State of Connecticut

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Forty-third Annual Report

OF

The Connecticut Agricultural Experiment Station

Being the annual report for the year ended October 31

1919

and including Bulletins Nos. 215 to 222

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PUBLICATION

APPROVED BY

THE BOARD OF CONTROL.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

OFFICERS AND STAFF

October 31, 1919.

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

Vegetable Growing.
W. C. PELTON, B.S.

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ERRATA.

Page 90, line 3, for 12536 read 12537.

Page 94, second line from the bottom, reference "2" to a foot-note. Should be dropped to the bottom line.

Report of the Board of Control

OF

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION

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

As required by law, the Board of Control of The Connecticut Agricultural Experiment Station herewith respectfully presents its report for the year ending October 31, 1919.

For the first time in its history, this Station has lost by death an active member of its scientific staff.

Miss Edna Louise Ferry, a graduate of the New Haven High School and of Mount Holyoke College, after graduate study in the Sheffield Scientific School of Yale University, specializing in physiological chemistry, in 1913 received the degree of Master of Science, being the first woman to receive this degree from Yale.

In 1909 Miss Ferry accepted an engagement in the research laboratory of this Station and held this position until her death, on October 7, 1919.

By her collaboration in the numerous contributions to scientific journals made by the research department, Miss Ferry achieved wide recognition among students of nutrition.

Miss Ferry's address on The Food Value of Milk, delivered at the last annual meeting of the Dairymen's Association, was a clear exposition of the subject, in the joint interest of producers and consumers, and created very unusual interest in the research work of this Station.

By her ability she won a place among scientific investigators and by her high courage in the face of very difficult conditions she earned the respect and affectionate regard of all her associates.

Legislation Concerning the Station.

The General Assembly, January Session, 1919, passed the following acts affecting this Station:

Chapter 181 provides that the botanist, entomologist and forester of the Station shall examine any applicant as to his

qualifications to improve, protect, or preserve trees, and to issue certificates of such qualification, and that no person without such certificate shall do work of protecting and preserving trees, outside of the town in which he resides.

Chapter 21 amends the statute concerning mosquito breeding areas by providing that the cost of supervision and inspection shall be wholly borne by the State.

Chapter 204 repeals the fertilizer law formerly in force and enacts a new one. The more important differences between the two are in the definition of the term commercial fertilizers, which now includes cotton seed meal, ashes and vegetable meals used as fertilizers, in the provision for a tonnage fee as well as a registration fee, and in the directions for sampling.

Chapter 257 authorizes the building of a laboratory for the joint use of the State Department of Health and this Station and appropriates one hundred thousand dollars therefor.

House Bill No. 765, file number 689, appropriates for the biennial period beginning July 1, 1919,

For the Station's current expenses	$45,000.00
Food and drug investigations	5,000.00
Suppression of gypsy and brown-tail moths and inspection of imported nursery stock	70,000.00
Suppression of bee diseases	4,000.00
Control of white pine blister rust	10,000.00
Mosquito elimination	10,000.00
State entomologist	15,000.00
State forester's expenses	6,000.00
Purchase of forest land	5,000.00
Fire warden service	10,000.00

A brief summary of the more important work of each department of the Station follows:—

The Botanical Department.

Dr. Clinton in Charge.

This department has made a very comprehensive and important study of the white pine blister rust, concerning chiefly its botanical relations and the channel of infection of the pine. The account of this investigation is nearly ready for distribution as Bulletin No. 214.

Fertilizer experiments in a peach orchard at Yalesville and a study at Mt. Carmel of fertilizers in relation to diseases of garden crops have been continued.

In addition to the plant disease survey which Doctor Clinton has carried on for years, there has been a special survey, with reference to the possible presence of potato wart disease in the State, the Station coöperating with the Bureau of Plant Industry of the U. S. Department of Agriculture.

Spraying experiments with apples and peaches, potato variety tests, and further study of peach yellows have also been carried on. Two hundred and fifty-three samples of seeds have been tested, either for purity or vitality, in the interest of both seedsmen and farmers.

The Chemical Department.

Dr. Bailey in Charge.

The work of the year, largely under statute requirements, has involved analyses of 873 samples of commercial and other fodder materials and field crops, over 500 samples of fertilizers and about 2250 samples of food and drug products. Also, 1540 pieces of Babcock glassware have been examined, as to their accuracy of calibration.

Expert testimony in court has been required in 15 cases.

An exhibit was prepared to represent the work of the analytical laboratory, at the Farmers' Week exhibit in Hartford, in January of this year.

Publications from this department include the regular annual report on Fertilizers, Bulletin 209; Food Products and Drugs, Bulletin 210; Commercial Feeding Stuffs, Bulletin 212, and Condensed Milk, Malted Milk, Milk Powder, Bulletin 213. The chemist in charge has assisted the Dairy and Food Commissioner and the Director of this Station in preparing additions to the Rules and Regulations relating to the State Food and Drug Law, and has continued to serve as expert on diabetic foods for the American Medical Association, and as a Referee of the Association of Official Agricultural Chemists.

The Entomological Department.

Dr. Britton in Charge.

The inspection work required by Statute has included the examination of 96 nurseries, 1075 cases of imported nursery stock, 249 cases of bulbs, and 707 apiaries containing 5861 colonies of bees.

In coöperation with the Federal Bureau of Entomology, the fight to control the gypsy moth has been carried on vigorously and fewer infestations have been found this year.

On account of the menace of the European corn borer, considerable scouting has been done throughout the State, but up to the present this pest has not been found.

Experiments have been carried on in two large greenhouses, to control the chrysanthemum midge, a serious imported pest, and in the experiment field studies have been continued on insects attacking cucurbits, the results of which will shortly be published.

Some time has been given to the preparation of papers to be published by the State Geological and Natural History Survey.

Mr. Walden has continued his duties as deputy to the Director, in charge of mosquito elimination. In this connection there has been little new work undertaken, but the work of maintenance has been carried on as effectively as the scarcity of efficient labor would permit.

Dr. Philip Garman, who began his duties September 1, 1919, is studying the biology of the bulb mite.

The entomologist has coöperated with the farm bureaus and has furnished information about insect pests whenever needed. He also serves as Chairman of the Tree Protection Examining Board.

The entomologist has prepared Bulletin 211, being his eighteenth annual report, and Bulletin 208, Insects Attacking the Potato Crop in Connecticut.

The Forestry Department.

Mr. Filley in Charge.

In the Portland state forest 30,000 pines have been set on cut-over land and 65,000 seedlings have been transplanted at Mt. Carmel, for use in the forest next year.

The cutting of chestnut ties and poles is continued, the product finding a ready market.

No planting has been done in the other state forests because of difficulty in getting labor. The area of the state forests has been increased this year by 254 acres, making the amount now owned by the State 3970 acres.

There were 1028 forest fires in 1918, only 100 occurring in the fall. In 1919, 627 forest fires occurred previous to July 1st, burning over 22,000 acres, with an estimated property damage of $58,000.00.

The forester is by law a member of the State Park Commission. The Commission, in the six years of its existence, has acquired 4000 acres of park land in different parts of the State. This is largely in woodland and the forester has been called upon for advice as to its value and treatment and he is responsible for all forestry operations in these State parks. During the summer and fall Mr. Moss has been doing the field work for a forest map of the Macedonia Brook tract of 2000 acres, in Kent, the expense being borne by the Park Commission.

The work of controlling the blister rust has been done in coöperation with the botanical department. The eradication work in Norfolk has been extended this year and similar work has been done on a much smaller area in Pomfret. The work of past years in Norfolk shows encouraging results in the lessening amount of infected material.

The Department of Market Gardening.

Mr. Pelton in Charge.

Variety tests of beans, tomatoes, celery, peas, melons, squashes, and pumpkins have been conducted. The coöperative celery test reported last year was replaced by a strain test of Easy Blanching and Paris Golden, the two varieties now of most interest in Connecticut. The tests of peas and melons were intended to determine the value of certain local varieties not commonly known outside of the State. Squash and pumpkin testing was undertaken, to get data that would be of help in the judging of these vegetables at state and local fairs. Several varieties of western beans that have now been under observation for two years will be dropped from further trial.

The sweet corn cross of Stowell's Evergreen and Golden Bantam was tested again, in comparison with fifteen commercial types of similar crosses, and as it proved inferior to some of

these and superior to none of the best white varieties known, its planting will be discontinued.

A start has been made on two new projects outlined during the winter. Under the cover crop project, notes have been made on nine types of vetch and on the relative rapidity and volume of growth of some of the common crops used for green manuring. A series of plots has been laid out for comparative tests of cover crops and fertilizers with animal manures and fertilizers in rotations of vegetable crops. These plots have been in operation for one year.

Work on the project entitled "Standardization of Vegetable Crops" has consisted entirely of strain tests of beets, carrots, and string beans which were arranged to determine to what extent the variability of the seed affects the variability of the commercial product.

Owing to the fact that an extra field meeting was held by the Connecticut Vegetable Growers' Association, of which the Market Gardener is Secretary, and a longer excursion conducted, more than the usual amount of time has been devoted to the needs of that Association.

Researches Supported by the Adams Fund.

Dr. Osborne and Dr. Jones in Charge.

It is required by the Federal authorities that the Adams fund received from the United States shall be spent wholly in scientific investigation on subjects approved by the Office of Experiment Stations and preferably on projects continued through a term of years.

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

The principal subjects to receive attention in this department during the past year have been the distribution of the water-soluble vitamine among fresh vegetables and green fodders; the preparation of protein free from this vitamine; the relative proportion of the fat-soluble vitamine in numerous vegetable products used for human food and for feeding farm animals and the relative nutritive value of wheat, rye, oats, and barley, when these grains serve as the sole source of protein in the ration.

The other Adams project, in charge of Dr. Jones, is a study of the laws of inheritance in maize and tobacco.

Particular study is devoted to the application of the principles, learned from the long continued experiments on inbreeding and cross-breeding, to methods of improving maize.

Some important results of this study are given by Dr. Jones in Bulletin 207, The Effects of Inbreeding and Cross-breeding upon Development.

The new variety of tobacco produced by the crossing of standard varieties, followed by many years of selecting for uniformity and constancy, is being tested on an extensive scale in many different parts of the State, with promising results.

In this connection, but not supported by the Adams fund, a coöperative corn variety test has been carried on at Storrs and at the New Haven Station which has yielded information concerning desirable varieties of corn for Connecticut and sources of seed. A summary of the results of this test has been prepared, making a mimeograph paper of 18 pages, giving the results of seven years' work, names of persons from whom seed of desirable varieties may be obtained, and a map of the State, showing the corn varieties specially recommended for different sections of the State.

Conferences and Field Meetings.

At the exhibition in connection with Farmers' Week in Hartford, January 20-24, 1919, the Station showed material illustrating the different departments of its work, filling the space allotted to it.

On Monday, June 2d, there began a conference of the county agents and other members of the Extension Service with the staff of this Station. The aim of this meeting was to get better acquaintance, both with the members of the staff and with the scope and, to some extent, with the results of our work. The conference continued for three days and proved to be mutually profitable.

On July 22d and 23d was held an institute for tree workers. The object was to have experts discuss those matters connected with the treatment of trees which were of special importance to those who were applying for licenses to practice as tree surgeons.

The examinations of applicants for licenses showed that need of this kind of instruction was quite urgent.

A conference of plant pathologists, chiefly from the eastern states, was held August 18th-21st. There were sessions for papers and discussions both here and at the Storrs Station, which were also attended by the county agents and others. Trips were made to farms in various parts of the State, where there were matters of special interest to students of plant diseases.

The annual Station field day was on August 24th. There were about 400 present at Mt. Carmel to inspect the experimental work being done there and to hear some discussion by experts of present potato problems.

On October 23d and 24th a conference of county agents and Extension Service workers was held in the state forest at Portland, where the Station forester discussed the care of woodland belonging to farmers, illustrated by the work going on at the forest under his direction.

Changes in the Station Staff.

Major John P. Street, chief of the chemical department, absent on leave in the U. S. service at the time of our last report, resumed his place on the staff on June 19th, but resigned on August 1st, to accept a position with the National Canners Association, in Indianapolis, at a much higher salary than he received here.

Lieut. C. B. Morison, chemist, returned to the Station from army service in February, 1919, but resigned in October to take a position in the American Institute of Baking, in Minneapolis, also at a much higher salary.

Corp. Irving W. Davis, assistant entomologist and deputy in charge of gypsy moth work, returned to his duties on Jan. 15, 1919, after six months' service in the U. S. Marine Corps.

Mr. Henry W. Hicock was engaged in September as an assistant in the forestry department.

Publications.

During the year the Station has issued the annual report for 1918, consisting of Bulletins 207-214, and Bulletin of Information No. 9, aggregating 506 pages, with 44 full page plates.

A considerable part of the Station's work, particularly in scientific research, cannot be printed in its bulletins, partly for lack

of space and partly because it is not of immediate value to farmers, to whom the larger part of our editions is sent.

Following is a list of papers written by the staff and published elsewhere:

By Dr. Jones.

Some Factor Relations in Maize with Reference to Linkage. (Jones and Gallastegui.) Amer. Naturalist; 53, 239-246.

Selection of Pseudo-Starchy Endosperm in Maize. Genetics; 4, 354-393.

Inbreeding and Outbreeding: Their Genetic and Sociological Significance. (East and Jones.) 1919. A book published by Lippincott, Philadelphia.

Inbreeding in Corn Improvement. Breeder's Gazette; May 8, 1919, 1111-1113; May 15, 1919, 1182; May 22, 1919, 1245.

Hybrid Vigor and Its Meaning. Scientific American; Sept. 6, 1919, 230-231, 239-241.

What Puts the "Pop" in Pop Corn. Rural New Yorker; Jan. 18, 1919, 74.

Some Curious Freaks of Corn. Rural New Yorker; July 5, 1919, 1043.

By Dr. Osborne and others in his Department.

In the Journal of Biological Chemistry:

The Vitamines in Green Foods. Osborne and Mendel. 1919, XXXVII, 187-200.

A Method of Expressing Numerically the Growth-Promoting Value of Proteins. Osborne, Mendel and Ferry. 1919, XXXVII, 223-229.

The Nutritive Value of the Wheat Kernel and Its Milling Products. Osborne and Mendel. 1919, XXXVII, 557-601.

The Nutritive Value of Yeast Protein. Osborne and Mendel. 1919, XXXVIII, 223-227.

Nutritive Factors in Plant Tissues. II. The Distribution of Water-Soluble Vitamine. Preliminary Report. Osborne and Mendel. 1919, XXXIX, 29-34.

Preparation of Protein Free from Water-Soluble Vitamine. Osborne, Wakeman and Ferry. 1919, XXXIX, 35-46.

In the Proceedings of the Society for Experimental Biology and Medicine:

Vitamines in Green Leaves. Osborne and Mendel. 1918, XVI, 15-16.

The Extraction of "Fat-Soluble Vitamines from Green Foods." Osborne and Mendel. 1919, XVI, 98-99.

In the Boston Medical and Surgical Journal:

The Chemistry of Nutrition. (Correspondence.) Osborne. 1919, CLXXXI, 77.

In the Proceedings of the Amer. Physiological Society. Amer. Journal Physiology:

The Nutritive Value of Yeast Protein. Osborne and Mendel. 1919, XLIX, 138.

In the Conn. Dairymen's Association's 38th Report:

The Food Value of Milk. Edna L. Ferry. 17-49.

In the Rural New Yorker:

The Food Value of Milk. Osborne. May 3, 1919, 765-766.

Seven articles by Osborne:
Vitamines: The Life-Giving Food Elements. The Absolute Necessity of Milk. Part I, June 21, 1919, 985-986.
Part II, June 28, 1919, 1019-1020.
The Story of the Vitamines: A Thorough Discussion of the Vital Principles of Food. Part I, Aug. 23, 1919, 1229-1230.
Part II, Aug. 30, 1919, 1263-1264.
Part III, Sept. 6, 1919, 1294.
Part IV, Sept. 13, 1919, 1333.
Part V, Sept. 20, 1919, 1383.

By Dr. Britton.

In the Florists' Exchange:
The Iris Borer Again. 1918, XLVI, 531.
The Chrysanthemum Midge. 1919, XLVI, 45.
Insects Attacking Maples and Elms. 1919, XLVII, 1331.
A Tree Protection Institute. 1919, XLVIII, 205.
In Science:
Book-Review: Washburn's Injurious Insects and Useful Birds. 1919, XLIX, 425.
In the Conn. Vegetable Growers' Association's Report, 1918:
Report of Committee on Injurious Insects, p. 28.
In the Proceedings, Fifth Annual Meeting, New Jersey Mosquito Extermination Association, 1918:
Progress in Mosquito Control in Connecticut in 1917, p. 100.
In the American Fruit Grower:
Automobile Truck Power Sprayers. Oct., 1919, p. 6.
In the Journal of Economic Entomology:
Kerosene Emulsion *vs.* Nicotine Solution for Combating the Potato Aphid. (Britton & Zappe.) 1919, XII, 71.

Other activities of members of the staff may be seen from the following figures:

Letters written	9,654
Addresses at meetings of farmers	60
Papers in scientific journals	20
Contributions in papers and magazines	27
Specimens of insects and fungi identified in answer to inquiries	536
Additions to herbarium	325
Seed samples tested	253

All of which is respectfully submitted.

(Signed) George A. Hopson,
Secretary.

New Haven, Connecticut, October 31, 1919.

REPORT OF THE TREASURER

June 30, 1919.

E. H. Jenkins, in account with The Connecticut Agricultural Experiment Station for the nine months* ending June 30, 1919.

Receipts.

Balance on hand, October 1, 1918 (Analysis Fees)		$308.91
State Appropriation, Agriculture	$14,062.50	
State Appropriation, Food	1,875.00	
State Appropriation, Insect Pest	4,500.00	
United States Appropriation, Hatch	6,250.00	
United States Appropriation, Adams	6,250.00	
Analysis Fees	6,000.00	
Connecticut State Dept. of Health (rent)	150.00	
Miscellaneous Receipts	1,040.69	
From Lockwood Trust Income (including sale of Mt. Carmel Farm Produce, $2,161.67)	8,161.67	
		48,289.86
		$48,598.77

Disbursements.

E. H. Jenkins, director, salary		$2,100.00
E. H. Jenkins, treasurer, "		300.00
V. E. Cole,	salary	858.33
L. M. Brautlecht,	"	558.33
J. P. Street,	"	86.66
T. B. Osborne,	"	1,800.00
E. M. Bailey,	"	1,800.00
C. B. Morison,	"	783.33
C. E. Shepard,	"	1,191.67
W. E. Britton,	"	1,950.00
G. P. Clinton,	"	1,950.00
E. M. Stoddard,	"	524.99
W. O. Filley,	"	1,875.00
A. E. Moss,	"	1,500.00
Edna L. Ferry,	"	990.00
D. F. Jones,	"	1,875.00
Michael D'Esopo,	"	787.50
Florence McCormick,	"	583.33
W. C. Pelton,	"	1,500.00
H. D. Edmond,	"	900.00
V. L. Churchill,	"	809.58
William Veitch,	"	627.91
Etta L. Avery,	"	396.00
C. D. Hubbell,	"	660.00
George E. Graham,	"	766.66
C. A. Gallastegui,	"	50.00
Alta H. Moss,	"	360.00
Mrs. L. D. Kelsey		431.20

* To conform with the fiscal year of the State.

Henry Kiley	$ 780.00
Frank Sheldon	780.00
Oliver J. Welch	780.00
T. F. Barrows	580.00
H. W. Edwards	693.33
Kenneth Terrell	203.50
Ervin Applegate	50.83
Labor	2,591.80
Publications	295.87
Postage	149.44
Stationery	283.58
Telephone and Telegraph	163.38
Freight and Express	176.42
Gas, Electricity and Kerosene	764.31
Coal	156.45
Water	108.10
Chemicals	705.11
Laboratory Supplies	337.47
Agricultural and Horticultural Supplies	147.82
Miscellaneous Supplies	582.03
Fertilizers	527.66
Feeding Stuffs	419.50
Library and Periodicals	534.54
Tool, Machinery and Appliances (new)	724.86
" " " " (repairs)	386.60
Furniture and Fixtures (new)	311.12
" " " (repairs)	62.17
Scientific Apparatus (new)	111.20
" " (repairs)	13.50
Traveling by the Board	244.19
Traveling by the Staff	802.44
Gasoline for Automobiles	374.71
Traveling in connection with Adams Fund Investigations	74.72
Insurance	654.51
Insect Pest Appropriation to State Entomologist	4,500.00
Contingent	247.95
New Buildings	2.48
Betterments	38.50
Repairs	201.43
Grounds	12.00
Total Disbursements	$48,589.01
Balance on hand, June 30, 1919 (Analysis Fees)	9.76
	$48,598.77

NEW HAVEN, CONN., Aug. 4, 1919.

THIS IS TO CERTIFY that we have audited the accounts of E. H. Jenkins, Treasurer of The Connecticut Agricultural Experiment Station, for the fiscal period Oct. 1, 1918, to June 30, 1919, inclusive, and have found them correct.

WILLIAM P. BAILEY,
JAMES P. TOBIN,
Auditors of Public Accounts.

CONNECTICUT
AGRICULTURAL EXPERIMENT STATION
NEW HAVEN, CONN.

BULLETIN 215 DECEMBER, 1919

ECONOMY IN FEEDING THE FAMILY

THE FOOD VALUE OF MILK

BY EDNA L. FERRY

CONTENTS

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

THE FOOD VALUE OF MILK

At the annual meeting of the Connecticut Dairymen's Association in January, 1919, Miss Edna L. Ferry of this Station gave an address with the above title.

"At the conclusion of Miss Ferry's address it was voted to ask the Experiment Station to prepare a bulletin on the food value of milk which could be distributed among consumers."

In response to the request this bulletin has been prepared, which is largely a transcript of Miss Ferry's paper. Her untimely death has put on others the work of editing it which has consisted chiefly in slight changes in form and arrangement.

INTRODUCTION.

Milk is the only food that supplies all of the food elements which the new-born animal must have in order to live and grow.

Among wandering Indian tribes the child whose mother fails to nurse it is doomed to die because no other milk can be had.

In countries where milch animals are scarce, as in Japan and China, mothers from necessity, if not from choice, nurse their children for relatively long periods, sometimes for two and even three years.

In countries where dairy cattle are abundant the cow is the foster mother of a large part of the infant population which for one reason or another does not have its mother's milk.

The world has had no more pitiful tragedies in the present war than the starving to death—or to life-long inefficiency—of a large infant population.

Hoover, who had the best chance to observe and who is given to sober statement without exaggeration, says:

"One of the first acts of the Germans was to denude the people of Belgium to a very large extent and the north of France almost wholly of their cattle. In consequence it has been necessary to maintain a stream of condensed milk for the whole of the last four years.

"The European races are absolutely dependent for the rearing of their young on these cattle. There is no cruelty to a population greater than to rob them of their dairy stock."

The need of milk is not limited to the first year of life. When the child is able to enlarge its diet and take solid food, milk is

an indispensable adjunct. Of the 27 brands of "infant foods" in market, which were examined by this Station (Report 1915, p. 324), 16 claim to contain milk and the directions for the use of 9 others prescribe mixture with milk.

All through childhood and youth bread and milk and cereal and milk are recognized as "growing foods."

Milk, too, is the most commonly prescribed food for adults in severe illness and a resource in time of sudden exhaustion.

It is hardly too much to say that public health, content and civilization follow the cow.

The work of Dr. Osborne at this Station has largely contributed to the discovery of the reasons for this unique value of milk which are leading to a greater appreciation and more rational use of it. This work has been in a way incidental to a general study of the character and function of proteins and of the laws of nutrition. The investigations on the chemistry of the proteins have been carried on for many years by Dr. Osborne and in the nutrition studies which followed he has had the valuable coöperation of Dr. Lafayette B. Mendel of Yale University.

Constitution of Proteins.

The foundation of our new knowledge regarding milk was laid by finding out and setting forth the composition and structure of a large number of different proteins, which are the flesh-growing materials of the body and an indispensable part of all the vital body fluids. This work showed for the first time their great variety and the fact that a nearly identical percentage composition of their elements (nitrogen, carbon, oxygen, hydrogen, and sometimes sulphur and phosphorus) went along with wide differences in structure and in physical and chemical properties; and that in the same food material, whether animal or vegetable, two or more proteins of quite different quality were usually found together.

Dr. Osborne's work, with that of others, showed that a protein was no such simple thing as salt or sugar, but was made up of about eighteen different complexes, knots of nitrogen-containing groups called amino-acids, each of them a complicated structure in itself.

The following table gives the names of these amino-acids, the approximate percentage of each in several of the common proteins and shows the striking differences in their amount.

Comparative composition of proteins.

AMINO-ACIDS	ZEIN (MAIZE)	GLIADIN (WHEAT)	CASEIN (MILK)	LACTAL-BUMIN (MILK)	EDESTIN (HEMP-SEED)
	per cent.	*per cent.*	*per cent.*	*per cent.*	*per cent.*
Glycocoll	0.00	0.00	0.00	0.00	3.80
Alanine	13.39	2.00	1.50	2.50	3.60
Valine	1.88	3.34	7.20	0.90	6.20
Leucine	19.55	6.62	9.35	19.40	14.50
Proline	9.04	13.22	6.70	4.00	4.10
Phenylalanine	6.55	2.35	3.20	2.40	3.09
Aspartic acid	1.71	0.58	1.39	1.00	4.50
Glutaminic acid	26.17	43.66	15.55	10.10	18.74
Serine	1.02	0.13	0.50	?	0.33
Tyrosine	3.55	1.50	4.50	2.20	2.13
Cystine	?	0.45	?	?	1.00
Histidine	0.82	1.49	2.50	1.53	2.19
Arginine	1.55	3.16	3.81	3.01	14.17
Lysine	0.00	?	7.61	8.10	1.65
Tryptophane, about	0.00	1.00	1.50	+	+
Ammonia	3.64	5.22	1.61	1.32	2.28
	88.87	84.72	66.92	56.46	82.28

In view of these great differences of structure and composition of proteins, the question arose: have they nevertheless about the same food value as has been assumed, or have they not? If they have not, the principles on which our whole art of cattle feeding is founded has lost a large part of its foundation.

Clearly, the only way to settle the question was to study the feeding effect of each protein by itself on both growth, maintenance and production.

Before the work here was begun, all experimenters who endeavored to feed animals on diets composed of pure nutrients failed. Both mature and young animals promptly declined in weight on such diets. To-day we have such an understanding of the influence of food on growth that merely by changing a single constituent of the diet we can stop the growth of a young animal at any stage of development, maintain it for many months in perfect health, but without growth, and later cause it to grow

again at a normal rate to full maturity and reproduce. It is due to the use of milk in the earlier attempts in feeding animals experimentally that we owe our success in developing methods of feeding which have opened up entirely new fields for investigation.

Our first attempts to make an animal grow on a mixture of pure protein, fat, carbohydrate and inorganic salts were no more successful than those of our predecessors, but we soon found that animals which failed to thrive on our artificial diets could be restored promptly to excellent condition by giving them a mixture of dried milk, starch and lard, and that control animals fed on a similar diet from weaning grew normally to full maturity and reproduced. Although the artificial diets were almost exactly like the milk diets, in respect to the kind and proportion of the then known nutrients, the milk diet was entirely adequate as a food, whereas the artificial diet was wholly inadequate. Wherein this profound difference lay was a mystery. By a process of elimination we were forced to the conclusion that the water-soluble portion of the milk contained something which was essential for life, and later that the fat component contained something which was indispensable for long-continued growth. This discovery that milk contains two hitherto unsuspected substances, now known as the water-soluble and fat-soluble vitamines, which will be referred to later, made it possible for us to become pioneers in the study of various problems relating to growth and maintenance. The field of study thus opened has been entered by numerous investigators here and abroad with results of far-reaching importance.

The experiments here to be described were made with albino rats because these small animals are omnivorous and can be fed with such quantities of the experimental rations as we are able to prepare in the laboratory in a state of purity. To insure perfect accuracy it is necessary that these rations shall consist of ingredients which are chemically pure and to prepare such rations in quantity is very laborious and costly. The results of these experiments can be accepted as giving evidence of the true food value of milk because they are in harmony with our experience in feeding not only ourselves but also farm animals.

The question may be asked—Are the results of experiments in

feeding rats, or other of the lower animals, applicable to human beings?

While the foods suited to different species of animals may differ widely in their appearance and physical properties, the digestible nutrients contained in them are very much alike in their chemical characters, so that by the processes of digestion quite similar products result from apparently very different kinds of food. Such differences as exist are rather in proportion than in kind. Furthermore, the tissues of the different types of animals are chemically even more alike than their foods and, consequently, their nutritive requirements are in principle much more nearly the same than those unfamiliar with the chemistry of nutrition would suppose.

The conditions in feeding farm animals are necessarily so complex that it is generally impossible to recognize the influence of any individual constituent of the ration. In our experiments with rats, on the contrary, the conditions have been so simplified that definite conclusions can be drawn regarding the rôle of each factor involved. Thus, if two series of animals are fed on mixtures of protein, fat, carbohydrate and inorganic salts, which are identical except for the kind of protein used, and one series grows normally whereas the other fails to grow at all, it is obvious that the protein alone was the determining element in the food. By means of large numbers of such experiments extending over a period of several years, we have fixed the nutritive values of many proteins, several fats, the various inorganic salts and also have studied a number of combinations of natural food products both of animal and vegetable origin which are extensively used in the daily rations of man or domestic animals.

The Proteins of Milk.

Previous to 1912 a discussion of the nutritive value of any food stuff would have been confined to a consideration of the total quantities of protein, fat, carbohydrate and salts which it contained and its value as a source of energy. As a result of work which has been done at this Station, and later in other laboratories, the field for discussion has become much broader, for it has been demonstrated that the *quality* of the protein present in any food is of even more importance than the *quantity*,

and a realization of the essential rôle which the so-called vitamines play in normal nutrition has raised many more problems.

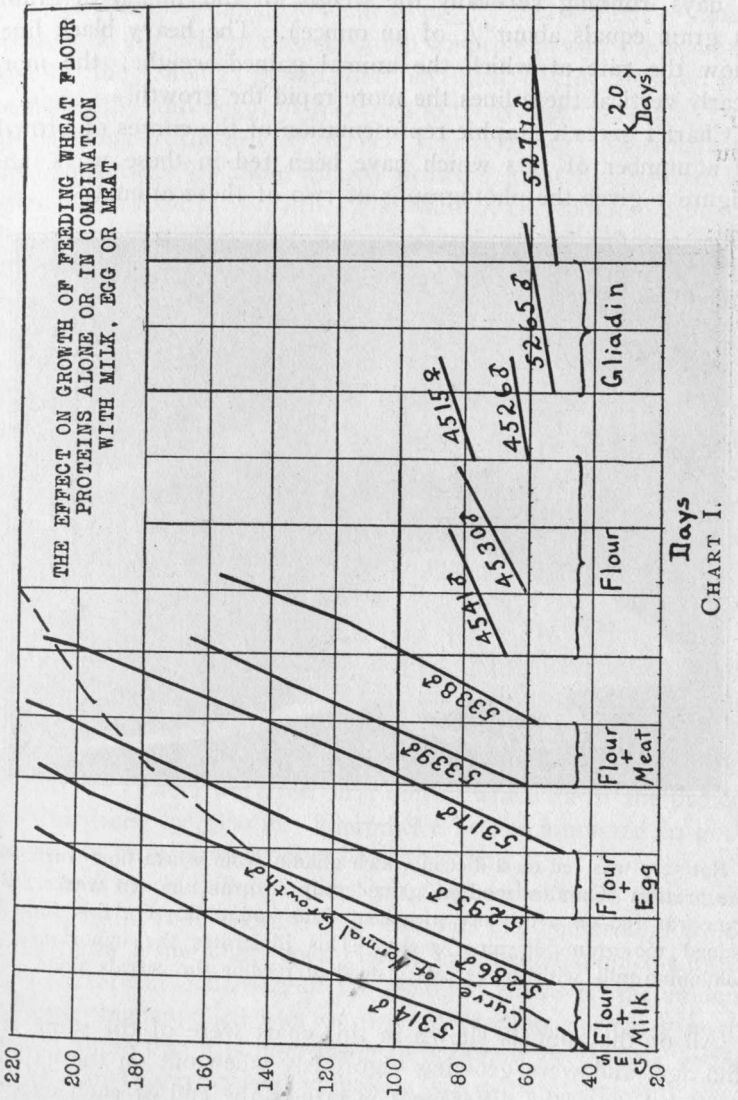
Milk contains several different proteins, but there are only two which occur in notable quantity, and these are casein, the protein found in cheese, and lactalbumin, the principal protein of whey. These two proteins differ not only in their chemical structure, but also in their nutritive value. Both suffice to promote the normal growth of young rats, but lactalbumin is somewhat more efficient for growth than is casein, for in comparable periods of time a given quantity of lactalbumin will enable an animal to gain about 33 per cent. more in weight than the same amount of casein.

This is instructive from a practical standpoint for it demonstrates that the whey, obtained as a side product from the manufacture of cheese, contains one of the most valuable food proteins known and should not be wasted. Casein, which forms about 80 per cent. of the milk proteins, is more easily digested than any other protein known and behaves in the digestive tract very much like a predigested protein. This property makes it especially desirable as a food for infants or persons with weak digestions.

For centuries people have been accustomed to use foods of animal origin with bread and other cereal products which form so large a proportion of the average dietary. Bread and milk, eggs on toast, meat sandwiches and the use of milk on breakfast cereals are just a few illustrations of this custom. If any one who was enjoying a meal of any of these mixtures were asked why he chose the combination of the animal with the vegetable product instead of eating either one alone, he would probably say that "it tasted good," or "it satisfied his appetite better that way," or something else equally indefinite. It is only recently, while engaged in investigating the nutritive value of wheat flour, that we discovered how well the proteins of milk, eggs and meat supplement the deficiencies of the wheat proteins. We now have a truly scientific reason for this universal dietary practice.

If an animal is fed on wheat flour as the sole source of protein in an otherwise adequate ration, it will grow very slowly, if at all, even when relatively large amounts of the proteins are eaten. If, however, one-third of the wheat protein is replaced by an

equivalent quantity of protein in the form of milk, eggs, or meat, the animal will grow at a practically normal rate.



To illustrate this as well as the results of our other experiments with various diets of known composition, in a condensed form, we have employed charts giving the curves of body

weight during the time of feeding. In reading these charts the squares running horizontally represent time of feeding expressed in days, running vertically the weight of the animal in grams (1 gram equals about $^1/_{30}$ of an ounce). The heavy black lines show the rate at which the animal gained weight; the more nearly vertical these lines the more rapid the growth.

Chart I gives a graphic representation of the curves of growth of a number of rats which have been fed in these ways, and Figure 1 gives the photographs of two of these animals.

FIGURE 1

Rat 5277 was fed on a diet in which gliadin from wheat flour furnished the protein. On this food he gained only 10 grams in ten weeks. Rat 5314 was fed on a mixture of wheat flour and milk. On this food he gained 160 grams in nine weeks. This illustrates the importance of combining milk with the cereals instead of feeding the cereals alone.

All of the animals shown in this chart were of the same size and age, and were growing vigorously when put on the experimental diets. The differences in size at the end of each experiment are due solely to the protein of the diet. In this series of experiments the percentage of protein and nutritive ratio of the mixtures were practically identical, the foods differing only in

the kind of protein. The animals in the group labelled "flour" received all of their protein from wheat flour, those in the groups labelled "flour + milk," "flour + egg," and "flour + meat" received a diet whose concentration of protein was the same as that of the "flour" group, but one-third of the protein was furnished by milk, egg, or meat respectively, the remaining two-thirds being furnished by flour. It is obvious that relatively small quantities of these animal proteins greatly improved the value of the food for growth. The value of these animal products lies in the fact that they are chemically so constituted as to supplement the chemical deficiencies of the flour proteins. To those who are unfamiliar with the chemistry of proteins this may seem mysterious and confusing, hence a few words of explanation are necessary.

By digestion the proteins are broken up into the amino-acids already mentioned on page 5, which are then used in constructing the new proteins of the tissues of the growing animal. Unless the food protein furnishes a sufficient amount of each of these amino-acids which are needed to make the tissues required for normal growth the animal grows correspondingly slower than it would if more of the needed amino-acid were available.

Wheat flour contains two proteins, one of which, called gliadin, yields only a very small amount of the amino-acid called lysine. The effect of a limited supply of lysine on growth is illustrated by rats 5277 and 5265, whose curves of body weight are shown in Chart 1. These were fed on a diet in which all of the protein was furnished by gliadin. They have been maintained in good health, but have gained only about 10 grams.

The rats on the "flour" diets grew somewhat more than those on the gliadin food because flour contains another protein which yields more lysine than does gliadin and hence supplements to some extent this deficiency of the gliadin. However, the amount of lysine thus supplied was too little to promote normal growth. In this connection it is interesting to note how perfectly a young animal can be maintained in health, but without growing even for a very long time when its diet is adequate in respect to everything except the chemical constitution of its food protein. Such animals can be thus kept as infants for indefinite periods.

Chart II shows how little growth was made during nine months on a diet in which gliadin from wheat flour furnished all the protein. At the end of these nine months the rat was given a similar diet containing enough dried milk to replace the gliadin,

FIGURE 2

Figure 2 shows the contrast between feeding a good or a bad protein to a young rat. The two upper rats are five months old and have been fed on diets exactly alike except the one at the top had casein from milk on which it grew normally, and the one in the middle had gliadin from wheat flour on which it could not grow at all, so that when it was five months old it weighed exactly the same as the rat at the bottom which was only one month old.

and in two weeks on that food it gained as much in body weight as it had during the preceding nine months. It continued to grow normally on the milk diet to full adult size; a striking illustration of the value of milk proteins for growth. If, instead

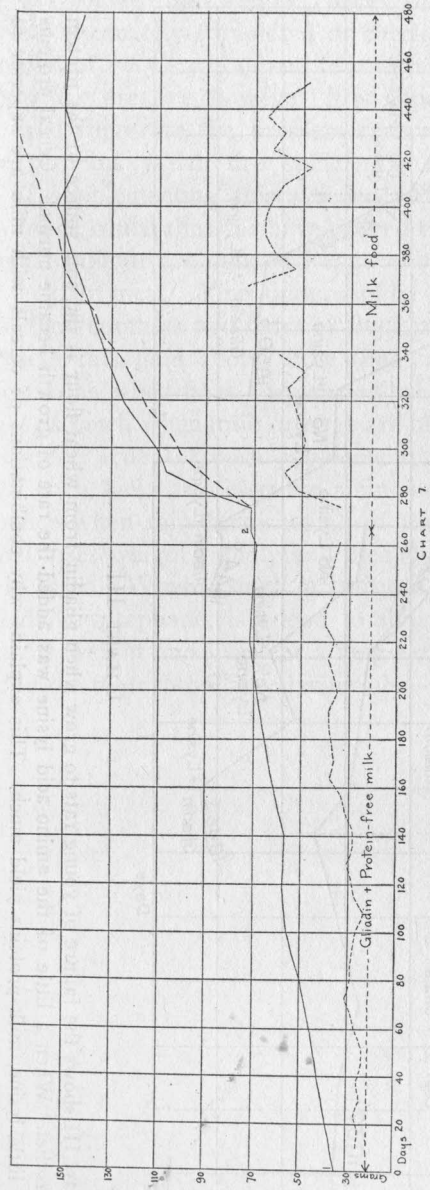


CHART II.

The solid line in Chart II shows the body weight of a rat which was fed for about nine months from the time of weaning on a diet containing gliadin from wheat flour as the sole source of protein. After 268 days, as indicated by the figure 2, the proteins of milk replaced the gliadin. Growth soon began at a normal rate for the size of the rat, which is shown by the broken line. The dotted line below shows the amount of food eaten during the experiment.

of replacing the gliadin with milk, we had added to the gliadin food a small amount of lysine, the effect would have been the same.

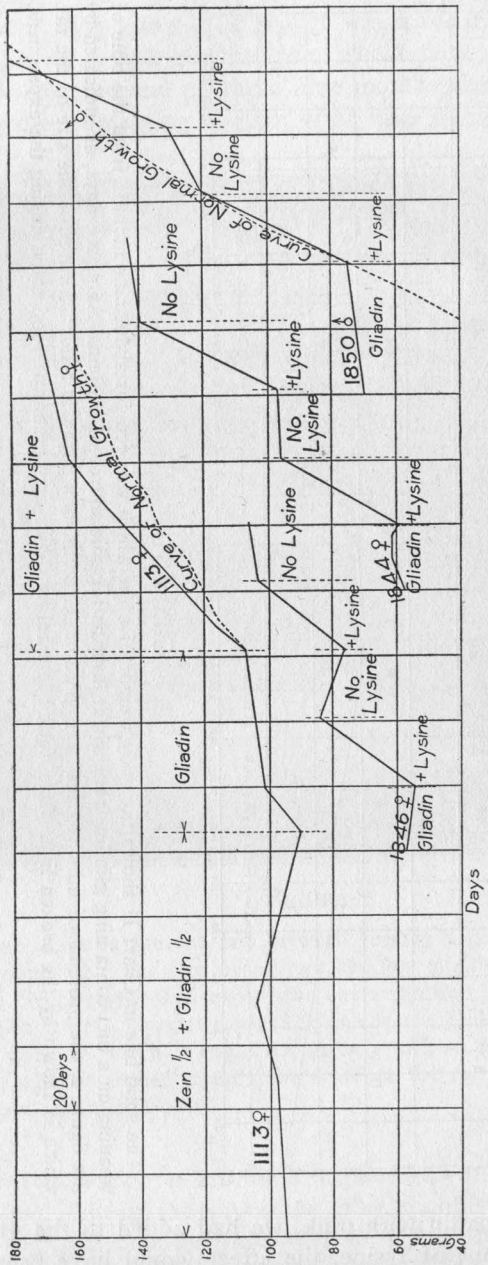


CHART III.

Chart III shows the failure of young rats to grow when gliadin from wheat flour is the sole source of the protein in the diet. When a little of the amino-acid lysine was added the rate of growth became normal. Cereal proteins yield little lysine, milk proteins yield much. This explains why combinations of cereals with milk are superior to cereals alone as food for the young.

Chart III shows the weight curves of several rats whose growth was alternately stimulated or checked by the addition to a gliadin diet of very small quantities of lysine or by its removal.

In every day practice, however, it is impossible to feed lysine, as such, and therefore the problem resolves itself into finding available proteins which are sufficiently rich in lysine to be capable of supplementing this deficiency of the flour proteins. The two foods which thus far have proved to be the most efficient supplements to flour are milk and eggs; either of these is somewhat better than meat. Thus under similar conditions of feeding when the food contains two parts of flour proteins to one part of meat protein rats gain about three times as much per unit of protein eaten as when flour furnishes all the protein, and nearly four times as much when milk or eggs are used as supplements.

The same is true for corn supplements. Zein, the principal protein of corn, lacks two essential amino-acids, tryptophane and lysine, hence when zein furnishes all of the protein of the diet, the animal loses weight rapidly and dies almost as soon as if no food were eaten. When a small quantity of one of these missing amino-acids, tryptophane, is added to the zein diet, the animal maintains its weight and lives for a long time but does not grow. If in addition to tryptophane, lysine also is added, the animal grows.

