwich than for five years. It also riddled the leaves of some trees in the village of Glastonbury.

The blue elm beetle, *Altica ulmi* Woods, was brought to the Station September 11 from West Haven where it was feeding on the leaves of elm trees.

The imported poplar and willow beetle, *Plagiodera versicolora* Laich, is spreading eastward into the State from New York, especially along the coast. One correspondent wrote that around Stamford and Greenwich there was scarcely a willow except the pussy willow that was not two-thirds skeletonized.

The fall webworm, *Hyphantria cunea* Dru., was unusually abundant in late summer and fall, particularly in the northern portion of the State, where it defoliated fruit and nearly all kinds of deciduous trees along the roadside.

The maple borer, *Glycobius speciosus* Say, seemed to be more abundant than usual, and specimens of the adult beetles were received from Hamden, New Haven, Plymouth, Ridgefield, Torrington and South Meriden. The Torrington correspondent had killed thirty-five beetles on the trunks of nearby trees. This is probably the most serious pest of the sugar maple in Connecticut, and in many localities the trees are sadly disfigured or killed by its continued attacks.

The woolly maple leaf scale, *Phenacoccus acericola* King, causes more or less injury to sugar maple trees each year in the cities and villages of the State. I have never observed it to be abundant on trees in the open country or woodlands. During 1922, specimens of this insect were received from Bristol, East Haven, Glastonbury, Hamden, New London, Stratford and Wethersfield. It was also observed in New Haven.

The native gray birches, *Betula populifolia,* growing around New Haven and through the central and eastern portions of the State were skeletonized and turned brown in late summer by the birch leaf skeletonizer, *Bucculatrix canadensisella* Chambers.