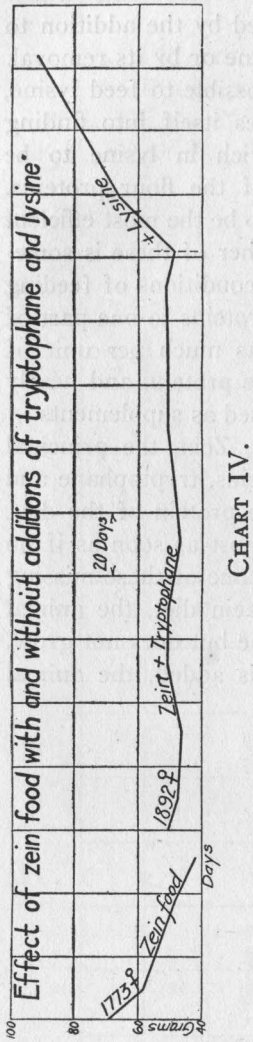


CHART IV.

Chart IV shows the important part played by amino-acids in nutrition. Zein, which forms about one-half the protein of corn meal, lacks two of these, known as tryptophane and lysine. Unless tryptophane is added to a diet containing zein as its sole source of protein, life cannot long be maintained. Unless lysine is also added, growth is impossible. The proteins of milk contain an abundance of both of these amino-acids.

Chart IV shows the curves of body weight of rats receiving zein alone as well as zein in combination with tryptophane or with tryptophane and lysine. Note that the body weight of one of these rats remained constant for six months when the diet contained zein and tryptophane. When small amounts of both lysine and tryptophane were added to the zein food the rat grew.

Figure 3 shows in a striking manner how essential it is to supply the young animal with protein which furnishes sufficient lysine. The lower picture is that of a young rat which lived for seven months in perfect health on a food containing zein + tryptophane as its sole protein. During all of this time it failed to grow and weighed only 70 grams. It did not even show signs

FIGURE 3.

The lower photograph is that of a rat which has been fed for seven months on a diet containing zein (one of the proteins from corn) + a small amount of amino-acid tryptophane. On this diet the rat could live but could not grow. The upper photograph is one of the same animal taken a few months later, after casein from milk had replaced the zein and tryptophane.

of maturing for, as you can see, it looks exactly like a recently weaned rat; it has remained a baby. At the end of seven months casein was used to replace the zein + tryptophane. No other change was made in the diet. During the next three months it grew at the normal rate to 230 grams, and as the upper picture shows, became a fine, vigorous animal.

What this means might be illustrated in this way. For about one-fifth of its life period the rat did not grow. Calling a man's span of life seventy years the case would be somewhat like that of a boy, kept as a healthy infant in arms until fourteen years old—weighing perhaps sixteen to twenty pounds—and who, by a change of diet when fourteen years old, attained a man's size and weight at the age of twenty-one.

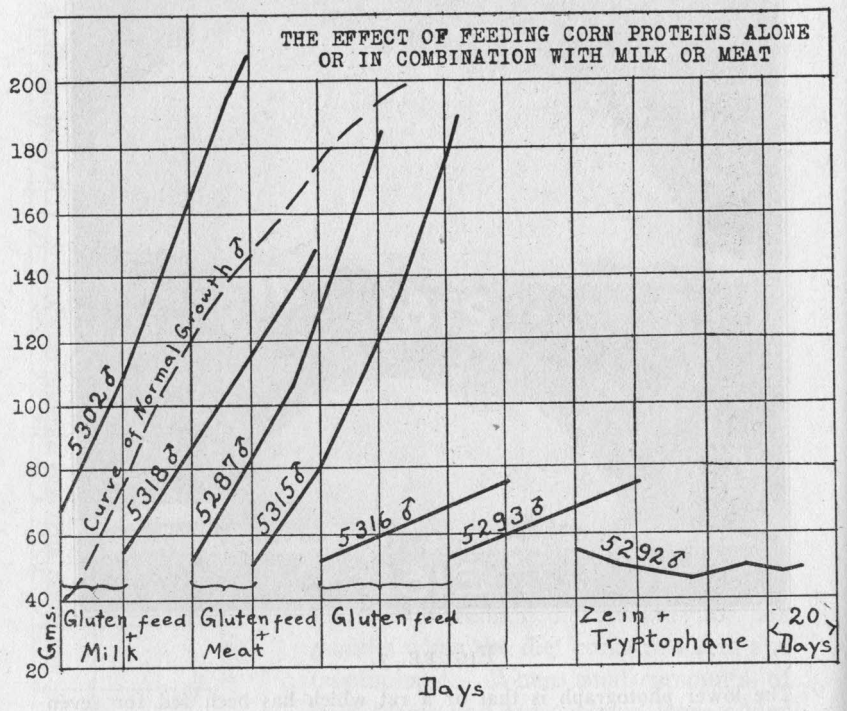


CHART V.

Two of the rats, 5293 and 5316, whose curves of body weight are shown in Chart V, had a ration in which the protein was furnished by gluten feed. Rats 5302, 5318, 5287 and 5315 on the other hand had two-thirds of their protein in the form of gluten feed and the other third as milk or meat. The nutritive ratios of all of these three foods were alike, but the results were strikingly different.

This juggling with proteins and amino-acids is very interesting to the chemist and physiologist for it represents a triumph of science which excites the wonder of those who appreciate the

almost insurmountable difficulties encountered in these investigations. It would be of little use to discuss it here, if these facts could not be applied to the feeding problems of the household and farm. Amino-acids are not commercially obtainable but products are at hand which contain proteins which furnish these

FIGURE 4

Figure 4 shows photographs of some of the animals whose curves of body weight are shown in Chart V. Although all three were of the same age, Rat 5302 which had received a mixture of gluten feed and milk is nearly three times as large as 5293 which received the gluten feed alone and more than four times as large as 5292 which was fed on zein plus tryptophane.

amino-acids in readily obtainable form. Now let us see how we can apply these facts.

When corn as a whole is fed, the other proteins in this seed supplement the zein to such an extent that the animal can grow slowly, but if the corn is combined with milk, the proteins of which are rich in both tryptophane and lycine, growth is very rapid.

Thus it appears that the chemical constitution of the protein of the food influences growth and that it is absolutely necessary to provide animals with protein of the right kind, if they are to grow well. This applies not only to growth, but also to milk or egg production. Both milk and eggs are rich in protein. The animals producing them need large amounts of protein in their food, but until the differences in the chemical constitution of the proteins of different feeds were discovered, it was not appreciated how important it is to provide protein of the right kind. This fact has been unconsciously recognized by milk producers for they always feed protein from several sources. This practice is an attempt to furnish a mixture of proteins which will mutually supplement each other, but whether the mixtures now in general use are yielding the best results at the least cost remains to be determined. As yet we do not know the actual protein requirements of milk production. Are these similar to those of growth? This problem remains for future study.

That a proper combination of proteins may mean much in the way of profits when growing animals are fed is illustrated by the following from a bulletin recently issued by the Ohio Agricultural Experiment Station. In a series of experiments, comparing the value of corn alone with combinations of corn and tankage, or corn and skim milk, it was shown that a bushel of corn fed alone produced only nine pounds of gain. The same quantity of corn fed in combination with 5.5 pounds of tankage produced 13.3 pounds of gain, and corn fed with 168 pounds of skim milk, equal to 17 pounds of dry food, increased the gain to 21.8 pounds per bushel of corn fed. In other words, each ten pounds of the dry matter in the skim milk replaced 54.9 pounds of corn. Expressing these results in terms of dollars and cents, corn alone produced pork at a loss of $8.38 per 100 pounds of gain, whereas nine parts of corn fed with one part of tankage produced pork at a profit of $14.91 per 100 pounds of gain, and

one part of corn fed with three parts of skim milk yielded a profit of $35.59 per 100 pounds of gain.

The Vitamines of Milk.

Another constituent of milk which has a unique value in the dietary is the butter fat. If a young rat is fed on a ration adequate in all respects except that the fat is furnished by lard, or vegetable oils like olive oil, it will grow normally for a period of about 80 days, then suddenly it declines in weight and soon

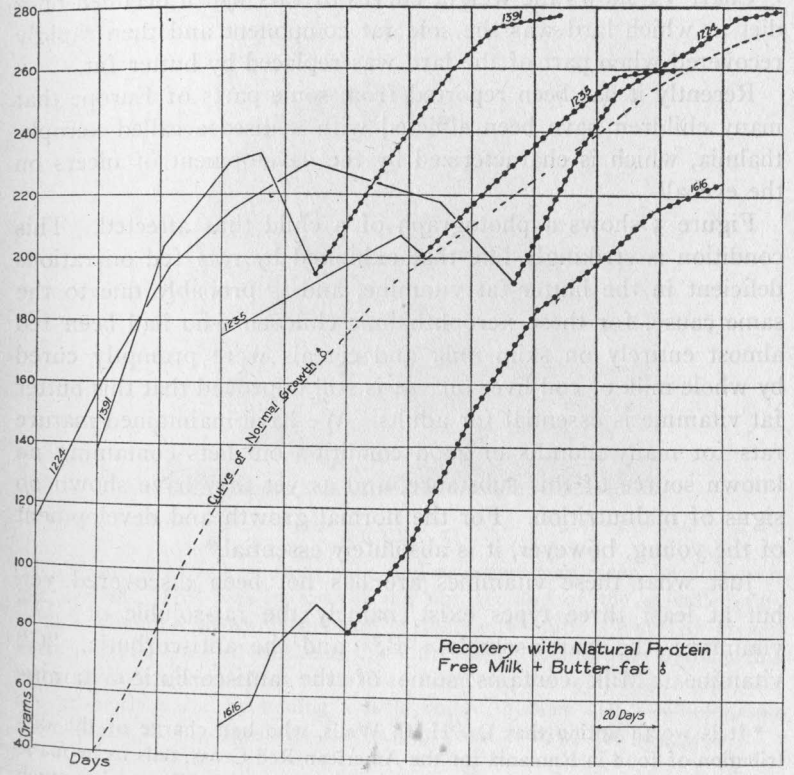


Chart VI.

Chart VI shows that butter fat contains something essential for normal growth. These curves show that after feeding a diet of purified foodstuffs, the fat being lard, the animals after growing normally for several weeks suddenly began to lose weight. When a part of the lard was replaced by butter fat (shown by the beaded line), they immediately recovered. These animals would have died in a few days if this change had not been made.

dies. Such animals frequently suffer from sore eyes and in many cases develop large ulcers on the eyeball. A small amount of butter fat added to the diet causes an immediate recovery of health, gain in weight and prompt restoration of the eyes to their normal condition. This marvellous effect is due to the presence in the butter fat of something of, as yet, unknown nature, which for the time being is called the fat-soluble vitamine. The presence or absence of this substance in any foodstuff can be detected only by feeding young animals.

Chart VI shows the weight curves of rats which declined on a diet in which lard was the sole fat component and then rapidly recovered when part of the lard was replaced by butter fat.

Recently it has been reported from some parts of Europe that many children have been afflicted with a disease called xerophthalmia, which is characterized by the development of ulcers on the eyeball.

Figure 5 shows a photograph of a child thus affected. This condition is strikingly like that exhibited by rats fed on rations deficient in the butter-fat vitamine, and is probably due to the same cause, for these xerophthalmic children who had been fed almost entirely on skim milk and cereals were promptly cured by whole milk or cod liver oil. It is still unproved that this butter fat vitamine is essential for adults. We have maintained mature rats for many months in good condition on diets containing no known source of this substance, and as yet they have shown no signs of malnutrition. For the normal growth and development of the young, however, it is absolutely essential.*

Just what these vitamines are has not been discovered yet, but at least three types exist, namely the fat-soluble or "A" vitamine; the water-soluble, "B," and the antiscorbutic, "C" vitamine. Milk contains some of the antiscorbutic vitamine

* It is worth noting that Dr. H. C. Wells, who had charge of the distribution of food in Rumania for the American Red Cross, tells us he made successful application of our observation that cod liver oil contains much of the fat-soluble vitamine.

A cargo of cod liver oil at Archangel having been offered to him he immediately ordered it sent to Rumania hoping by its use to save the eyesight of thousands of children whose eyes were in the same condition as those of rats fed on a diet deficient in the fat-soluble vitamine. By giving this cod liver oil to these children a large majority were saved from permanent blindness, even after their eyeballs had become entirely opaque.

which prevents scurvy, though less than do some of the vegetable and fruit juices, notably orange juice. This vitamine is sensitive to heat, hence children fed on pasteurized or boiled milk are more susceptible to infantile scurvy than are those fed on unheated milk, unless the scurvy-preventing vitamine is given them in some fruit or vegetable juice in which it is abundant.

The relation of the fat-soluble vitamine to nutrition, and its presence in butter fat have already been discussed at considerable

FIGURE 5

This child was fed on skim milk, and as a result an ulcer developed on one eyeball. This was because it did not get any of the so-called fat-soluble vitamine which is present in the butter fat. Plenty of cream, butter, or cod liver oil will cure this child's eye. Young rats develop this same disease when fed on diets free from the fat-soluble vitamine and are promptly cured by adding a little butter to their diet. (Photograph from Bloch, C. E., Ugeskrift for Laeger, Mar. 8, 1917, **79**, 309, 349.)

length. It is only necessary to add that this vitamine is quite resistant to heat, for we have passed live steam through melted butter fat for two and one-half hours without destroying its potency.

The third type of vitamine, known as the water-soluble vitamine, is also present in milk. Without an adequate supply of

this food accessory in the diet, life cannot be maintained. An animal which is fed on a ration containing no known source of this vitamine dies within a short time. If, however, when apparently dying, a very little of this food accessory is given, it recovers with surprising rapidity. This may be given in the form of milk, yeast, commercial wheat embryo, or any other natural foodstuffs.

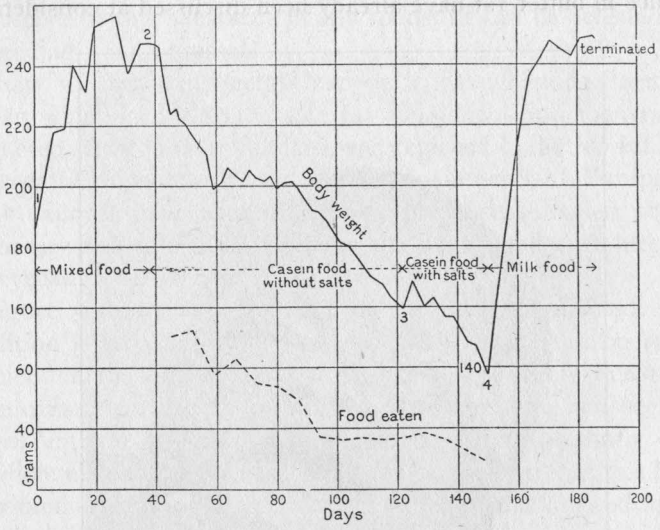


CHART VII.

Chart VII illustrates the typical recovery (in Period 4) of a rat which had declined on a diet lacking the so-called water-soluble vitamine (Periods 2 and 3), when the animal was given milk which contains this vitamine. This rat would have been dead in a few days if the milk had not been given.

Chart VII shows the rapid decline in weight typical of feeding a food deficient in the water-soluble vitamine. It also shows the effect of feeding an abundance of dried milk as a source of this vitamine.

That the water-soluble vitamine is something apart from and independent of the fat or protein of the milk is shown by the results of our experiments. For many years we used the product obtained by evaporating to dryness milk freed from fat and protein as a source of the water-soluble vitamine in the diets fed to our experimental animals.

Chart VIII shows that this product which we have called "protein-free milk" is just as efficient as a source of water-soluble vitamine as is the whole milk. Contrary to what appears to be generally believed, the water-soluble vitamine is resistant to heat. "Protein-free milk" prepared by evaporating at a temperature not far below that of boiling water is just as efficient

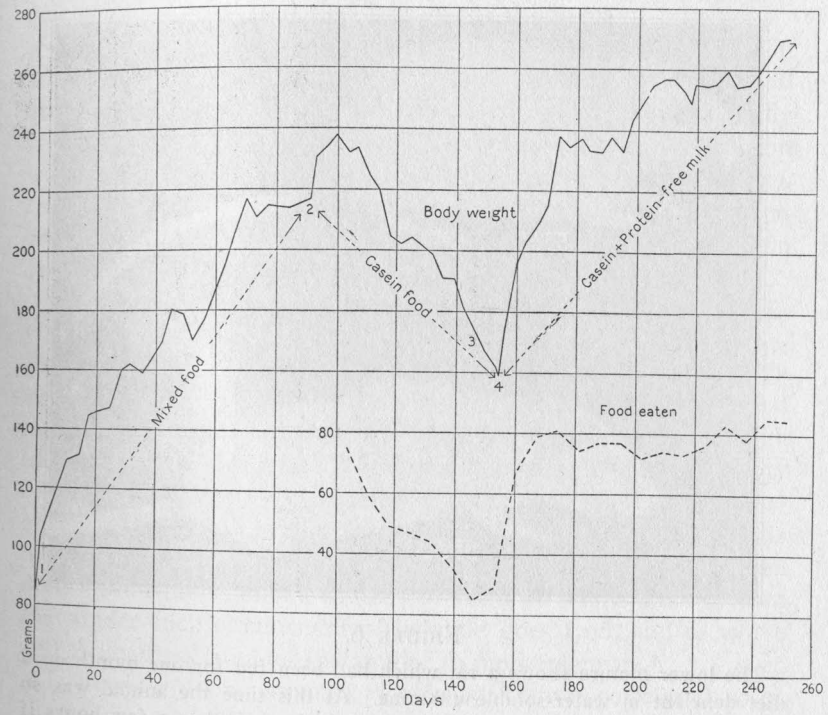


CHART VIII.

Chart VIII is a further illustration of the necessity of an abundance of the water-soluble vitamine in the food, if the animal is to live. In Period 1 the animal grew normally on an ordinary mixed diet. In Period 2, on a diet adequate, except for the lack of this vitamine, it declined rapidly and would soon have died if some source of this vitamine such as protein-free milk (milk freed from fat and protein) had not been fed (Period 3). The protein-free milk contains not only the salts and the lactose of the milk but also the water-soluble vitamine. On the casein diet the weekly food intake (shown by the dotted line at the bottom) declined steadily from nearly 80 grams to a little over 20 grams, but rose immediately to about 80 grams when the protein-free milk (water-soluble vitamine) was given.

as a source of vitamine as is an equivalent quantity of fresh, unheated milk. Even boiling for several hours does not destroy this vitamine.

By what means this vitamine exerts its marvellously beneficial influence is still unknown. The rapid gains in weight following its use are always accompanied by a very great increase in the

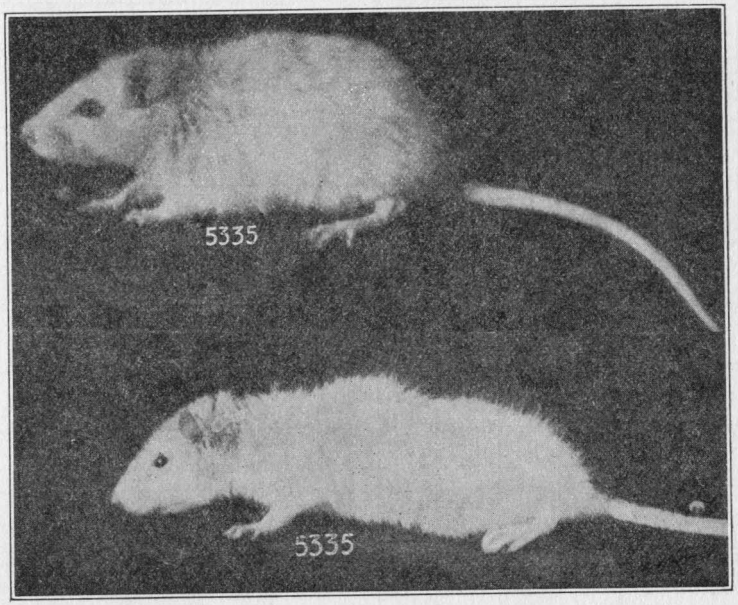


FIGURE 6.

The lower picture shows a rat which had been fed for one month on a diet deficient in water-soluble vitamine. At this time the animal was so weak it was scarcely able to stand and would have died in a few hours if some source of this vitamine had not been furnished. After the picture was taken a small daily dose of yeast which is very rich in the water-soluble vitamine was given to the rat, the food remaining otherwise exactly as before. Twelve days later the upper picture was taken. The result is apparent.

amount of food eaten, the weekly food intake frequently being doubled and sometimes even quadrupled when a small amount of vitamine-containing food is given to an animal declining on a food free from water-soluble vitamine. The vitamine may act simply as a stimulant to a jaded appetite, and the better growth may be

due solely to the increased food intake; or it may supply one or more essential factors needed to complete an inadequate diet, and the effect of adding the vitamine may be analogous to that obtained by adding a missing amino-acid, or a sufficient supply of some inorganic element which was present in too small an amount to permit of normal nutrition. When we know more about the chemical nature of the vitamines, we may be able to discover just what part they take in the processes of nutrition.

Professor Hopkins of England reported some experiments in which he obtained very striking results by feeding daily small quantities of fresh milk to rats which were on a diet supposedly free from water-soluble vitamine. From his data the conclusion was drawn that milk is very rich in this type of food accessory. In some recent attempts to duplicate his results, we found it necessary to use much larger quantities of milk than he did in order to get comparable results.

Undiluted milk contains all the vitamine necessary for the young animal, but in feeding babies it is the practice to dilute cow's milk with water and to reinforce the mixture with milk sugar. By this procedure the vitamine content of the original milk is so far reduced that the bottle-fed baby may get enough of this essential food factor only when it takes a liberal quantity of the food. Whenever appetite fails, the food intake and consequently the vitamine intake are reduced. The effect of this is to further reduce the appetite because the amount of food eaten depends on the vitamine content of the diet. It is thus evident that under such circumstances the child goes from bad to worse and the endless troubles so familiar to mothers ensue.*

In feeding young animals trouble is rarely encountered when

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*In this connection it is interesting that Dr. Amy L. Daniels and Dr. Albert H. Byfield have just published in the American Journal of Diseases of Children a report of their experience with additions of the water-soluble vitamine to the milk diets of bottle-fed babes. These experiments were founded on our discovery that milk contains less water-soluble vitamine than had been previously supposed. In each case there was a marked increase in the rate of growth of the infant when the additional vitamine was given and a slowing of the rate when it was omitted. From these experiments it appears that the standard milk mixtures, used for feeding infants, furnish too little of the water-soluble vitamine even when consumed in normal amounts.

the food is right. On the other hand very slight defects in the food lead to countless difficulties.

The Sugar of Milk.

At present we do not know whether or not milk sugar has any greater value for nutrition than have other carbohydrates. It has been thought that liberal quantities of milk sugar in the diet produce lactic acid in the intestine and thus transform the bacterial flora from a type which produces putrefaction to one which checks this process. None of the other kinds of carbohydrates tested has this effect, but to what extent this change is advantageous to the body is as yet undecided.

The Mineral Matters of Milk.

Milk also holds a valuable place in the average dietary, on account of the composition of its mineral constituents. Cereal foods contain relatively little calcium, sodium or chlorine, hence animals are unable to grow on diets composed solely of cereals unless these inorganic deficiencies are supplemented. Milk, on the other hand, is rich in calcium, for it contains about three times as much as does the entire wheat grain, and about six times as much as does corn meal. The presence of an abundant supply of calcium in the food is essential, for it not only contributes to the maintenance of the proper neutrality of the body fluids, but is needed to form strong and well-developed skeletons. A liberal consumption of milk by growing children is, therefore, desirable as a "factor of safety" against deficiencies in the mineral nutrients of the other constituents of the dietary.

The Cost and Economy of Milk.

Now let us consider the cost of this exceptionally valuable food as compared with other common foods and see how much truth there is in the statement that its cost makes its free use prohibitive to all but a few.

It is difficult to put an exact value on a complicated product like milk, but a fair estimate of its relative value compared with other food products can be reached by calculating the cost of the several types of food elements in milk and other staple products. Milk sugar has the same food value as cane sugar. We can

buy a pound of the latter for 11 cents, so we may assign this value to the sugar in milk. Milk fat has a higher value than have ordinary food fats as shown by the higher price of butter, but let us assume that in milk, fat is worth no more than lard, say about 35 cents a pound.

One hundred pounds of average milk contain about 12.5 pounds of solids of which five pounds is sugar, worth 55 cents at 11 cents a pound, and four pounds of fat worth $1.40 at 35 cents a pound, or $1.95 for the fat and sugar. One hundred pounds of milk contain 46½ quarts, which at 16 cents a quart is $7.45. Subtracting $1.95 from $7.45 leaves $5.50 for the 3.3 pounds of dry protein in the one hundred pounds of milk, or $1.67 per pound.

Now, how much does dry protein cost in meat or eggs? One hundred pounds of lean round of beef contain 7.3 pounds of fat worth $2.55. Subtracting this from $50, which one hundred pounds of this cut of beef now costs at retail, leaves $47.45 for 19.5 pounds of dry protein, or $2.43 a pound; 76 cents a pound more than milk protein. The difference is even greater for eggs, for by the same method of calculating, in storage eggs at 55 cents a dozen protein costs $2.64 a pound, or 97 cents a pound more than milk protein. According to this method of calculation only when the lean round of beef sells for 35 cents a pound and eggs sell for 35 cents a dozen are they as cheap sources of protein as is milk at 16 cents a quart. Thirty-five cents spent for milk at the present price buys nearly as much protein, about two and one-half times as much fat and more than twice as much energy as is contained in a pound of lean Hamburg steak. In buying milk, moreover, one is procuring protein of exceptional value because it enhances the nutritive value of our cereal foods. In addition one is obtaining a liberal supply of vitamines, whose value cannot be estimated in dollars and cents, for as yet we have no adequate knowledge regarding their relative abundance in different foods.

Since milk is so vitally essential as a food for growing children and is such a valuable supplement to a diet composed largely of cereals, vegetables, meat, sugar and fats, the production of milk should be stimulated so that there may be an abundance of milk and milk products of the highest possible grade at prices which shall put them within the reach of all.

SUMMARY.

Milk is absolutely essential for the life of infants and very young children.

It is a most desirable adjunct to the diet of older, rapidly growing children.

It is the main dietary reliance in cases of disordered digestion or extreme illness.

Milk contains an abundance of protein, fat, carbohydrate and mineral nutrients, and its proteins are not only of superior value when used alone, but they are especially adapted to supplement the protein deficiencies of the cereals which form so large a part of the daily ration of mankind. Its mineral nutrients also supplement the deficiencies of the cereals, meat, sugar and fats in these important elements. Moreover it contains the three vitamines without which life cannot be maintained.

The scurvy-preventing vitamine is destroyed by heat and therefore if infants are fed on pasteurized or sterilized milk the use of orange juice or some vegetable extract is necessary to avoid the possibility of scurvy.

Whole milk contains enough water-soluble vitamine to meet an infant's requirements, but if "the top of the bottle" diluted with water is fed, the supply of this essential vitamine may be insufficient unless it is supplemented from some other source.

Milk is the only food known which is capable of serving as the sole constituent of an adequate ration.

Milk is a cheaper form of food at 16 cents a quart than either beef at 35 cents a pound or eggs at 35 cents a dozen.

CONNECTICUT

AGRICULTURAL EXPERIMENT STATION

NEW HAVEN, CONN.

BULLETIN 216 DECEMBER, 1919

ENTOMOLOGICAL SERIES, No. 27.

INSECTS ATTACKING SQUASH, CUCUMBER, AND ALLIED PLANTS IN CONNECTICUT.

BY W. E. BRITTON.

CONTENTS

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

Insects Attacking Squash, Cucumber and Allied Plants in Connecticut.

By W. E. Britton, *Entomologist.*

A paper on this subject was published in the report of this Station for 1908, page 805, but it has long been out of print. The present paper follows the plan of the earlier one, but has been revised, enlarged, and wholly rewritten, and is published in this form so that the information can be placed in the hands of truck crop growers throughout the state.

For the past five years, cucurbitaceous plants have been grown each year at the Station farm at Mount Carmel for the purpose of studying the insects attacking them and methods of control. Consequently this paper is more than a compilation, and embodies the results of our own experiments and experience.

Cucumbers, squashes, pumpkins and melons are grown rather extensively in Connecticut, and are attacked and often severely injured by a number of insect pests. For the hasty identification of these insects the reader is referred to the following key revised from the earlier paper mentioned above:—

KEY TO INSECTS OF SQUASHES, PUMPKINS, CUCUMBERS AND MELONS.

Boring in the roots and stem— PAGE

Small, slender larvae tunneling in the main root or stem below ground

Striped cucumber beetle, *Diabrotica vittata* 34

Large, stout larvae boring in squash stems above ground

Squash vine borer, *Melittia satyriniformis* 39

Devouring the stem and leaves—

Small (1.2 mm.) purplish jumping springtails

The garden flea or springtail, *Sminthurus hortensis* 37

(2 mm.) black jumping beetles, feeding upon the young leaves

Cucumber flea beetle, *Epitrix cucumeris* 38

Larger (5-7 mm.) yellowish beetles feeding upon the leaves.

Body yellow, marked with three longitudinal black stripes

Striped cucumber beetle, *Diabrotica vittata* 34

Body greenish yellow, marked with twelve black spots

Twelve-spotted cucumber beetle, *Diabrotica xii-punctata* 37

Large (8-10 mm.) hemispherical beetle, orange, marked with black spots, or yellow larva with black spines

Squash lady-beetle, *Epilachna borealis* 42

Sucking sap from the under side of the leaves—

Small dark green or brownish plant lice, often very abundant
Melon aphid *Aphis gossypii* 47

Larger bright green plant lice usually not abundant
Squash aphid, *Macrosiphum cucurbitae* 49

Grayish-brown bug with spicy odor (15 mm. when full-grown)
Squash bug, *Anasa tristis* 44

Small greenish-white scale-like insects on the under leaf surface of plants growing under glass or near greenhouses. Pure-white moth-like adults resting on the leaves, and flying about
Greenhouse white-fly, *Asterochiton vaporariorum* 50

CHEWING INSECTS.

The Striped Cucumber Beetle.

Diabrotica vittata Fabr.

As soon as the plants appear above the surface of the ground, and sometimes before, they are attacked as shown on plate I, c, by small beetles, striped lengthwise with yellow and black. These

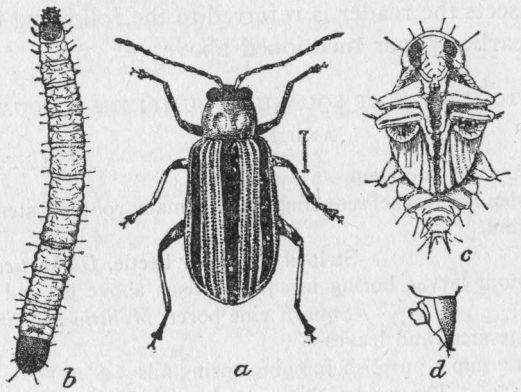


Figure 7. The striped cucumber beetle: *a*, adult beetle; *b*, larva; *c*, pupa; *d*, side view of anal segment. All greatly enlarged. (After Chittenden, Circular 31, Bureau of Entomology, U. S. Department of Agriculture.)

beetles eat away the tender tissue of seed leaves and young stems, often killing the plants unless treatment is given. They are about one-fifth of an inch (5 mm.) in length, with thorax and wing-covers yellow, with head and three longitudinal stripes, black. See figure 7, and plate I, b.

At the time the beetles are feeding they are also mating and the females lay eggs around the stem, just below the surface of the ground. These eggs are shown on plate I, a. The larvae hatching from them are slender whitish grubs with black heads, which tunnel in the roots or main stem in the ground, sometimes causing considerable injury, as shown on plate II, though probably this injury is less than that caused by the adults. The tunnels afford entrance for the wilt diseases which are often serious. The white pupa stage lasts about a week and occurs in the ground. There are two generations each year in the South, but only one in Connecticut, and the winter is passed by the adult beetles in the ground. Late in the summer the beetles are often abundant and feed upon the flowers of squashes and cucumbers and also upon goldenrod and other native flowers. They are often found resting in the curled leaves of the old vines.

One parasite, a Tachinid fly, *Celatoria diabroticae* Shimer, has been reared from the striped cucumber beetle in California and Texas.

METHODS OF CONTROL.

Control methods in vogue against this insect may be classified as follows:—

(1) Cultural practices.
(2) Covering the plants.
(3) Applying poisons or repellents.

(1) Cultural practices consist of crop rotation, the use of quick-acting fertilizers to force plant growth, plowing, destroying old vines, time of planting, and the use of trap crops. Some of these need no explanation. It is advisable where possible, to plant the seeds in berry baskets or paper pots under glass and set them in the field when they are five or six inches tall as they are not so liable to be destroyed. Deep plowing in the spring will expose many hibernating adults which may be killed before they have a chance to attack the vines. As soon as the crop has been harvested in the fall, the vines should be gathered and burned to kill the insects resting on them. A light harrowing of the ground immediately afterwards will kill many of them.

Trap crops of squash or beans may be planted early around the field to attract the beetles. These can then be poisoned and

many of the beetles will be killed before the regular crop is ready to be attacked.

(2) The hills may be covered with plant protectors of wire cloth or cheese cloth to keep the beetles away from the plants. Cloth covered protectors are for sale on the market, or may be made at home by cutting a barrel hoop in two equal parts and fastening the centers of the two pieces together at right angles, setting the ends in the ground and covering with cheese cloth or mosquito netting. Still better, fasten the ends of the semicircular pieces to another hoop lying horizontally and cover the whole with netting to make a portable frame protector. As soon as the plants fill the protectors, the protectors may be removed and stored, for the following season. The cloth will usually last about two years, possibly three, then the frames will need recovering. It is often necessary to mend or patch the netting when small holes get torn in it. Boxes and various other forms of wood and netting may be adapted for service as plant protectors, but they are for use in the home gardens.

All forms of plant protectors must be placed over the hills before the beetles appear. Factory-made protectors are shown on plate III, c.

(3) Most commercial growers apply poison to the young plants as a protection. Lead arsenate is perhaps the best for this purpose, and it may be used as a spray or as a dry powder. The beetles do not like to come out of the ground through a layer of dry powder, and a heavy application of dry arsenate of lead is usually effective. If the plants are sprayed, it is essential that the under surface of the leaves be coated or the beetles will congregate there and eat away the substance of the plant. Where cucumbers are grown, it is advisable to spray them with Bordeaux mixture to which lead arsenate may be added at the rate of two ounces of the paste or one ounce of the dry powder to one gallon of the liquid.

Various other dry powders, such as air-slaked lime, gypsum or land plaster, and soot, freely dusted upon and around the plants are of considerable value in controlling the striped cucumber beetle.

The Twelve-Spotted Cucumber Beetle, or Southern Corn Root Worm.

Diabrotica xii-punctata Oliv.

Though having a long list of food plants, including nearly all of the common vegetables, and not usually considered as a particular pest of cucurbitaceous plants, it has been so abundant in certain fields in some seasons that considerable damage must have resulted from it. In the South, the larvae are a serious pest of corn roots, and it is called the corn root worm. It also attacks rye, millet, and garden beans, often doing considerable damage.

The adult beetle shown on plate III, a, is somewhat larger and stouter than the striped cucumber beetle, and averages about 7 mm. in length. The wing-covers are greenish-yellow, marked with twelve black spots varying in size and arranged in three transverse rows. The thorax is bright yellow and the head black. The legs, except basal half of thighs, and the antennae are blackish; basal half of thighs greenish-yellow.

The life history is similar to that of the striped beetle, each female laying two or three hundred eggs in the soil. These eggs hatch in from one to three weeks, and the larvae tunnel in the roots of corn and other plants, becoming mature in from two to five weeks: then they pupate in earthen cells in the ground, the beetles emerging a week or two later.

When abundant this insect can be controlled in the same manner as the striped cucumber beetle.

The Garden Flea or Springtail.

Sminthurus hortensis Fitch.

Small seedling plants of many kinds are occasionally injured by very small jumping flea-like purplish insects which swarm in the soil and eat small holes in the leaves and stems, sometimes killing the plants. If the plants reach several inches in height and produce their second leaves, they will not be injured by these springtails.

The garden flea or springtail is about one-twentieth of an inch long, dark purple with pale yellow spots, and at the tip of the

abdomen there is borne a peculiar forked appendage by means of which it jumps.

This is one of the lowest forms of insects, and is very abundant for two or three weeks just as the seedlings are coming up.

Dusting with insect powder or ground tobacco is suggested as a remedy. Spraying with nicotine would doubtless kill great numbers of the springtails.

The Cucumber or Potato Flea-Beetle.

Epitrix cucumeris Harris.

The seedling plants of cucumbers are often attacked and injured by a small black jumping beetle which eats holes in the leaves. This is the same pest that commonly injures potato, tomato, egg-plants and tobacco in Connecticut fields and is shown in figure 8. It is about one-sixteenth of an inch in length, legs and antennae are yellowish, wing-covers and thorax, jet black.

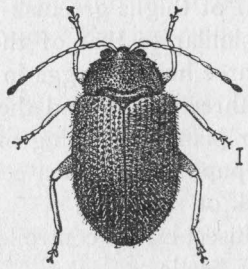


Figure 8. The cucumber flea beetle *Epitrix cucumeris,* greatly enlarged. (After Chittenden, Bureau of Entomology, U. S. Department of Agriculture.)

The adult beetles live through the winter under leaves and rubbish and the eggs are laid in May and June. The larvae are white thread-like worms which feed upon roots and therefore live and transform beneath the surface of the ground. Probably there are two, and possibly three, generations each year.

Flea beetles may be killed by arsenical sprays; driven away by repellents; or trapped by mechanical devices.

Ordinarily the application of lead arsenate to control the striped cucumber beetle will also control flea-beetles. Bordeaux mixture

is recognized as a repellent by gardeners, and may well be applied with the lead arsenate as it is needed to control certain fungous diseases and should be sprayed against both upper and under surfaces of the leaves.

Insect powder, one pound in ten gallons of water, or lead arsenate mixture in which gelatine has been incorporated gave the best results in tests in 1914 at the New Jersey Station.*

For controlling flea-beetles on potatoes, Prof. C. L. Metcalf devised a sticky box or trap which has been described,† but which is hardly necessary to consider in connection with cucurbitaceous plants. The application of lead arsenate will usually be found sufficiently effective.

The Squash-Vine Borer.

Melittia satyriniformis Hubn.

With the possible exception of the striped cucumber beetle, which is occasionally very destructive, the squash-vine borer is the most important pest of squashes and pumpkins in Connecticut. This insect causes the vines to wither in July and August, and to die before maturing their crop. Cucumbers and melons are seldom attacked if squashes and pumpkins are plentiful in the neighborhood.

The larva or borer tunnels in the main stem near the surface of the ground as shown on plate IV, and decay sets in often involving the whole stem which frequently becomes entirely severed, thus shutting off the supply of sap to the plant. The wilting is usually the first sign of attack, though an earlier examination would show the yellow pellets of frass or excrement which are thrown out of holes in the stem.

The adult is one of the clear-wing or Sesiid moths having a wing-spread of from one to one and one-fourth inches. The fore wings are opaque dark olive-green with a metallic luster and a fringe of brownish-black. The rear wings are transparent with a bluish reflection, and veins and fringe are black. The thorax and antennae are colored about like the fore wings, with

* Report New Jersey Agricultural College Experiment Station for 1914, page 378.

† Journal of Economic Entomology, Vol. 8, page 240, 1915: Report Conn. Agr. Expt. Station for 1918, page 105.

abdomen reddish-brown, legs bright orange and tarsi black with white bands. When at rest the wings are folded horizontally as shown in figure 9, b.

The egg is about one millimeter in diameter, oval in outline, flattened at the point of attachment, and is dull red in color. The female may lay two hundred or more eggs, and at first these are deposited singly on the stem of the vine near its base during June or early July in Connecticut. Later in the season, the eggs may be laid at almost any point on the plant and the borers are often found in the leaf petioles. From six to fifteen days are

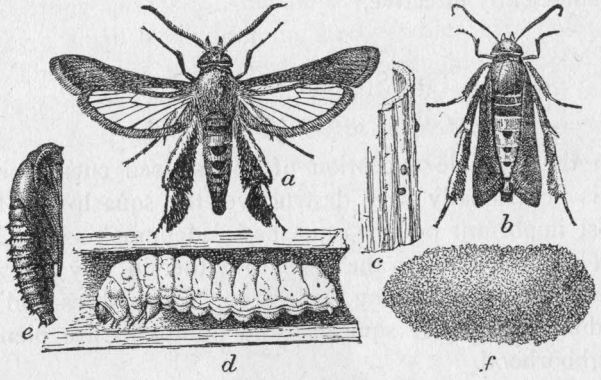


FIGURE 9. The squash borer: *a*, male moth; *b*, female, with wings folded as when at rest; *c*, eggs on section of squash stem; *d*, full-grown larva in the stem; *e*, pupa; *f*, pupal cell. All one-third larger than natural size. (After Chittenden, Circular 38, Bureau of Entomology, U. S. Department of Agriculture.)

required for the eggs to hatch and the young larvae enter the stem and begin their depredations, usually working toward the root, but frequently going in the opposite direction. Later in the summer the larvae may be found tunneling in all parts of the stem, leaf petioles and even in the fruit. The mature larva is a fat white grub, with black head, and is about an inch in length. When ready to transform it goes into the ground one or two inches below the surface, and spins a tough brownish cocoon, into the outer layer of which particles of soil are fastened. This cocoon is about three-fourths of an inch long. In Connecticut the caterpillars remain in their cocoons until the following season.

There are two broods in the South but only one in Connecticut. Between the latitudes of Long Island and Washington, D. C., there is a partial second brood.

The pupa is about five-eighths of an inch in length, is dark brown, and its head bears a sharp horn-like projection by means of which it cuts its way out of the cocoon.

This insect occurs throughout the eastern half of the United States from Canada south to Mexico and into South America.

METHODS OF CONTROL.

The application of arsenical and contact insecticides are of no avail against this insect. Cultural practices must be relied upon to hold it in check, and are as follows:—

(1) Plant early squashes as trap crops to be destroyed later.
(2) Cut out the borers with a knife.
(3) Cover the vines with soil to induce the growth of new roots.
(4) Collect and burn the old vines as soon as the crop is harvested.
(5) Crop rotation.

(1) In some localities growers have been successful in planting early varieties such as crooknecks between the rows or around the margins of the field. The moths will lay their eggs on these plants which can later be pulled up and burned. The main crop appearing later will escape the larger part of the infestation.

(2) Wherever a plant has become infested, a careful cut lengthwise the stem with a small, sharp knife will disclose the borer, which can then be killed with the knife. A careful examination of the basal portion of the vine will disclose the presence of a borer, as the yellow frass is always thrown out through a hole in the side of the stem. Such an examination should be made early in July and repeated several times during the month and even in August. If the vine has not been seriously injured and decay has not set in, the incision will heal.

(3) As there is always danger that a borer may be overlooked, each vine should be covered with soil at a point two or three feet from its base after it is well started running along the ground. New roots will be formed at this point and even if decay

wholly destroys the stem at its base the new roots enable the plant to keep on and mature its crop. The writer has seen a squash vine yield a good crop, when treated in this way, where the main stem was entirely severed from its root system.

(4) As the moths do not all appear at the same time, the egg-laying period extends over a long time or perhaps the greater portion of the summer. Consequently, larvae may be present somewhere in the vines late in the season. Gathering and burning the vines after the crop has been harvested will destroy many of these larvae which have not gone into the ground to pupate.

(5) As the squash-vine borer hibernates in the ground, it is advisable not to grow squashes on the same field year after year.

The Squash Lady-Beetle.

Epilachna borealis Fabr.

Though nearly all of the lady-beetles are carnivorous and therefore beneficial because they feed upon and destroy injurious insects such as aphids and scale insects, there is one exception in

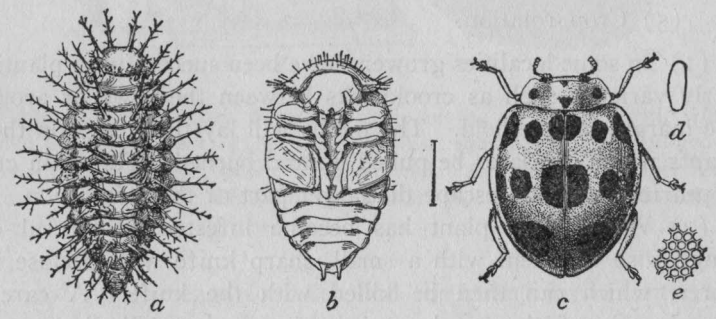
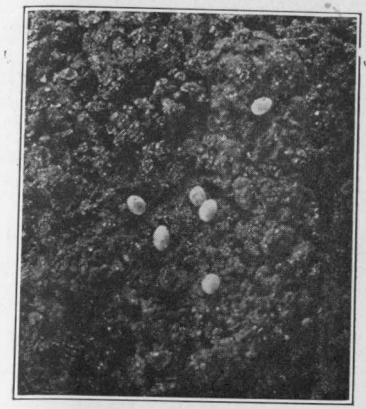
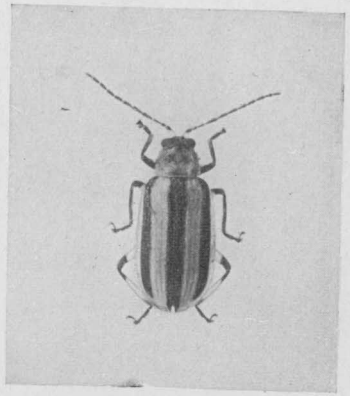


Figure 10. The squash lady-beetle: *a*, larva; *b*, pupa; *c*, adult beetle, three times natural size; *d*, egg, four times natural size; *e*, surface of same highly magnified. (After Chittenden, Bulletin 19, Bureau of Entomology, U. S. Department of Agriculture.)

Connecticut in the squash lady-beetle. This species (both adults and larvae) feeds upon the leaves of cucurbitaceous plants but does more injury to squash than to the other plants of this group. The adult beetles pass the winter under the bark of dead trees,



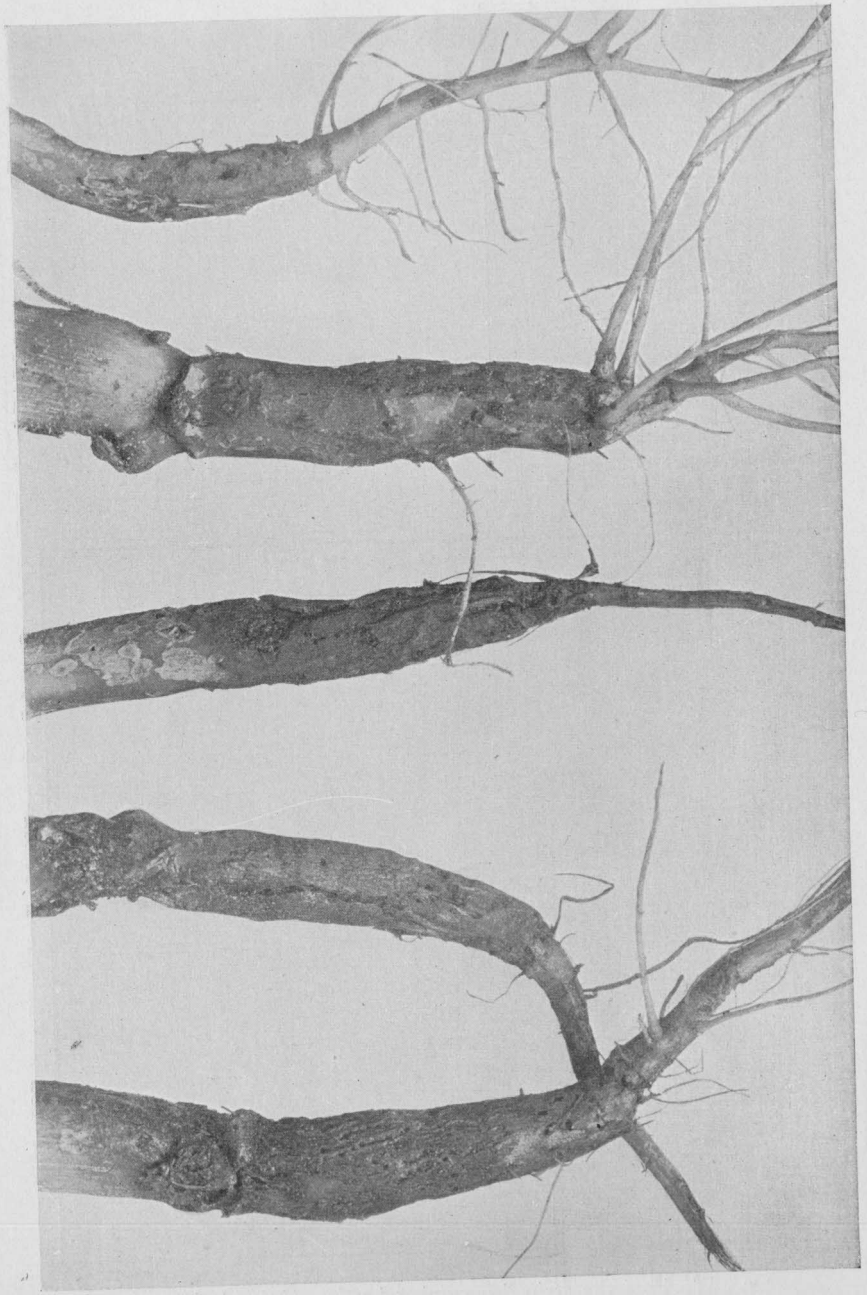
a. Eggs, as laid in the soil. Five times enlarged.



b. Striped cucumber beetle. Enlarged four times.

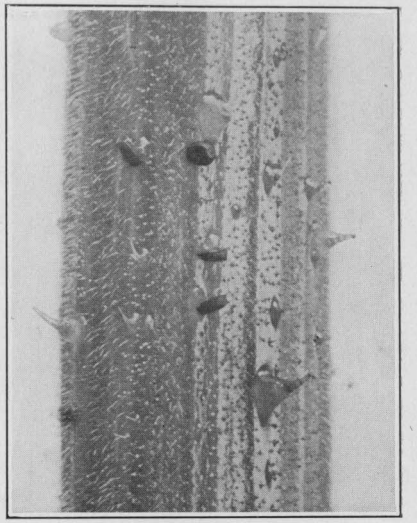
c. Work of the striped cucumber beetle. Natural size.

STRIPED CUCUMBER BEETLE.

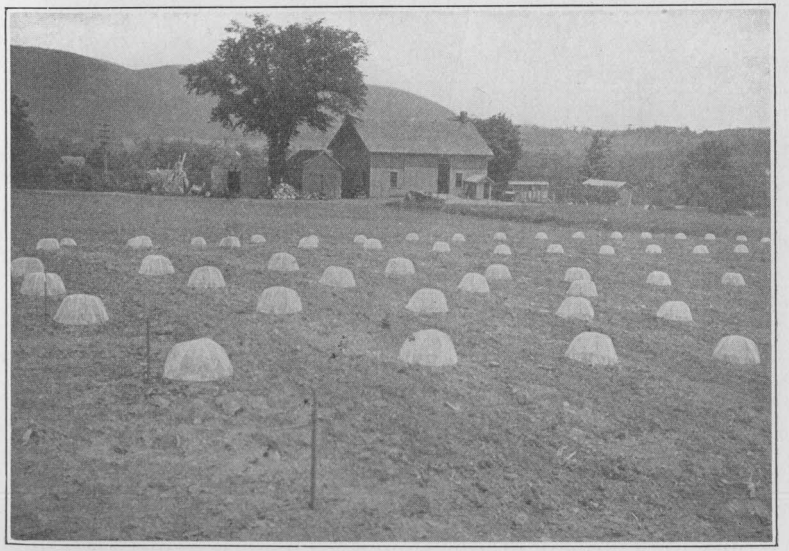


Cucumber plants injured by the larvae of the striped beetle.
Natural size.

a. Twelve-spotted cucumber beetle. Enlarged four times.



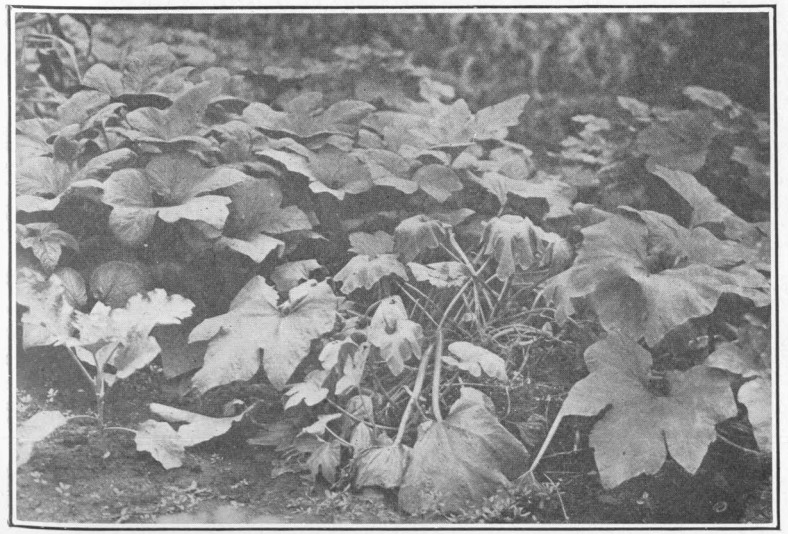
b. Eggs of squash-vine borer.



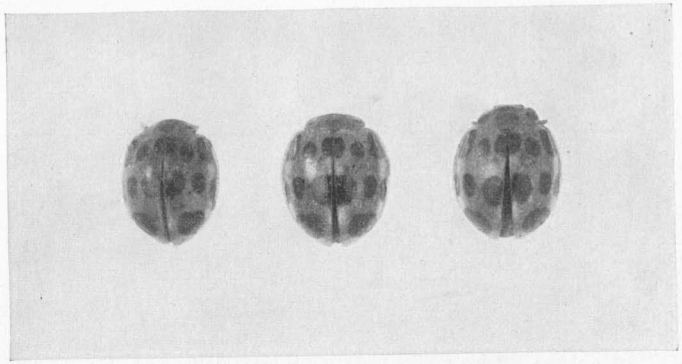
c. View at farm showing protectors over cucumber plants.

SQUASH BORER: ADULT AND WORK OF LARVAE IN SQUASH STEMS.
Slightly enlarged.

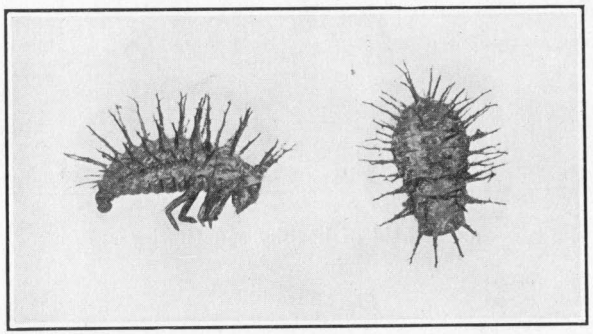
a. A field of healthy squash vines.



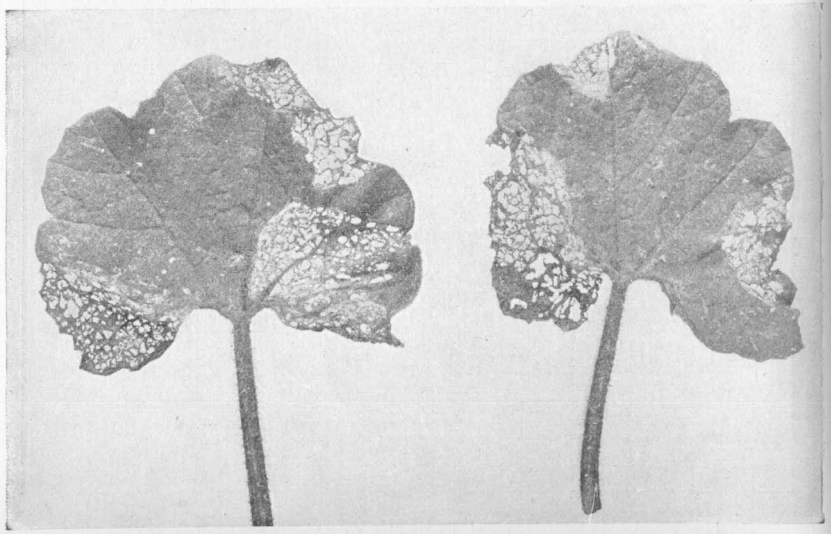
b. Vine wilting from the attacks of the squash-vine borer.



c. Squash lady-beetle. Twice natural size.

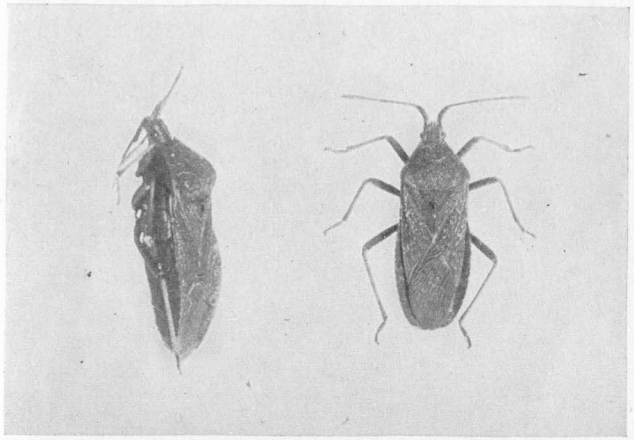


b. Larva of squash lady-beetle. Enlarged.

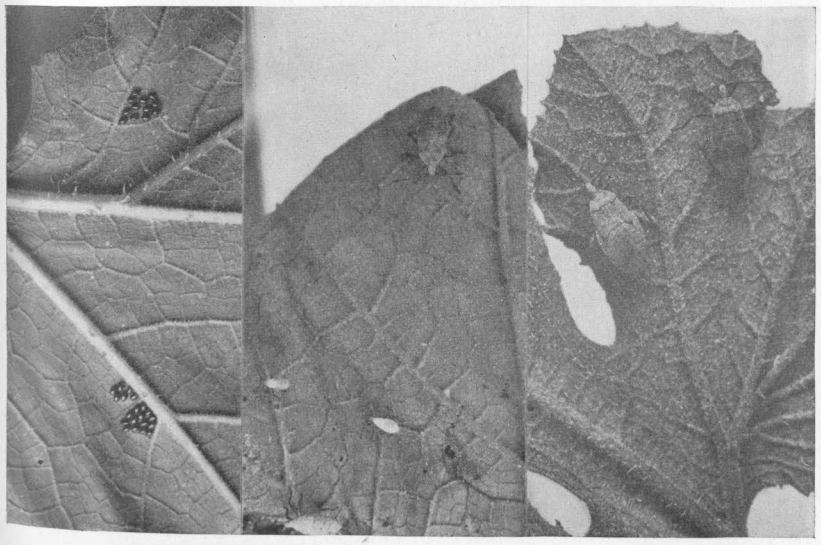


c. Work of the squash lady-beetle. Greatly reduced.

SQUASH LADY-BEETLE.



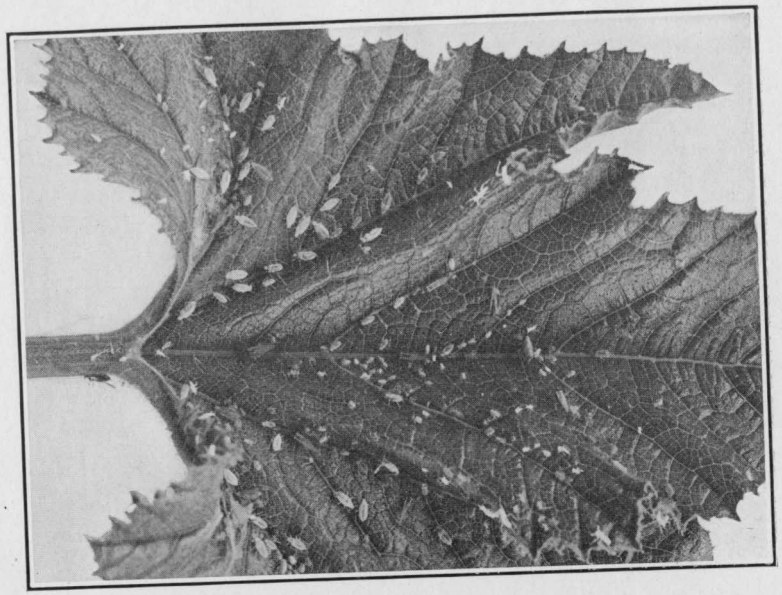
a. Squash bug. Twice natural size.



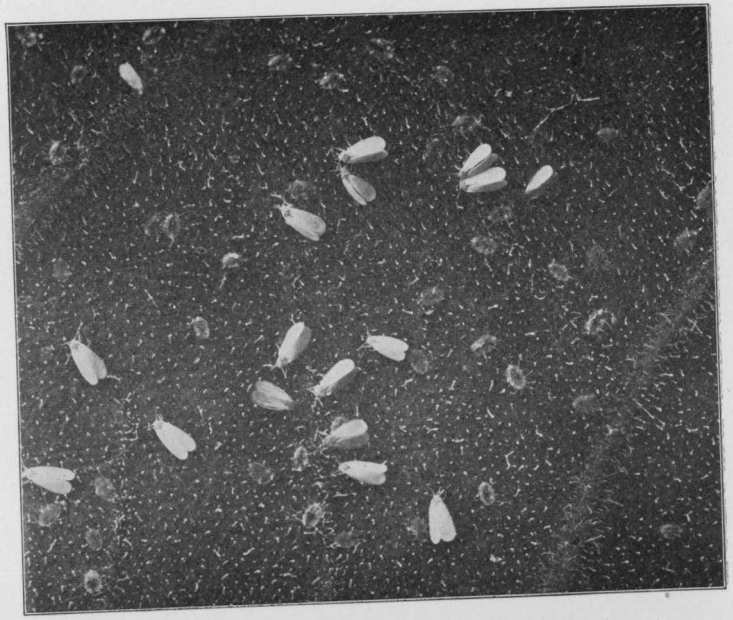
b. Eggs and young squash bugs. All natural size.

SQUASH BUG.

PLATE VIII.



a. The potato aphid on squash leaf. Natural size.



b. Greenhouse white-fly. Adults and pupa skins. Enlarged four times.

stumps, etc., or other sheltered places, emerging in June and laying their eggs on the under surface of the squash leaves, These hatch in about twelve days and the larvae begin to feed upon the under side of the leaves. The larvae appear in Connecticut about the middle of July and become fully grown in about three weeks or early in August. The larva is about three-eighths of an inch in length, yellow, with six rows of long black branched spines. The pupa is yellow and like those of its kind is attached by the tail to the under surface of the leaf: it lasts from six to nine days. There is only one generation each year. All stages of this insect are shown in figure 10; adults and larvae on plate VI.

Though the larvae are found feeding upon the under side of a leaf in July and August, the adults are generally present at the same time as well as earlier and later, feeding upon the upper surface. The adult has the peculiar habit of marking out with its mandibles a definite area on the leaf, and then feeding within this area. This form of injury is shown on plate VI, c. The squash lady-beetle is usually a minor pest being present only in small numbers; handpicking is generally the best method of control in such cases. If abundant the vines should be sprayed with lead arsenate, using perhaps two pounds of the paste in fifty gallons of water.

Other Chewing Insects.

Cutworms.—The small plants are often eaten off by cutworms, which are the larvae of several species of Noctuid moths. In small plantations these can be hunted and crushed, but in large fields where cutworms are destructive, the following mash should be employed:—

Wheat bran	5 pounds
Paris green or white arsenic	5 ounces
Lemon or orange	1 fruit
Molasses	1 pint
Water	7 pints

Mix the dry poison and bran together. Squeeze the juice from the orange or lemon into the water and also add the pulp and peel cut in small pieces: then add the molasses and stir. Mix the syrup thoroughly with the poisoned bran. This will make a rather dry mash which may be scattered thinly over the field

at the time when the injury is first noticed. As the cutworms feed at night, the mash should be applied just before dark: the cutworms will be attracted by the fresh citrus juice and molasses. If allowed to become dry before night, it will have lost in some measure its attraction for the cutworms. Late fall plowing and very thorough harrowing will reduce the numbers of cutworms.

Wireworms.—These are the larvae of click beetles and often are so abundant as to injure various crops. They are slender, hard, cylindrical grubs usually smooth and shiny and light brown in color. They injure plants by tunneling in the roots, especially the main stem below the surface of the ground. Crop rotation, fall plowing and thorough harrowing are the best preventives.

In the South, the pickle worm *Diaphania nitidalis* Stoll, and the melon worm *Diaphania hyalinata* Linn., cause much injury to crops of melons, cucumbers and squashes, but though they occur in Connecticut, they are rare and seldom are found feeding upon these plants in cultivated fields. Planting a succession of summer squashes at intervals of two weeks as trap crops seems to be the best method of controlling these insects.

Certain other general feeders sometimes attack squashes and cucumbers. The stalk borer *Papaipema nitela* Guen. was found by the writer in the stem of a melon plant in 1918. Various caterpillars of the families Noctuidae and Arctiidae occasionally feed upon the blossoms, leaves or young fruit, but can scarcely be considered as pests of the crop in Connecticut.

SUCKING INSECTS.

The Squash Bug.

Anasa tristis Degeer.

The squash bug, or "stink bug," is an important pest of squashes and pumpkins, though as a rule it does not injure cucumbers and melons in Connecticut. It injures the plants by puncturing the tissues of a vein on the under side of a leaf, and sucking out the sap. This causes the leaf to wilt badly and die. Frequently all the leaves on a vine wilt from the attacks of these bugs and the entire vine dies.

The range of this insect covers the entire United States, and is from Canada to Central America. The adult bugs hibernate

in any convenient place where they can find shelter, such as in old vines and rubbish, under loose bark, boards, etc., and emerge late in the spring and attack the young plants. In addition to their punctures and withdrawal of sap from the plant, it is

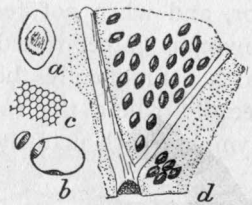


Figure 11. Eggs of squash bug as they are laid on the under side of a leaf. Enlarged. (After Chittenden, Bulletin 19, Bureau of Entomology, U. S. Department of Agriculture.)

thought that some poisonous substance is injected into the wound. A few punctures are sufficient to kill a small plant.

The female bugs lay on the under side of the leaves, dark brown shiny eggs in clusters containing between twenty and forty each, arranged in more or less regular rows, often in the

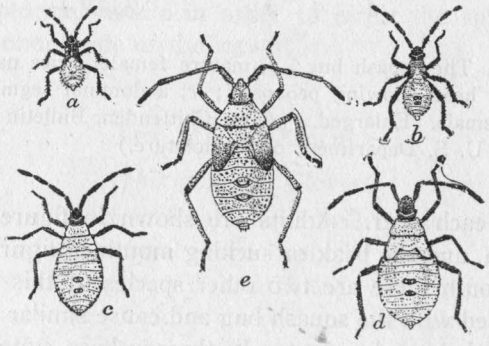


Figure 12. Nymphs of the squash bug; different stages, about twice natural size. (After Chittenden, Bulletin 19, Bureau of Entomology, U. S. Department of Agriculture.)

forks of veins, as shown in figure 11. From six to fifteen days afterward, these eggs hatch and the young nymphs remain together on the under side of the leaf where the egg cluster was laid. They are at first green with pink head, legs and antennae,

but after the first molt, they are ash-gray in color. They molt five times during the nymphal period of four or five weeks, during which they are sucking the sap from the plants. The nymphs are shown in figure 12, and on plate VII, b.

The full-grown bug is about five-eighths of an inch long, dark grayish-brown in color, and when not feeding or laying eggs, the adults and larger nymphs gather round the base of the plant or under clods of earth. Frequently they congregate on the immature fruits, especially where the foliage has been killed by frost before the nymphs reach maturity. There is only one

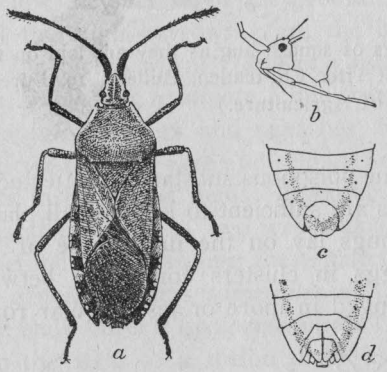


FIGURE 13. The squash bug: *a*, mature female, twice natural size; *b*, side view of head showing proboscis; *c*, abdominal segments of male; *d*, same of female. Enlarged. (After Chittenden, Bulletin 19, Bureau of Entomology, U. S. Department of Agriculture.)

generation each year. Adults are shown in figure 13, and on plate VII, a, and the beak or sucking mouth in figure 14.

In the South there are two other species of this genus which are associated with the squash bug and cause similar injury to the plants though less abundant. In the southern states, the southern leaf-footed plant bug *Leptoglossus phyllopus* Linn. injures melons and various other vegetable crops, and in the central states, the northern leaf-footed plant bug *Leptoglossus oppositus* Say, occasionally attacks cucurbitaceous plants, but these insects have not been recorded from Connecticut.

Methods of Control.—The adults are hard to kill and such methods as the burning of all old vines and rubbish around the

field, trapping under boards and handpicking are the means of destroying them. Egg-masses on the leaves may be crushed, or scraped off with the edge of a knife. The nymphs, especially the younger ones, may be killed by spraying with kerosene emulsion,

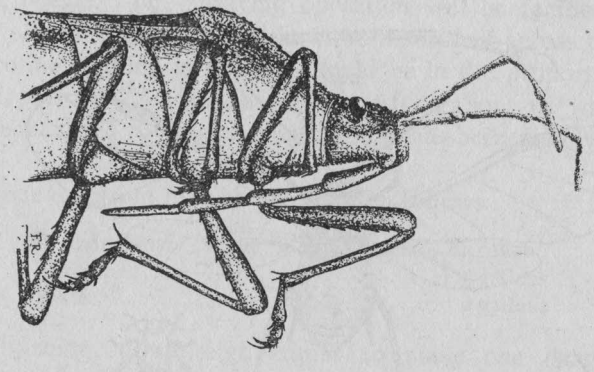


FIGURE 14. Squash bug. Enlarged view showing head and proboscis.

or with nicotine solution, two teaspoonfuls in a gallon of water, to which an inch cube of laundry soap has been dissolved and added. In applying any spray to kill the nymphs, it is necessary to use an upturned nozzle in order to direct the spray against them on the under side of the leaves.

THE MELON APHID.

Aphis gossypii Glover.

This is one of the most troublesome insect pests of cucumbers and melons throughout its range over the eastern half of the United States and southward into Brazil. In Connecticut it is present in nearly every field of cucumbers and melons, and being on the under side of the leaves, it escapes notice until the leaves begin to curl on account of its attacks. It is much less troublesome on squashes and pumpkins, but has a long list of food plants, including many of our common vegetables, and cotton in the South. It is apparently able to subsist on a large number of common weeds, though its complete life history is still unknown. Whether it produces winter eggs, or each year migrates from the South, or lives over in greenhouses is still a matter for specula-

tion. It is able to multiply so rapidly that plants are often injured in a short time. The infested leaves curl backward or downward, making it very difficult to reach the aphids with a spray. The melon aphid is shown in figure 15. It is preyed upon by our common lady-beetles, larvae of syrphid flies, lace-

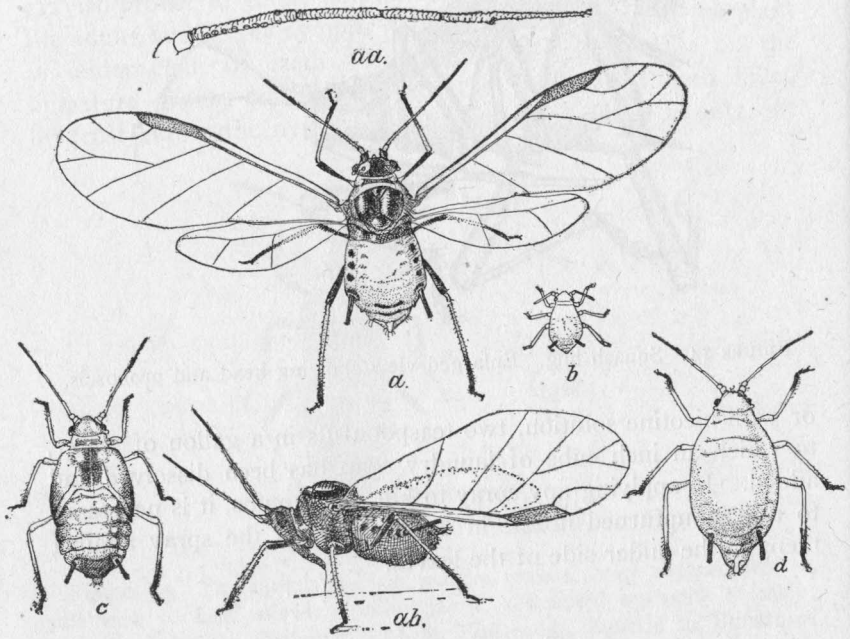


FIGURE 15. The melon aphis: *a*, winged female; *aa*, enlarged antenna of same; *ab*, dark form, side view; *b*, young nymph; *c*, last stage of nymph; *d*, wingless female. All greatly enlarged. (After Chittenden, Circular 80, Bureau of Entomology, U. S. Department of Agriculture.)

wing flies, and several species of parasitic four-winged flies aid in holding it in check.

Control.—In small gardens the vines can be watched and when the aphids first appear, the vines should be sprayed or fumigated to kill them. For fumigating, covers can be made by stretching table oilcloth over light wood frames. Each frame should be large enough to cover a hill, and either carbon disulphide (bisulphide) one teaspoonful to each cubic foot of space, or tobacco fumes may be employed as a fumigant. The former should be

placed in a shallow dish or saucer under the cover. Tobacco fumes may be obtained by burning tobacco stems, or some preparation of nicotine and paper.

In spraying, either kerosene emulsion or nicotine solution may be used, and the nozzle should be upturned by using a rod bent near the nozzle. The spraying operation will be facilitated by training all vines to run along the rows instead of across them.

If nicotine solution is used, it should be in the proportions of one-half pint of "Black Leaf 40" in fifty gallons of water, to which about three pounds of laundry soap has been dissolved and added.

Kerosene emulsion may be prepared as follows

Laundry soap (about 30 oz.)	3 cakes
Kerosene	3 gallons
Water	2 gallons

After churning, dilute eight times to make one barrel (50 gallons.)

The soap should be cut into thin slices and dissolved in hot water over a fire. Then remove from the fire, add the kerosene and churn vigorously for a few moments by passing the liquid through a spray pump having a small opening in the nozzle, and the stream directed back into the container. This makes a uniform creamy mass from which the oil does not separate on standing. Then dilute with the necessary amount of water and spray against the under surface of the leaves.

In all spraying operations a good pressure should be maintained, and a fine nozzle used. In commercial plantations, sometimes the first plants found to be infested are pulled up and buried or burned to kill the aphids. Dusting with insect powder or fine tobacco dust applied with a powder gun is also practiced in some cases. In any event, the treatment should be given before the leaves have curled as it is difficult afterward to hit the aphids.

THE SQUASH APHID.

Macrosiphum cucurbitae Middleton.

This is a light green aphid, considerably larger than the melon aphid, but is never as abundant and therefore never as destructive as that species.

The Potato Aphid, *Macrosiphum solanifolii* Ashm., was found on squash at the Station in 1909 and again in 1914. It is shown on plate VIII, a.

Both the aphids mentioned above, if sufficiently abundant to warrant the outlay, may be controlled by the same methods advised for the melon aphid.

The Greenhouse White-Fly.

Asterochiton (Aleyrodes) vaporariorum Westwood.

Cucurbits growing under glass or out of doors near greenhouses are often attacked and considerably injured by the greenhouse white-fly. The white moth-like adults are found resting on the under sides of the leaves where they lay eggs and where the nymphs also occur. The eggs are very small, ovate, whitish, and are attached to the leaf by a short stalk at the larger end. The nymphs are oval, flat, light green, and resemble scale-insects. The empty pupa skins are silvery white and adhere for a long time to the leaf. The adults are pure white and in appearance look as if sprinkled with flour. This insect is shown on plate VIII, b, but a more detailed description may be found in the Reports of this Station for 1902, page 148, and for 1906, page 275.

The same treatment recommended for the melon aphid will control the greenhouse white-fly. Spraying with soap and water (common laundry soap, one pound dissolved in eight gallons) is also effective.

In greenhouses it is often advisable to fumigate the entire house with hydrocyanic acid gas, using one-half ounce of cyanide for each thousand cubic feet of space with an exposure of three hours. This is by far the most effective of all treatments. If spraying is depended upon to hold the pest in check it must be repeated frequently.

Summary.

Chewing insects which attack and injure squash, pumpkin, cucumber and melon plants in Connecticut are the striped cucumber beetle, the squash-vine borer, and occasionally the twelve-spotted cucumber beetle, the cucumber flea beetle, the garden flea or springtail, the squash lady-beetle, cutworms and wireworms. The striped and twelve-spotted beetles can be controlled by covering the plants with netting, or by spraying or dusting them with lead arsenate. The cucumber flea-beetle and the squash lady-beetle may likewise be controlled with lead arsenate.

To control the squash-vine borer, plant early squashes as a trap crop to be destroyed later: cut out the borers with a knife: cover the stems of the vines with soil to induce the formation of new roots: collect and burn all the old vines as soon as the crop is harvested. Cutworms can best be controlled by the use of a poisoned bran mash, and wireworms by fall plowing and rotation of crops.

The most troublesome sucking insects on cucurbits in Connecticut are the squash bug and the melon aphid. Minor pests of this nature are the squash aphid, potato aphid, and greenhouse white-fly. All of these pests can be controlled by spraying at the right time with nicotine solution and soap, with kerosene emulsion, or by fumigating.

Gathering and burning the old vines and other rubbish on the field after the crop has been harvested is a worthy practice and will tend to reduce the numbers of all insects attacking the crop.

Rotation of crops should also be practiced, where possible.

Information concerning each of these pests and how to control them is given in the foregoing pages, and most of them are shown on plates I-VIII.

CONNECTICUT

AGRICULTURAL EXPERIMENT STATION

NEW HAVEN, CONN.

BULLETIN 217 DECEMBER, 1919

Fertilizer Report for 1919

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

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Report on Commercial Fertilizers, 1919.

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

In 1919, forty-eight individuals and firms entered 339 brands of fertilizers for sale in this state, classified as follows:

Nitrogenous superphosphates with potash	108
Nitrogenous superphosphates without potash	158
Bone manures and tankage	23
Fish, castor pomace, chemicals and miscellaneous	50
Total	339

During the spring months Mr. Churchill, the Station's agent, visited 98 towns and villages in the state and gathered 501 samples. These represented all the registered brands except the following:

American Agricultural Chemical Co.'s Grass and Oats Fertilizer[1], East India Mayflower 1916[1]; *Bowker's* Stockbridge 5-8 General Crop; *Listers'* Complete Tobacco Manure 1916[1], Crescent Ammoniated Superphosphate 1916[1], Excelsior Guano 1916, 1-8-2 Fertilizer[1], Squirrel Brand Fertilizer 1916[1]; *National* Nitrogen Phosphate Mixture No. 6; *Nitrate Agencies Co.'s* Ground Bone, 4-8-2 Fish and Potash Formula, H. G. Ground Tankage; *Parmenter & Polsey's* Potato Fertilizer; *Pawtucket Rendering Co.'s* Animal 3½-10[2]; *Sanderson's* Plain Superphosphate.[3]

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[1] Not sold in the state.
[2] Manufacturer's sample analyzed.
[3] Purchaser's sample analyzed.

Of the fifteen samples above listed six were not sold in the state, and of two other brands, one manufacturer's sample and one purchaser's sample were analyzed.

CLASSIFICATION OF FERTILIZERS ANALYZED.

	Number of samples.
1. *Containing nitrogen as the chief active ingredient:*	
Nitrate of soda	8
Sulphate of ammonia	1
Cotton seed meal	95
Castor pomace	4
Peanut meal	1
2. *Containing phosphoric acid as the chief active ingredient:*	
"Barium-phosphate"	3
Raw rock phosphate	2
Precipitated bone phosphate	2
Basic lime phosphate	2
Acid phosphate	16
3. *Containing potash as the chief active ingredient:*	
Cotton hull ashes	3
Other potash materials	13
4. *Containing nitrogen and phosphoric acid:*	
Fish manures	15
Slaughter house tankage	9
Bone and tankage	1
Bone manures	16
5. *Mixed fertilizers:*	
Nitrogenous superphosphates without potash	166
Nitrogenous superphosphates with potash	108
Home-mixed fertilizers	4
6. *Miscellaneous fertilizers and waste products:*	
Tobacco stems and stalks	3
Lime-Fertile and Nitro-Fertile	2
Sheep manure	10
Wood ashes	21
Lime and lime-kiln ashes	3
Peat and muck	7
Other miscellaneous articles (soils not included)	27
Total	542

I. RAW MATERIALS CHIEFLY VALUABLE FOR NITROGEN.

NITRATE OF SODA.

Eight samples were analyzed as follows:

12533. Sold by Apothecaries Hall Co., Waterbury. Sampled at the factory.

12562. Sold by Sanderson Fertilizer & Chemical Co., New Haven. Sampled at the factory.

12889. Sold by Coe-Mortimer Co., New York City. Stock of C. E. Taylor, Meriden.

12734. Sold by Armour Fertilizer Works, Chrome, N. J. Stock of Geo. S. Phelps & Co., Thompsonville.

12728. Sold by American Agricultural Chemical Co., New York City. Stock of C. Buckingham, Southport.

12987. Sold by Nitrate Agencies Co., New York City. Stock of F. S. Platt Co., New Haven.

12718. Sent by G. S. Jennings, Southport.

12891. Sold by Wilcox Fertilizer Co., Mystic. Sampled at factory.

ANALYSES OF NITRATE OF SODA.

Station No.	12533	12562	12889	12734	12728	12987	12718	12891
Per cent. of								
Nitrogen guaranteed	15.00	15.00	15.00	14.81	15.00	15.00	....	15.00
Nitrogen found	15.60	15.08	15.04	15.64	15.42	15.80	15.92	15.36
Cost per ton	$90.00	90.00	95.00	100.00	100.00	110.00	....	....
Nitrogen costs cents per pound	28.8	29.8	31.5*	31.9	32.4	34.8	....	....

All of the samples examined fully met their guaranties and all were of average quality.

The cost of nitrogen in these samples ranged from about 29 to 35 cents per pound, the average being 31.5 cents.

Nitrate of soda has been a relatively cheap source of fertilizer nitrogen this year. The nitrogen in it is more quickly and completely available to crops than nitrogen from any other commercial source. As a spring top-dressing on grass land and on

* f. o. b. Cartaret, N. J.

winter grain which has suffered some winter-killing, as well as a source of nitrogen in home mixtures, nitrate of soda deserves more attention and use than it has received from farmers.

The figures gathered by the Bureau of Soils at Washington indicate that about 29 per cent. of the nitrogen in the mixed fertilizers made in 1918 was in form of nitrate of soda, 16 per cent. in form of sulphate of ammonia and the balance, about 55 per cent., in organic forms. These percentages probably will change with changes in the relative cost of the three forms of nitrogen.

The price of nitrate in Chili is fixed by what is bid in the London market. During the war the demands for the manufacture of munitions and the scarcity of shipping, high insurance rates, etc., caused nitrate to advance sharply in price and then to disappear from the market. At this writing, November, 1919, the wholesale quotation is $58 per ton which should represent a retail price of about $70.

SULPHATE OF AMMONIA.

Only a single sample was examined.

12560. Sold by the Barrett Co., New York City. Stock of Berkshire Fertilizer Co. Cost $100 per ton. It contained 20.9 per cent. of nitrogen. Nitrogen in this article therefore cost 23.9 cents per pound, which is the cheapest source of nitrogen that has been in our market this year.

COTTON SEED MEAL.

Ninety-five samples of meal bought for use as a fertilizer have been examined.

Seventy-six of them met their guaranteed compositions and need no further notice here. Seventeen failed to meet their guaranties and their analyses appear in the following table.

The average percentage of nitrogen in the 95 samples examined was 5.97 and the average ton cost, in car lots, $63.21.

The average nitrogen content of the samples which met their guaranty was 6.11 per cent.; the average of those which failed to meet their guaranties was 5.71 per cent.

Cotton seed meal contains about 2.9 per cent. of phosphoric acid and 1.9 per cent. of potash.

These ingredients are not guaranteed and are disregarded in sales. Charging the cost of meal wholly to nitrogen, the average cost per pound of nitrogen has been 53 cents.

If the phosphoric acid in the meal is credited at 6 cents and potash at 30 cents, the average cost of nitrogen as shown by our analyses has been 40.5 cents per pound.

The average figures for the past seven years are as follows:

Year.	Number analyzed.	Cost per ton.	Per cent. nitrogen.	Nitrogen costs cents per pound.
1913	315	$33.00	6.89	20.7
1914	224	....	6.77	21.6
1915	182	....	6.96	19.9
1916	177	39.52	6.65	20.9
1917	95	44.20	6.10	26.5
1918	56	57.41	5.98	36.0
1919	95	63.21	5.97	40.5

There has been a yearly rise in the average price of cotton seed meal, amounting to 91 per cent., a yearly decrease in the amount of nitrogen amounting to 13 per cent. and in consequence the actual cost per pound of nitrogen has increased nearly 95 per cent. At this writing, November 1919, cotton seed meal is quoted in New York at $70 to $75 per ton.

As evidence of the economic confusion wrought by the war, it is stated that Egypt has 85,000 tons of meal for which there is no home demand and no shipping available to transport it.

Coal on the other hand is hard to get at $80 per ton in that country and cotton seed cake is being used for heating. 1¾ tons of cake is said to be the equivalent in heating power of one ton of coal.

There appears to be no present prospect of cheaper cotton seed meal in the market.

Under the new fertilizer law cotton seed meal is classed as a commercial fertilizer and is subject to the same requirements as any other fertilizer.

CASTOR POMACE.

Four samples were analyzed as follows:

12730. Sold by American Agricultural Chemical Co., New York City. Stock of W. Howard, Windsor.

12732. Sold by Apothecaries Hall Co., Waterbury. Stock of Wm. J. Reeves, Windsorville.

COTTON SEED MEALS BELOW GUARANTY.

Station No.	Manufacturer or Jobber, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.	Cost per ton.
	American Cotton Oil Co., New York City.				
12449	62640	Griffin Tobacco Co., No. Bloomfield	4.14	5.76	....
	F. W. Brode & Co., Memphis, Tenn.				
12028	34825	Ernest N. Austin, Suffield	6.32	6.58	$56.00
12737	.....	E. N. Austin, Suffield	6.29	6.50	60.00
	The Buckeye Cotton Oil Co., Cincinnati, Ohio.				
12454	40069	Griffin Tobacco Co., No. Bloomfield	5.50	5.76	....
12457	88578	Griffin Tobacco Co., No. Bloomfield	5.47	5.76	....
12624	2240 N. Y., P. & N.	Spencer Bros., Inc., Suffield	5.48	5.76	65.00
12625	52310 P. M.	Spencer Bros., Inc., Suffield	5.53	5.76	65.00
12679	2775 L. & N.	Spencer Bros., Inc., Suffield	5.20	5.76	65.00
12741	97818 Erie	Spencer Bros., Inc., Suffield	5.48	5.76	64.50
	E. Crosby & Co., Brattleboro, Vt.				
12659	52618 G. K.	George S. Phelps & Co., Thompsonville	5.51	5.75	66.00
	Humphreys-Godwin Co., Memphis, Tenn.				
12796	142132 I. C.	Loomis Bros Co., Granby	4.89	5.76	....
	Olds & Whipple, Hartford.				
11512	.....	O. H. Osborne, Warehouse Point	6.34	7.00	....
12194	.....	.....	6.68	7.00	....
	Park & Pollard Co., Boston, Mass.				
12771	.....	Ahern Bros., East Windsor Hill..	6.30	6.56	....
12687	71464 U. P.	Ahern Bros., East Windsor Hill..	6.28	6.56	72.00
	J. E. Soper Co., Boston, Mass.				
12501	43588 R. I.	Spencer Bros., Inc., Suffield	5.33	5.76	64.50
12502	115177 N. Y. C. & H. R.	Spencer Bros., Inc., Suffield	5.57	5.76	64.50

12565. Sold by H. J. Baker & Bro., New York City. Stock of Olds & Whipple, Hartford.

12665. Sent by L. J. Prior, East Hartford.

ANALYSES OF CASTOR POMACE.

Station No.	12730	12732	12565	12665
Per cent. of				
Nitrogen guaranteed	4.53	4.52	4.50	....
Nitrogen found	4.43	5.34	5.82	5.45
Cost per ton	$62.00	$55.00	$55.10	....

Castor pomace of average composition contains about 1.95 per cent. of phosphoric acid and 0.95 per cent. of potash. If we value them at 6 cents and 30 cents per pound respectively

Castor pomace at about the average price of $57 per ton has furnished nitrogen for about 47.1 cents per pound, six cents more than its cost in cotton seed meal.

PEANUT MEAL.

11719. Peanut meal, sent by F. B. Sherwood, New Milford, contains nitrogen 6.30 per cent., phosphoric acid 1.51 and potash 1.42 per cent. There can be little doubt that it would serve as a substitute for cotton seed meal in tobacco fertilizers.

II. RAW MATERIALS CHIEFLY VALUABLE FOR PHOSPHORIC ACID.

BARIUM-PHOSPHATE.

12567. Grade B. Sold by Witherbee, Sherman & Co., Port Henry, N. Y. Stock of A. N. Pierson Inc., Cromwell. Guaranteed 16 per cent. phosphoric acid. Cost $18.00 per ton.

It contained 15.61 per cent. phosphoric acid, chiefly in insoluble form.

12892. Grade C. Sold by Witherbee, Sherman & Co., Port Henry, N. Y. Stock of Raymond Coleman, Cheshire. Guaranteed 14 per cent. phosphoric acid. Cost $22.50 per ton.

It contained 14.98 per cent. phosphoric acid. Barium-Phosphate is a misnomer. The material is apparently a mixture of ground apatite with some sulphide of barium.

The state of combination of the sulphur in this mixture is shown in the following table.

12567 is new stock. **12306** is material which had lain in storage since last year.

	12567	12306
Total phosphoric acid	15.61	15.35
"Available" phosphoric acid	0.54	0.52
Insoluble phosphoric acid	15.07	14.83

	12567	12306
Total sulphur	0.88	1.49
Of which as sulphide	0.63	0.58
Of which as sulphate	0.03	0.28
Of which as thiosulphate	0.22	0.63
Total barium	3.12	5.42
Of which soluble in acid	3.01	4.28
Free sulphur	....	.0025

The differences between the two are probably in part due to atmospheric action and in part are differences in the original composition.

The actual amount of barium sulphide cannot exceed 3.32 per cent.

RAW ROCK PHOSPHATE.

Two samples were analyzed as follows:

13321. Tacco Ground Phosphate. Sold by Tennessee Agricultural Chemical Corporation, Centerville, Tenn. Sent by A. W. Forbes, East Haven.

12890. Phoslime. Sold by Florida Soft Phosphate & Lime Co., Ocala, Fla. Stock of Meriden Grain & Feed Co., Meriden.

ANALYSES OF RAW ROCK PHOSPHATE.

Station No.	13321	12890
Water-soluble phosphoric acid	0.16	....
Citrate-soluble phosphoric acid	1.19	....
Citrate-insoluble phosphoric acid	25.74	....
Total phosphoric acid	27.09	21.95
"Available" phosphoric acid found	1.35	....
Cost per ton	....	$40.00

PRECIPITATED BONE PHOSPHATE.

Two samples analyzed as follows:

12726. Sold by Olds & Whipple, Hartford. Sampled at factory. Cost $1.60 per unit available phosphoric acid.

12667. Sent by L. J. Prior, East Hartford.

ANALYSES OF PRECIPITATED BONE PHOSPHATE.

Station No.	12726	12667
Water-soluble phosphoric acid	2.12	1.86
Citrate-soluble phosphoric acid	26.80	32.48
Citrate-insoluble phosphoric acid	3.44	3.58
Total phosphoric acid	32.36	37.92
"Available" phosphoric acid found	28.92	34.34
"Available" phosphoric acid guaranteed	32.00	....
Cost of "available" phosphoric acid per pound	**8¢**	....

This is essentially a calcium phosphate, a by-product of chemical manufacture, very fine and, as the analyses show, in very soluble condition.

BASIC LIME PHOSPHATE.

Two samples were analyzed as follows:

12729. Sold by American Agricultural Chemical Co., New York City. Stock of S. B. Warner, Windsor. Cost $27.75 per ton. Guaranteed 13 per cent. "available" phosphoric acid, 14 per cent. total phosphoric acid.

12800. Basic Fruit and Legume Phosphate. Sold by Coe Mortimer Co., New York City. Stock of J. M. Harmon, Meriden. Cost $24.50 per ton. Guaranteed 13 per cent. "available" phosphoric acid, 14 per cent. total phosphoric acid.

ANALYSES OF BASIC LIME PHOSPHATE.

Station No.	12729	12800
Water-soluble phosphoric acid	1.40	6.62
Citrate-soluble phosphoric acid	12.74	7.42
Citrate-insoluble phosphoric acid	1.13	1.06
Total phosphoric acid	15.27	15.10
"Available" phosphoric acid	14.14	14.04
Cost of "available" phosphoric acid per pound	**9.8¢**	**8.7¢**

DISSOLVED ROCK PHOSPHATE OR ACID PHOSPHATE.

Sixteen samples were analyzed as follows:

12669. Sold by Baugh Chemical Co., Baltimore, Md. Stock of Farmers' Exchange, Meriden.

12951. Sold by Wilcox Fertilizer Co., Mystic. Stock of M. E. Thompson, Ellington.

12723. Sold by L. T. Frisbie Co., New Haven. Stock of F. S. Platt Co., New Haven.

12561. Sold by Sanderson Fertilizer & Chemical Co., New Haven. Sampled at factory.

12802. Sold by Coe-Mortimer Co., New York City. Stock of Conyers Farm, Greenwich.

12969. Sold by National Fertilizer Co., New York City. Stock of W. L. Thorpe, North Haven.

12558. Sold by Apothecaries Hall Co., Waterbury. Sampled at factory.

12736. Sold by Bowker Fertilizer Co., New York City. Stock of C. G. Lawton, Brooklyn, Conn.

12563. Sold by F. S. Royster Guano Co., Baltimore, Md. Stock of F. E. Beach, Branford.

12557. Sold by American Agricultural Chemical Co., New York City. Stock of D. L. Clark & Son, Milford.

12733. Sold by Armour Fertilizer Works, Chrome, N. J. Stock of Quality Seed Store, Stamford.

12712. Sold by Coe-Mortimer Co., New York City. Stock of Gunther Bros., Rockville.

12559. Sold by American Agricultural Chemical Co., New York City. Stock of W. J. Lobdell, Stratford.

12609. Sold by American Agricultural Chemical Co., New York City. Stock of E. H. Latimer & Son, Southington.

12810. Sold by Nitrate Agencies Co., New York City. Stock of A. F. Brinckeroff, Georgetown, Conn.

12689. Sold by Sanderson Fertilizer and Chemical Co., New Haven. Sent by J. L. Watrous, Middlefield.

ANALYSES OF ACID PHOSPHATE.

Station No.	Water-soluble phosphoric acid.	Citrate-soluble phosphoric acid.	Citrate-insoluble phosphoric acid.	Total phosphoric acid.	"Available" phosphoric acid found.	"Available" phosphoric acid guaranteed.	Cost per ton.	"Available" phosphoric acid cost cents per pound.
12669	12.79	2.74	1.39	16.92	15.53	16.00	$24.75	7.9
12951	15.48	2.39	0.14	18.01	17.87	16.00	31.00	8.6
12723	14.82	3.04	0.13	17.99	17.86	16.00	32.00	8.9
12561	13.53	3.17	0.38	17.08	16.70	16.00	30.00	8.9
12802	12.48	3.62	1.55	17.65	16.10	16.00	31.50	9.7
12969	14.14	2.30	1.65	18.09	16.44	16.00	34.00	10.3
12558	10.68	3.37	0.14	14.19	14.05	14.00	30.00	10.6
12736	11.88	2.88	1.42	16.18	14.76	14.00	32.00	10.7
12563	10.63	4.70	1.34	16.67	15.33	16.00	33.00	10.7
12557	11.18	2.97	1.48	15.63	14.15	14.00	30.69	10.8
12733	13.99	2.84	0.06	16.89	16.83	16.00	40.00	11.8
12712	11.85	4.76	1.36	17.97	16.61	14.00	31.50	13.5
12559	12.31	3.22	1.92	17.45	15.53	16.00	30.00	14.2
12609	13.45	2.72	1.43	17.60	16.17	16.00	....	....
12810	13.57	2.54	2.02	18.13	16.11	16.00	....	....
12689	14.14	3.52	0.43	18.09	17.66	16.00	....	....

The cost of available phosphoric acid in this form has ranged from 7.9 to 14.2 cents per pound, an average of 10.5 cents. It has cost about one cent a pound more in the 14 per cent. goods than in the 16 per cent.

The average prices given in our reports for the last 8 years are as follows:

1912	5.6 cents
1913	4.7
1914	4.65
1915	3.99
1916	6.7
1917	6.2
1918	7.9
1919	10.5

The price of acid phosphate has advanced almost to prohibitive prices in spite of the fact that oil of vitriol, which combined with lime makes up about half the weight of acid phosphate, has declined in price since the armistice. Various contributing causes have been brought forward to explain the facts: The increased cost of labor and of freight, the scarcity of shipping to bring the rock to northern factories, a strike at the phosphate mines which has for a time stopped the output of rock phosphate, car shortage and the indisposition of manufacturers to sell farmers anything other than ready mixed fertilizers at a reasonable price. The practice of selling acid phosphate on condition that a certain amount of mixed fertilizer is sold with it is an unfair and illegal practice under the laws at present in force.

The effect of this situation is, in our judgment, to increase the sales of raw phosphates, ground apatite mixed with barium sulphide, Tennessee floats and fine ground soft Florida rock, rather than to increase the use of factory mixed goods, and to the trial of all possible home mixtures to increase the availability of these slower acting forms of phosphoric acid.

From the preceding discussion we may put together the approximate cost per pound of phosphoric acid in those articles in which phosphoric acid is the chief fertilizing ingredient.

Total phosphoric acid	
In barium-phosphate	5.7–7.5
Florida soft phosphate	9.1
Available phosphoric acid	
Acid phosphate	10.5
Basic lime phosphate	8.7–9.8
Precipitated bone phosphate	8.0

At these prices certainly precipitated bone phosphate has been the best purchase, price and fertilizing value considered.

Considering the relative cost of "available" phosphoric acid and the two forms of less soluble phosphoric acid, it is quite certain that on our light humus-poor soils and for the variety of crops generally grown in the state the more soluble forms at present prices are preferable.

III. RAW MATERIALS OF HIGH GRADE CONTAINING POTASH.

COTTON HULL ASHES.

Three samples were analyzed as follows:

12480. Sold by Olds & Whipple, Hartford. Stock of John Wolf, Windsor. Cost $6 per unit of water-soluble potash, equivalent to 30 cents per pound for actual potash. It contained 29.30 per cent. potash.

12654. Sold by Olds & Whipple, Hartford. Stock of John Wolf, Windsor. Cost $6 per unit of water-soluble potash, equivalent to 30 cents per pound for actual potash. It contained 19.10 per cent. of potash.

12902. Sold by Olds & Whipple, Hartford. Stock of New England Tobacco Corp., John Wolf, manager, Windsor. Cost $4 per unit of water-soluble potash, equivalent to 20 cents per pound for actual potash. It contained 25.70 per cent. of potash.

Sample **12480** was sold in March. The price of **12902**, sold by the same firm three months later, reflects the falling price of potash.

POTASH SALTS.

The following analyses show the composition of potash salts from various sources, probably all of them American. They were not taken from stock on sale in this state, but were contributed chiefly by Prof. Whitney, chief of the U. S. Bureau of Soils:

		Per cent. of water-soluble potash.
12438	Muriate of potash from kelp	60.08
12440	Kelp ash	36.72
12439	Searles Lake ("Trona Potash")	31.98
12442	Nebraska potash	26.20
12441	Potash extracted from green sand marl	53.80
12443	Potash from blast furnace	12.28[1]
12444	Cement flue blast furnace	11.30[2]
12445	Molasses residue	38.06[3]

[1] Total potash 20.46.
[2] Total potash 12.76.
[3] 20.14 per cent. as muriate, 12.42 as sulphate, 5.51 as carbonate.

The Searles Lake potash contains borax in considerable amount. A very large amount of borax in a fertilizer may cause injury or ruin to crops. The U. S. Department of Agriculture, acting under authority conferred during the war, has ordered manufacturers not to sell fertilizers containing more than 0.1 per cent. borax without plainly showing the amount of borax on the containers.

The following samples were taken in the Connecticut market:

12485. American Potash. Sent by Prof. W. L. Slate, Jr., Storrs, Conn. It contained 52.36 per cent. of potash.

12509. Antioch Nebraska Potash. It contained 22.18 per cent. of which 4.41 per cent. was muriate and 17.77 per cent. sulphate.

OTHER MATERIALS CONTAINING POTASH.

12029. Alpha Potash-Lime Fertilizer. Made by Alpha Portland Cement Co., Easton, Pa. Sent by E. N. Austin, Suffield. It contained 2.33 per cent. of potash and 25.92 per cent. of lime. Cost $13 per ton.

12568. Alpha Potash-Lime Fertilizer. Made by Alpha Portland Cement Co., Easton, Pa. Stock of Louis H. Porter, Stamford. Guaranteed 2.50 per cent. potash. It contained 2.17 per cent. potash. Cost $12 per ton.

If potash is valued at 30 cents per pound, the price current in the spring of 1919, the valuation of the potash alone about covers the cost of the fertilizer.

Wood ashes have been used considerably as a source of potash on the tobacco crop being bought at $6 to $6.30 per unit of potash which is equivalent to 30 to 32½ cents per pound. Analyses of wood ashes are given on later pages of this report.

NITRAPO.

With the potash salts may be classed this material, offered by the Nitrate Agencies Co. of New York City. It is stated to be a product of refineries in Chili.

12703. Sent by the Hartford county agricultural agent. It contains 14.52 per cent. of nitrogen and 19.94 per cent. of potash. It contains less than one-half per cent. of chlorine and no borax. The price quoted is $175 per ton in New York. Allowing 31½ cents per pound for nitrogen the potash costs 41.3 cents per pound or $8.26 per unit.

IV. CONTAINING NITROGEN AND PHOSPHORIC ACID.

FISH MANURES.

Fifteen analyses of this material appear in the table. In only one, **12841,** is the nitrogen less than was guaranteed but four failed to meet the guaranty of phosphoric acid.

13509 is fish bought in the previous year.

The six other samples of which the prices are given and the composition is normal have the following average composition:

Nitrogen	8.36
"Available" phosphoric acid	7.45
Insoluble phosphoric acid	3.04
Cost per ton	$101.00

If the "available" phosphoric acid is valued at 10½ cents per pound, its cost in acid phosphate, and the insoluble phosphoric acid at 4 cents, the average cost of nitrogen in fish manures has been about 49.6 cents per pound.

ANALYSES OF

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.
	Sampled by Station:	
12731	American Agr. Chem. Co.	Jacob Lang, Windsor
12672	Apothecaries Hall Co.	H. B. Cornwall, Meriden
12692	Berkshire Fertilizer Co.	Max Lavitt, Ellington
12720	L. T. Frisbie Co.	Frisbie Branch, Hartford
12863[1]	A. L. Koster, Suffield	Am. Sumatra Tob. Co., Win. Locks
12968[2]	A. L. Koster, Suffield	Michael Cannon, Ellington
13509	Russia Cement Co., Boston	Griffin Tobacco Co., Bloomfield
12923	Olds & Whipple	Manufacturer
12943	Va.-Car. Chemical Co.	S. J. Stevens, Glastonbury
	Sampled by Purchaser:	
12755	A. Manning, South Manchester	Jos. Prekop, West Suffield
12470		E. J. Eaton, New London
12601	A. W. Higgins, S. Deerfield, Mass.	Aaron Dobkin, Ellington
12841	A. L. Koster, Suffield	Fassler & Silberman, Hartford
12423		Am. Sumatra Tob. Co., E. Hartford
12666		L. J. Prior, East Hartford

[1] Chlorine 0.24. [2] Chlorine 0.15.

SLAUGHTER HOUSE TANKAGE.

Of the seven samples drawn by the station six represent products low in nitrogen. *(For analyses see page 70.)*

The three samples from Meriden, made by C. M. Shay Co., are much below their guaranty of nitrogen.

If the phosphoric acid in these samples is valued at 6 cents, the average cost of nitrogen is about 42.1 cents. If on the other hand nitrogen is reckoned worth 49.6 cents per pound, as in fish scrap, the phosphoric acid costs 4.1 cents.

MIXED BONE AND TANKAGE.

12978. Listers Celebrated Ground Bone and Tankage Acidulated, made by Listers Agricultural Chemical Works, Newark, N. J. From stock of G. C. Neal, Hamden. *(For analysis see page 70.)*

FISH MANURES.

Nitrogen.				Phosphoric acid.			Total phosphoric acid.		
As ammonia.	As organic.	Total found.	Total guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Cost per ton.
0.37	5.97	6.34	5.76	0.40	3.92	0.95	5.27	5.50	.....
0.10	8.15	8.25	8.20	0.23	8.09	5.37	13.69	5.50	$100.00
0.25	7.38	7.63	7.40	0.64	6.16	0.91	7.71	7.00	105.00
0.21	8.12	8.33	7.41	0.27	5.89	1.34	7.50	14.00	90.00
0.12	8.42	8.54	8.23	0.29	3.02	0.55	3.86	5.00	.....
....	....	8.38	8.23	0.31	2.02	0.82	3.15	5.00	.....
0.10	7.95	8.05	....	0.51	8.23	7.01	15.75	....	50.00
0.13	8.03	8.16	8.23	0.42	7.19	4.43	12.04	5.50	110.00
0.12	9.14	9.26	8.20	0.45	5.47	1.32	7.24	2.00	100.00
0.60	4.77	5.37	....	0.62	6.80	3.22	10.64	10.00	70.00
0.10	9.84	9.94	....	0.63	1.04	0.52	2.19	....	.....
0.12	8.39	8.51	7.00	0.36	9.54	4.84	14.74	16.00	100.00
....	....	7.38	8.23	0.28	3.59	0.83	4.70	5.00	.....
0.12	8.69	8.81	....	0.51	5.02	1.80	7.33	....	.....
0.05	7.10	7.15	....	0.63	6.93	7.36	14.92	....	.....

ANALYSES OF

Station No.	Manufacturer.	Dealer or Purchaser.
	Sampled by Station:	
12670	Apothecaries Hall Co.	H. B. Cornwall, Meriden
12735	Armour Fertilizer Works	Quality Seed Store, Stamford
12671	F. O. Brown, Leonards Bridge	Meriden Farmers' Exchange
12719	Conn. Fat Rend. & Fertz. Co.	Manufacturer
12790	C. M. Shay Co.	Peter Levine, Meriden
13367	C. M. Shay Co.	Chas. T. Kinney, Meriden
13368	C. M. Shay Co.	W. T. Rice, South Meriden
	Sampled by Purchaser:	
12431	Allison Bros., Middletown	Raymond J. Harris, Middletown
12676		Rhett Fletcher, Mount Carmel

PERCENTAGE COMPOSITION OF MIXED BONE AND TANKAGE.

Total nitrogen found	2.53
Total nitrogen guaranteed	2.67
Total phosphoric acid found	10.98
Total phosphoric acid guaranteed	12.00
Finer than 1–50	62.00
Coarser than 1-50	38.00

BONE MANURES.

(ANALYSES ON PAGE 72.)

All of the sixteen brands examined substantially meet their guaranties. In twelve brands more than 50 per cent. of the bone was finer than 1-50 inch.

The average cost of all the brands was $58.27 per ton. If nitrogen is given a value of 49.6 cents a pound, as in cotton seed meal, a pound of phosphoric acid cost 5.2 cents.

If phosphoric acid is valued at 6 cents, nitrogen costs 43.8 cents.

Following is a statement of the *approximate* average prices which have been paid in this state for nitrogen, phosphoric acid and potash during the spring of 1919.

SLAUGHTER HOUSE TANKAGE.

Nitrogen.				Phosphoric acid.		Mechanical analysis.		
As ammonia.	As organic.	Total found.	Total guaranteed.	Found.	Guaranteed.	Finer than 1-50 inch.	Coarser than 1-50 inch.	Cost per ton.
0.18	3.72	3.90	3.29	21.77	20.00	42.0	58.0	$55.00
0.25	7.30	7.55	7.40	7.77	6.87	41.0	59.0	80.00
0.13	5.32	5.45	4.92	15.67	14.00	37.0	63.0	57.00
0.31	2.82	3.13	3.00	22.85	20.00	58.0	42.0	45.00
0.34	3.14	3.48	5.00	19.32	15.00	55.0	45.0	57.00
0.37	3.64	4.01	5.00	17.09	16.00	49.0	51.0	....
0.30	3.52	3.82	5.00	18.48	16.00	57.0	43.0	....
0.12	6.72	6.84	....	12.29	....	45.0	55.0	45.00
....	....	3.78	....	22.90	....	62.0	38.0	....

	Cents per pound.
Nitrogen in nitrate of soda, 29 to 35	31.5
sulphate of ammonia	23.9
cotton seed meal	40.5
castor pomace	47.1
fish	49.6
tankage	42.1
bone	43.8
Total phosphoric acid in ground apatite	5.7 to 7.5
Florida rock	9.1
Available phosphoric acid in precipitated bone	8.0
basic lime phosphate	8.7 to 9.8
acid phosphate	10.5
Potash in cotton hull ashes	30.0
wood ashes	30 to 32.5
from cement manufacture	24 to 28
in "Nitrapo"	41.3

V. MIXED FERTILIZERS.

NITROGENOUS SUPERPHOSPHATES WITHOUT POTASH.

In a following table are 166 analyses representing nearly all the brands of this class offered for sale in this state in 1919.

ANALYSES OF

Station No.	Manufacturer and Brand.	Dealer or Purchaser.
	Sampled by Station:	
12985	Am. Agr. Chem. Co., Fine Ground Bone	W. C. Mansfield, North Haven ...
12984	Amer. Agr. Chem. Co., High Grade Ground Bone	J. A. Glasnapp, West Cheshire ...
12983	Armour Fertz. Works, Bone Meal	F. S. Bidwell & Co., Wind. Locks
12982	Berkshire Fertz. Co., Ground Bone	Max Lavitt, Ellington
12981	Coe-Mortimer Co., Fine Ground Bone..	J. P. Barstow & Co., Norwich
12980	L. T. Frisbie Co., Fine Bone Meal	F. S. Platt & Co., New Haven
12979	Listers Agr. Chem. Works, Bone Meal	Paul Lanz, Rockville
12974	Pawtucket Ren. Co., Pure Ground Bone	A. D. Briggs, Pomfret
12880	Rogers & Hubbard Co., Pure Raw Knuckle Bone Flour	Cadwell & Jones, Hartford
12967	Rogers & Hubbard Co., Strictly Pure Fine Bone	David Bros., Durham
12977	F. S. Royster Guano Co., Fine Ground Bone Meal	Silliman Hdw. Co., New Canaan ..
12976	Sanderson Fertz. & Chem. Co., Fine Ground Bone	Manufacturer
12934	M. L. Shoemaker & Co., Swift Sure Bone Meal	Olds & Whipple, Hartford
12434	Springfield Ren. Co., Fine Ground Bone	G. S. Phelps & Co., Thompsonville
12469	Van Iderstine Co., Pure Ground Bone..	E. B. Clark Seed Co., Milford
12975	Worcester Rend. Co., Royal Worcester Pure Fine Ground Bone	F. M. Cole, Putnam

COMPOSITION AND COST OF THE BRANDS.

In almost all cases excepting those having 4.11 per cent. of nitrogen (5 per cent. ammonia) or more, either 8 or 10 per cent. of available phosphoric acid is guaranteed.

13	samples	have	a	guaranty	of	.82	per cent.	nitrogen.
21	"	"	"	"	"	1.65	"	"
23	"	"	"	"	"	2.47	"	"
26	"	"	"	"	"	3.29	"	"
36	"	"	"	"	"	4.11	"	"
8	"	"	"	"	"	5.53	"	"
9	"	"	"	still higher nitrogen guaranty.				
30	"	unclassified.						
166								

BONE MANURES.

Nitrogen.		Phosphoric acid.		Mechanical analysis.		
Found.	Guaranteed.	Found.	Guaranteed.	Finer than 1-50 inch.	Coarser than 1-50 inch.	Cost per ton.
3.43	2.47	24.51	22.89	65.0	35.0	.....
3.38	3.29	23.08	20.50	70.0	30.0	$56.00
2.80	2.47	25.07	22.00	60.0	40.0	59.00
3.76	3.30	22.34	20.00	36.0	64.0	60.50
2.67	2.47	22.26	22.35	59.0	41.0	58.00
3.25	2.46	23.85	20.00	32.0	68.0	55.00
3.78	2.47	23.56	23.00	64.0	36.0	56.50
3.05	2.47	25.25	23.00	64.0	36.0	48.00
3.90	3.82	25.28	24.70	68.0	32.0	70.00
3.58	3.29	22.06	20.59	58.0	42.0	62.00
2.47	2.47	24.36	22.90	51.0	49.0	59.00
3.06	2.47	25.07	22.00	49.0	51.0	50.00
5.20	5.14	23.69	20.88	74.0	26.0	66.50
3.36	2.46	25.23	23.00	65.0	35.0	54.00
2.26	2.00	28.86	27.00	48.0	52.0	.....
3.41	2.47	22.06	23.00	57.0	43.0	53.00

Comparing brands containing the same amount of available phosphoric acid but different amounts of nitrogen, it is possible to approximately determine the average cost price of nitrogen. Thus 11 brands with 10 per cent. available phosphoric acid contain 0.82 per cent. and cost $41.14; 19 contain 1.65 nitrogen and cost $49.77; .82 per cent. or 16.4 lbs. of nitrogen in the ton cost $49.77 — $41.14 = $8.63 ÷ 16.4 = 52 cents per pound for nitrogen. Rising from a guaranty of 1.65 per cent. nitrogen to 2.47 per cent., nitrogen costs 32.3 cents. Rising from 2.47 per cent. to 3.29 per cent., nitrogen costs 36.4 cents.

It is clear, as has always been contended by the station, that the higher grade fertilizers, notwithstanding their higher price, are the more economical.

Guaranties.

Fifteen samples contained less nitrogen than was guaranteed, and 12 contained less phosphoric acid.

In most cases, however, the money value of the deficiency in one ingredient was made good by an overrun in the other.

Eight samples failed to thus make good by the amounts given below, valuing nitrogen at 45 cents per pound and available phosphoric acid at 10 cents.

12959	Bradley's Special Potato Manure	$2.42
12916	Armour's Special Tobacco Grower	1.91
12715	Coe-Mortimer's Top Dressing Manure, 1916	2.13
12534	Lowell Potato Phosphate	2.83
12835	Mapes General Crop, 1916	2.58
12843	National Nitrogen Phosphate Mixture No. 5	4.83
12776	Royster's Landmark Ammoniated Phosphate	5.14
12925	Royster's Penguin Ammoniated Phosphate	1.31

But of Armour's Special Tobacco Grower, a second sample which fully met its guaranty was drawn from another source.

A second sample of Coe-Mortimer's Top Dressing Manure 1916 was also found to meet its guaranty. The same is true of Royster's Penguin Ammoniated Phosphate as appears from the analysis in the table.

Quality of the Nitrogen.

The solubility of the water-insoluble nitrogen in all factory mixtures has been determined by the permanganate methods of Jones and Street. In the following brands the presence of inferior forms of nitrogen was indicated by both methods:

12520 Atlantic Packing Co.'s Grain Fertilizer.
12783 Berkshire Fertilizer Co.'s Grass Special.
12612 Berkshire Fertilizer Co.'s Potato and Vegetable Phosphate.
12597 Berkshire Fertilizer Co.'s Root Fertilizer.
12717 Coe-Mortimer Co.'s Tobacco Special.
12531 Lowell Fertilizer Co.'s Potato Manure.
12849 New England Fertilizer Co.'s Corn and Grain Fertilizer.
12848 New England Fertilizer Co.'s Standard Phosphate.
13031 Rogers & Hubbard Co.'s Bone Base Soluble Corn and General Crops.

The Berkshire Fertilizer Co. explains that their formulas were calculated to furnish the full amount of nitrogen necessary to meet their guaranties in available form *without counting the nitrogen in garbage tankage* which was added as a conditioner or dryer. To such use of garbage tankage or other conditioner no objection is made, but in these cases the formulas did not meet the guaranties without counting in the inferior nitrogen of the conditioner.

Analyses Needing Special Notice.

12700, Atlantic Packing Co.'s Tobacco Special was below guaranty in nitrogen and far above it in available phosphoric acid. The manufacturer objected that this did not fairly represent the composition of this brand. A second sample of this brand was therefore drawn and analyzed, **12953,** which fully met the guaranty.

12778, the above firm's Top-Dresser, was deficient in nitrogen. The manufacturer showed that this was stock carried over from the previous season. Another sample, representing the present season's output, **12986,** also showed a slight deficiency of nitrogen.

13156, Coe-Mortimer's Top-Dressing Manure, 1916, being found deficient in available phosphoric acid, a portion of our sample was sent to the manufacturer's chemist whose analysis differs from ours in these respects:

	Station figures.	Manufacturer's figures.
Available phosphoric acid	7.33	7.74
Total phosphoric acid	8.55	9.08

Frequently manufacturers have called for portions of our samples for their own test, but in all other cases so far as reported their results and ours have substantially agreed. We cannot explain the discrepancy in this case.

NITROGENOUS SUPERPHOSPHATES WITHOUT POTASH.

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.	Nitrogen. In nitrates.	Nitrogen. In ammonia.	Nitrogen. Organic, water-soluble.	Nitrogen. Organic, water-insoluble.	Nitrogen. Total. Found.	Nitrogen. Total. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. So-called "Available." Found.	Phosphoric Acid. So-called "Available." Guaranteed.	Station No.
	Sampled by Station:																
	American Agricultural Chem. Co., New York City.																
12591	Ammoniated Fertilizer A	Milford	$36.00	0.14	0.15	0.11	0.74	1.14	0.82	7.20	3.86	0.93	11.99	11.00	11.06	10.00	12591
12590	Ammoniated Fertilizer AA	Milford	43.95	....	0.56	0.19	1.00	1.75	1.65	7.58	2.88	1.02	11.48	11.00	10.46	10.00	12590
12756	Ammoniated Fertilizer AAA	Milford	55.00	....	1.12	0.34	1.14	2.60	2.47	8.94	2.11	0.83	11.88	11.00	11.05	10.00	12756
12592	Ammoniated Fertilizer AAAA	Southport	58.00	1.29	0.94	0.34	0.87	3.44	3.29	8.38	2.17	0.86	11.41	11.00	10.55	10.00	12592
12955	Complete Tobacco Manure without Potash	Ellington	....	1.07	0.08	0.06	3.40	4.61	4.53	1.10	3.45	0.27	4.82	4.00	4.55	3.00	12955
12511	5–8 Fertilizer	New Haven	....	0.93	1.90	0.14	1.12	4.09	4.11	7.10	1.54	0.79	9.43	9.00	8.64	8.00	12511
12957	Odorless Grass and Lawn Top Dressing without Potash	Ellington	....	1.49	1.34	0.13	1.34	4.30	4.11	6.31	3.46	1.33	11.10	11.00	9.77	10.00	12957
12757	Odorless Grass and Lawn Top Dressing without Potash	Stafford Springs	70.00	1.80	1.22	0.29	0.77	4.08	4.11	6.70	3.26	1.43	11.39	11.00	9.96	10.00	12757
12956	Special Vegetable Fertilizer	Ellington	....	1.07	1.14	0.07	1.15	3.43	3.29	6.34	3.60	1.42	11.36	11.00	9.94	10.00	12956
12593	Tobacco Special	Glastonbury	....	0.99	0.24	0.04	3.08	4.35	4.11	1.34	4.36	0.35	6.05	5.00	5.70	4.00	12593
12644	Bradley's Grain Fertilizer	Putnam	39.00	....	0.36	0.14	0.54	1.04	0.82	6.12	3.64	0.90	10.66	11.00	9.76	10.00	12644
12759	Bradley's Root Crop Manure	Groton	66.00	0.92	1.46	....	1.07	3.45	3.29	7.25	3.06	1.22	11.53	11.00	10.31	10.00	12759
12645	Bradley's Special Corn Phosphate without Potash	Norwich	50.00	0.27	0.63	....	0.91	1.81	1.65	6.15	4.43	1.32	11.90	11.00	10.58	10.00	12645
12959[1]	Bradley's Special Potato Manure without Potash	Groton	57.00	0.34	0.78	0.10	0.97	2.19	2.47	6.54	3.51	1.05	11.10	11.00	10.05	10.00	12959
12646	Bradley's Special Potato Fertilizer without Potash	Groton	50.00	0.05	0.65	0.17	0.90	1.77	1.65	5.92	4.34	1.47	11.73	11.00	10.26	10.00	12646
12512	Bradley's Tobacco Manure without Potash	Suffield	75.00	1.04	0.17	....	3.25	4.46	4.53	0.68	4.26	0.38	5.32	4.00	4.94	3.00	12512
12763	East India Tobacco Special without Potash	Gaylordsville	70.00	0.81	0.36	0.24	3.05	4.46	4.53	0.98	3.88	0.50	5.36	4.00	4.86	3.00	12763
12648	Quinnipiac Special Corn Manure without Potash	New London	50.00	0.09	0.63	0.07	1.01	1.80	1.65	6.59	4.05	0.77	11.41	11.00	10.64	10.00	12648
12766	Quinnipiac Special Potato Phosph. without Potash	New London	52.00	0.15	0.63	0.05	0.98	1.81	1.65	7.02	3.88	0.87	11.77	11.00	10.90	10.00	12766
12767	Quinnipiac Wrapper Leaf Brand Manure without Potash	Hazardville	72.00	0.93	0.07	0.08	3.49	4.57	4.53	1.73	3.31	0.22	5.26	4.00	5.04	3.00	12767
12912	Williams and Clark's Seed Leaf Tobacco Manure without Potash	South Manchester	73.00	0.85	0.44	0.12	3.29	4.70	4.53	0.89	4.21	0.51	5.61	4.00	5.10	3.00	12912
12910	Williams and Clark's Special Americus Corn Phosphate without Potash	Ellington	46.00	....	0.85	0.21	0.81	1.87	1.65	5.52	4.42	2.43	12.37	11.00	9.94	10.00	12910
12911	Williams and Clark's Special Americus Potato Manure without Potash	Ellington	46.75	0.14	0.81	0.03	0.78	1.76	1.65	5.62	4.53	2.48	12.63	11.00	10.15	10.00	12911
	Apothecaries Hall Co., Waterbury, Conn.																
12698	Liberty Corn, Fruit and All Crops	Windsorville	....	0.11	0.15	0.36	1.38	2.00	1.65	6.91	2.65	0.41	9.97	11.00	9.56	10.00	12698
12699	Liberty Market Gardeners' Special	Windsorville	60.00	....	1.31	0.62	1.57	3.50	3.29	8.99	2.05	0.63	11.67	11.00	11.04	10.00	12699
12779	Liberty Potato and Vegetable Special	Windsorville	....	....	0.73	0.52	1.38	2.63	2.47	8.35	2.18	0.31	10.84	11.00	10.53	10.00	12779
12780	Liberty Tobacco Special	Windsorville	72.00	0.25	2.00	....	1.61	3.86	4.11	3.41	1.66	0.24	5.31	5.00	5.07	4.00	12780
12954	Liberty Tobacco Special	Windsorville	....	0.27	2.01	....	1.74	4.02	4.11	3.35	1.56	0.31	5.22	5.00	4.91	4.00	12954
12594	Liberty Top Dresser for Grass and Grain	Milldale	72.00	1.89	1.71	0.22	1.08	4.90	4.94	6.94	1.68	0.28	8.90	9.00	8.62	8.00	12594
	Armour Fertilizer Works, Chrome, N. J.																
12916[1]	Special Tobacco Grower No. 2	South Manchester	71.00	0.79	0.09	0.10	2.64	3.62	4.11	3.02	2.23	2.48	7.73	4.50	5.25	4.00	12916
13157	Special Tobacco Grower No. 2	Agawam, Mass.	....	0.29	2.06	1.78		4.13	4.11	2.94	2.07	0.17	5.18	4.50	5.01	4.00	13157
12611	2–10–0	Rockville	50.00	0.16	0.81	0.09	0.65	1.71	1.65	6.37	3.04	1.54	10.95	10.50	9.41	10.00	12611
12516	4–10–0	Windsor Locks	63.00	0.24	1.60	0.22	1.23	3.29	3.29	8.05	2.18	0.95	11.18	10.50	10.23	10.00	12516

[1] See note, page 74.

NITROGENOUS SUPERPHOSPHATES WITHOUT POTASH—(*Continued*).

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.	Nitrogen. In nitrates.	Nitrogen. In ammonia.	Nitrogen. Organic, water-soluble.	Nitrogen. Organic, water-insoluble.	Nitrogen. Total. Found.	Nitrogen. Total. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. So-called "Available." Found.	Phosphoric Acid. So-called "Available." Guaranteed.	Station No.
	Sampled by Station:																
	Atlantic Packing Co., New Haven, Conn.																
12520[1]	Grain Fertilizer	New Haven	$45.75	0.19	0.74	0.28	0.49	1.70	1.64	7.25	3.60	0.50	11.35	11.00	10.85	10.00	12520
12519	Potato Phosphate	New Haven	53.50	....	0.96	0.61	0.85	2.42	2.46	6.55	3.92	0.79	11.26	11.00	10.47	10.00	12519
12701	Special Vegetable	New Haven	63.00	1.23	0.25	0.83	1.00	3.31	3.26	5.81	5.31	2.41	13.53	11.00	11.12	10.00	12701
12700[2]	Tobacco Special (C. S. Meal)	South Windsor	65.20	1.15	0.08	0.96	1.65	3.84	4.10	3.91	4.63	1.57	10.11	7.00	8.54	6.00	12700
12953	Tobacco Special (C. S. Meal)	Burnside	....	1.07	0.14	1.06	1.83	4.10	4.10	3.01	4.93	2.24	10.18	8.00	7.94	6.00	12953
12778[2]	Top Dresser	New Haven	67.75	0.73	1.87	0.42	0.88	3.90	4.10	5.56	3.35	0.52	9.43	9.00	8.91	8.00	12778
12986[2]	Top Dresser	Factory	....	0.71	1.14	0.99	1.14	3.98	4.10	5.69	3.49	0.70	9.88	9.00	9.18	8.00	12986
	Berkshire Fertilizer Co., Bridgeport, Conn.																
12690	Ammoniated Bone Phosphate	Norwichtown	40.00	0.03	0.59	0.10	0.37	1.09	0.80	4.65	5.63	0.79	11.07	11.00	10.28	10.00	12690
12783[1]	Grass Special	Ellington	....	3.15	1.07	0.04	0.48	4.74	5.00	4.09	1.56	0.38	6.03	5.00	5.65	4.00	12783
12613	Market Garden Fertilizer	Ellington	....	0.74	1.50	0.14	0.96	3.34	3.30	7.84	1.87	0.49	10.20	9.00	9.71	8.00	12613
12612[1]	Potato and Vegetable Phosphate	Centerbrook	52.00	....	0.86	0.35	0.59	1.80	1.70	2.88	8.70	1.15	12.73	11.00	11.58	10.00	12612
12597[1]	Root Fertilizer	Wethersfield	50.75	1.08	0.90	0.15	0.48	2.61	2.50	3.70	4.66	0.63	8.99	9.00	8.36	8.00	12597
12691	Tobacco Grower	Ellington	....	0.83	0.98	0.24	1.86	3.91	4.11	1.82	2.83	0.28	4.93	4.00	4.65	3.00	12691
12784	Tobacco Starter	Suffield	....	2.45	0.62	0.60	1.35	5.02	5.00	3.05	1.93	0.28	5.26	5.00	4.98	4.00	12784
	F. E. Boardman, Middletown, Conn.																
12808	Fertilizer for General Crops	Factory	57.00	0.69	1.35	0.33	0.91	3.28	3.29	4.91	3.03	0.54	8.48	....	7.94	7.00	12808
	Bowker Fertilizer Co., New York City.																
12696	Four Ten Hill and Drill	Willimantic	52.00	0.84	1.48	0.16	1.02	3.50	3.29	7.31	2.87	1.27	11.45	11.00	10.18	10.00	12696
12693	One Ten Sure Crop	Yantic	39.00	....	0.32	0.13	0.58	1.03	0.82	6.51	3.89	0.81	11.21	11.00	10.40	10.00	12693
12787	Superphosphate with Ammonia 1%	Terryville	46.00	....	0.03	0.34	0.46	0.83	0.82	7.04	3.30	1.25	11.59	11.00	10.34	10.00	12787
12522	Superphosphate with Ammonia 2%	Yalesville	51.00	....	0.44	0.32	0.89	1.65	1.65	7.10	2.93	1.61	11.64	11.00	10.03	10.00	12522
12598	Superphosphate with Ammonia 3%	Plainville	57.00	....	0.85	0.39	1.27	2.51	2.47	8.78	2.01	0.65	11.44	11.00	10.79	10.00	12598
12695	Superphosphate with Ammonia 4%	Yalesville	70.00	0.90	1.46	....	1.02	3.38	3.29	8.19	1.97	0.97	11.13	11.00	10.16	10.00	12695
12786	Superphosphate with Ammonia 5%	Simsbury	....	0.30	1.44	0.83	1.67	4.24	4.11	4.03	4.32	2.60	10.95	9.00	8.35	8.00	12786
12614	Three Ten All Round	Rockville	55.00	....	1.15	0.37	1.11	2.63	2.47	8.74	1.71	1.41	11.86	11.00	10.45	10.00	12614
12435	Tobacco Grower 1916	Thompsonville	71.00	1.01	....	0.11	3.15	4.27	4.11	1.10	4.74	0.28	6.12	5.00	5.84	4.00	12435
12694	Two Ten Farm and Garden	Norwich	54.00	0.64	0.13	0.19	0.72	1.68	1.65	2.21	7.89	2.01	12.11	11.00	10.10	10.00	12694
	F. O. Brown, Leonard's Bridge, Conn.																
12806	Vegetable and Potato Grower	Farmington	57.00	0.61	0.85	0.58	0.86	2.90	2.87	7.07	3.93	0.82	11.82	11.00	11.00	10.00	12806
12807	Oats and Top Dressing	Farmington	....	0.80	0.95	1.23	1.40	4.38	4.10	5.50	3.61	0.57	9.68	9.00	9.11	8.00	12807
	E. D. Chittenden Co., Bridgeport, Conn.																
12804	Complete Tobacco and Onion Grower without Potash	Enfield	66.50	1.95	1.23	0.03	0.40	3.61	3.29	6.60	3.93	1.62	12.15	11.00	10.53	10.00	12804
12600	Vegetable and Onion Grower without Potash	Greens Farms	57.00	0.65	1.25	0.08	0.57	2.55	2.46	7.25	3.23	1.29	11.77	11.00	10.48	10.00	12600
	E. B. Clark Seed Co., Milford, Conn.																
12711	Special Mixture for General Use	Factory	56.00	0.07	2.21	0.27	1.20	3.75	3.25	8.92	2.86	1.41	13.19	12.00	11.78	10.00	12711

[1] See note, page 74. [2] See note, page 75.

NITROGENOUS SUPERPHOSPHATES WITHOUT POTASH—(*Continued*).

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.	Nitrogen. In nitrates.	Nitrogen. In ammonia.	Nitrogen. Organic, water-soluble.	Nitrogen. Organic, water-insoluble.	Nitrogen. Total. Found.	Nitrogen. Total. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. So-called "Available." Found.	Phosphoric Acid. So-called "Available." Guaranteed.	Station No.
	Sampled by Station:																
	The Coe-Mortimer Co., New York City.																
12714	Excelsior Potato Fertilizer 1916	Greenwich	$67.50	1.66	1.25	0.02	1.17	4.10	4.11	7.77	2.59	1.20	11.56	11.00	10.36	10.00	12714
12524	High Grade Ammoniated Superphosphate 1916	Milford	48.50	....	1.27	0.63	0.96	2.86	2.47	7.61	3.37	0.46	11.44	11.00	10.98	10.00	12524
12713	Prolific Crop Producer 1916	Abington	61.50	1.43	0.97	0.21	0.93	3.54	3.29	6.60	3.43	1.02	11.05	11.00	10.03	10.00	12713
12717[1]	Tobacco Special	Rockville	69.00	0.87	0.60	none	2.64	4.11	4.11	1.74	4.57	0.60	6.91	5.00	6.31	4.00	12717
12715[1]	Top Dressing Manure 1916	Poquonock	90.00	2.43	2.85	0.12	0.65	6.05	6.58	7.20	2.12	0.38	9.70	9.00	9.32	8.00	12715
13156[2]	Top Dressing Manure 1916	Somerville	87.00	2.94	2.75	0.93		6.62	6.58	4.49	2.84	1.22	8.55	9.00	7.33	8.00	13156
	The Essex Fertilizer Co., Boston, Mass.																
12638	Fish Fertilizer	Rockville	58.00	....	0.95	0.57	0.87	2.39	2.46	6.92	4.23	0.72	11.87	11.00	11.15	10.00	12638
12615	Grain, Grass and Potato Fertilizer	South Manchester	47.00	0.07	0.08	0.42	0.48	1.05	0.82	8.06	2.65	1.42	12.13	11.00	10.71	10.00	12615
12811	Market Garden	North Haven	59.00	0.56	0.92	0.57	0.73	2.78	2.87	7.53	3.92	0.27	11.72	11.00	11.45	10.00	12811
12799	Potato Phosphate	Hartford	64.00	0.71	1.27	0.50	0.77	3.25	3.29	7.02	4.07	1.27	12.36	11.00	11.09	10.00	12799
12812	Special Tobacco 5-4	Rockville	77.00	1.38	0.10	1.00	1.85	4.33	4.10	1.21	5.64	1.36	8.21	5.00	6.85	4.00	12812
12853	Tobacco Manure 5-6	Granby	....	1.52	0.12	1.07	1.72	4.43	4.10	3.46	4.91	1.33	9.70	7.00	8.37	6.00	12853
	The L. T. Frisbie Co., New Haven, Conn.																
12525	Connecticut Special for All Crops	Meriden	68.00	....	0.88	0.97	0.63	2.48	2.46	6.87	4.24	0.70	11.81	11.00	11.11	10.00	12525
12721	Corn and Grain Fertilizer	New London	....	0.13	0.73	0.29	0.54	1.69	1.64	6.74	4.37	0.56	11.67	11.00	11.11	10.00	12721
12860	One Ten	Norwich	....	0.17	0.21	0.20	0.33	0.91	0.82	7.78	3.61	0.27	11.66	11.00	11.39	10.00	12860
12616	Market Garden and Top Dresser	Rockville	71.00	0.98	0.98	1.19	1.08	4.23	4.11	5.68	3.42	0.75	9.85	9.00	9.10	8.00	12616
12526	Potato and Vegetable Grower	Guilford	55.00	0.36	1.13	0.77	1.02	3.28	3.28	7.27	3.63	0.77	11.67	11.00	10.90	10.00	12526
12569	Tobacco Special	Glastonbury	69.75	1.17	0.09	1.05	1.77	4.08	4.10	2.94	3.21	1.74	7.89	7.00	6.15	6.00	12569
	International Agricultural Corp., Buffalo, N. Y.																
12814	Buffalo Farmers' Choice	Moosup	40.25	0.35	0.19	0.03	0.62	1.19	0.80	7.94	4.34	1.18	13.46	11.00	12.28	10.00	12814
12820	Buffalo Garden Truck	West Cheshire	60.00	1.18	0.51	0.49	1.30	3.48	3.30	7.70	2.81	1.05	11.56	11.00	10.51	10.00	12820
12816	Buffalo New England Special	Southington	49.00	0.75	0.20	0.17	0.66	1.78	1.60	6.48	3.83	1.09	11.40	11.00	10.31	10.00	12816
12433	Buffalo Onion, Vegetable and Potato	Thompsonville	54.00	0.96	0.53	0.15	1.03	2.67	2.50	7.07	3.54	1.59	12.20	11.00	10.61	10.00	12433
12818	Buffalo Tobacco Grower	West Suffield	....	1.08	1.11	0.20	1.82	4.21	4.10	0.76	3.61	1.04	5.41	5.00	4.37	4.00	12818
12819	Buffalo Tobacco Special	Enfield	62.50	0.70	0.50	0.19	2.06	3.45	3.30	0.84	3.11	0.72	4.67	4.00	3.95	3.00	12819
	A. L. Koster, Suffield, Conn.																
12864	A. S. T. Special Corn Fertilizer	East Hartford	....	0.17	2.59	0.03	1.74	4.53	4.10	7.11	2.05	0.67	9.83	10.00	9.16	8.00	12864
	Lister's Agricultural Chemical Works, Newark, N. J.																
12921	Celebrated Tobacco Fertilizer without Potash	Warehouse Point	72.75	1.03	0.05	0.15	2.78	4.01	4.53	1.58	2.50	0.15	4.23	4.00	4.08	3.00	12921
12865	Complete Tobacco Fertilizer without Potash	Burnside	68.00	1.03	1.03	0.76	1.11	3.93	4.11	2.43	2.32	0.97	5.72	5.00	4.75	4.00	12865
12529	Plant Food 1916	Yalesville	40.00	....	0.14	0.50	0.43	1.07	0.82	6.82	3.44	1.70	11.96	11.00	10.26	10.00	12529
12821	Superior Ammoniated Superphosphate 1916	Danbury	63.00	1.43	1.45	0.26	0.51	3.65	3.29	8.13	2.12	0.79	11.04	11.00	10.25	10.00	12821
	Lowell Fertilizer Co., Boston, Mass.																
12833	Animal Brand	Wallingford	60.00	0.07	0.87	0.82	1.23	2.99	2.87	7.12	4.22	1.94	13.28	11.00	11.34	10.00	12833
12922	Bone Fertilizer	Southington	58.00	0.10	0.07	1.00	0.87	2.04	2.06	6.82	3.79	1.75	12.36	11.00	10.61	10.00	12922

[1] See note, page 74. [2] See note, page 75.

NITROGENOUS SUPERPHOSPHATES WITHOUT POTASH—(*Continued*).

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.	Nitrogen. In nitrates.	Nitrogen. In ammonia.	Nitrogen. Organic, water-soluble.	Nitrogen. Organic, water-insoluble.	Nitrogen. Total. Found.	Nitrogen. Total. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. So-called "Available." Found.	Phosphoric Acid. So-called "Available." Guaranteed.	Station No.
	Sampled by Station:																
	Lowell Fertilizer Co., Boston, Mass. (*Continued.*)																
12832	Empress Brand	Saybrook	$48.00	0.10	0.10	0.57	0.64	1.41	1.23	7.37	3.56	1.79	12.72	11.00	10.93	10.00	12832
12535	Potato, Corn and Vegetable	Warehouse Point	68.00	0.83	0.99	1.02	1.14	3.98	4.10	5.94	3.57	0.70	10.21	9.00	9.51	8.00	12535
12531[1]	Potato Manure	Wallingford	58.00	....	0.96	0.83	0.86	2.65	2.46	6.81	3.82	1.69	12.32	11.00	10.63	10.00	12531
12534[1]	Potato Phosphate	Suffield	62.00	0.63	0.95	0.54	0.68	2.80	3.29	7.27	3.52	1.04	11.83	11.00	10.79	10.00	12534
12834	Tobacco Grower	Warehouse Point	69.75	1.52	0.11	0.86	1.66	4.15	4.11	3.65	4.46	1.55	9.66	7.00	8.11	6.00	12834
	The Mapes Formula and Peruvian Guano Co., New York City.																
12837	C. S. Special without Potash	Hartford	68.00	0.81	1.11	0.21	2.16	4.29	4.12	0.39	3.94	0.79	5.12	4.00	4.33	4.00	12837
12835[1]	General Crop 1916	Windsor Locks	46.00	0.63	0.43	....	0.58	1.64	1.65	0.86	5.85	4.55	11.26	10.00	6.71	8.00	12835
	National Fertilizer Co., New York City.																
12427	Five Four Tobacco Manure	Somers	....	0.96	0.52	2.76		4.24	4.11	1.21	4.28	0.42	5.91	5.00	5.49	4.00	12427
12545	Five Four Tobacco Manure	Silver Lane	68.00	1.05	0.09	....	2.97	4.11	4.11	2.05	3.02	0.46	5.53	5.00	5.07	4.00	12545
12539	Nitrogen Phosphate Mixture No. 1	Guilford	....	....	0.07	0.15	0.79	1.01	0.82	5.49	4.82	0.70	11.01	11.00	10.31	10.00	12539
12541	Nitrogen Phosphate Mixture No. 2	Wallingford	48.00	....	0.08	0.38	1.20	1.66	1.65	7.21	3.07	1.82	12.10	11.00	10.28	10.00	12541
12842	Nitrogen Phosphate Mixture No. 3	Willimantic	55.00	0.47	1.14	0.04	0.96	2.61	2.47	6.62	3.70	1.60	11.92	11.00	10.32	10.00	12842
12540	Nitrogen Phosphate Mixture No. 4	Guilford	....	0.94	1.40	0.14	0.95	3.43	3.29	7.44	3.43	0.99	11.86	11.00	10.87	10.00	12540
12843[1]	Nitrogen Phosphate Mixture No. 5	Windsorville	69.00	0.50	1.15	0.52	1.29	3.46	4.11	2.74	5.77	2.53	11.04	9.00	8.51	8.00	12843
12844	Tobacco Special without Potash	Rockville	....	0.78	0.23	0.06	3.30	4.37	4.53	1.08	3.90	0.52	5.50	4.00	4.98	3.00	12844
	New England Fertilizer Co., Boston, Mass.																
12849[1]	Corn and Grain Fertilizer	Norwich	....	0.05	0.12	0.50	0.60	1.27	1.23	7.26	3.69	2.11	13.06	11.00	10.95	10.00	12849
12542	Potato Fertilizer	Meriden	52.50	0.19	0.86	0.72	0.79	2.56	2.46	6.74	3.71	1.52	11.97	11.00	10.45	10.00	12542
12850	Special Tobacco Manure	Hazardville	70.00	1.27	0.12	0.96	1.86	4.21	4.10	3.09	5.47	1.73	10.29	7.00	8.56	6.00	12850
12848[1]	Standard Phosphate	Rockville	43.00	0.08	0.07	0.32	0.40	0.87	0.82	7.12	3.22	1.22	11.56	11.00	10.34	10.00	12848
12543	Superphosphate	North Haven	59.00	0.62	0.89	0.57	0.80	2.88	2.87	7.64	3.61	0.43	11.68	11.00	11.25	10.00	12543
12851	Tobacco Grower 5–4	Warehouse Point	68.00	1.43	0.08	1.00	1.69	4.20	4.10	0.84	5.42	1.59	7.85	5.00	6.26	4.00	12851
	Nitrate Agencies Co., New York City.																
12852	4–10 Universal Mixture	Milford	56.00	1.37	0.94	0.08	0.84	3.23	3.29	7.80	2.28	0.68	10.76	11.00	10.08	10.00	12852
	Olds and Whipple, Hartford, Conn.																
12576	Special Grass Fertilizer (less Potash)	Factory	66.30	0.10	1.33	0.13	3.51	5.07	4.95	4.12	1.79	0.95	6.77	4.00	5.82	4.00	12576
12428	Special High Grade Tobacco Starter	Somers	....	0.48	3.36	5.21		9.05	9.06	2.23	1.59	0.64	4.46	3.00	3.82	3.00	12428
12544	Special Onion, Corn and Potato Fertilizer	Factory	47.26	....	1.00	0.35	1.49	2.84	2.45	5.62	3.16	0.64	9.42	8.00	8.78	8.00	12544
12870	Special Phosphate	Factory	57.95	0.13	1.16	0.20	2.78	4.27	4.11	3.94	1.49	1.00	6.43	4.00	5.43	4.00	12870
12429	Tobacco Special Fertilizer	Somers	....	1.04	0.05	3.17		4.26	4.11	1.72	2.55	1.69	5.96	3.00	4.27	3.00	12429
	Parmenter and Polsey Fertilizer Co., Boston, Mass.																
12872	Plymouth Rock Brand	Highwood	57.00	0.59	0.88	0.59	0.81	2.87	2.87	7.40	3.76	0.45	11.61	11.00	11.16	10.00	12872
12873	Special Tobacco	Warehouse Point	66.00	1.16	0.19	1.26	1.94	4.55	4.10	1.32	4.40	1.33	7.05	5.00	5.72	4.00	12873
12871	Star Brand Superphosphate	Highwood	53.00	0.13	1.05	0.42	0.83	2.43	2.46	6.68	4.03	0.60	11.31	11.00	10.71	10.00	12871

[1] See note, page 74.

NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.
	Sampled by Station:	
	Pawtucket Rendering Co., Pawtucket, R. I.	
12894	Farm Favorite Brand 2½–10	Norwich
12893	Potato Fertilizer 4–10	Hebron
	Reliable Fertilizer Co., South Manchester, Conn.	
12896	Fish and Phosphate	Factory
	The Rogers and Hubbard Co., Portland, Conn.	
12874	All Soils-All Crops Phosphate	Hazardville
13327	Bone Base Oats and Top Dressing	Somerville
12879	Bone Base Oats and Top Dressing	Milford
13031[1]	Bone Base Soluble Corn and General Crops Manure	Gildersleeve
12875	Bone Base Soluble Corn and General Crops Manure	Branford
12877	R. & H. Bone Base Soluble Tobacco Manure	Gildersleeve
12578	R. & H. Complete Phosphate	Branford
12618	R. & H. Climax Tobacco Brand	Windsor
12617	R. & H. Potato Phosphate	Gildersleeve
	F. S. Royster Guano Co., Baltimore, Md.	
12577	Corn and Oats Ammoniated Phosphate	Branford
12777	Corn and Oats Ammoniated Phosphate	New Canaan
12776[1]	Landmark Ammoniated Phosphate	New Canaan
12925[1]	Penguin Ammoniated Phosphate	Glastonbury
13317	Penguin Ammoniated Phosphate	East Hartford
12579	Perfecto Tobacco Formula	Windsor
12627	Prime Fish Ammoniated Phosphate	New Canaan
12928	Steven's Formula	Glastonbury
	Sanderson Fertilizer and Chemical Co., New Haven, Conn.	
12931	High Grade Ammoniated Phosphate	Stratford
12932	Phosphate without Potash	Shelton
12631	Special without Potash	Wethersfield
12580	Tobacco Grower 1916	Silver Lane
12930	Top Dressing for Grass and Grain, 1916, without Potash	Mount Carmel
	M. L. Shoemaker and Co., Philadelphia, Pa.	
12935	Swift-Sure Phosphate for Tobacco and General Use	Glastonbury
	Springfield Rendering Co., Springfield, Mass.	
12936	Animal Fertilizer	Thompsonville

[1] See note, page 74.

WITHOUT POTASH—(*Continued*).

Dealer's cash price per ton.	Nitrogen. In nitrates.	Nitrogen. In ammonia.	Nitrogen. Organic, water-soluble.	Nitrogen. Organic, water-insoluble.	Nitrogen. Total. Found.	Nitrogen. Total. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. So-called "Available." Found.	Phosphoric Acid. So-called "Available." Guaranteed.	Station No.
$58.00	0.74	0.09	0.46	0.95	2.24	2.06	6.21	3.96	0.86	11.03	11.00	10.17	10.00	12894
59.50	1.38	0.04	0.62	1.23	3.27	3.26	6.54	3.99	0.55	11.08	11.00	10.53	10.00	12893
47.00	....	0.22	0.39	1.18	1.79	1.64	8.24	3.07	1.56	12.87	10.50	11.31	10.00	12896
67.25	0.22	2.98	0.06	0.59	3.85	3.30	8.21	4.75	1.61	14.57	13.50	12.96	12.50	12874
83.50	3.92	0.10	2.07		6.09	6.00	0.07	5.47	8.89	14.43	12.00	5.54	6.00	13327
....	4.36	0.06	0.32	1.63	6.37	6.00	....	4.60	7.55	12.15	12.00	4.60	6.00	12879
53.25	0.33	0.89	0.45	0.73	2.40	2.50	2.49	7.09	3.48	13.06	12.00	9.58	10.00	13031
55.00	0.32	0.95	0.32	0.76	2.35	2.50	2.22	8.23	3.79	14.24	12.00	10.45	10.00	12875
77.50	0.12	1.56	1.21	2.13	5.02	5.00	1.15	9.53	2.70	13.38	13.00	10.68	10.00	12877
45.00	....	0.74	0.13	0.38	1.25	1.00	4.92	2.51	0.96	8.39	8.00	7.43	7.50	12578
71.00	0.05	1.94	0.57	1.77	4.33	4.12	0.07	2.94	1.66	4.67	4.00	3.01	3.00	12618
57.00	....	1.35	0.19	0.57	2.11	2.00	9.26	5.38	1.52	16.16	15.00	14.64	14.00	12617
40.00	....	0.28	0.14	0.45	0.87	0.82	4.42	3.00	1.02	8.44	8.50	7.42	8.00	12577
37.00	....	0.03	0.31	0.50	0.84	0.82	4.28	3.60	0.91	8.79	8.50	7.88	8.00	12777
63.50	....	1.32	0.27	1.14	2.73	3.29	7.13	2.82	0.64	10.59	10.50	9.95	10.00	12776
47.00	0.17	0.64	0.23	0.70	1.74	1.65	5.26	3.68	1.38	10.32	10.50	8.94	10.00	12925
65.00	0.11	0.85	0.25	0.62	1.83	1.65	6.71	3.69	0.91	11.31	10.50	10.40	10.00	13317
71.00	0.20	0.99	0.10	2.73	4.02	4.11	1.44	3.22	0.93	5.59	4.50	4.66	4.00	12579
44.75	....	0.90	0.24	0.46	1.60	1.65	5.21	3.11	0.90	9.22	8.50	8.32	8.00	12627
....	0.11	0.82	0.16	3.10	4.19	4.11	1.76	3.28	0.70	5.74	4.50	5.04	4.00	12928
59.50	0.22	1.50	0.45	1.30	3.47	3.29	6.35	3.67	1.83	11.85	11.00	10.02	10.00	12931
48.00	0.24	0.74	0.31	1.20	2.49	1.65	4.67	4.97	1.82	11.46	11.00	9.64	10.00	12932
49.00	0.36	1.12	0.37	1.01	2.86	2.47	6.91	3.57	1.84	12.32	11.00	10.48	10.00	12631
68.03	1.05	0.12	0.14	3.34	4.65	4.53	0.93	3.97	0.22	5.12	4.00	4.90	3.00	12580
....	1.24	1.04	0.74	1.88	4.90	4.11	4.23	4.24	2.62	11.09	9.00	8.47	8.00	12930
....	0.14	1.90	0.29	1.24	3.57	3.28	7.34	3.70	2.56	13.60	12.00	11.04	9.00	12935
54.00	0.11	0.81	1.09	0.76	2.77	2.46	7.03	4.24	0.78	12.05	11.00	11.27	10.00	12936

NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.
	Sampled by Station:	
	Virginia-Carolina Chemical Co., New York City.	
12960	Ammoniated Bone Phosphate for All Crops	Thomaston .....
12941	High Grade Corn and Vegetable Compound without Potash	North Haven .....
12582	Indian Brand for Tobacco (C. S. M. without Potash)	Glastonbury .....
12635	Tobacco and Onion Special	Glastonbury .....
	What Cheer Chemical Co., Pawtucket, R. I.	
12491	Ammonia 4 Acid Phosphate 10	Guilford .....
	Wilcox Fertilizer Co., Mystic, Conn.	
12899	Corn Special	Ellington .....
12898	Grain Fertilizer	Ellington .....
12584	Grass Fertilizer	Suffield .....
	Worcester Rendering Co., Auburn, Mass.	
12897	Royal Worcester Corn and Grain Fertilizer	Putnam .....
12641	Royal Worcester Potato and Vegetable Fertilizer..	Putnam .....
	Sampled by Purchasers:	
12556	Amer. Agri. Chem. Co.'s Ammoniated Fertz. AAA	*Deep River:*—Connecticut Valley Orchard Co. .....
12840	A. L. Koster's A. S. T. Special Corn Fertilizer ...	*Hartford:*—Fassler and Silberman .....
12437	Olds and Whipple's Tobacco Special Fertilizer ...	*West Suffield:*—H. C. Nelso
13335	What Cheer Chemical Co.'s Special Tobacco	*Silver Lane:*—Thos. Molumph
	Manufacturer's Sample:	
13238	Pawtucket Rendering Co.'s Animal Brand	Pawtucket, R. I. .....

WITHOUT POTASH—(*Concluded*).

Dealer's cash price per ton.	Nitrogen.						Phosphoric Acid.							Station No.
	In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Total. Found.	Total. Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total. Found.	Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	
$55.00	0.10	0.10	0.32	1.29	1.81	1.65	8.42	2.15	0.20	10.77	11.00	10.57	10.00	12960
53.50	0.21	0.97	0.14	1.24	2.56	2.47	8.62	2.36	0.23	11.21	11.00	10.98	10.00	12941
....	0.26	2.05	....	1.81	4.12	4.11	2.61	1.96	0.37	4.94	5.00	4.57	4.00	12582
....	....	1.50	0.50	1.41	3.41	3.29	6.27	1.66	0.33	8.26	9.00	7.93	8.00	12635
....	0.40	0.08	3.25		3.73	3.29	2.79	5.82	6.97	15.58	10.00	8.61	....	12491
60.50	0.56	0.87	0.46	1.57	3.46	3.30	7.67	3.04	0.83	11.54	11.00	10.71	10.00	12899
45.00	0.18	0.08	0.28	1.26	1.80	1.65	6.69	3.82	1.14	11.65	11.00	10.51	10.00	12898
69.00	1.11	0.87	0.46	1.62	4.06	4.12	6.21	2.78	1.28	10.27	9.00	8.99	8.00	12584
50.00	0.53	0.26	0.61	0.73	2.13	2.06	6.10	4.37	0.63	11.10	11.00	10.47	10.00	12897
63.00	0.56	0.98	1.01	0.83	3.38	3.23	6.72	4.48	0.75	11.95	11.00	11.20	10.00	12641
....	....	....	....	....	2.64	2.47	....	....	....	12.03	11.00	....	....	12556
....	....	....	....	....	4.17	4.10	7.18	1.26	0.54	8.98	....	8.44	8.00	12840
68.50	0.68	0.09	3.72		4.49	4.11	1.99	1.32	0.83	4.14	3.00	3.31	3.00	12437
55.00	....	....	....	....	4.75	3.00	2.21	3.03	0.88	6.12	....	5.24	....	13335
53.20	0.41	0.56	0.69	1.09	2.75	2.87	6.79	3.30	0.54	10.63	11.00	10.09	10.00	13238

NITROGENOUS SUPERPHOSPHATES CONTAINING POTASH.

In the table are given 107 analyses of brands belonging to this class. *(See page 92.)*

Composition and Cost of the Brands.

The amounts of potash guaranteed are naturally much smaller than before the war.

Of the samples drawn by the station agent

1	per cent.	of	potash	was	guaranteed	in	72	samples.
2	"	"	"	"	"	"	15	"
3	"	"	"	"	"	"	9	"
4	"	"	"	"	"	"	7	"
							103	

Of nitrogen

.82	per cent.	was	guaranteed			in	14	samples.
1.65	"	"	"			"	24	"
2.47	"	"	"			"	17	"
3.29	"	"	"			"	18	"
4.11	"	"	"			"	11	"
Over 4.11	per cent.	in	.....				18	"
Scattering	.....						4	"
							106	

To compare the relative economy of purchase of goods having these different guaranties of nitrogen we may make a "valuation" of the fertilizer elements guaranteed in each, allowing 45 cents per pound for nitrogen, 10 cents for "available" phosphoric acid and 30 cents for potash.

This has been done in the case of each brand, the valuation then compared with the average cost of each formula having the same nitrogen guaranty, the percentage difference between the quoted retail price calculated and the weighted average determined. The results are as follows:

Percentage Difference between Cost and Valuation.

						Percentage difference.	Average cost per ton.
10	brands	carrying	0.82	per cent.	nitrogen	52.2	$46.99
23	"	"	1.65	"	"	35.3	58.39
14	"	"	2.47	"	"	32.4	62.21
14	"	"	3.29	"	"	23.3	71.41
10	"	"	4.11	"	"	38.8	73.38

The "percentage difference" represents approximately the percentage amount, reckoned on the cost of the fertilizer ingredients themselves, which covers the costs, profits and losses of manufacture and selling.

The practical lesson taught by it is that it does not pay the buyer to get low grade goods if he wishes to buy a fertilizer for general use. The ton price is lower but the plant food in them costs more.

In cases where he wishes to use a relatively small amount of nitrogen with a larger quantity of phosphoric acid on a special crop, oats for example, he can generally save money by buying a small amount of high grade fertilizer and using with it a proper amount of acid phosphate, if he does not find it even more economical to buy all the chemicals unmixed and prepare the mixture himself. The economy of this practice must be largely determined in each case by costs of the chemicals and labor locally, and method of payment.

Guaranties.

Of the brands sampled by the station, 7 failed to meet their guaranty of nitrogen, 4 failed in available phosphoric acid and 9 in potash while two were deficient in both nitrogen and potash. In all cases, however, except those named below, the deficiency in one ingredient was fully covered in money value by the excess of another.

In five brands the money value of the deficiencies was more than one dollar per ton, valuing nitrogen at 45 cents, available phosphoric acid at 10 cents and potash at 30 cents per pound.

		Deficiency.
12781	Armour's Grain Grower 2–8–2	1.18
12709	Bowker's Complete Manure	1.97
12970	Bowker's Lawn and Garden Dressing	2.52
12831	Listers Special Tobacco Fertilizer 1916	1.18
12895	Pawtucket Rendering Co.'s 2–8–4 Fertilizer	2.10

Quality of the Nitrogen.

The solubility of the water-insoluble nitrogen as determined by the two methods in use (the neutral permanganate and alkaline permanganate methods) indicates that a portion of the organic nitrogen is of inferior agricultural value in the following brands:

12781 Armour's Grain Grower 2–8–2.
12915 Atlantic Packing Co.'s 2–8–4.
12536 Mapes's Potato Manure 1916.
12629 Royster's Fish and Potash Guano.
12924 Royster's Truckers' Delight.

Analysis requiring Special Notice.

12628. This sample, page 96, contained very much less nitrogen than was guaranteed in the brand which it was supposed to represent and also contained 2.52 per cent. of potash which was not guaranteed in that brand. It is quite certain that through some error the sample does not at all represent the brand the name of which it bore.

Borax in Fertilizers.

Borax is known to occur in the potash salts obtained from Searles Lake in California and it has been proved that even rather small amounts of borax in a fertilizer may be poisonous to crops.

The United States Department of Agriculture prescribes that no fertilizer shall contain more than two pounds of borax or its equivalent in the ton unless the actual amount of borax is plainly stated on the package or its tag.

The Maine Department of Agriculture through its Division of Inspection has ruled that any fertilizer containing an appreciable amount of borax or its compounds will be deemed to be adulterated.

In our opinion there is very little chance that any dangerous amount of borax will be found in fertilizers hereafter. Manufacturers are fully aware of the danger, which may be as disastrous to their business as to that of their customers.

HOME-MIXED NITROGENOUS SUPERPHOSPHATES.

13400. Made by H. D. Johnson, Highwood. 630 lbs. tankage, 400 lbs. Nebraska potash, 800 lbs. acid phosphate, 100 lbs. nitrate of soda.

12988. Made by Wesley N. Peck, Mt. Carmel. "Two parts acid phosphate, one part cotton seed meal."

12972. Mixed by Olds & Whipple, Hartford, to order of the American Sumatra Tobacco Co., Silver Lane Plantation.

12971. Mixed by the same firm for the same corporation, Windsor Locks Plantation.

Analyses.

	13400	12988	12972	12971
Nitrogen in nitrates	1.56	....	0.98	0.63
as ammonia	0.30	....	0.07	0.07
organic, water-soluble		....	0.08	0.47
active insoluble	2.34	....	2.22	1.58
inactive insoluble		....	2.02	1.73
total	4.20	2.03	5.37	4.48
Phosphoric acid, water-soluble	0.70	11.73	0.67	0.70
citrate-soluble	4.96	1.34	5.55	5.90
citrate-insoluble	2.64	0.20	0.23	0.26
total	8.30	13.27	6.45	6.86
Potash, calculated as muriate	1.36	....	....	0.76
as sulphate	3.21	....	....	2.90
total	4.57	0.66	....	3.66

VI. MISCELLANEOUS FERTILIZERS AND WASTE PRODUCTS.

TOBACCO STEMS AND STALKS.

Three samples were analyzed as follows:

13390. Green Tobacco Stalks. Sent by W. S. Pinney & Co., Suffield.

12495. Tobacco Stems. Sent by L. Wetstone, Ellington.

13525. Whipped Tobacco Stems. Sent by Windsor Paper and Waste Company, Windsor.

Analyses of Tobacco Stems.

Station No.	13390	12495	13525
Nitrogen	0.27	2.13	1.03
Phosphoric acid	0.05	0.53	0.56
Potash (total)	0.41	6.09	4.84

The sample of green tobacco stalks, **13390**, consisted of 29 stalks from shade grown tobacco. Calculating 11,000 stalks to the acre, they would contain the following:

Nitrogen	60.5 pounds
Phosphoric acid	11.2 "
Potash	91.9 "

(*Continued on page 98.*)

NITROGENOUS SUPERPHOSPHATES WITH POTASH.

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.	Nitrogen. In nitrates.	Nitrogen. In ammonia.	Nitrogen. Organic, water-soluble.	Nitrogen. Organic, water-insoluble.	Nitrogen. Total. Found.	Nitrogen. Total. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. So-called "Available." Found.	Phosphoric Acid. So-called "Available." Guaranteed.	Potash. As muriate.	Potash. Total.	Potash. Guaranteed.	Station No.
	Sampled by Station:																			
	American Agricultural Chemical Co., New York City.																			
12643	Complete Potato Mixture	Southport	$80.00	0.78	1.32	0.21	1.07	3.38	3.29	9.15	1.65	0.46	11.26	11.00	10.80	10.00	3.28	3.28	3.00	12643
12652	Odorless Grass and Lawn Top Dressing Revised	Windsor	24.00	2.46	0.15	0.16	0.85	3.62	3.91	3.94	2.02	0.50	6.46	6.00	5.96	5.00	0.68	1.37	1.00	12652
12510	Sure Growth Phosphate 1916	Glastonbury	58.25	0.47	1.11	0.16	1.07	2.81	2.47	3.27	5.79	1.71	10.77	10.00	9.06	9.00	0.74	1.17	1.00	12510
12761	Bradley's Complete Manure for Potatoes and Vegetables	Groton	68.00	0.82	1.52	0.06	1.02	3.42	3.29	6.78	3.01	1.16	10.95	10.00	9.79	9.00	0.72	1.13	1.00	12761
12760	Bradley's Corn Phosphate 1916	Willimantic	55.00	0.08	0.63	0.09	0.95	1.75	1.65	6.76	3.31	1.15	11.22	11.00	10.07	10.00	0.70	1.12	1.00	12760
12607	Bradley's New Method Fertilizer 1916	Norwalk	45.00	....	0.03	0.31	0.54	0.88	0.82	6.37	2.55	0.84	9.76	9.00	8.92	8.00	0.84	1.08	1.00	12607
12647	Bradley's Potato Manure 1916	Suffield	59.00	0.74	0.73	0.22	0.90	2.59	2.47	7.68	2.27	1.01	10.96	10.00	9.95	9.00	0.64	1.12	1.00	12647
12762	Bradley's Potato Fertilizer 1919	Willimantic	55.00	0.16	0.59	0.05	0.94	1.74	1.65	6.85	3.59	1.15	11.59	11.00	10.44	10.00	0.72	1.10	1.00	12762
12905	Bradley's B. D. Sea Fowl Guano	East River	50.00	....	0.08	0.43	0.51	1.02	0.82	7.68	2.96	0.87	11.51	11.00	10.64	10.00	1.00	1.00	1.00	12905
12973	Bradley's Tobacco Manure Carbonate	East Hartford	....	1.00	0.05	0.92	2.63	4.60	4.53	0.40	4.48	0.12	5.00	4.00	4.88	3.00	0.52	*3.05	3.00	12973
12610	Bradley's Unicorn 1916	Bristol	53.00	0.12	0.45	0.23	0.86	1.66	1.65	7.84	1.57	1.04	10.45	10.00	9.41	9.00	0.96	0.96	1.00	12610
12765	East India Corn King 1916	Southport	58.75	0.46	0.78	0.17	1.01	2.42	2.47	8.12	1.53	0.97	10.62	10.00	9.65	9.00	0.84	1.01	1.00	12765
12764	East India Economizer Phosphate 1916	North Haven	....	0.09	0.06	0.25	0.41	0.81	0.82	6.58	2.17	0.92	9.67	9.00	8.75	8.00	0.78	0.95	1.00	12764
12906	East India Potato and Garden Manure	Bloomfield	67.75	0.82	0.86	0.25	1.33	3.26	3.29	5.38	4.09	1.88	11.35	10.00	9.47	9.00	0.47	1.10	1.00	12906
12608	Great Eastern General 1916	New Canaan	45.00	0.13	0.14	0.16	0.56	0.99	0.82	4.48	3.57	1.06	9.11	9.00	8.05	8.00	0.99	0.99	1.00	12608
12907	Quinnipiac Ammoniated Dissolved Bone 1916	South Manchester	45.00	0.10	0.41	0.22	0.83	1.56	1.65	7.56	1.61	1.01	10.18	10.00	9.17	9.00	0.84	0.96	1.00	12907
12515	Quinnipiac Climax Phosphate 1916	Southport	42.00	0.10	0.11	0.24	0.44	0.89	0.82	6.65	2.53	0.99	10.17	9.00	9.18	8.00	0.72	1.00	1.00	12515
12649	Quinnipiac Fish and Potash Mixture 1916	Windsor	56.75	0.47	0.74	0.27	1.39	2.87	2.47	5.76	3.22	1.10	10.08	10.00	8.98	9.00	0.48	0.90	1.00	12649
12650	Quinnipiac Market Garden Manure 1916	Southport	66.75	0.06	1.18	0.89	0.96	3.09	3.29	8.43	1.90	1.07	11.40	10.00	10.33	9.00	0.60	0.97	1.00	12650
12909	Wheeler's Cuban Tobacco Grower 1916	Granby	73.75	0.86	0.05	....	3.44	4.35	4.53	1.58	3.07	0.36	5.01	4.00	4.65	3.00	0.35	1.10	1.00	12909
12651	Wheeler's Corn Fertilizer 1916	East Hampton	56.00	....	0.53	0.33	0.93	1.79	1.65	9.06	1.44	1.24	11.74	11.00	10.50	10.00	0.58	0.75	1.00	12651
12908	Wheeler's Potato Manure 1916	East Hampton	57.75	0.11	0.67	0.25	1.03	2.06	2.06	8.47	1.81	1.18	11.46	11.00	10.28	10.00	0.80	0.96	1.00	12908
12513	Williams and Clark's Matchless Fertilizer 1916	Waterbury	54.00	0.46	0.48	....	0.91	1.85	1.65	5.54	5.09	0.63	11.26	10.00	10.63	9.00	0.40	1.09	1.00	12513
12913	Williams and Clark's Meadow Queen Fertilizer 1916	Milford	58.00	0.12	1.05	0.22	0.98	2.37	2.47	7.68	1.45	1.10	10.23	10.00	9.13	9.00	0.96	1.07	1.00	12913
12514	Williams and Clark's Special Prolific Crop Producer	Waterbury	47.00	0.10	0.11	0.21	0.39	0.81	0.82	6.63	2.25	0.86	9.74	9.00	8.88	8.00	0.76	0.92	1.00	12514
	Armour's Fertilizer Works, Chrome, N. J.																			
12595	Armour's Crop Grower	New Canaan	48.00	0.21	0.23	0.06	0.50	1.00	0.82	3.73	4.55	0.78	9.06	8.50	8.28	8.00	0.69	1.99	2.00	12595
12781	[1], [2]Armour's Grain Grower 2-8-2	New London	64.00	0.67	0.12	0.14	0.72	1.65	1.65	4.11	3.99	1.37	9.47	8.50	8.10	8.00	0.60	1.77	2.00	12781
12518	Armour's 2-8-3	Windsor Locks	....	1.01	0.17	0.07	0.56	1.81	1.65	5.50	2.56	0.72	8.78	8.50	8.06	8.00	1.52	3.13	3.00	12518
12958	Armour's Special Tobacco Grower No. 1	Suffield	47.00	1.02	0.07	0.23	2.75	4.07	4.11	2.38	2.56	2.19	7.13	4.50	4.94	4.00	0.23	1.09	1.00	12958
12517	Armour's Wheat, Corn and Oats (Special) 1-7-1 Fertz.	New Haven	....	0.09	0.34	0.09	0.44	0.96	0.82	2.31	4.70	0.91	7.92	7.50	7.01	7.00	1.02	1.02	1.00	12517
	Atlantic Packing Co., New Haven, Conn.																			
12914	Atlantic 2-8-2	New Britain	63.00	0.37	0.51	0.32	0.47	1.67	1.64	6.23	2.95	0.47	9.65	9.00	9.18	8.00	2.29	2.29	2.00	12914
12915	[2]Atlantic 2-8-4	New Britain	78.00	0.37	0.49	0.29	0.44	1.59	1.64	6.18	3.03	0.45	9.66	9.00	9.21	8.00	3.72	3.72	4.00	12915
	Berkshire Fertilizer Co., Bridgeport, Conn.																			
12782	Berkshire Complete Fertilizer	Ellington	68.00	0.24	2.20	0.02	0.45	2.91	2.50	7.76	2.26	0.33	10.35	9.00	10.02	8.00	2.09	2.09	2.00	12782
12785	Berkshire Complete Tobacco	Scitico	....	0.97	1.60	0.24	1.56	4.37	4.11	2.41	1.88	0.19	4.48	4.00	4.29	3.00	0.31	1.55	1.00	12785
	Bowker Fertilizer Co., New York City.																			
12709	[1]Bowker's Complete	Milldale	82.00	1.61	0.79	0.05	1.05	3.50	3.29	8.51	1.84	0.77	11.12	11.00	10.35	10.00	0.76	2.87	3.00	12709
12707	Bowker's Complete 3-8-3	Rockville	63.00	0.38	1.24	0.16	0.69	2.47	2.47	6.82	1.95	0.70	9.47	9.00	8.77	8.00	1.74	2.64	3.00	12707

[1] See note, page 89. [2] See note, page 90.

* Potash as carbonate 2.05.

NITROGENOUS SUPERPHOSPHATES WITH POTASH—(*Continued*).

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.	Nitrogen. In nitrates.	Nitrogen. In ammonia.	Nitrogen. Organic, water-soluble.	Nitrogen. Organic, water-insoluble.	Nitrogen. Total. Found.	Nitrogen. Total. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. So-called "Available." Found.	Phosphoric Acid. So-called "Available." Guaranteed.	Potash. As muriate.	Potash. Total.	Potash. Guaranteed.	Station No.
	Sampled by Station:																			
	Bowker Fertilizer Co., New York City. (*Continued.*)																			
12523	Bowker's Farm and Garden Phosphate 1916, Revised	New Haven	$60.00	0.78	0.06	0.17	0.76	1.77	1.65	6.10	3.43	2.12	11.65	10.00	9.53	9.00	0.56	1.19	1.00	12523
12708	Bowker's Hill and Drill Phosphate 1916	Hazardville	62.50	0.08	1.29	0.70	0.52	2.59	2.47	8.02	2.18	0.81	11.01	10.00	10.20	9.00	0.39	1.00	1.00	12708
12970	[1]Bowker's Lawn and Garden Dressing 1918	New Haven	75.00	0.39	0.98	0.17	0.65	2.19	2.47	6.93	1.43	0.77	9.13	9.00	8.36	8.00	0.47	0.88	1.00	12970
12706	Bowker's Potato Phosphate 1916	Norwich	60.00	0.59	0.45	0.18	0.64	1.86	1.65	5.69	5.22	1.69	12.60	11.00	10.91	10.00	0.66	1.11	1.00	12706
12697	Bowker's Sure Crop Phosphate 1916	Waterbury	50.00	0.13	0.11	0.23	0.49	0.96	0.82	7.80	2.34	1.46	11.60	11.00	10.14	10.00	0.72	0.93	1.00	12697
12599	Stockbridge General Crop Manure 1916	Milldale	70.00	0.99	1.31	0.04	0.96	3.30	3.29	7.87	1.42	0.92	10.21	10.00	9.29	9.00	0.08	0.98	1.00	12599
	E. D. Chittenden Co., Bridgeport, Conn.																			
12710	Complete Tobacco and Onion Grower 2% Potash	Suffield	...	0.12	1.85	0.40	1.12	3.49	3.29	5.18	2.46	0.27	7.91	9.00	7.64	8.00	0.70	2.02	2.00	12710
12798	Connecticut Tobacco Grower with 2% Potash	West Suffield	95.00	0.25	2.61	0.33	2.05	5.24	4.94	2.52	2.30	0.77	5.59	5.00	4.82	4.00	0.40	2.09	2.00	12798
12803	Tobacco Special with 2% Potash	Suffield	79.00	0.25	1.96	0.08	1.88	4.17	4.11	2.54	2.17	0.79	5.50	5.00	4.71	4.00	0.40	1.98	2.00	12803
	Coe-Mortimer Co., New York City.																			
12716	New Englander Special 1916	Brooklyn	...	....	0.38	0.06	0.50	0.94	0.82	5.09	2.88	0.78	8.75	9.00	7.97	8.00	0.74	1.08	1.00	12716
12801	Red Brand Excelsior Guano 1916	Poquonock	73.00	0.43	1.10	0.76	1.79	4.08	4.11	2.43	5.45	3.30	11.18	9.00	7.88	8.00	0.72	1.17	1.00	12801
	Essex Fertilizer Co., Boston, Mass.																			
12858	Essex 2-8-2	South Manchester	64.00	0.10	0.51	0.48	0.64	1.73	1.64	6.25	2.22	0.75	9.22	9.00	8.47	8.00	2.10	2.10	2.00	12858
	L. T. Frisbie Co., New Haven, Conn.																			
12859	Frisbie's 1-8-3	Norwich	...	0.19	0.19	0.13	0.26	0.77	0.82	6.41	2.17	0.12	8.70	9.00	8.58	8.00	2.64	2.64	3.00	12859
12861	Frisbie's 2-8-2	New London	...	0.09	0.86	0.34	0.52	1.81	1.64	4.39	4.46	0.60	9.45	9.00	8.85	8.00	0.84	1.84	2.00	12861
12862	Frisbie's 2-8-4	Hartford	66.50	0.14	0.80	0.32	0.52	1.78	1.64	3.26	5.75	0.73	9.74	9.00	9.01	8.00	1.71	4.03	4.00	12862
12527	Frisbie's 4-8-4	Branford	82.50	0.67	1.00	0.82	1.12	3.61	3.29	3.72	5.03	1.25	10.00	9.00	8.75	8.00	1.75	3.94	4.00	12527
	International Agricultural Corporation, Buffalo, N. Y.																			
12813	Buffalo Economy	West Cheshire	52.00	0.56	0.32	0.15	0.64	1.67	1.65	6.52	3.46	1.05	11.03	11.00	9.98	10.00	1.07	1.07	1.00	12813
12815	Buffalo General Favorite	West Suffield	...	0.09	0.24	0.12	0.41	0.86	0.80	4.98	3.68	1.54	10.20	9.00	8.66	8.00	1.11	1.11	1.00	12815
12817	Buffalo Potato and Corn	Moosup	85.00	0.20	0.59	0.18	0.93	1.90	1.65	0.93	7.14	1.20	9.27	9.00	8.07	8.00	2.99	3.48	4.00	12817
12528	Buffalo Tip Top	Waterbury	52.00	0.09	0.23	0.17	0.37	0.86	0.80	4.96	3.63	1.20	9.79	9.00	8.59	8.00	1.90	1.90	2.00	12528
	Lister's Agricultural Chemical Works, Newark, N. J.																			
12827	Ammoniated Dissolved Superphosphate 1916	Andover	56.00	0.17	....	0.33	0.69	1.67	2.86	2.06	4.48	3.70	1.29	9.47	9.00	8.18	8.00	0.90	0.90	1.00	12827
12828	Corn and Potato Fertilizer 1916	Danbury	54.00	....	0.10	1.26	0.77	2.13	2.06	6.14	3.08	1.35	10.57	9.00	9.22	8.00	0.39	0.96	1.00	12828
12830	Perfect Potato Manure 1916	Rockville	65.00	0.04	1.67	0.72	1.07	3.50	3.29	5.62	3.42	1.73	10.77	10.00	9.04	9.00	0.56	1.11	1.00	12830
12530	Potato and Corn No. 2 Fertilizer 1916	Yalesville	60.00	0.19	0.24	0.87	0.92	2.22	2.06	5.02	4.17	2.41	11.60	11.00	9.19	10.00	0.56	0.99	1.00	12530
12831	[1]Special Tobacco Fertilizer 1916	Brookfield	52.00	0.06	0.40	0.90	0.88	2.24	2.06	4.03	4.21	2.98	11.22	11.00	8.24	10.00	0.66	1.12	1.00	12831
12829	Standard Pure Superphosphate of Lime 1916	Burnside	57.00	0.33	0.33	0.72	1.68	3.06	2.47	5.74	3.31	1.85	10.90	10.00	9.05	9.00	0.96	1.04	1.00	12829
12826	Success Fertilizer 1916	East Canaan	52.00	....	1.17	0.57	0.78	1.52	1.23	7.68	2.95	1.97	12.60	11.00	10.63	10.00	0.90	1.00	1.00	12826
	Mapes Formula and Peruvian Guano Co., New York City.																			
12536	[2]Corn Manure 1916 Brand	Suffield	59.00	1.53	0.05	0.13	1.16	2.87	2.47	0.78	7.20	4.26	12.24	10.00	7.98	8.00	0.56	1.01	1.00	12536
12537	Potato Manure 1916 Brand	Meriden	72.00	3.22	0.05	....	0.50	3.77	3.71	2.60	4.87	1.18	8.65	8.00	7.47	8.00	0.60	1.22	1.00	12537

[1] See note, page 89. [2] See note, page 90.

NITROGENOUS SUPERPHOSPHATES WITH POTASH—(*Continued*).

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.	Nitrogen. In nitrates.	Nitrogen. In ammonia.	Nitrogen. Organic, water-soluble.	Nitrogen. Organic, water-insoluble.	Nitrogen. Total. Found.	Nitrogen. Total. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. So-called "Available." Found.	Phosphoric Acid. So-called "Available." Guaranteed.	Potash. As muriate.	Potash. Total.	Potash. Guaranteed.	Station No.
	Sampled by Station:																			
	Mapes Formula and Peruvian Guano Co., New York City. (*Continued.*)																			
12836	C. S. Tobacco Manure	Burnside	....	0.91	0.97	0.15	2.54	4.57	4.12	0.35	4.08	0.57	5.00	4.00	4.43	4.00	0.70	1.26	1.00	12836
12538	Tobacco Starter Improved	Hartford	$71.00	3.41	0.04	0.36	1.03	4.84	4.12	1.07	5.14	2.94	9.15	8.00	6.21	6.00	1.08	1.40	1.00	12538
	National Fertilizer Co., New York City.																			
12868	Complete Root and Grain Fertilizer 1916	Silver Lane	68.00	1.46	0.92	0.24	0.78	3.40	3.29	7.37	2.02	1.15	10.54	10.00	9.39	9.00	0.40	1.06	1.00	12868
12867	Eureka Potato Fertilizer 1916	Guilford	....	0.17	1.30	....	0.93	2.40	2.47	7.37	2.60	0.52	10.49	10.00	9.97	9.00	0.52	0.88	1.00	12867
12866	Market Garden Revised Fertilizer	Willimantic	72.00	0.61	1.18	0.10	0.68	2.57	2.47	4.85	4.10	0.70	9.65	9.00	8.95	8.00	2.07	2.88	3.00	12866
12845	Universal Grain and Potato Fertilizer	Willimantic	46.00	....	0.33	0.09	0.48	0.90	0.82	5.38	3.01	0.64	9.03	9.00	8.39	8.00	0.35	1.03	1.00	12845
12846	Universal Phosphate 1916	Wallingford	46.00	0.06	0.13	0.19	0.43	0.81	0.82	7.30	2.89	1.22	11.41	11.00	10.19	10.00	0.12	0.88	1.00	12846
12847	XXX Fish and Potash 1916	South Manchester	57.00	0.52	0.55	0.23	1.07	2.37	2.06	5.81	4.87	1.52	12.20	11.00	10.68	10.00	0.36	0.93	1.00	12847
	Olds and Whipple, Hartford, Conn.																			
12869	Complete Corn, Potato and Onion Fertilizer	Factory	59.62	1.33	0.27	0.11	2.28	3.99	3.30	1.22	5.78	1.07	8.07	6.00	7.00	6.00	0.80	1.24	1.00	12869
12575	Complete Tobacco Fertilizer	Factory	67.62	0.52	0.15	0.33	3.38	4.38	4.11	1.07	3.02	0.29	4.38	3.00	4.09	3.00	0.32	1.47	1.00	12575
	Pawtucket Rendering Co., Pawtucket, R. I.																			
12895	[1]2–8–4 Fertilizer	Gilead	66.50	....	0.75	0.33	0.31	1.39	1.75	5.96	3.63	0.36	9.95	9.00	9.59	8.00	3.64	3.64	4.00	12895
	Rogers and Hubbard Co., Portland, Conn.																			
13318	Hubbard's Bone Base Fertilizer for Seeding Down	Factory	61.00	0.50	0.06	0.50	1.77	2.83	2.47	0.43	6.75	11.48	18.66	15.00	7.18	6.00	2.22	4.15	4.00	13318
12876	Hubbard's Bone Base Soluble Potato Manure	Milford	....	1.86	0.54	0.45	1.39	4.24	4.25	1.25	8.90	2.60	12.75	13.00	10.15	10.00	1.07	1.98	2.00	12876
12878	R. and H. Tobacco Grower (Vegetable Formula)	Gildersleeve	85.00	0.66	0.17	0.28	4.10	5.21	5.00	0.19	5.30	2.32	7.81	5.00	5.49	4.00	0.31	1.15	1.00	12878
13366	R. and H. Tobacco Grower (Vegetable Formula)	Windsor Locks	....	1.11	0.11	0.11	3.73	5.06	5.00	0.13	4.97	2.17	7.27	5.00	5.10	4.00	0.35	1.13	1.00	13366
	F. S. Royster Guano Co., Baltimore, Md.																			
12927	Arrow Head Tobacco Formula	Glastonbury	....	0.30	0.78	0.16	3.06	4.30	4.11	1.83	2.73	0.56	5.12	4.50	4.56	4.00	0.17	1.88	2.00	12927
12630	Dreadnaught Guano	Plainville	61.00	....	0.84	0.34	0.70	1.88	1.65	4.47	3.74	1.05	9.26	8.50	8.21	8.00	0.23	2.07	2.00	12630
12629	[2]Fish and Potash Guano	Branford	50.00	0.09	0.89	0.23	0.44	1.65	1.65	5.57	2.57	0.78	8.92	8.50	8.14	8.00	0.23	0.93	1.00	12629
12628	[2]	Madison	62.00	....	0.96	0.28	0.83	2.07	....	4.75	5.60	0.79	11.14	....	10.35	....	....	2.59	....	12628
12926	Pipe of Peace Tobacco Formula	Norwich	74.25	0.10	0.83	0.24	2.69	3.86	4.11	1.24	2.47	0.65	4.36	3.50	3.71	3.00	0.11	1.23	1.00	12926
12924	[2]Trucker's Delight Guano	East Granby	82.25	0.09	1.68	0.50	0.94	3.21	3.29	1.97	6.22	1.25	9.44	8.50	8.19	8.00	1.04	3.96	4.00	12924
	Sanderson Fertilizer and Chemical Co., New Haven, Conn.																			
12634	Atlantic Coast Bone, Fish and Potash 1916	Branford	53.50	....	0.60	0.25	1.03	1.88	1.65	2.27	6.81	2.69	11.77	10.00	9.08	9.00	0.76	1.09	1.00	12634
12632	Corn Superphosphate 1916	Branford	54.00	....	0.68	0.31	1.02	2.01	1.65	4.44	5.70	2.92	13.06	11.00	10.14	10.00	0.56	1.09	1.00	12632
12581	Formula A 1916	Guilford	65.00	1.22	0.90	0.14	1.33	3.59	3.29	6.89	3.01	1.10	11.00	10.00	9.90	9.00	0.45	1.31	1.00	12581
12929	Formula B 1916	Windsor Locks	....	0.65	0.86	0.22	1.32	3.05	3.28	5.42	4.39	2.43	12.24	10.00	9.81	9.00	0.44	1.00	1.00	12929
12633	Potato Manure 1916	East Hampton	57.00	....	1.16	0.11	0.87	2.14	2.06	1.97	6.02	1.71	9.70	9.00	7.99	8.00	0.64	0.98	1.00	12633
12933	Kelsey's Bone, Fish and Potash 1916	Branford	....	0.43	0.81	0.16	1.08	2.48	2.47	3.71	5.30	2.84	11.85	10.00	9.01	9.00	0.58	1.02	1.00	12933

[1] See note, page 89. [2] See note, page 90.

NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealer's cash price per ton.
	Sampled by Station:		
	Virginia-Carolina Chemical Co., New York City.		
12937	Indian Brand for Tobacco No. 1	Tariffville	$79.00
12938	Indian Brand for Tobacco No. 2	Granby	70.00
12939	National Corn, Grain and Grass Top Dressing	Hartford	68.00
12940	Owl Brand Potato and Truck Fertilizer with 1% Potash	Hartford	54.00
12583	Star Brand Potato and Vegetable Compound	North Haven	78.00
12636	XXXX Fish and Potash Mixture	North Haven	50.00
	Wilcox Fertilizer Co., Mystic, Conn.		
12585	Fish and Potash	Branford	62.00
12950	4-8-4 Fertilizer	Factory	....
12944	High Grade Fish and Potash	Factory	....
12619	Potato Fertilizer	Meriden	48.50
12637	Potato, Onion and Vegetable Phosphate	Mystic	61.00
12900	Tobacco Special	Ellington	75.00
	S. D. Woodruff and Sons, Orange, Conn.		
12642	Home Mixture	Factory	50.00
	Sampled by Purchaser:		
12839	American Agricultural Chemical Co.'s Bradley Fertilizer	Hartford	....
12918	Olds and Whipple's Complete Tobacco Fertilizer	Hartford	....

If a cutter were available it would pay to cut these stalks and spread evenly and plow under in the fall unless a cover crop had been sown.

LIME-FERTILE AND NITRO-FERTILE.

These are two fertilizers made by the Fertile Chemical Co., Cleveland, Ohio, and entered for sale in the state. Their analyses follow:

12564. Nitro-Fertile. Sampled from stock of Church and Morse, Meriden. Price 60 cents per bottle.

12566. Lime-Fertile. Sampled from stock of A. R. Brewer & Co., Hartford. Price 35 cents for a 5 lb. package.

WITH POTASH—(*Concluded*).

Nitrogen.						Phosphoric Acid.							Potash.			
				Total.					Total.		So-called "Available."					
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As muriate.	Total.	Guaranteed.	Station No.
0.19	2.08	0.16	1.59	4.02	4.11	2.28	2.30	0.67	5.25	5.00	4.58	4.00	0.45	1.94	2.00	12937
0.16	2.12	0.22	1.62	4.12	4.11	2.84	1.95	0.38	5.17	5.00	4.79	4.00	0.20	1.07	1.00	12938
0.69	0.95	0.35	1.00	2.99	3.29	7.32	1.49	0.78	9.59	9.00	8.81	8.00	0.35	1.10	1.00	12939
0.80	0.23	0.08	0.58	1.69	1.65	5.44	3.67	0.95	10.06	9.00	9.11	8.00	0.31	1.01	1.00	12940
0.11	2.41	0.30	0.98	3.80	3.29	5.37	3.35	0.27	8.99	9.00	8.72	8.00	0.80	2.90	3.00	12583
....	1.20	0.29	0.58	2.07	1.65	4.40	2.83	0.23	7.46	9.00	7.23	8.00	0.20	0.81	1.00	12636
0.11	0.30	0.45	1.81	2.67	2.46	6.26	2.32	0.59	9.17	9.00	8.58	8.00	1.41	1.41	1.00	12585
1.40	0.26	0.39	1.38	3.43	3.30	5.28	3.28	2.98	11.54	9.00	8.56	8.00	3.38	4.10	4.00	12950
0.09	0.34	0.49	2.12	3.04	2.46	2.01	6.37	2.78	11.16	9.00	8.38	8.00	0.31	3.36	3.00	12944
0.76	0.12	0.10	0.79	1.77	1.65	6.12	2.94	0.79	9.85	9.00	9.06	8.00	2.23	2.23	2.00	12619
0.56	0.91	0.27	1.52	3.26	3.30	7.31	2.21	0.64	10.16	10.00	9.52	9.00	1.28	1.28	1.00	12637
0.51	0.64	....	3.00	4.15	4.11	1.71	3.85	4.61	10.17	5.00	5.56	4.00	1.00	1.46	1.00	12900
1.11	0.09	0.16	1.71	3.07	3.29	6.66	5.03	2.58	14.27	....	11.69	8.00	....	0.16	1.00	12642
....	....	....	....	4.61	4.53	0.43	4.38	0.10	4.91	4.00	4.81	3.00	0.52	*3.13	3.00	12839
....	....	....	....	4.20	4.11	0.49	3.42	0.31	4.22	3.00	3.91	3.00	0.48	1.54	1.00	12918

* 2.19 as carbonate.

ANALYSES.

	12564		12566	
	Found	Guaranteed	Found	Guaranteed
Nitrogen as nitrates	2.52	...	....	...
total	2.52	2.0	....	...
Phosphoric acid	3.70	3.0	3.03	3.0
Potash calculated as sulphate	1.47	...	....	...
as muriate	3.27	...	....	...
total	4.74	3.0	....	...

SHEEP MANURE.

Ten samples were analyzed as follows:

12758. Pulverized Sheep Manure. Sold by American Agricultural Chemical Co., New York City. Stock of Geo. E. Ackley Co., New Milford.

12521. Liberty Brand Sheep Manure. Sold by Apothecaries Hall Co., Waterbury. Stock of Chas. A. Templeton, Waterbury.

12596. Sheep Manure. Sold by Armour Fertilizer Wks., Chrome, N. J. Stock of F. S. Bidwell & Co., Windsor Locks.

12809. Ground Sheep Manure. Sold by Berkshire Fertilizer Co., Bridgeport. Stock of C. Buckingham, Southport.

12805. Magic Brand Pulverized Sheep Manure. Sold by Chicago Feed and Fertilizer Co., Chicago, Ill. Stock of The F. S. Platt Co., New Haven.

12952. Sheep Manure. Sold by Mid-West Potash and Fertilizer Co., Omaha, Neb. Stock of S. D. Woodruff & Sons, Orange.

12724. "Sheeps Head" Pulverized Sheep Manure. Sold by Natural Guano Co., Aurora, Ill. Stock of Rackliffe Bros. Co., New Britain.

12727. Wizard Brand. Sold by Pulverized Manure Co., Chicago, Ill. Stock of Lightbourn & Pond Co., New Haven.

12490. Sheep Manure. Sold by Natural Guano Co., Aurora, Ill. Sampled and sent by Cadwell & Jones, Hartford.

12674. "Magic" Sheep Manure. Sold by Chicago Feed and Fertilizer Co., Chicago, Ill. Sampled and sent by F. F. Hitchcock, Woodbury.

ANALYSES OF SHEEP MANURE.

Station No.	12758	12521	12596	12809	12805	12952	12724	12727	12490	12674
Per cent. of										
Nitrogen as nitrates	....	....	0.38	....	....	....	0.16	0.09	....	....
" " ammonia	0.30	0.12	0.14	0.37	0.10	....	0.29	0.19	0.18	....
" organic	1.72	1.70	1.48	2.08	1.34	....	1.93	1.83	2.34	....
" total found	2.02	1.82	2.00	2.45	1.44	1.26	2.38	2.11	2.52	1.96
" " guaranteed	2.06	2.00	1.65	1.70	1.85	....	2.25	1.80	....	2.67
Phosphoric acid, water-soluble	0.35	0.36	0.15	0.12	0.29	0.28	1.14	0.58	1.09	....
Phosphoric acid, citrate-soluble	1.34	0.99	1.48	0.44	0.84	1.01	0.98	0.96	0.72	....
Phosphoric acid, citrate-insoluble	0.46	0.22	0.14	0.12	0.15	0.12	0.13	0.12	0.10	....
Phosphoric acid, total found	2.15	1.57	1.77	0.68	1.28	1.41	2.25	1.66	1.91	1.62
Phosphoric acid, total guaranteed	1.25	1.50	1.00	1.00	1.50	....	1.00	1.00	....	2.84
Water-soluble potash found	2.71	2.13	4.41	1.91	2.46	1.46	2.48	2.34	2.85	2.71
Water-soluble potash guaranteed	1.00	2.00	2.50	1.00	1.25	....	1.50	1.00	....	1.25
Chlorine	1.10	0.33	1.34	0.17	0.72	0.23	0.56	0.83	....	....
Cost per ton	$46.00	42.00	46.00	44.00	50.00	....	55.00	55.00	46.00	45.00

The average composition and cost per ton of sheep manure as determined from these analyses are as follows:

Nitrogen	1.99
Phosphoric acid	1.63
Potash	2.55
Cost per ton	$48.00

The agricultural value of fresh manure is largely in the organic matter which it contains in forms that decay quickly and in its bacterial life. The use of dry sheep manure is chiefly in greenhouse work and on lawns.

"WOOD ASHES."

In the table are given 21 analyses of material sold under this name. Six of the samples are certainly not fairly called wood ashes. **12655** has the composition of lime-kiln ashes and **12147** does not contain even as much potash as ordinary lime-kiln ashes.

During the war, wood ashes have been sold on the "unit" basis, a unit being one per cent. or 20 pounds. The price this year has ranged from $6 to $6.50 per unit or from 30 to 32½ cents per pound of potash without regard to the lime or phosphoric acid contained in the ashes.

The higher per cent. of phosphoric acid, 6.40, contained in the ashes sold by E. E. Dickinson & Co., **12418,** is explained by the fact that the ashes came from witch hazel brush. The fine twigs carry considerably more phosphoric acid than does mature wood. With reference to **12102** and **12159** Mr. Joynt states that none of the other cars shipped at the same time from the same storehouse showed less than 5.6 per cent. of potash. Sample **12102** was drawn by the director personally with the greatest care to take portions from all accessible parts of the car and the analysis was most carefully checked.

LIME AND LIME-KILN ASHES.

13543. Ground Oyster Shells from S. P. Woodward, Bethany.

12919. Lime ashes. Sent by L. A. Bevan, Danbury. Cost $15 per ton.

12855. Lime-kiln ashes made by New England Lime Co., Boardman. Sent by Howard I. Hine, New Milford. Cost $12 per ton.

ANALYSES OF WOOD ASHES.

Station No.	Car No. and Dealer or Purchaser.	Insoluble in acid (sand).	Water-soluble potash.	Lime.	Phosphoric acid.	Cost per ton.
12792	C. M. Beach Co., New Milford	4.02	0.84	36.19	0.90	.....
12791	C. M. Beach Co., New Milford	2.35	8.61	32.59	1.50	.....
12342	Car R. I. 56111. Frank Brockett, Suffield	17.30	5.00	30.64	1.94	$23.00
12748	Conn. Sumatra Tobacco Co., Buckland, No. 1	15.90	1.73	27.62	1.13	.....
12749	Conn. Sumatra Tobacco Co., Buckland, No. 2	14.92	1.77	25.72	1.11	.....
12750	Conn. Sumatra Tobacco Co., Buckland, No. 3	15.22	1.94	26.70	1.11	.....
12418	E. E. Dickinson & Co., Essex	5.45	5.45	46.55	6.40	.....
12620	Car C. P. 149238. Edward Eggert, Hartford	14.02	6.10	33.88	2.30	*
12147	A. N. Farnham, Westville	74.42	0.04	....	....	.....
12102	Car 197813. John Joynt, Lucknow, Ont. Henry Fuller, Suffield	10.86	4.47	31.34	1.85	*
12191	John Joynt, Lucknow, Ont. A. R. Ford Co., Suffield	19.93	4.85	29.30	1.91	32.00
12159	John Joynt, Lucknow, Ont. Harvey Fuller, Suffield. B. & O. 183128	13.58	3.94	29.84	3.00	†
12500	John Joynt, Lucknow, Ont. F. L. Harvey, Windsor Locks	11.65	6.94	37.15	2.14	†
12621	John Joynt, Caribou, Me. Griffin Tobacco Co., Inc. N. Bloomfield. Car 6976	13.23	5.92	33.96	2.15	*
12622	John Joynt, Caribou, Me. Griffin Tobacco Co., Inc. N. Bloomfield. Car 1546	10.60	5.62	35.48	2.16	*
12623	John Joynt, Caribou, Me. Griffin Tobacco Co., Inc. N. Bloomfield. Car 14804	15.08	6.30	32.59	2.43	*
12655	Clarence E. Lee, New Milford	4.73	0.86	38.53	0.81	.....
11549	W. L. Mitchell, New Haven. F. J. Beach, Woodmont	11.53	2.92	28.70	1.12	28.00
12432	W. L. Mitchell, New Haven. J. E. Shepard, South Windsor	17.70	3.08	27.63	1.19	20.00
12184	Olds & Whipple, Hartford. Car 3719	9.42	6.27	34.76	2.10	*
12640	Wm. L. Peck, New York. C. E. Daniell, Woodbury	39.20	3.47	23.39	1.41	‡28.00

*$6.50 per unit of water-soluble potash. †$6.00 per unit of water-soluble potash. ‡f. o. b. Brightwood, L. I.

ANALYSES OF LIME AND LIME-KILN ASHES.

Station No.	13543	12919	12855
Water-soluble potash	none	3.84	1.95
Lime	40.94	36.86	36.70
Magnesia	....	9.40	14.59

12919 supplies water-soluble potash at 19 cents per pound, relatively a very cheap price. The cost in **12855** is about 30 cents.

SOILS.

A very large number have been tested for acidity but the results are not of any general interest or value.

PEAT AND MUCK.

12164 was sent by M. F. McLaughlin, Bridgeport, **12165** by L. Peterson, East Hartford, and **12146** by T. H. Thorne, superintendent, New Canaan.

These require no further notice.

The samples represented by the first three analyses in the table were sent by Henry H. Witzke, Fairfield. They are from a maple swamp in which the peat is at least 20 feet deep. The three samples were taken at depths of 6, 12 and 18 feet respectively. They consist of peat with very little mixture of soil.

12165 was sent with the question whether it would be good on sandy land. This sample, too, is a rich peat. If used in large amount and well distributed through a sandy soil it would undoubtedly improve its water-holding power though of very little value as a fertilizer. The nitrogen of peat is very inert being the part which has resisted decay and solution.

Peat which has been more than half dried makes one of the best absorbents in the manure trenches, tends to prevent loss of ammonia and improves the manure.

13359 is stated to be everglade soil taken near the southern end of Lake Okeechobee in Florida on which sugar cane and vegetables can be grown very successfully without the use of any fertilizer.

This consists of about equal parts of mineral matter or soil and of peat. It has a higher per cent. of nitrogen than any other of the samples; probably it is never subject to drought and may grow crops for a time without fertilizers or manure.

	12464	12465	12466	12165	12164	13359	12146
As received:							
Water	90.86	86.29	56.28	12.10	17.80	15.33	67.18
Organic and volatile	8.62	12.82	39.63	76.32	54.37	42.49	11.95
Ash	0.52	0.89	4.09	11.68	27.83	42.18	20.87
Nitrogen	0.16	0.16	0.11	1.57	1.56	2.00	0.34
Phosphoric acid	....	....	....	....	....	0.32	....
Potash	....	....	....	....	....	0.23	....
Calculated water-free:							
Organic and volatile	94.26	93.49	90.62	86.73	66.15	50.18	36.40
Ash	5.74	6.51	9.38	13.27	33.85	49.82	63.60
Nitrogen	1.77	1.18	0.25	1.78	1.89	2.36	1.05
Phosphoric acid	....	....	....	....	....	0.38	....
Potash	....	....	....	....	....	0.27	....

VARIOUS MARINE FERTILIZERS.

12471, Dried Sea Kelp and **12657**, Dried Ground Mussel bed, both prepared by E. J. Eaton, New London.

13474, Cove Mud and **13475**, Channel Weed, sent by E. E. Knapp, Essex.

ANALYSES.

	12471	12657	13474	13475
Water	....	....	2.89	5.55
Organic and volatile	....	....	7.57	26.02
Mineral matter	....	....	89.54	68.43
Nitrogen	1.23	1.33	0.38	1.30
Phosphoric acid	0.35	0.32	0.26	0.49
Potash	2.54	0.14	0.57	0.77

The plant food in the dried kelp and dried mussel bed is probably quite readily available to crops. Whether either can profitably be used depends altogether on the cost of getting out the material and transporting it. Kelp was formerly used with profit on some seashore farms where it was abundant and the haul to the land was short. The best results were got where it was hauled at once to the land and immediately plowed in. The same probably applies to channel weed **13475.**

With regard to **13474** Mr. Knapp says there is a limitless quantity, not over 1000 feet from porous land needing amendment.

It is a fine material not unlike ordinary soil, as far as the analysis indicates, having in the water-free material only 7.8 per cent. of organic matter.

The percentages of nitrogen and phosphoric acid are also small. Marine mud hauled out in the fall and allowed to stand over winter has been found to have considerable value as an amendment and fertilizer. It cannot be recommended as certainly profitable in any case but is worth a trial on a small scale.

VARIOUS NITROGENOUS WASTE PRODUCTS.

11818. Sent by B. W. Ellis, Co. Agent, Rockville. This is material which has been used as a bird food and as such sold for about $90 a ton. It contained 6.98 per cent. of nitrogen and 3.84 of phosphoric acid. Probably both are in available form and if so the price would not be more nearly prohibitive of its use as a fertilizer than is the present price of cotton seed meal.

12461. Sent by H. Hawkes, Sound Beach, is stated to be from a dressed beef company and contained 7.16 per cent. of nitrogen.

12773, Skin Choppings and Hair, contained 9.40 per cent. nitrogen. **12774**, Dyed Waste Fur, contained 11.68 per cent. Both samples were sent by G. M. Reynolds, Glennville. Neither of them is of much agricultural value in their present shape.

12961. Shavings from Lace Leather, sent by Jewell Belting Co., Hartford, contained 11.85 per cent. nitrogen of little agricultural value.

11724 and **11725.** Cotton by-products from American Sumatra Tobacco Co., East Hartford.

13370. Fertilizer from Willy Waldag, Suffield. **12704** and **12705** from Hyman Botwinik, Colchester, stated to be made by Shay of New London. **13473**, sent by B. W. Ellis, Co. Agent, Putnam, stated to be Berkshire Fertilizer. **12797**, sent by W. A. Bertini, Granby, marked "Hayti," bought of Berkshire Fertilizer Co. **12882**, a fertilizer sold by the Quality Seed Store, Stamford. Sent by A. F. Aulick, Stamford. **13253**, fertilizer from J. L. Crowley, Westerly, R. I.

ANALYSES.

	11724	11725	13370	12704	12705	13473	12797	12882	13253
Per cent. of									
Nitrogen	1.78	1.42	0.78	4.76	3.18	3.51	3.91	1.25	4.95
Phosphoric acid	0.82	0.80	0.87	14.43	11.64	...	...	12.82	...
Potash	1.55	1.19	1.81	0.34	0.42	...	...	1.43	...

Two samples marked Sewage Sludge were examined.

12493 received from Andrew Ure, Highwood, contained nitrogen 0.28, phosphoric acid 0.22 and sand and soil 78.20 per cent. **13360**, sent by Frank Bachmann, New Haven, stated to be made by the Independent Dye Co., Long Island, contained 16.35 per cent. of phosphoric acid.

13472. Stated to be Wilcox Fertilizer Co.'s 4-8-4 Potato Fertilizer. Sent by Wm. Inderelst, Mystic, with request to test for borax. It was found to contain about 0.29 per cent. of boric acid.

VITAMITE.

13372. Sold by John R. Keefe, Newark, N. J. This claims to be "a new bacterial culture, unlike others on the market." This station is not equipped to make bacterial examinations. Of

plant food Vitamite contains 1.42 per cent. nitrogen, 0.90 of phosphoric acid and 1.26 of potash. Sand and mineral matter amounted to 65.30 per cent.

A sample of "Slag," sent by Dr. J. H. Potts, New Britain, **13323**, contained 2.68 per cent. of difficultly soluble phosphoric acid.

A sample of bleaching powder, **13398**, sent by Thames Dyeing and Bleaching Co., New London, had 19.27 per cent. available chlorine. Totally unfit for agricultural use.

12948. Sent by L. M. Benham, Highwood, as a potash fertilizer from New Jersey, probably a Sand Marl, contained 2.88 per cent. of potash soluble in strong acid, of which only 0.11 per cent. was soluble in water.

13405. Sent by Robt. A. Warner, Westville, who states that it is a marl mined at Disputanta, Va., which is sold to local farmers at $6.50 per ton.

It contained

Phosphoric acid	0.03
Water-soluble potash	0.02
Total potash	0.11
Lime	47.34
Insoluble in acid	10.55

12094. A fertilizer referred to the station for analysis in a disagreement between chemists was found to contain 1.22 per cent. of nitrogen.

NINETEENTH REPORT

OF THE

STATE ENTOMOLOGIST

OF

CONNECTICUT

FOR THE YEAR 1919

(Being Bulletin 218 Connecticut Agricultural Experiment Station)

BY

W. E. BRITTON, PH.D.

State Entomologist

NEW HAVEN, CONN.

1920

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

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NOTE REGARDING AUTHORSHIP.

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BULLETIN 218
NINETEENTH REPORT
OF THE
State Entomologist of Connecticut

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

I submit, herewith, my nineteenth report as State Entomologist of Connecticut for the year 1919. Pursuant to the action of the General Assembly in changing the time of beginning of the fiscal year, the financial statement covers the nine months ending June 30, 1919. As much of the work of the department extends through the summer, the other part of this report covers the season as usual, and includes brief reports of the work of inspecting nurseries, imported nursery stock and bulbs, apiaries, and suppressing the gipsy moth: also separate accounts of the white pine weevil, the pine bark aphid, various borers and other insects attacking corn in Connecticut, outbreak of the green clover worm on beans, chrysanthemum gall midge experiments, progress of mosquito extermination work, and miscellaneous notes on common pests and unusual insects of the season.

Respectfully submitted,

W. E. BRITTON,
State and Station Entomologist.

REPORT OF THE RECEIPTS AND EXPENDITURES OF THE STATE ENTOMOLOGIST FROM OCTOBER 1, 1918, TO JUNE 30, 1919.

RECEIPTS.

From E. H. Jenkins, Treasurer	$4,500.00	
Account of 1918, Balance	1,440.71	
State Comptroller, Gipsy Moth Account	541.98	
M. P. Zappe, Automobile Mileage	4.20	
		$6,486.89

EXPENDITURES.

For Field, Office and Laboratory Assistance:	
B. H. Walden,* salary	$1,166.64
M. P. Zappe, salary	1,125.00
K. F. Chamberlain, salary	420.00

* For seven months: remainder paid from mosquito appropriation.

Martha DeBussy,† salary	$336.00	
Gladys M. Finley, salary	222.00	
Other Assistance	169.67	
		$3,449.31
Printing and Illustrations		50.50
Postage		30.13
Stationery		23.37
Telegraph and Telephone		4.58
Office Supplies		37.10
Library		224.62
Machinery, Tools and Supplies		143.95
Express Freight and Cartage		3.61
Traveling Expenses		350.41
Automobile Tires and Repairs		279.56
Balance Cash on Hand		1,889.75
		$6,486.89

Memorandum:—This account of the State Entomologist has been audited by the State Auditors of Public Accounts. The item of $541.98 credited as having been received from the State Comptroller is really a transfer from the appropriation for suppressing gipsy and brown-tail moths and for inspecting imported nursery stock, and covers the time and automobile mileage of members of the department staff while engaged in inspecting imported stock.

The reason for making this financial statement cover nine months instead of a full year is on account of the change in the beginning of the fiscal year from October 1st to July 1st, made by the last session of the Legislature.

Summary of Inspection and Office Work.

305 samples of insects received for identification.
96 nurseries inspected.
88 regular certificates granted.
22 parcels of nursery stock inspected and certified.
57 orchards and gardens examined.
131 shipments, containing 1,075 cases, 1,164,701 plants, imported nursery stock inspected.
44 shipments or 33.5 per cent. found infested with insects or fungi.
317 shipments, containing 924 cases, 1,529,775 imported bulbs inspected.
723 apiaries, containing 6,070 colonies inspected.
48 apiaries, containing 78 colonies found infested with European foulbrood.
22 apiaries, containing 69 colonies found infested with American foulbrood.
2,308 letters written on official work.
121 circular letters.
621 post cards.

† Resigned March 4, 1919.

254 reports of inspection to Federal Horticultural Board.
798 bulletins, etc., mailed on request or to answer inquiries.
51 packages sent by mail or express.
23 lectures and addresses at institutes, granges, etc.

Publications of Entomological Department, 1919.

By W. E. Britton.

Eighteenth Report of the State Entomologist (Bulletin 211), 108 pages, 7 figures, 16 plates; 10,000 copies distributed in May, 1919.

Insects Attacking the Potato Crop in Connecticut (Bulletin 208), 20 pages, 6 figures, 8 plates; 10,000 copies distributed in March, 1919.

Report of Committee on Injurious Insects, Report of Connecticut Vegetable Growers Association for 1918, page 28, 1919.

Report of Committee on Injurious Insects, Proceedings Twenty-Eighth Annual Meeting, Connecticut Pomological Society, page 95, 1919.

The European Corn Borer, Proceedings Twenty-Eighth Annual Meeting Connecticut Pomological Society, page 159, 1919.

Progress in Mosquito Control in Connecticut in 1917. Proceedings Fifth Annual Meeting New Jersey Mosquito Extermination Association, page 100, 1918.

The Iris Borer Again, *Florists' Exchange,* Vol. xlvi, page 531, October 5, 1918.

The Chrysanthemum Midge, *Florists' Exchange,* Vol. xlvii, page 45, January 11, 1919.

Insects Attacking Maples and Elms, *Florists' Exchange,* Vol xlvii, page 1,331, June 28, 1919.

A Tree Protection Institute, *Florists' Exchange,* Vol. xlviii, page 205, August 2, 1919.

Book Review—Washburn's Injurious Insects and Useful Birds, *Science,* Vol. xlix, page 425, May 2, 1919.

Elm Leaf Beetle, *New Hampshire Sentinel,* July 23, 1919.

Automobile Truck Power Sprayers, *American Fruit Grower,* 2 figures, page 6, October, 1919.

Corn Borers, *New England Farms,* June 28, 1919.

Corn Borers, *Connecticut Agricultural College Press Bulletin,* July 10, 1919.

Corn Borers, *Hartford County Farm News,* July, 1919.

Tree Protection Institute, *Hartford County Farm News,* July, 1919.

By W. E. Britton and M. P. Zappe.

Kerosene Emulsion versus Nicotine Solution for Combating the Potato Aphid, *Journal of Economic Entomology,* Vol. 12, page 71, 1919.

By M. P. Zappe.

Aphis Control, Proceedings Twenty-Eighth Annual Meeting, Connecticut Pomological Society, page 145, 1919.

DEPARTMENT STAFF

W. E. BRITTON, PH.D., *State and Station Entomologist.*
B. H. WALDEN, B.AGR., *Photographic and Mosquito Work.*
IRVING W. DAVIS, B.SC., *Deputy in Charge of Moth Work.*
MAX P. ZAPPE, B.S., *Inspection and General Work.*
KENYON F. CHAMBERLAIN,* *Inspection and General Work.*
PHILIP GARMAN, PH.D.,† *Research Work.*
} *Assistant Entomologists.*

MISS MARTHA DEBUSSY,‡
MISS GLADYS M. FINLEY,§
} *Clerks and Stenographers.*

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

Messrs. Walden and Zappe have continued as assistants in the general work of the department. Mr. Chamberlain, who was employed to inspect nurseries in 1918, was reengaged for the season beginning February 24. Mr. Davis was discharged from military service and resumed his duties in charge of the gipsy moth work January 15. During his absence Mr. Ashworth acted as superintendent and deputy.

Dr. Philip Garman, a graduate of the University of Kentucky, class of 1913, was appointed a member of the staff and began his duties September 1. Dr. Garman was a graduate student at the University of Illinois, receiving his doctor's degree in 1916. He was then assistant entomologist at the Maryland Agricultural Experiment Station for three years. Though Dr. Garman may be called upon sometimes to assist in the general work of the department, he will be engaged chiefly in research in connection with injurious and beneficial insects.

Miss Martha DeBussy served as clerk and stenographer from August 26, 1918, to March 4, 1919, when she resigned to accept a position with larger salary. Miss Gladys M. Finley was appointed to fill the position.

Messrs. Coley and Yates have made the inspections of apiaries, as in preceding years, on a *per diem* basis.

Mr. Walden has continued to serve as deputy to the Director in mosquito elimination work, which required nearly all of his time during the summer months. He has done considerable photographic work and has aided in the inspection of nurseries, imported nursery stock and bulbs. He has been in charge of the

* Beginning February 24.
‡ Resigned March 4.
† Beginning September 1.
§ Beginning March 6.

department during the absence of the Entomologist. Mr. J. Kirby Lewis was employed from August 11 to October 4 to inspect nurseries and bulbs. Mr. Geo. D. Stone, who has been on the gipsy moth force, was employed around Milford in April and May, and again in July to examine corn fields over the state. He also helped to inspect nurseries and imported bulbs, returning in October to the gipsy moth work.

All of the regular members of the staff and the temporary assistants mentioned above have rendered faithful and efficient services which have been appreciated.

CHIEF LINES OF WORK.

The regular inspection work as provided for by statute, such as the gipsy and brown-tail moth work, the inspection of nurseries, orchards, gardens, etc., the inspection of imported nursery stock and apiaries has been conducted as in former years.

At the suggestion of the Federal Horticultural Board made during the summer, an attempt has been made to examine all bulbs imported from foreign countries. These shipments began arriving about August 1st, and during the next four months we inspected more than three hundred separate shipments containing 924 cases of bulbs.

Mr. Walden has continued as deputy to the Director in charge of the mosquito drainage work of the state, which during the year has for the most part been maintenance. A few new tide gates have been built, and there have been extensions to the drainage systems in a few towns, but no extensive new work has been carried out.

Mr. Zappe conducted experiments in controlling the chrysanthemum gall midge *Diarthronomyia hypogaea* Loew., in two large commercial greenhouses, in the late winter, and has also continued his studies on the life history of an undescribed sawfly of the genus *Itycorsia* which feeds upon Austrian pine.

Messrs. Zappe and Britton have continued the field experiments begun five or six years ago for the control of the insects attacking cucumbers, squashes, pumpkins and melons in Connecticut. The Entomologist has prepared a paper on this subject which was published as Bulletin No. 216.

Dr. Garman, who began his duties September 1, has already worked out the life history of the bulb mite, *Rhizoglyphus echin-*

opus Fumouse and Robin, which up to that time had not been published. The results of his studies are now being prepared for publication.

On account of the menace of the European corn borer, *Pyrausta nubilalis* Hubner, much scouting has been done in various parts of the State to learn whether or not the pest occurred in Connecticut. Though up to this time it has not been found within our State, several borers resembling it were discovered. All are native or long established species, which in themselves need cause no alarm. Many corn fields were visited in late winter and the corn stalks examined in the shock or as left standing in the field. In Milford where borers were found in the stalks, through co-operation with the owners, the stalks were cut and burned in several fields. Mr. George D. Stone was in immediate charge of this work.

Later in the season, Mr. Stone visited a number of towns in each county, and examined the growing corn in the fields, sending to the laboratory specimens of all insects found attacking the corn crop.

In the following pages of this report, the various papers describe in detail these lines of effort.

By action of the General Assembly, the Entomologist is a member of the new Tree Protection Examining Board, and at present he is serving as Chairman of the Board.

The Entomologist has also co-operated with the Farm Bureaus, and has furnished information about insect pests where needed.

Some time and attention during the year has been given to the preparation of papers to be published by the State Geological and Natural History Survey.

INSPECTION OF NURSERIES.

The annual inspection of nurseries commenced on August 7, but on account of the unusual abundance of rainy weather and the arrival of shipments of imported bulbs to be inspected, the work was retarded and not finished until October 29. Most of this inspection work was done by Messrs. Zappe, Chamberlain, Walden, Lewis, Davis and Stone, but occasionally they were assisted by Messrs. Garman and Britton. Mr. Lewis was employed temporarily from August 11 until October 4 for this purpose. Mr. Stone, who had been borrowed from the gipsy

moth force service to inspect corn fields, was also pressed into service to inspect nurseries, but returned to gipsy moth work on October 8. Mr. Davis inspected practically all of the nurseries in the eastern part of the State.

The men were transported chiefly by automobile, but Mr. Stone travelled to many outlying nurseries on his motorcycle.

The system of inspection adopted was similar to that of former years. Where important pests were found the trees or plants were marked, and the owner or manager was instructed to destroy or treat them as the needs of the case required. Certificates were not granted until a written statement was received that the directions had been carried out.

In inspecting nurseries year after year, the same kinds of pests are found though they may vary somewhat in the order of their abundance. Thus in 1919 the number of nurseries infested by our common nursery pests corresponds very closely to that of 1918, and is as follows:—

Insects:—Oyster-Shell Scale 38; San José Scale 19; Spruce Gall Aphid 19; White Pine Weevil 5; Tulip Tree Scale 4; Pine Leaf Scale 3; Scurfy Scale 3; Elm Scale 2; Euonymus Scale 2; Green Apple Aphid, *Chermes cooleyi*, Woolly Aphid, Rose Scale, Pine Tube Moth, Peach Borer and Leopard Moth, one each.

Plant Diseases:—Poplar Canker 5; Black Knot of Plum, Fire Blight, and Crown Gall, one each.

In 32 nurseries no pests were found.

As in 1918, the oyster-shell scale was the most common and abundant pest on nursery stock, and before certificates could be granted many trees and shrubs had to be destroyed. San José scale infestations were about the same as last year. The tulip tree scale was found in four nurseries, but was entirely absent in 1918. The Oriental peach moth *Laspeyresia molesta* Busck was not found in any nursery.

Four new nurseries and one old nursery were inspected in the spring and certificates granted; they were again inspected in the fall and are marked (2) on the list.

Twenty-two packages were inspected and certificates granted.

Of the 83 names on the list of nurserymen for 1919, six are new, the names of two have been changed and three have gone out of business. Six nurseries had not destroyed or treated their infested stock in time to receive certificates before this report

went to press. The acreage devoted to the growing of nursery stock remains about the same as last year.

The list for 1919, with location, acreage, date and number of certificate of each is as follows:—

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1919.

Name of Firm.	Address.	Acreage.	Certificate Issued.	No. of Certificate.
Barnes Bros. Nursery Co.	Yalesville	150	Sept. 9	1003
Beattie, Wm. H.	New Haven	1	Sept. 22	1011
Bertolf Bros.	Sound Beach	25	Oct. 1	1022
Brainard Nursery & Seed Co.	Thompsonville	6	Nov. 5	1055
Braley & Co.	Burnside	1	Sept. 2	995
Bretschneider, A.	Danielson	1	Sept. 11	999
Brown, F. K. (2)	Greenwich	2	Sept. 26	1017
Burr & Co., C. R.	Manchester, Ellington and Durham	500	Sept. 9	1000
Burroughs, Thos. E.	Deep River	3	Sept. 26	1015
Chapman, C. B.	Groton	1	Sept. 11	1006
Chapman, C. E.	North Stonington	4	Sept. 11	1005
Coari & Co. (2)	Norwalk	2	Oct. 10	1042
Conine Nursery Co.	Stratford	50	Sept. 23	1012
Conley, L. D.	Ridgefield	5	Oct. 1	1025
Conn. Agricultural College (Prof. S. P. Hollister)	Storrs	1	Sept. 2	990
Conn. Agr. Experiment Station (W. O. Filley, State Forester)	New Haven	1	Oct. 7	1034
Conway, W. B.	New Haven	1	Nov. 6	1059
Crofut & Knapp Farm	Norwalk	20	Nov. 12	1066
Cross Highway Nurseries	Westport	6	Nov. 5	1057
Dallas, Inc., Alexander	Waterbury	1	Aug. 30	989
Elm City Nursery Co., Woodmont Nurseries, Inc.	Woodmont & New Haven	155	Sept. 27	1018
Fairfield Landscape & Nurseries Co.	Cannondale	5	Nov. 10	1063
Falcon's Flight Farms Nursery (B. Austin Cheney, Prop.)	Litchfield	1	Sept. 26	1016
Gardner's Nurseries	Cromwell	10	Oct. 30	1050
Geduldig, Estate of G.	Norwich	1	Nov. 12	1065
Goodwin Associates, Inc., The James L.	Hartford	1	Oct. 21	1048
Heath & Co.	Manchester	1	Sept. 9	1002
Hilliard, H. J.	Sound View	1	Sept. 2	993
Hiti Nurseries (J. H. Bowditch Prop.)	Pomfret Center	5	Sept. 6	996
Holcomb, Irving	Simsbury	1	Sept. 11	1007

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1919—*Cont'd.*

Name of Firm.	Address.	Acreage.	Certificate Issued.	No. of Certificate.
Horan & Son, Jas.	Bridgeport	1	Nov. 4	1053
Houston & Sons, J. R.	Mansfield	4	Sept. 2	991
Hoyt's Sons Co., Inc., The Stephen	New Canaan	300	Oct. 23	1049
Hubbard & Co., Paul M.	Bristol	12	Nov. 1	1051
Hunt & Co., W. W.	Hartford	10	Sept. 15	1008
Isselee, Charles	Darien	10	Nov. 7	1062
Kelley, James J.	New Canaan	1	Oct. 15	1045
Kellner, Herman H.	Danbury	1	Oct. 1	1024
Keso Nursery (J. J. Kelsey, Prop.)	Clinton	1	Sept. 23	1014
Laddin's Rock Nursery (W. L. Marks, Prop.) (2)	Stamford	5	Oct. 6	1031
Larkin Bros., The	New London	1	Sept. 6	997
Long, J. A., Mrs.	East Haven	1	Sept. 30	1020
Mallett Co., George A.	Bridgeport	1	Nov. 3	1052
Maplewood Nurseries (T. A. Peabody, Mgr.)	Norwich	1	Sept. 2	992
Marigold Farm (H. Kelley, Prop.)	New Canaan	2	Sept. 27	1019
McDermott, E. F.	Windsor	1	Oct. 3	1028
Meier & Gillette	West Hartford	2	Nov. 5	1056
Munro, Charles	New Haven	1	Sept. 30	1021
New Haven Nurseries	New Haven	10	Oct. 9	1038
New Haven Park Commissioners (G. X. Amrhyn, Supt.)	New Haven	30	Oct. 7	1033
New London Cemetery Association (Ernest E. Rogers, Pres.)	New London	1	Nov. 7	1061
New London County Nurseries (W. J. Schoonman, Prop.) (2)	New London and Stonington	5	Dec. 9,	1069
North-Eastern Forestry Co.	Cheshire	20	Aug. 26	988
Oakland Nurseries	Manchester	1	Sept. 9	1001
Palmer, Est. of L. M.	Stamford	5	Oct. 1	1026
Park Gardens	Bridgeport	1	Oct. 10	1040
Pequod Nursery Co.	Meriden	15	Sept. 11	1004
Phelps, J. Wesson.	Bolton	1	Sept. 2	994
Phelps & V. T. Hammer Co., The J. W.	Branford	2	Oct. 21	1047
Pierson, A. N., Inc.	Cromwell	50	Aug. 23	987
Platt, Co., The Frank S.	New Haven	1	Oct. 7	1035
Pomeroy, Edwin C.	Northville	1	Nov. 6	1058
Purinton, Mrs. C. O.	Hartford	1	Oct. 6	1032
Quality Seed Store	Stamford	1	Oct. 4	1029
Reck, Julius	Bridgeport	1	Oct. 10	1039
Rockfall Nursery Co. (P. Marotta, Prop.) (2)	Rockfall	1	Nov. 4	1054

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1919—*Conc'd.*

Name of Firm.	Address.	Acreage.	Certificate Issued.	No. of Certificate.
Saxe & Floto	Waterbury	1	Dec. 2,	1068
Schleichert, F. C.	Bridgeport	1	Oct. 10	1041
Scott, J. W.	Hartford	5	Nov. 17	1067
Sierman, C. H.	Hartford	5	Oct. 17	1046
South Wilton Nurseries	South Wilton	5	Oct. 9	1036
Stannard Hill Greenhouses (J. E. Brooks, Prop.)	Westbrook	1	Sept. 23	1013
Steck, Charles A.	Bethel	2	Oct. 9	1037
Stratfield Nursery Co.	Bridgeport	4	Nov. 11	1064
Traendly & Schenck	Rowayton	2	Oct. 1	1027
Upson, R. E.	Marion	1	Nov. 6	1060
Verkade, H.	New London	2	Sept. 15	1009
Vidbourne & Co., J.	Hartford	7	Oct. 14	1043
Wallace, Arthur T.	Wallingford	2	Oct. 14	1044
Wild, Henry	Riverside	1	Oct. 4	1030
Wilson & Co., C. E.	Manchester	10	Sept. 9	998
Yale University Forest School	New Haven	1	Sept. 22	1010
Young, Mrs. Nellie A.	Pine Orchard	1	Oct. 1	1023
Total acreage		1,525		

INSPECTION OF IMPORTED NURSERY STOCK.

For the past ten years an attempt has been made by this department to inspect all woody nursery stock, entering the state, that had been imported from foreign countries. The establishment of the Federal Horticultural Board in 1912, and its system of permits and notices adopted soon afterward, made it possible to examine a much larger proportion of shipments entering the State. From that time to the present, nearly all shipments have been examined, but of course it is nearly impossible to intercept all pests that might be brought over. Especially is this true of plants like azaleas and rhododendrons and certain conifers which are usually shipped with a ball of earth about the roots. Then, too, certain insects may crawl out of the cases and escape before the stock is unpacked or even during the operation.

There had been a rapid increase each year in the number of shipments of this kind coming to Connecticut until the war. In 1917 and 1918, the number of shipments dropped off markedly on account of the blockade and scarcity of tonnage in shipping.

After the armistice was signed, however, and shipping again resumed, considerable stock was shipped. The Federal Horticultural Board announced an embargo, Quarantine 37, on most kinds of nursery stock and woody field grown florist's stock to take effect June 30, 1919. Certain kinds of stock like seedling fruit and manetti rose, which are used for propagation and which are shipped with roots bare, will still be allowed to enter under the rules and regulations prescribed by the Federal Horticultural Board. There is an arrangement by which new and promising forms and varieties may be imported through the U. S. Department of Agriculture.

The trade evidently tried to bring into the country as much stock as possible before the new restrictive measures went into effect. Consequently between October 1st, 1918, and June 30, 1919, 131 shipments containing 1075 cases and 1,164,701 plants were received in Connecticut and inspected by members of this department. This is nearly twice the number of shipments and nearly three times the number of cases inspected last year, and an increase of 38 per cent in the number of plants. Forty-four shipments or 33.5 per cent were infested with insects or fungi some of which are pests.

Most of this stock was inspected by Messrs. Zappe and Chamberlain, but Messrs. Walden, Davis, and Britton assisted during the rush season. The time required to inspect this stock amounts to 707.5 hours, or 94.3 days of 7½ hours each, or 3.62 months of 26 working days each.

The sources of this stock are given in the following table:—

SOURCES OF IMPORTED NURSERY STOCK, 1918-1919.

Country.	No. of Shipments.	No. of Cases.
Holland	98	937
France	14	73
England	8	23
Scotland	5	5
Ireland	3	3
Bermuda	2	32
Japan	1	2
Total	131	1,075

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

Month.	No. of Shipments.	No. of Cases.	No. of Plants.
December, 1918	4	5	20,000
January, 1919	7	55	293,473
February	19	85	70,360
March	9	40	157,107
April	83	242	588,754
May	7	40	34,999
June	2	8	8
Total	131	1,075	1,164,701

Notices were received of five additional shipments containing 35 cases which were not inspected. Three of these shipments were reshipped and sent out of the State, one contained only herbaceous stock, and one was unpacked and the plants distributed before it was possible to inspect them.

As was the situation last year, none of these shipments came directly from Italy, Belgium or Germany.

As in former years, most of the insects and fungi found in the shipments are (1) species which are already present in this country or (2) species which are not important as pests. However, there are some exceptions. Among the insects intercepted when the plants were inspected in 1919, are the Brown-tail moth, *Euproctis chrysorrhoea* Linn., regarded as an important pest but already present in the New England states; European tent-caterpillar *Malacosoma neustria* Linn., a pest of trees in Europe, which though several times intercepted on stock brought into this country, is not yet established here; *Agelastica alni* Linn., and *Emphytus cinctus* Linn., also brought in many times but not established here; *Otiorhynchus sulcatus* Fabr., *Coccus hesperidum* Linn., and the oyster-shell scale are already established in this country. The infestations found during the year are given in detail as follows:—

PESTS FOUND ON IMPORTED NURSERY STOCK, 1918-1919.
44 Shipments Infested.

Insects, etc.

Agelastica alni Linn. on trees. Van Gelderen & Co., Boskoop, Holland.
Amara communis Panz. Trees. Koster & Co., Boskoop, Holland.
Anisodactylus binotatus Fabr. Trees. Visser Bros., Naarden, Holland.
Aphodius granarius Linn. on Taxus. Koster & Co., Boskoop, Holland.
Barypithes pellucidus Boh. Taxus trees. Koster & Co., Boskoop, Holland.
Carabus nemoralis Mull. on trees. Van Heinigen Bros. & Co., Boskoop, Holland.

Clivina fossor Linn. on trees. Van Heinigen Bros. & Co., Boskoop, Holland.
Coccinella 7-punctata Linn. Azaleas. H. M. Hardyzer, Boskoop, Holland.
Coccus hesperidum Linn. on laurel trees. Flandria Societe Anonyme, Bruges, Belgium.
Curculionid larvae. Trees. H. M. Hardyzer, Boskoop, Holland.
Elaterid larvae on shrubs. H. M. Hardyzer, Boskoop, Holland; Van Heinigen Bros. & Co., Boskoop, Holland.
Emphytus cinctus Linn. on Manetti Rose. R. H. Bath, Ltd., Wisbech, England; S. Bide & Sons, Farnham, Surrey, England; Vincent Lebreton, La Pyramid-Trelaze, France; As. Ouwerkerk, Boskoop, Holland; Thomas Smith & Sons, Troon, Scotland; Louis Leroy Nurseries Co., Angers, France.
Emphytus cinctus Linn. larva. E. Turbat & Co., Orleans, France.
Euproctis chrysorrhoea Linn. on fruit trees. Franco-American Seedling Co., Nantes, France.
Falagria sp. D. Prior & Sons, Colchester, England.
Forficula auricularia Linn. on trees. H. M. Hardyzer, Boskoop, Holland.
Lampyrid larva on Juniper trees. Van Heinigen Bros. & Co., Boskoop, Holland.
Lathrobium brunnipes Fabr. on trees. Van Heinigen Bros. & Co., Boskoop, Holland; M. Koster & Sons, Boskoop, Holland.
Lepidopterous pupa on spruce. M. Koster & Sons, Boskoop, Holland.
Malacosoma neustria Linn. on shrubs. Visser Bros., Naarden, Holland.
Milliped on Manetti Rose. Vincent Lebreton, La Pyramide-Trelaze, France.
Mycetaea hirta Mar. D. Prior & Sons, Colchester, England.
Nest of Rats on blue spruces. Harry Koolbergen, Boskoop, Holland.
Noctuid cocoon on trees. Franco-American Seedling Co., Nantes, France.
Pterostichus vulgaris Linn. In soil. Koster & Co., Boskoop, Holland.
Otiorhynchus sulcatus Fabr. Taxus. Van Heiningen Bros. & Co., Boskoop, Holland.
Oyster Shell Scale on Boxwood. Sliedrecht & Co., Boskoop, Holland; Schaum & Van Tol, Boskoop, Holland; Koster & Co., Boskoop, Holland; Visser Bros., Naarden, Holland; Ebbinge & Van Groos, Boskoop, Holland; Van Heiningen Bros. & Co., Boskoop, Holland; H. den Ouden & Son, Boskoop, Holland; C. Van Kleef & Co., Boskoop, Holland; F. J. Grootendorst & Sons, Boskoop, Holland; W. Van & Sons, Boskoop, Holland; As. Ouwerkerk, Boskoop, Holland.
Sow bug on shrubs. K. Kromhout & Sons, Boskoop, Holland.
Spiders eggs, one mass on shrubs. K. Kromhout & Sons, Boskoop, Holland.
Triaena plebeja Gyllh. on trees. Ebbinge & Van Groos, Boskoop, Holland.

Plant Diseases.

Crown Gall on Manetti Rose. S. Bide & Sons, Farnham, Surrey, England; Vincent Lebreton, La Pyramide-Trelaze, France; Thomas Smith & Sons, Troon, Scotland; As. Ouwerkerk, Boskoop, Holland; Louis Leroy Nurseries Co., Angers, France.

INSPECTION OF IMPORTED BULBS.

At the suggestion of the Federal Horticultural Board, an attempt has been made, at least for a definite period, to inspect the imported bulbs entering Connecticut, in order to ascertain whether or not any dangerous pests are liable to be introduced in this way. Bulbs were not prohibited under Quarantine No. 37, and no effort has ever been made before to inspect them in Connecticut. The first to arrive were lily bulbs from Bermuda, then narcissus paper whites from France which began coming in July. Later came tulip and hyacinth bulbs from Holland and lily bulbs from Japan.

The source of the shipments inspected are as follows:—

Country.	No. of Shipments.	No. of Cases.
France	104	302
Holland	147	436
Japan	43	141
China	9	26
Bermuda	4	6
England	10	13
Total	317	924

The inspections by months are as follows:—

Month.	No. of Shipments.	No. of Cases.	No. of Bulbs.
July	1	3	200
August	46	102	71,900
September	57	199	231,835
October	109	334	629,495
November	104	286	596,345
Total	317	924	1,529,775

On November 14, notice was received from the Federal Horticultural Board that arrangements had finally been made for these bulbs to be examined at the ports of entry of Boston, New York, Washington, New Orleans, Seattle, Tacoma and San Francisco by Federal inspectors. Consequently, hereafter, at least until further notice, it will not be necessary for us to examine bulbs.

Most of this inspection work has been done by Messrs. Zappe and Chamberlain, but Mr. Davis has inspected those shipments going into the eastern end of the State and Messrs. Lewis, Garman, Stone, Walden and Britton have all helped at times in the work.

In 67 shipments or 21.1 per cent. pests were found, the most common being the bulb mite *Rhizoglyphus hyacinthi* Boisdv., known in Europe as *R. echinopus* Fumouse & Robin, which was found in 39 shipments. Apparently this mite will attack and injure any kind of bulbs, and also some of the stems growing out of them. Another pest found in imported bulbs is the bulb fly *Merodon equestris* Fabr., which was found in 4 shipments. Both the bulb mite and the bulb fly have been brought into this country many times and are no doubt established here.

The time required to inspect these bulbs is equivalent to one man working 847½ hours or 113 days of 7½ hours each, or 4⅓ months of 26 working days each.

The data regarding the infested shipments of bulbs are as follows:—

PESTS FOUND ON IMPORTED BULBS, 1919.
67 Shipments Infested.
Insects, etc.

Atheta sp. C. J. Speelman & Sons, Holland (1).

Capsid bug. Van Zonneveld Bros. & Philippo, Holland (1).

Cathartus advena Wal. C. G. Van Tubergen, Jr., Haarlem, Holland (1).

Elaterid larva in hyacinths. C. J. Speelman & Sons, Sassenheim, Holland (1).

Lepidopterous larvae in buckwheat chaff. L. Van Leeuwen & Son, Holland (5); M. Van Waveren, Holland (1); C. J. Speelman & Sons, Sassenheim, Holland (1); Baartman & Koning, Sassenheim, Holland (1).

Merodon equestris Fabr. L. Van Leeuwen & Son, Sassenheim, Holland (1); M. Veldhuyzen Van Zanten & Son, Lisse, Holland (1); J. Schilpzand & Sons, Hillegem, Holland (1); Van Zonneveld Bros. & Philippo, Sassenheim, Holland (1).

Pyralis farinalis Linn. in buckwheat chaff. L. Van Leeuwen & Son, Sassenheim, Holland (1); C. J. Speelman & Sons, Sassenheim, Holland (1).

Rhizoglyphus echinopus Fumouse and Robin. A. & L. Bremond Freres, Ollioules, France (1); Guldemond & Son, Lisse, Holland (4); Meskers Bros., Holland (1); K. Van Bourgondier & Son, Hillegem, Holland (3); C. Colyn & Son, Voorhout, Holland (1); M. Veldhuyzen Van Zanten & Son, Lisse, Holland (2); J. Schilpzand & Sons, Hillegem, Holland (2); Lagarde & Speelman, Ollioules, France (2); Van Zonneveld Bros. & Philippo, Sassenheim, Holland (5); Vandervooit Alkemade, Naardwyk, Holland (1); L. Van Leeuwen & Son, Island of Guernsey (2); D. Nieuweuhuis & Sons, Lisse, Holland (1); C. J. Speelman & Sons, Holland (5); Zanbergen Bros., Valkenberg, Holland (1); Drevon-Tegelaar & Co., Ollioules, France (1); M. Van Waveren & Sons, Hillegem, Holland (3); Van Meeuwen & Tegelaar, Lisse, Holland (3); Richachiro Tanoi, Yokohama, Japan (1).

Sitodrepa panicea Linn. Van Zooneveld Bros. & Philippo, Sassenheim, Holland (1).
Staphylinids in narcissus. Zaubergen Bros., Valkenberg, Holland (1).
Tenebrio molitor Linn. in chaff packing. L. Van Leeuwen & Son, Holland (1); C. G. Van Tubergen, Jr., Holland (1).
Tenebrio sp. (?) in buckwheat chaff. Van Zooneveld Bros. & Philippo, Holland (2); Baartman & Koning, Sassenheim, Holland (1).
Typhoea fumata Linn. C. G. Van Tubergen, Jr., Haarlem, Holland (1).

Fungi.

Papulospora sp. L. Van Leeuwen & Sons, Sassenheim, Holland (1).
Penicillium sp. L. Van Leeuwen & Sons, Sassenheim, Holland (1).

INSPECTION OF APIARIES.

There has been no change in the personnel of the inspectors or in the system of inspecting apiaries, during the year; Mr. H. W. Coley of Westport has inspected in Fairfield, New Haven, Middlesex and New London Counties, and Mr. A. W. Yates of Hartford has inspected in Litchfield, Hartford, Tolland and Windham Counties, each working on a *per diem* basis.

On account of the change in the fiscal year, all work done prior to July 1, 1919, was paid for out of the old appropriation, leaving a balance of $43.70. The General Assembly increased the appropriation from $750.00 to $2000.00 annually, the new and increased appropriation becoming available July 1, 1919. The wages of the inspectors were increased July 1 from four to five dollars per day, which accounts in part for the increased cost of inspection per apiary and per colony, over former years. The report of the inspection work for the entire season is contained in this paper.

The General Assembly at the request of the Connecticut Beekeepers Association enacted a law, requiring beekeepers to register with the town clerks of their respective towns, as follows:—

CHAPTER 174, PUBLIC ACTS OF 1919.

An Act concerning Registration of the Owners of Honey Bees.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Section 1. Every person owning one or more hives of bees shall, annually, on or before the first day of October, make application to the town clerk of the town in which such bees are kept, for the registration of such bees, and such town clerk shall issue to such applicant a certificate of registration upon the payment of a recording fee of twenty-five cents, which certificate shall be in the form prescribed and upon blanks furnished by the commissioner of domestic animals and shall be recorded in the office of such town clerk.

Sec. 2. A record of such registration with the name and place of residence of the registrant and the definite location in the town where bees are kept by him shall be recorded in a separate book in the office of the town clerk, which records shall be accessible to the public.

Sec. 3. Any owner of bees who shall fail to register as required by the provisions of this act shall be fined not more than five dollars.

Approved, May 1, 1919.

This law will enable the inspectors to find the apiaries, so that in localities where diseases occur, it will be much easier to eradicate them.

During the season, 723 apiaries, containing 6,070 colonies, were inspected. The record for 1918 was 385 apiaries, and 2,913 colonies. In making these inspections, 102 towns were visited as against 83 last year. Inspections were made in the following towns which were not visited last year:

Fairfield County—Bridgeport.
New Haven County—Branford, Cheshire, Guilford, Hamden, Meriden, Oxford and Wolcott.
Middlesex County—Durham, East Haddam, East Hampton, Killingworth, Middletown, Portland, Saybrook and Westbrook.
New London County—Lisbon, Stonington and Groton.
Litchfield County—Bethlehem, Harwinton, Thomaston, Torrington, Warren and Washington.
Hartford County—Avon, East Hartford, Glastonbury, Granby, Manchester, Marlborough, Rocky Hill, Southington, West Hartford, Wethersfield and Windsor.
Tolland County—Andover, Bolton and Tolland.
Windham County—Brooklyn, Putnam, Thompson and Woodstock.

On the other hand, several towns in which inspections were made in 1918 were not visited this year. These are as follows:—

Fairfield County—Trumbull.
New Haven County—Ansonia.
Litchfield County—Colebrook, Cornwall, Goshen, Kent, New Hartford, Norfolk, Canaan, Salisbury, Sharon and Winchester.
Tolland County—Columbia, Ellington and Somers.
Windham County—Ashford, Canterbury and Chaplin.

In Avon, Oxford, Saybrook and Westbrook no inspections had ever been made until 1919. There still remain twelve towns where inspections have never been made, as follows: Tolland County, Union; Windham County, Eastford; Fairfield County, Sherman and New Fairfield; New Haven County, East Haven; Middlesex County, Essex, Chester, Middlefield and Old Saybrook; New London County, Lebanon, Preston and Voluntown. An effort will be made to inspect some of the apiaries in these towns next year.

The inspections made during 1919 show that the European foul brood continues to decrease as has been the case each year for the past ten years since the inspection service began. In 1910 when the first inspections were made, 75.9 per cent of the apiaries and 49.7 per cent of the colonies had European foul brood. In 1919, the infestation was only 6.6 per cent of the apiaries, and 1.2 per cent of the colonies. During the past season European foul brood was found in the following 34 towns:—Fairfield County, Bridgeport, Norwalk, Redding and Stamford: New Haven County, Cheshire and Wolcott: Middlesex County, Durham: New London County, Norwich and Old Lyme: Litchfield County, Bethlehem, Bridgewater, Thomaston, Torrington, and Watertown: Hartford County, East Hartford, Farmington, Glastonbury, Granby, Manchester, Marlborough, New Britain, Plainville, West Hartford, Wethersfield, Windsor and Windsor Locks: Tolland County, Coventry and Vernon: Windham County, Brooklyn, Killingly, Pomfret, Scotland, Sterling and Windham.

American foul brood was first found by the inspectors in 1914, and since then in two or three places each year, but the percentage of apiaries infested has never been much above one per cent, or of colonies one-third of one per cent, until 1919, when 3.0 per cent of the apiaries and 1.1 per cent of the colonies were found infested. The disease, therefore, has been more prevalent and infests a higher percentage of apiaries than ever before. One of the principal centers of infestation was Wallingford, where twenty-seven colonies in eleven apiaries were found diseased. It was also present in the following eight towns;—Stamford, Shelton (Huntington). Wallingford, Madison, Killingworth, East Lyme, Waterford and East Hampton. These towns are all in

Mr. Coley's territory in the southern half of the State, and must be given particular attention next year.

The statistics of the apiaries examined in 1919 in each of the 102 towns are given by counties in the following tables, the summary occurring on page 134.

APIARIES INSPECTED IN 1919.

	No. Apiaries Inspected.	No. Apiaries Diseased.	No. Colonies Inspected.	No. Colonies Diseased.
Fairfield County:				
Bethel	2	0	5	0
Bridgeport	4	1	100	2†
Danbury	9	0	90	0
Darien	3	1	26	1§
Easton	2	1	86	1§
Fairfield	9	0	193	0
Greenwich	12	0	166	0
Huntington	1	1	3	1*
Monroe	1	0	2	0
New Canaan	5	1	37	1†
Norwalk	10	2	97	5†
Redding	6	0	64	0
Ridgefield	7	0	69	0
Stamford	21	6	230	7‡
Stratford	2	0	63	0
Westport-Weston	10	0	120	0
Wilton	13	0	156	0
	117	13	1,515	18
New Haven County:				
Beacon Falls	1	0	28	0
Branford	5	1	41	4§
Cheshire	7	1	58	1†
Derby	2	0	47	0
Guilford	3	1	34	5‖
Hamden	7	1	28	1†
Madison	7	2	29	2*§
Meriden	18	0	146	0
Middlebury	1	0	34	0
Milford	1	0	52	0
Naugatuck	6	0	37	0
New Haven	3	0	28	0

* American Foul Brood.
† European Foul Brood.
‡ 2 American Foul Brood, 1 European Foul Brood and 4 Sacbrood.
§ Sacbrood.
‖ Paralysis.

	No. Apiaries Inspected.	No. Apiaries Diseased.	No. Colonies Inspected.	No. Colonies Diseased.
Oxford	3	0	25	0
Prospect	6	0	53	0
Seymour	2	0	26	0
Wallingford	20	11	155	27*
Waterbury	6	0	26	0
Wolcott	2	1	14	1†
	100	18	861	41
Middlesex County:				
Durham	5	3	114	11¶
East Haddam	4	0	47	0
East Hampton	3	1	36	4*
Killingworth	2	1	11	2*
Middletown	1	0	31	0
Portland	3	0	30	0
Saybrook	2	0	20	0
Westbrook	1	0	8	0
	21	5	297	17
New London County:				
East Lyme	5	3	69	5*
Groton	4	0	6	0
Lisbon	1	0	8	0
Montville	6	0	42	0
New London	3	0	42	0
Norwich	9	1	106	1†
Old Lyme	2	1	53	2†
Stonington	1	1	20	2‖
Waterford	5	2	46	18*
	36	8	392	28
Litchfield County:				
Bethlehem	3	1	3	1†
Bridgewater	9	1	65	1†
Harwinton	2	0	7	0
Litchfield	13	0	153	0
New Milford	8	0	79	0
Plymouth	7	0	19	0
Thomaston	8	1	49	1†
Torrington	7	1	133	1†
Warren	4	0	31	0

* American Foul Brood.
† European Foul Brood.
¶ 10 American Foul Brood, 1 European Foul Brood.
‖ Paralysis.

	No. Apiaries Inspected.	No. Apiaries Diseased.	No. Colonies Inspected.	No. Colonies Diseased.
Watertown	6	3	57	3†
Washington	4	0	137	0
	71	7	733	7
Hartford County:				
Avon	2	0	13	0
Berlin	7	0	75	0
Bloomfield	2	0	159	0
Bristol	11	0	100	0
Burlington	10	0	54	0
Canton	15	0	67	0
East Granby	3	0	19	0
East Hartford	15	1	95	2†
East Windsor	9	0	98	0
Enfield	8	0	39	0
Farmington	21	1	98	1†
Glastonbury	27	4	119	9†
Granby	4	1	48	1†
Hartford	24	1	99	1‖
Manchester	14	1	87	1†
Marlborough	2	1	46	3†
New Britain	9	1	100	6†
Newington	4	0	50	0
Plainville	10	3	31	9†
Rocky Hill	3	0	24	0
Southington	5	0	14	0
South Windsor	8	0	32	0
Suffield	9	0	34	0
West Hartford	25	1	117	2†
Wethersfield	11	2	55	3†
Windsor	11	2	28	2†§
Windsor Locks	4	2	13	2†
	273	21	1,714	42
Tolland County:				
Andover	3	0	21	0
Bolton	5	0	16	0
Coventry	11	1	59	1†
Mansfield	5	0	41	0
Stafford	3	0	23	0
Tolland	2	0	4	0
Vernon	8	1	40	2†
Willington	11	0	33	0
	48	2	237	3

† European Foul Brood.
§ Sacbrood.
‖ Paralysis.

	No. Apiaries Inspected.	No. Apiaries Diseased.	No. Colonies Inspected.	No. Colonies Diseased.
Windham County:				
Brooklyn	1	1	2	1†
Killingly	6	2	32	3†
Plainfield	8	0	43	0
Pomfret	15	1	94	2†
Putnam	2	0	11	0
Scotland	5	2	47	2†
Sterling	2	1	9	2†
Thompson	2	0	20	0
Windham	15	1	58	1†
Woodstock	1	0	5	0
	57	8	321	11

Summary.

County	No. of Towns	No. Apiaries Inspected	No. Apiaries Diseased	No. Colonies Inspected	No. Colonies Diseased
Fairfield	18	117	13	1,515	18
New Haven	17	100	18	861	41
Middlesex	6	21	5	297	17
New London	9	36	8	392	28
Litchfield	11	71	7	733	7
Hartford	26	273	21	1,714	42
Tolland	8	48	2	237	3
Windham	10	57	8	321	11
	105	723	82	6,070	167

	No. Apiaries	No. Colonies
Inspected	723	6,070
Infested with European foul brood	48	78
Per cent. infested	6.6	1.2
Infested with American foul brood	22	69
Per cent. infested	3.0	1.1
Sacbrood	9	12
Pee paralysis	3	8
Average number of colonies per apiary		11.2
Cost of inspection		$1,771.03
Average cost per apiary		$2.45
Average cost per colony		.29

† European foul brood.

GIPSY AND BROWN-TAIL MOTH WORK IN 1919.

By Irving W. Davis.*
Assistant and Deputy in Charge of Moth Work.

This work has been conducted as in preceding years, in co-operation with the Federal Bureau of Entomology. Apparently there has been no marked wind-spread of the gipsy moth since 1916, consequently the results of careful and persistent efforts show a rather decided decrease in both the number of infestations and number of egg-clusters in the towns now infested. Moreover, in eight towns considered as infested in 1918, no infestations were found by the Federal Scouts. In seven of these and in three others,—making ten altogether, the quarantine has been removed.

The last session of the General Assembly increased the appropriation for suppressing the gipsy and brown-tail moths, and for inspecting imported nursery stock, to $70,000.00 for the biennial period ending June 30, 1921. The appropriation for similar work for the preceding biennial period was $40,000.00.

Present Status of the Brown-Tail Moth in Connecticut.

For the last three or four years, the brown-tail moth has been very scarce in Connecticut, due it is believed to natural enemies, or at least to natural causes. Consequently it has not seemed advisable for the state to attempt to carry out any control measures, or to order municipalities to take action in the matter. The Report of this Station for 1918, page 286, explains how the number of towns quarantined on account of this insect was reduced from seventy-one in 1915 to thirty-one in 1918. The number was further reduced to twenty-one the past year by the release of the following ten towns:—Stafford, Willington, Ashford, Mansfield, Windham, Franklin, Sprague, Bozrah, Norwich and Preston.

A close watch for winter nests was kept by State men when they were travelling about the State on other work, and likewise

* Note:—Mr. Davis returned January 15, 1919 from service in the U. S. Marine Corps, and since then has been in immediate charge of all field operations. During his absence, Mr. John T. Ashworth served acceptably as Superintendent.—W. E. Britton.

for adult moths around lights during the period of their flight in July. Very few of either were noticed. The Federal Scouts, however, found a few nests in Stonington near the Groton town line in the spring. These were sent to the laboratory at Melrose Highlands, for the purpose of recovering parasites.

Financial Statement.*

RECEIPTS.

Appropriation for biennial period ending Sept. 30, 1919.....	$40,000.00
Transfer by Board of Control	103.97
Total Receipts for biennial period	$40,103.97
Amount expended, year ending Sept. 30, 1918	22,644.18
Balance	$17,459.79

CLASSIFIED EXPENDITURES FOR THE NINE MONTHS ENDING JUNE 30, 1919.

Salaries and Wages:		
I. W. Davis†	$ 962.50	
J. T. Ashworth	925.00	
J. A. McEvoy	825.44	
F. C. Rich	827.26	
E. A. Smith	648.45	
R. G. Newton	509.34	
D. LaBelle	708.06	
H. L. Bodo	709.63	
J. W. Longo	429.35	
K. E. Buffington	443.30	
Other labor	3,383.17	
		$10,371.50
Printing and illustrations		6.50
Postage		6.27
Stationery		.20
Telegraph and Telephone		46.73
Office Supplies		53.80
Express, Freight and Cartage		285.94
Machinery, Tools and Supplies		3,200.22
Insurance		389.26
Rental and Storage		127.00
Traveling Expenses		1,004.40
Automobile Tires and Repairs		1,272.28
Inspection of Imported Nursery Stock		665.69
Miscellaneous		30.00
Total		$17,459.79

* The General Assembly at its last session changed the time of beginning the fiscal year from Oct. 1st to July 1st. Hence the classified expenditures cover only nine months.

† For six and one-half months.

Details of Gipsy Moth Work by Towns.

The following pages give a detailed account of the work in each of the infested towns:—

THOMPSON—86 Infestations—2448 Egg-clusters.

In the report of last year a decrease was noted in the number of gipsy moth colonies in Thompson, and it was explained that this was partly due to the fact that single egg-clusters were not counted as infestations. The same practice was followed this year and resulted in finding only eighty-six colonies, as compared with two hundred and seventy-five for the preceding year. These colonies were mostly in the central and eastern portion of the town, there being comparatively few found to the west of the New London and Worcester branch of the N. Y., N. H., and H. R. R. The colonies themselves were smaller than in some of the previous years, the largest containing less than one hundred egg-clusters. In many cases however the egg-clusters were scattered over a large area which made control measures difficult. During the early part of the spring a good deal of undergrowth was cut near many of the colonies, to make the control measures more effective. The larger infestations were also given special attention as were also those which were so located as to make spraying impracticable. Following this the colonies in windswept localities, from which there was great danger of spread of caterpillars, were banded with raupenleim. In the course of the spraying season, both the horse-drawn and automobile truck power sprayers were used in this town, and sixty-seven of the eighty-six colonies were sprayed.

WOODSTOCK—36 Infestations—876 Egg-clusters.

This town was the first one scouted this year, due to the fact that the western portion was not covered in the scouting of a year ago. It was expected that the western section would contain the majority of the colonies and exactly half of those found in Woodstock were located there near Woodstock Valley and from there south to the Eastford line. The northwestern section did not contain any colonies, and the remaining eighteen were scattered throughout the eastern part of the town. In several cases but one tree was infested and wherever possible these trees were cut and burned. A few of the woodland colonies were also

cleaned of undergrowth and as in Thompson the banding of trees was practised on all colonies in windswept locations. During the month of June, twenty-two of the colonies were sprayed with arsenate of lead, and the patrolling work later indicated a successful season.

UNION—1 Infestation—1 Egg-cluster.

The scouting for the gipsy moth in Union during the past winter was done by the Federal men. The town was only partly scouted and the result was the finding of a single egg-cluster.

PUTNAM—28 Infestations—777 Egg-clusters.

The gipsy moth colonies in Putnam were well scattered throughout the town, with the exception of one group which was found on the road leading north from East Putnam. Five infestations were located in this vicinity, but none were of a serious nature. The largest colony found was on the Torrey farm in the eastern part of the town. This colony, consisting of 359 egg-clusters, was found on a wooded hillside about 200 yards back from the road. The egg-clusters were scattered over ten acres, which naturally made this colony a difficult one to handle. During the spring a large part of this area was cleaned and the brush burned. This infestation was sprayed in the early part of June, and but few living caterpillars were found. The work of cleaning up the colonies was carried on at seven infestations in Putnam and twenty-six infestations were sprayed.

POMFRET—29 Infestations—314 Egg-clusters.

The twenty-nine infestations found in Pomfret were scattered throughout its entire area, but none of these were large, or in any way of a serious nature. The largest colony found was in the southeastern part of the town on land owned by Mr. Fayette L. Wright. This colony was in a large oak and stone wall and contained sixty-six egg-clusters, thirty-two of which were old ones. The undergrowth near this was cut and burned, and the remaining foliage was sprayed later in the season. Another important colony was found in the woodland near the Eastford town line. While this infestation contained only nineteen egg-clusters, these were so widely scattered that it made control measures difficult. This colony was sprayed during June as were also eleven others in this town.

EASTFORD—21 Infestations—173 Egg-clusters.

This town was scouted by the Federal men, and resulted in locating twenty-one infestations containing 173 egg-clusters. There were no colonies found in the extreme northern portion of the town, but in the south and central sections the infestations were well distributed. The most dangerous colony was found on land of Mr. Andrew Chilkott about a mile to the west of Eastford village. The growth here was largely oak and maple, and the egg-clusters were scattered over a considerable area of it. Its location together with the large area it covered rendered it impossible to do any banding, but this entire tract of woodland was sprayed. Another infestation of note was on land of Mr. John Fitts near the Ashford line. This was also in the woodland, but was not scattered as much as the former colony. It was also sprayed during June. Altogether ten of the infestations in Eastford were sprayed and five were cleaned of the undergrowth.

ASHFORD—1 Infestation—1 Egg-cluster.

Mr. H. L. McIntyre of the Federal force found a single egg-cluster of the gipsy moth in Ashford. This was sent to the Government Parasite Laboratory in Melrose Highlands, Mass., and the report from there stated that this egg-cluster was infertile.

KILLINGLY—27 Infestations—755 Egg-clusters.

The twenty-seven colonies of the gipsy moth found in this town were widely scattered, and none of them were considered of a serious nature. Among the larger colonies might be mentioned two which were in the northwestern part of the town and near the state road leading to Putnam. One of them was in two large pasture oaks and 107 egg-clusters were creosoted on these trees. The other colony, a short distance south of the first, was in an old apple tree. This tree was cut, and in the course of cleaning it up 118 egg-clusters were found and destroyed. In the course of scouting for larvae several egg-clusters were found and during June these areas were sprayed making in all thirty-eight different localities in Killingly which were sprayed this year.

BROOKLYN—16 Infestations—1433 Egg-clusters.

During the scouting this past winter, sixteen colonies of the gipsy moth were located here principally in the eastern and southern portions of the town, and among them were some of

the largest colonies found this season. One infestation worthy of note was found on land of Mr. DeMott in the eastern part of the town near the Killingly line. While there were 796 egg-clusters here, the growth was very small consisting of one or two small oak trees. This colony was sprayed early in the season with a hand-sprayer and from later observations it is believed that the colony has been exterminated. Another large colony was found in a maple swamp in the northern part of the town. This infestation was scattered over a large area and was so located that it was not feasible to spray it. The most dangerous colonies in this town were cleaned of undergrowth and during the month of June, fourteen of the colonies were sprayed with arsenate of lead.

HAMPTON—12 Infestations—30 Egg-clusters.

There were very few egg-clusters of the gipsy moth found in Hampton this year as compared with last, when 336 egg-clusters were destroyed. The colonies also were small; the largest containing only seven egg-clusters, and located around the borders of the town while in the central portion none were found. Five of them contained but a single egg-cluster each, and none of them were serious enough to warrant spraying.

MANSFIELD—1 Infestation—1 Egg-cluster.

Mansfield was scouted by the Federal men and their work consisted largely of scouting around the colonies of the previous year. Only one egg-cluster was found near one of these infestations.

STERLING—10 Infestations—216 Egg-clusters.

Sterling was first found infested by the gipsy moth in the winter of 1914-15. Scattering colonies were located during the next two years, but in 1917 a general infestation occurred. The result of the scouting this winter was the finding of ten colonies and several single egg-clusters. Most of the colonies were in the northern section of the town, a few were in the extreme southern portion, leaving an area in the central part where but few traces of the moth were found. The largest colony in the town contained forty-nine egg-clusters in the village of Oneco. This was on the eastern slope of a small hill and the egg-clusters were found in some oaks and a nearby stone wall. The presence of a lot of rubbish and undergrowth made cleaning necessary

and this colony was later sprayed. Other colonies of importance include one of thirty-two egg-clusters found in an abandoned orchard near the Killingly line, and one in the extreme southern part of the town on land of Addie Fenner. These colonies together with four others were sprayed during June.

PLAINFIELD—18 Infestations—756 Egg-clusters.

In this town the infestations were almost all rather large, three of them containing over 100 egg-clusters each. Two of these were in the north part of the town, and one in the south part near the Griswold line. These were all in orchards, which made control measures rather easy. No cleaning was necessary, but all three were sprayed. Several of the colonies in this town were found in pasture oaks. In such cases the nearby brush was cut and burned and wherever possible the infestation was later sprayed. The Federal sprayer was used in this town, and twelve of the colonies were sprayed.

CANTERBURY—10 Infestations—248 Egg-clusters.

Only ten infestations were found as the result of scouting Canterbury this past winter. These may be roughly located in three groups, one in the south part of the town in the vicinity of South Canterbury, another in the central part near Canterbury Plains, and the third in the northwestern corner near the Hampton line. The largest colony was found in an apple tree in the south part of the town. Fifty-eight egg-clusters were found when this tree was cut and as it together with the nearby brush was burned, it was not thought necessary to spray this infestation. In all, five colonies were considered serious enough to spray and in Canterbury this was accomplished by the Federal truck during the early part of June.

SCOTLAND—1 Infestation—3 Egg-clusters.

During the winter of 1917-18 seven infestations containing 136 egg-clusters were located in this town. This year but a single infestation was found and that contained only three egg-clusters. This was not sprayed, as it was not thought to be of sufficient importance.

VOLUNTOWN—3 Infestations—81 Egg-clusters.

Three infestations were found in Voluntown this year, all in the northern part of the town. All were located in apple trees,

and during April all were banded with raupenleim. One colony found on land of Sarah Greene contained seventy-five egg-clusters. Several larvae were found here in the early part of June and during the latter part of the month this infestation was sprayed with arsenate of lead.

GRISWOLD—8 Infestations—16 Egg-clusters.

The gipsy moth colonies in Griswold were all within a small area in the northeastern corner of the town. These colonies were all small and did not require much attention. In the course of the spraying work gipsy moth caterpillars were found at two places on the State road leading from Jewett City to Plainfield. Both of these were sprayed and the finding of several dead larvae a few days later indicated that the work had been effective.

LISBON—1 Infestation—3 Egg-clusters.

Lisbon was scouted by the Federal men during the past winter and only one infestation, containing three egg-clusters, was found.

NORWICH—1 Infestation—11 Egg-clusters.

One colony of eleven egg-clusters was found in the western part of Norwich near the Bozrah line. These were removed and sent to the Government Laboratory and it was later reported that all were infertile.

NORTH STONINGTON—1 Infestation—1 Egg-cluster.

In this town only one egg-cluster was found, and that near an infestation of the preceding year.

LEDYARD—1 Infestation—11 Egg-clusters.

The Federal men scouted this town, and found one colony which contained eleven egg-clusters. This colony was visited by the State men early in the season and as it was in a young apple orchard, the control was easily accomplished.

The following eight towns were scouted by the Federal men and no signs of the gipsy moth were found:

Chaplin
Windham
Franklin
Bozrah
Preston
Sprague
Groton
Stonington

The recent quarantine maps issued by the Government show that ten Connecticut towns have been removed from the area quarantined on account of the gipsy moth, namely:

Ashford
Mansfield
Windham
Franklin
Sprague
Bozrah
Norwich
Preston
Groton
Stonington

The last two—Groton and Stonington—are still quarantined on account of the brown-tail moth.

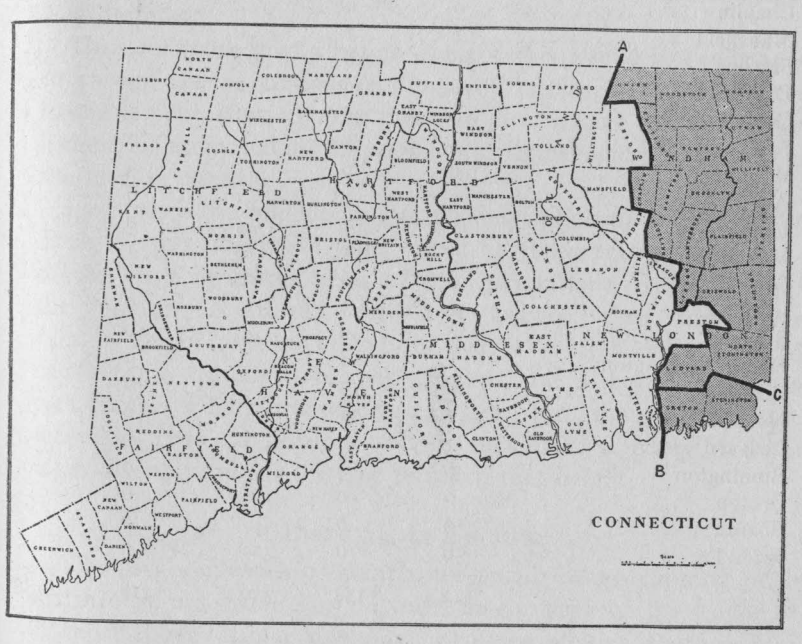

Figure 16. Map of Connecticut showing areas infested by gipsy and brown-tail moths. All territory east of the line A B is quarantined on account of the brown-tail moth. All territory east of the line A C is quarantined because of the gipsy moth.

The Connecticut territory now under Federal quarantine on account of the gipsy moth and the brown-tail moth, includes nineteen towns for the gipsy moth and twenty-one for the brown-tail moth, as shown on the map in figure 16.

Statistics of Infestations.

The following table summarizes the work by towns:—

	No. of Infestations	No. of Egg Clusters Destroyed	No. of Bands Applied	No. of Infestations Sprayed	No. of Larvae Destroyed
Thompson	86	2,448	221	67	2,881
Woodstock	36	876	173	22	....
Putnam	28	777	219	22	1,564
Pomfret	29	314	35	12	....
Eastford	21	163	36	10	....
Killingly	27	755	399	38	5,988
Brooklyn	16	1,433	246	14	887
Hampton	12	29	241	0	....
Chaplin	0	0	....	0	....
Mansfield	1	1	....	0	....
Sterling	10	216	362	7	337
Plainfield	18	756	492	12	529
Canterbury	10	248	349	5	2
Scotland	1	3	....	0	....
Windham	0	0	....	0	....
Ashford	1	1*	....	0	....
Union	1	1	....	0	....
Voluntown	3	81	86	1	....
Griswold	8	16	185	2	....
Lisbon	1	3	....	0	....
Sprague	0	0	....	0	....
North Stonington	1	1	....	0	....
Preston	0	0	....	0	....
Norwich	1	11*	....	0	....
Ledyard	1	11	....	0	....
Stonington	0	0	....	0	....
Groton	0	0	....	0	....
Bozrah	0	0	....	0	....
Franklin	0	0	....	0	....
	312	8,144	3,044	212	12,188

THE WHITE PINE WEEVIL.

Pissodes strobi Peck.

Notwithstanding the injury caused by the pine bark aphid, the white pine-currant blister rust and various other pests, it may be stated without fear of contradiction that the weevil causes more damage to young white pines in Connecticut than any of them and possibly more than all of them together.

* Egg-clusters infertile.

As no comprehensive account of this insect has ever appeared in the reports of this Station, and as frequent requests for information are received and supplied, it is desirable that the facts be brought together in available printed form for the use of the large and increasing number of owners of white pine plantations.

The insect causing this injury is a small brown snout beetle often called weevil or curculio belonging to the family Curculionidae of the order Coleoptera. It was described in the Massachusetts Repository and Journal of January 1817, by Professor W. D. Peck of Harvard University. This paper by Peck is believed to be the first in which an American injurious insect was described.

Thus for more than a hundred years, this weevil has continued to ravage the plantations and natural seedings of white pines in the Northeastern States, and though it seldom kills the trees, it deforms them making them unfit for timber and greatly checks the total or acreage growth.

Ever since the publication of the description of this insect by Peck in 1817, the white pine weevil has been recognized as one of the most injurious pests of pine plantations in this part of the country. It attacks young trees between three and twelve feet in height chiefly, killing the leader or topmost shoot and causing the trunks to become crooked and illshaped. After a tree reaches a height of twelve to fifteen feet, though sometimes weeviled, it is not injured so seriously, but in many cases it takes a long time for the tree to reach that height.

Evidence of Injury.

The first evidences of attack are small clear drops of pitch which ooze out from the punctures on the bark of the leader or topmost shoot. Later this pitch dries to whitish spots and in some cases runs down the stem. This oozing out of pitch may not be very conspicuous, however, and as a rule the owner does not notice anything the matter with his pines until the leaders begin to wilt and droop, usually during the month of July. In Connecticut this first shows early in the month but there are some trees which do not show it until later. The wilted and drooping leaders soon turn brown and die as is shown on plate IX.

Usually the attacks of the insect are confined to the leaders or topmost shoot, but occasionally lateral branches are weeviled,

and rarely weevils are found below the whorl of branches in two-year-old wood. Normally the weevils attack only wood of the previous season's growth.

White pine is the common host and the only forest tree in Connecticut seriously injured by *Pissodes strobi,* though this weevil is recorded as occasionally attacking other pines, and certain kinds of spruces. Small spruces in nurseries (chiefly Norway spruce) are commonly injured by this weevil. There are also other species of *Pissodes* which are found on some of the pines and spruces: for instance *Pissodes approximatus* Hopkins was reared from the thick bark of *Pinus resinosa,* attacking the old wood even down to the ground. Then *Pissodes affinis* Randall breeds in the thick bark of white pine stumps. All three species, *affinis, approximatus* and *strobi,* are found in Connecticut, but it is *strobi* which is responsible for the injury to young white pine trees.

Life History.

There is only one generation each year. Just where the adult beetles hibernate or pass the winter is a question. Hopkins says* "evidently in the ground." Though some closely allied weevils are found during the winter months under the bark of dead trees, stumps, etc., I do not recall ever having seen the white pine weevil in such places. As pupation takes place in the burrows in the leaders of the white pine, it would hardly seem necessary that the beetles go into the ground to pass the winter as adults. But wherever they hibernate they appear in Connecticut about May 1st on the young pines. They feed on the bark for a few days, and soon deposit their eggs in punctures (shown on plate XII, b.) in the bark of the leader or topmost shoot of the previous season's growth. The eggs hatch in from six to ten days, and the minute white grubs at first feed upon the cambium or inner bark, usually going downward and into the pitch. There is great variation in the length of the larval period depending upon food supply, latitude, altitude, etc., but as a rule the larva becomes fully grown in less than two months. It then excavates a larger and deeper burrow or cell in which, surrounded by shreds of wood like excelsior, it transforms. The cells are shown on plate XIII, and in Figure 17. The pupa stage lasts about ten days.

* Circular No. 90. Bureau of Entomology, U. S. Dept. of Agr., 1907.

There is a period of egg laying, so that with the variation in the length of the larval period, it is not uncommon to find the larvae in all stages of development and likewise pupae in the months of July and August. The adults begin to emerge through round holes in the bark as shown on plate XIII, a, the latter part of July and continue into September. Hopkins states* that the principal period of emergence is between July 25 and August 15, and that practically all adults will have emerged by the middle of September. According to Hopkins it is believed that an individual adult weevil may live for two or three years depositing eggs each year. As has already been stated, in Connecticut the adults appear about May 1st, and they are fairly abundant on the pines for five or six weeks. They are also common in

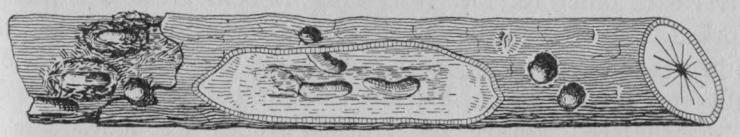

Figure 17. Pupal cases, larval cells and exit holes of the white pine weevil. About twice natural size.

August during the period of emergence. Reared and collected specimens in the Station Collection bear the following dates: April 22; May 1, 7, 8, 13, 14, 15, 17, 22, 29, 31; June 3, 9, 10, 17, 23; July 10; August 3, 9; September 4.

Distribution.

According to all accounts, the white pine weevil occurs from North Carolina northward into Canada and westward into Wisconsin, thus occupying the natural range of the white pine. It will probably be found in every town in Connecticut.

Food Plants.

As has already been stated, the chief injury is to white pine *Pinus strobus* but occasionally it attacks the Scotch pine *Pinus sylvestris,* the jack pine *Pinus divaricata,* the pitch pine *Pinus rigida,* the Norway spruce *Picea excelsa* and the red spruce *Picea rubens.*

* *Loco citato.*

Effect of Injuries.

When the leader of a pine tree dies, the height growth is seriously checked, but whether or not this affects the diameter growth is uncertain as data are not available covering this point. Usually one of the lateral branches in the whorl immediately below the leader grows faster than the others and soon assumes an upright position, taking the place of the fallen leader. This causes a crooked trunk which the tree will outgrow in a few years if no further weevil injury occurs. But possibly and probably the new self-appointed leader may likewise be weeviled the following year, and the axis of the tree is exaggerated in its crookedness.

Occasionally two laterals instead of one will straighten and rival each other for the leadership. If both grow, a crotch or forked trunk is the result. If one is afterward weeviled and the other escapes, no great harm will result ultimately. Occasionally several laterals assume the upright position and make an illshaped tree. Forked and crooked trunks are undesirable in the growth of timber and the checking of the height growth is a serious matter in forest plantations where it is an advantage to obtain the maximum growth in the minimum time to bring the greatest possible return on the investment. If the plantation is a small one for ornament, for windbreak or to cover a watershed, the effects of serious weevil injury are no less important. Weeviled trees are always unsightly and never develop as satisfactorily as uninjured trees.

Kellicott observed* that weeviled trees were more susceptible to the attacks of the pine tip moth *Pinipestis zimmermani* Grote.

Some plantations are very seriously injured by the white pine weevil, many trees losing a leader each season for a period of years, thus greatly interfering with the normal commercial development of the trees. Crooked, forked and otherwise deformed trees are not desirable for the production of timber and a stand of them would probably bring a lower price.

Description.

The adult beetle is about one-fourth of an inch (4.5 to 6 mm.) in length, reddish-brown in color, marked more or less distinctly

* Canadian Entomologist, Vol. xi, page 115, 1879.

by a spot or patch of whitish scales on the apical third of each wing-cover near the median margin. The color varies from light to dark reddish-brown, and the markings also show great variation: in some specimens they are exceedingly distinct while in others they are almost wanting,—the wing-covers being nearly unicolorous. There are small and irregularly arranged patches of white scales on the thorax, the femora, and on the under side of the thorax and abdomen, but these are inconspicuous or wholly wanting in some individuals. Head and legs are colored

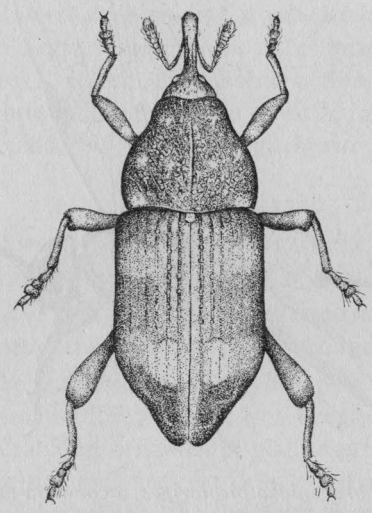

Figure 18. The white pine weevil. Enlarged about six times.

like the body, the head being elongated to form a slender snout after the fashion of the Curculionidae. The length of head and thorax together is only slightly less than that of the wing-covers. The thorax and head are both rather regularly and densely punctured, the punctures arranged chiefly in rows. The wing-covers are covered with horizontal striae with rows of pits in the grooves, the pits being considerably larger and deeper than the thoracic punctures.

The pupa is creamy white and about as long as the adult beetle. The eyes and the tips of the mandibles are brown, and as development progresses toward the end of the pupal stage, brownish color shows on the snout and legs. A pair of slender curved spines are borne at the tip of the abdomen.

The larva or grub is without feet, white and varying in size according to the age or period of development.

The egg has not been carefully studied in Connecticut, but according to Dr. Felt, is globular, whitish, transparent, about one-sixteenth of an inch in diameter and is deposited just beneath the bark. The adult weevil is shown in figure 18, and on plate XII, a, and larva and pupa on plate XIII, c.

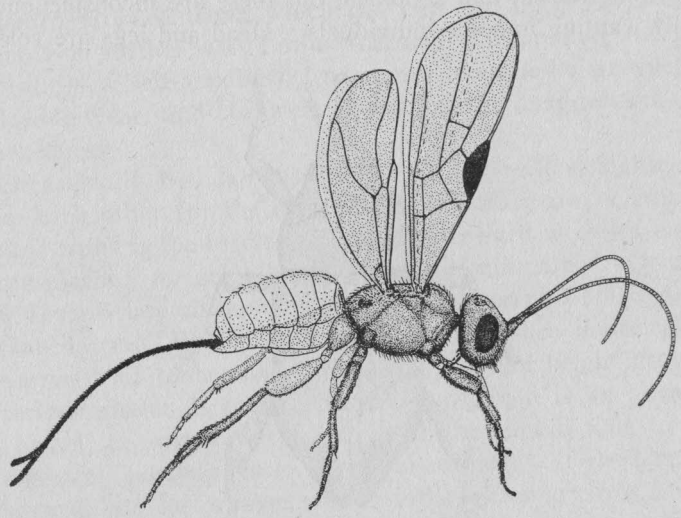

Figure 19. *Habrobraconidea bicoloripes,* a common parasite of the white pine weevil. Eight times enlarged.

Natural Enemies.

A number of natural enemies of the white pine weevil have been recorded. Birds, particularly woodpeckers, tear open the bark covering the cells, and devour the larvae, pupae and also the adults. Hopkins states* that "some of the larvae apparently die from disease, and when large numbers of them are crowded together the larger ones appear to feed on the smaller ones, so that on the average not more than from three to five per cent of the hatched larvae ever reach maturity and emerge from the infested terminals."

In Connecticut, an ichneumon parasite identified by Mr. H. L. Viereck as *Coeloides pissodis* Ashm. was reared from weevils

* Circular No. 90. Bureau of Entomology, U. S. Dept. of Agr., 1907.

collected at Rainbow, town of Windsor, in 1911. A closely allied species *Habrobraconidea bicoloripes* Viereck, shown in Figure 19, has been reared in large numbers from weeviled pine leaders from Rainbow in 1910 and 1912, Yalesville 1912 and Portland 1914, and the parasites have been identified, some by Mr. Viereck and some by S. A. Rohwer. Parasitized material gathered by Mr. Zappe in Portland in 1914 yielded 50 adult weevils and five parasites, showing a parasitism of eleven per cent. The following parasites identified by Mr. Rohwer have also been reared from weeviled material in Connecticut:—*Microbracon nanus* Prov., Portland 1914: *Eurytoma pissodis* Girault, Rainbow, 1912: *Rhopalicus suspensus* Ratz., New Haven, 1914: also *Cyanopterus* sp. from Stafford 1911, which Mr. Rohwer thinks may not be a parasite of the white pine weevil. In West Virginia, Dr. Hopkins reared the ichneumon fly *Spathius brachyrus* Ashm., from the weevils.

Methods of Control.

There are two possible means of reducing the amount of weevil injury as follows:—

(1) To remove and destroy the infested leaders.
(2) To prevent the leaders from becoming injured.

The former can be practiced in large white pine plantations where the latter on account of expense is not deemed practicable, but the latter is preferable in ornamental plantings where it is important to prevent injury and the cost does not matter.

Removing and destroying the leaders after they have been injured reduces the number of weevils and also the injury for the following year, but is it not better, where possible, to prevent the injury and thus save the leaders?

Removing Infested Leaders.

The only method practiced in forest plantations is to cut out all the leaders as soon as they begin to wilt, making the cut with a pair of pruning shears at the base of the leader just above the whorl of lateral branches. The shoots are then gathered and burned before the weevils emerge. If the severed leaders are allowed to remain on the ground for two months or until the beetles escape, the practice would be of no value in reducing their numbers for the next year, though it might improve the appearance of the plantation.

As some of the weevils are parasitized, and the parasites as well as their hosts are destroyed by fire, Dr. Hopkins of the Bureau of Entomology has recommended that the cut shoots be placed in a tight box or barrel with an opening covered with fine wire netting which will allow the small parasites to escape, but through which the adult weevils cannot pass. This arrangement provides for the destruction of the weevils, for they will die in the cage, but allows their parasites to gain the open air so that they may attack and destroy more weevils. Such a cage should be so placed that it will not catch and hold water. It should be in partial shade as it might easily become overheated in full sun so that all insects inside would be killed.

For such a cage, Dr. Hopkins suggests and figures a barrel with wire netting on one or both ends, and a box has been tried in the experimental forest plantation at Rainbow, Conn. At first the wood was so affected by the weather that cracks opened up sufficiently large to allow the weevils to escape. It is very important that the receptacle be tight enough to hold the adult beetles. One of these cages is shown on plate XIV, b.

Protecting the Leaders From Injury.

Simple experiments have been conducted by Mr. Walden and other entomologists of this Station for several years, with a view to discovering some application or other treatment to repel or destroy the adult weevils before they can lay their eggs, and thus save the leaders from injury. In order to be practicable the preparation must repel or poison the weevils without injuring the trees. Such a treatment would be welcome on many estates where pines are planted for ornament or shade and where weevil injury renders them very unsightly. Brief accounts of these tests may be found in the reports of this Station as follows: 1911, page 307; 1914, page 173; 1915, page 134.

Spraying.

It was found that commercial lime sulphur (1 part in 8 parts water) proved to be one of the best repellents tried. At first it was feared that this concentrated mixture, which is the same as is used on dormant trees to kill the San José Scale, would injure the leaves: but such was not the case. When applied at the proper time (about May 1st for most seasons in Connecticut)

only the old leaves are present. By old leaves is meant those of the preceding season's growth. Not the slightest injury could be detected, even where the mixture was applied directly to the foliage. The bark of the leader was coated with lime-sulphur applied with a small compressed air pump that can be carried about, as shown on plate XV, c.

Arsenate of lead, one ounce of the paste in one gallon of water, sprayed upon the leaders also gave some degree of protection, though not quite equal to the lime-sulphur. Both of these materials were tested in a small way in 1911, 1912 and again in 1915, and in nearly every case the weevil damage to the treated trees was less than half that of the untreated trees. In several cases not a single tree was weeviled where sprayed with lime-sulphur. In 1911 sixty per cent. of the check trees lost their leaders.

A number of other preparations were given a trial, and among these "whale-oil" or fish-oil soap, 8 ounces in one gallon of water, seemed to keep off most of the weevils without injury to the trees.

Mr. S. A. Graham of Minnesota has also experimented along this line and finds that creosote and carbolineum are more effective when applied to the leaders than lead arsenate and lime-sulphur, not a single tree being weeviled, though from thirty to forty per cent. of the untreated trees lost their leaders. However, some injury to the trees followed their use.

Mr. Graham also applied bands of tree tanglefoot to a number of pines, one band at the base and another just below the topmost whorl of branches. Very few of these trees were injured, which strongly indicates that the adults crawl up the trunks instead of flying into the tops of the trees. A large number of weevils were liberated in the vicinity of these trees and most of them were afterward found on the trunks below the lower tanglefoot bands.

Jarring.

In 1913, Dr. E. P. Felt, State Entomologist of New York, recommended* collecting the weevils from the pine leaders, using a net of about 15 inches diameter. "This work should begin in April, as soon as the weather is moderately warm, and be con-

* Tribune Farmer, August 7, 1913; also 29th Report New York State Entomologist, page 32, 1913.

tinued for several weeks at intervals of approximately a week or ten days. Practical work done this season shows that it is possible to make four collections from an acre of young pine at a cost of $1.28 an acre."

Dr. Felt states that at the outset two to four weevils were caught on each tree, but at the last collection only one or two were found in a row of perhaps 400 trees. Using Dr. Felt's experiments as a cue, similar tests were made in Connecticut in 1914 by Messrs. B. H. Walden and M. P. Zappe, about 1800 trees being treated and more than 1000 were under observation as checks.

For this purpose special nets were constructed having a rim about sixteen inches in diameter with a notch about three inches deep on the side to place against the trunk. After trying this net, it was found that more weevils could be captured by placing the net below the base of the leader and close to the trunk and rapping the opposite side of the leader with a stick as shown on plate XIV, a.

The tests were conducted in the State Forest reservations at Rainbow and Portland, on trees between five and eight feet in height, with results as follows:—

Rainbow.

	No. trees	Leaders infested	
		No.	Per cent.
Net used	337	9	2.64
Check	116	8	6.79

Portland.

	No. trees	Leaders infested	
		No.	Per cent.
Net used	1,462	141	8.9
Check	1,009	191	18.9

The season was late and five collections were made at Rainbow, on May 8, 14, 21, 28 and June 3. At Portland four collections were made on May 15, 23, 29, and June 5. Possibly earlier collections would have given better results, though the treated trees in both cases had less than half as many injured leaders as the checks. Probably six collections could have been made at a cost of between $1.50 and $2.00 per acre.

Thus it will be seen that by spraying or by jarring the leaders, it is possible to greatly reduce the amount of weevil injury, and

the cost, though perhaps too great in forest plantations, would certainly be warranted in small ornamental plantations.

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THE PINE BARK APHID.

Chermes pinicorticis Fitch.

There are several species of this genus which suck the sap from the various conifers. Some of these appear on the leaves, twigs or trunks, as bits of cotton or wool and are often called woolly aphids; others, like the spruce gall aphids, form swellings or galls at the base of the new growth, with the young developing inside the galls. In certain species the cotton-like tufts are present on the leaves and twigs and represent the females and eggs or migrants, and the galls on that or another host indicate another stage of the same insect.

It should be stated here that for many years several species of Chermes have been confused in entomological literature, and were disentangled by Dr. Edith M. Patch in her paper on "Chermes of Maine Conifers"* in 1909. The present species

*Bulletin No. 173, Maine Agricultural Experiment Station, 1909.

Chermes pinicorticis was not particularly studied by Dr. Patch, and the available literature regarding the species is based on former studies and observations. Confusion may therefore still exist regarding *pinicorticis* but this cannot be determined until some one has made a careful study of its life history. But disregarding the identity and life history, the damage caused by the insect, its appearance on the trees and control measures are such, we believe, as to warrant the present paper.

The white tufts are common on the needles of young white pine trees, and the white flocculent patches may be seen on the bark of the trunk and branches of both old and young white pines. Not only does the insect occur on cultivated trees, but also on native ones throughout Connecticut. Though the injury from its attack is not well understood, it probably checks the growth and reduces the vitality of the tree, and when abundant may cause serious injury. A slight infestation need cause no alarm.

Distribution.

Apparently this insect was first mentioned by Dr. Fitch as occurring in New York State in 1856. According to Storment* it has been recorded from New York, Illinois, Iowa, Maryland and the District of Columbia. Dr. Felt states** that Prof. Lawrence Bruner reported it from Nebraska in 1894. Dr. Patch states† that it occurs in Maine. It is also reported from Canada, Minnesota and Ohio and no doubt the species is very generally distributed, and may be expected to occur in nearly all the intervening territory wherever the white pine is grown. As has already been stated, it is found throughout Connecticut, material having been received from the following localities:—Avon, October 24, 1917: Danbury, June 6, 1914, May 22, 1917: Deep River, July 13, 14, 1915: Greenwich, July 10, 1910, October 4, 1911, June 13, 1913: Hazardville, January 5, 1918: Ivoryton, July 30, 1918: Middletown, June 11, 1907, May 28, 1913: New Canaan, June 22, 1917: New Hartford, July 1, 1909, July 18, 1919: New Haven, May 8, 1907, September 27, 1912: Rainbow, June 13, 1913: Riverside, June 22, 1915: Saugatuck, October 14,

* Insects of Illinois, 20th Report, appendix, pages iii-xxiv, 1898.

** Insects Affecting Park and Woodland Trees, page 193, 1905.

† Bulletin No. 173, Maine Agricultural Experiment Station, page 303, 1909.

1912: South Coventry, December 4, 1917: Southport, June 18, 1912: Sharon, July 2, 1912: Wallingford, July 10, 1914: Westbrook, November 3, 1916.

Appearance and Injury.

The pine bark aphid appears as white tufts of cotton or wool at the base of the needles on the twigs, and as white flocculent patches on the bark of trunks and branches as shown on plates XV and XVI. According to Storment* it occurs more abundantly and more generally on the north exposure of the trunk than on the other sides and around the base, and on the under sides of the lateral branches, indicating that it does not thrive in a strong light. Where there are only a few small scattered patches, they so closely resemble the hardened pitch or gum that without close examination, it is difficult to distinguish one from the other.

There is some question about the exact amount of damage done by the attacks of this insect, though it surely must be considerable in severe infestations. Storment** states that a heavy infestation will kill the lower branches and occasionally the entire tree, and that generally the effect of the infestation is manifest in the shortened leaves and shorter new growth.

Swaine† states that *"Chermes pinicorticis* Fitch is a common and destructive species throughout Eastern Canada, and seriously injures many young white pines, particularly those growing in the shade." Dr. Patch‡ regards it as "a serious enemy to young white pines both in nursery stock and in the open." Finally the Bureau of Entomology§ is responsible for the following statement:—"The pine bark louse (*Chermes pinicorticis* Fitch) was found to be commonly associated with and evidently causes a considerable percentage of the white-pine twig blight which has been so prevalent in the New England States the past year."

Though this insect chiefly attacks the white pine, it is recorded by Dr. C. G. Hewitt‖ as causing damage to Scotch pines in Canada.

* Insects of Illinois, 20th Report, appendix, page iv, 1898.

** Ibid, page iv, 1898.

† 43d Annual Report Entomological Society of Ontario, page 88, 1913.

‡ Maine Agricultural Experiment Station, Bulletin 202, page 160, 1912.

§ Year Book U. S. Department of Agriculture, page 575, 1908.

‖ Report of Dominion Entomologist, page 56, 1916.

Life History.

Though the life history of this insect has not been worked out in detail, it is stated that the eggs begin to hatch on or before the first of May, the young emerging in great numbers from the woolly or cottony masses. At first they are very small and hardly discernible with the unaided eye, and they crawl over the bark for a time seeking a favorable place to attach themselves. They usually settle on the tender bark of the young twigs and begin to suck the sap, increasing in size rather rapidly. They soon change to a dark reddish-brown color approaching black, and the waxy secretion soon hides them in a white mass as though it were a tuft of cotton or wool. Winged females appear about the middle of May, but cannot be found two weeks later. Though the full seasonal life history has apparently not been worked out, indications point to several broods during the summer, and the winter is probably passed by wingless females on the bark, more or less covered by the masses of wax, or "wool" as it is called in some of the literature dealing with this insect. It is not known whether the pine bark aphid remains on the pine throughout the entire season or whether it has an alternate host like many other species of aphids.

Natural Enemies.

Like other kinds of aphids, this species is preyed upon by various other insects which no doubt hold it in check under average conditions. The lady beetles are important and those recorded as feeding upon the pine bark aphid are the fifteen-spotted lady beetle *Anatis 15-punctata* Oliv., the two-spotted lady beetle *Adalia bipunctata* Linn., the twice-stabbed lady beetle *Chilocorus bivulnerus* Muls., and the spotted lady beetle *Megilla fuscilabris* Muls., commonly listed as *Megilla maculata* Degeer, a tropical species. The larvae of a syrphid fly, *Syrphus* sp., and of lace-wings or ant-lions, *Chrysopa* and *Hemerobia,* are listed by Mr. Storment as devouring the pine bark aphids.

Control Measures.

As long ago as June 1898, small pines on the Station grounds were infested with a species of woolly aphid which, though not identified at that time, from subsequent observations I am reasonably certain was *Chermes pinicorticis.* A single application of "Fir Tree Oil" in the form of a spray rid the trees of these woolly insects.

The most extensive control measures of which I have any record were carried out in June 1911 in the plantation of the Middletown Water Company in the town of Middlefield, Conn. The aphids were abundant on some of the trees and seemed to check their growth. In response to inquiries, I advised spraying the worst infested trees with kerosene emulsion. The superintendent feared that the insect would gain the upper hand and that injury would befall all of the trees; therefore he sprayed the entire 38,000 trees. I visited the place during the operation: 7,000 had already been sprayed. These trees were planted in 1904, consequently were not too large to be sprayed easily. This treatment killed the aphids, the white patches soon disappeared, and there was no material injury to the trees; an occasional slight burning of the needles was observed.

Dr. Felt* states that Dr. E. B. Southwick of the New York City Park Department has found that a driving spray was effective in combating this pest. In some cases, therefore, plain water from a hose if thrown from the nozzle with sufficient force, would prove the best remedy.

Mr. Storment† mentions the experiments in Illinois with kerosene emulsion which proved effective in killing not only the aphids but the eggs also.

In all probability a spray of nicotine solution and soap would also destroy these aphids, though for use in large plantations might prove more expensive than the kerosene emulsion.

Kerosene emulsion may be prepared as follows:—

Kerosene	2 gallons
Common Laundry Soap	1 pound
Water	1 gallon

Dissolve the soap in hot water, add the kerosene, and churn together with pump until a creamy mass is formed which thickens on cooling. Dilute nine times before using.

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* Insects Affecting Park and Woodland Trees, Vol. I, page 195, 1905.

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EXPERIMENTS TO CONTROL THE CHRYSANTHEMUM GALL MIDGE.

Diarthronomyia hypogaea LOEW.

BY M. P. ZAPPE.

This insect was probably first introduced into Connecticut by florists of the State buying new varieties from other chrysanthemum growers. One grower in particular who grows large quantities of chrysanthemums for cut flowers and cuttings first noticed the work of this insect in 1916, and says that in two years it has caused $5,000.00 damage. Other growers in the State suffered severe losses in 1917 and 1918. Seven towns in Connecticut are known to be infested with this insect, and the pest probably occurs in many others of which we have no record. The following towns are infested:—New Haven, Bridgeport, Hartford, Cromwell, Fairfield, Derby, East Haven.

Experiments were started in January 1919 to find some simple method of controlling this insect. Fumigation with hydrocyanic acid gas had been recommended, but this was quite a costly operation as it was only effective against the adult midges and had to be repeated every few days. There was also danger of burning the foliage by repeated fumigations, and danger to the operator and others who might come in contact with the gas which is deadly to human beings as well as insects.

The eggs of this insect are laid on the top of the plant where the new leaves are unfolding and as the leaves grow larger, the larvae make their way into the leaves. On large plants that are about to bloom the larvae get into the stem and enlarge and weaken it, causing the blossom to droop. Some varieties of chrysanthemums are very liable to attack by midges, while others are almost immune. In a house where several varieties are grown this is very evident. Some will be found badly infested, while others will not have a single gall. See plate XXXI.

The house in which the experiments were conducted was a small one, having a large center bench and a small one on each side. This house had been used for growing seedling pompons and at the time the experiment started the old plants had been cut off. New plants had sprung up from the roots and were about two inches tall. These plants were badly infested with midge galls.

The following treatments were applied:—

Section A. Screened.

Carbolic Acid Emulsion.

The section of the bench where this treatment was applied was screened with cheesecloth which after each spraying was carefully replaced in order to catch emerging adults from this plot and to prevent adults emerging elsewhere from attacking the plants. It was thought possible that the carbolic acid emulsion might penetrate the galls and kill the larvae within.

Crude carbolic acid.....¼ pint.
Yellow laundry soap.....¼ pound
Water.....1 quart

This was prepared in the following manner: the soap was dissolved in hot water, then the carbolic acid was added. This was all churned together until it became creamy. When ready to spray, this emulsion was diluted thirty times. The treatment was applied every three or four days for about two months, beginning January 3, and ending March 3, 1919. After six treatments a few adults began to emerge and later a few eggs were seen. At the end of the experiment after seventeen treatments, there were a few new galls present, but not nearly as many as under the screened check.

Section B. Screened Check.

This section of bench was screened on January 3, and on January 6 one male was found under the screen and another on January 13. On January 31 several adults of both sexes were seen and on March 3rd there were many new galls present on the small leaves.

Section C. Screened.

Nicotine Sulphate 40%.

This was used at the strength of one teaspoonful to one gallon of water plus one ounce of common yellow laundry soap. This treatment was applied every three or four days for two months. There were no adults seen under the screen, so it is safe to assume that they were killed either before they emerged, or while they were emerging. No young galls could be found at the end of the experiment.

Section D. Unscreened.

Check.

On February 3, one month after beginning of experiments, there were many eggs and larvae present on the young leaves. On March 3 there were many young galls present on plants in this section.

Section E. Unscreened.

Arsenate of Lead.

As the eggs of the chrysanthemum gall midge are laid on the surface of the leaves, it seemed to the writer that there might be a time when the young larvae were working their way into the leaves that arsenate of lead would kill them. This was applied the same as the other treatments using one ounce to one gallon of water. At first it looked as though this treatment would be of some value, as this section made a better growth and looked better than the rest. One month after starting the experiment there were many eggs and larvae present and at the conclusion of the experiment there were just as many new galls as on the check section.

Section F. Unscreened.

Fish Oil Emulsion.

This was made similar to the carbolic acid emulsion, except that one and one-half pints of fish oil were used instead of crude carbolic acid. This was diluted ten times. At the end of the first month injury was noticed; the edges of the leaves turned brown and dried up. The dilution was changed to one to fifteen, and at the end of the experiment there were a few new galls present on the young leaves.

Section G. Unscreened.

Powdered Tobacco.

It was thought that this might act as a repellent and prevent oviposition. It was applied by sifting on the top of the plants through a cheesecloth bag. This treatment proved of no value, as there were many new galls present at the end of the experiment.

Section H. Unscreened.
Scalecide.

This was used at a strength of one to twenty, and after a few treatments the edges of the leaves were burned, especially the older leaves. There were no new galls on the leaves that were left on the plant at the end of the experiment.

Section I. Unscreened.
Scalecide.

This treatment was used at a weaker strength than the above, being diluted one to thirty. After two months of treatment there was a slight injury to the leaves, but there were no new galls.

Section J. Unscreened.
Nicotine Sulphate 40%.

This experiment was started about a month later than the others and ended on the same date as the other experiments. At the beginning of the experiment there were many eggs and young larvae present on the new growth. These were all dead three days later. This treatment was applied every three or four days, and continued for a month. At the end of the experiment no new galls could be found.

Another experiment was conducted in a commercial greenhouse, using nicotine sulphate, 1 teaspoonful to one gallon of water and two-thirds of an ounce of soap. This was for the purpose of checking up our other results with the nicotine spray. Young chrysanthemum plants in this house had quite a number of old galls present and were sprayed at intervals of three or four days. The bench treated was mostly of one variety, except the ends, which had a few plants of other varieties. The bench was divided into three parts, both end sections were sprayed and the center section left for a check.

On February 5 the first treatment was given and at this time there were many eggs present, also large galls on the older leaves. The owner of the house began to take cuttings from the sprayed portions of the house on the 27th of February. All these cuttings were put into a propagating house with cuttings from untreated plants from other houses. On March 3 these

cuttings were examined and the sprayed ones were free from young midge galls, and on the untreated ones there were a number of young galls started. There were also a large number of galls present on the check portion of the bench in the house where the spraying was done.

Summary.

From the results of our investigations, it would appear that the best time to combat this insect is while it is still in the egg stage, or shortly afterward before the young larvae are entirely within the leaf.

Scalecide killed all eggs and young larvae, but injured the foliage. 40% Nicotine Sulphate and soap applied every three or four days will control this insect and most florists keep this on hand at all times so that this is probably the easiest and best spray for commercial florists to use.

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PREVALENCE OF GREEN CLOVER WORM ON BEANS.
Plathypena scabra Fabr.

An outbreak of the green clover worm occurred in 1919, and bean plants in nearly all parts of the state were suddenly riddled. At first, the caterpillars which were on the under side of the leaves, dropping to the ground on being disturbed, escaped notice. A careful examination, however, revealed them in large numbers and of all sizes. Both common beans and Lima beans were attacked, and more or less irregular holes eaten in the leaves. In some cases only the veins were left and the pods were also eaten.

Specimens were received from New Haven, Orange and Putnam, and correspondence and telephone calls regarding this insect occupied considerable attention of the office force the last week

in July and the first week in August. The Hartford County Farm Bureau reported twenty telephone calls in one day inquiring about the insect feeding upon beans.

In conversation with other entomologists, I learn that this outbreak was not local, but reached over a large portion of the northeastern United States.

The only prior record on hand of such an outbreak was in 1908, but it was not as severe as that of 1919. An account of the insect with illustrations was printed in the Report of this Station for 1908, page 828. Some of the same illustrations are used herein.

On account of the many complaints and inquiries, the following statement was given out to the press, on August 2, and was printed in many of the newspapers of the state:—

Green Worms Threaten Bean Crop.

"Slender green striped worms are now devouring the leaves of beans in fields and gardens, and unless prompt measures are taken, the entire crop may be destroyed.

Lima and other shell beans should be sprayed with arsenate of lead, using one ounce of the paste or one-half ounce of the dry powder, in one gallon of water. It would be unsafe to apply this poison to string or snap beans which are nearly ready to harvest, but such beans may be treated by spraying the under surface of the leaves with common laundry soap, four ounces in one gallon of water, or nicotine solution, one teaspoonful in one gallon of water with an inch cube of soap dissolved and added. When disturbed, the worms wriggle and drop to the ground, where they can be reached by the contact spray which will kill all of them that it hits. It may be feasible to shake the vines, and spray the ground afterwards."

Injury to Beans.

The injury is caused by the larvae which eat holes in the leaves. These holes are usually rather irregular in shape, and as the injury progresses, only the net work remains. The writer observed many gardens and fields of beans where the leaves were badly eaten. Pole beans, bush beans, shell beans, string beans and Lima beans were all attacked and severely injured.

Some injury was also done to soy beans. In a number of cases the larvae had eaten holes into the pods. At first the larvae do not eat entirely through the leaf, but the upper epidermis remains. In some cases the injury did not go beyond this point, and the leaves showed these holes as peculiar transparent spots.

Food Plants.

Clover is the common food plant of this insect, but occasionally, when abundant, it attacks and injures beans. Other plants attacked are peas, vetch, soy beans, tickweed (*Meibomia* sp.), strawberry and blackberry.

Habits and Life History.

This insect passes the winter in the adult stage and in the vicinity of Washington, D. C., the moths often fly during warm sunny days of winter. They emerge from winter quarters early. Chittenden records three generations annually in the latitude of the District of Columbia, though Coquillett found only two broods in Illinois. The eggs require from four to six days to hatch, and the caterpillars reach maturity in about twenty-five days. From ten to fourteen days are passed in the pupa stage.

In 1908, the first adult that was reared from larvae, emerged on July 24. Another emerged on July 29 from a cocoon formed July 16. The moths do not appear with any particular regularity, but are found throughout the latter part of the summer. Specimens in the Station collection bear dates ranging from June to November.

The larvae usually feed from the under side of the leaves and wriggle violently when disturbed. The small ones drop on silken threads, but those nearly grown drop to the ground, wriggling and throwing themselves about. Different sized larvae are found feeding side by side. The larva is slender, about the same color as the leaf upon which it feeds, and it loops with the front half of the body somewhat after the manner of a Geometrid larva. Many of the partially grown larvae were yellow and had a sickly appearance. Probably such would never transform.

Description.

Egg:—About 0.5 mm. in diameter and 0.35 mm. in height. Globular, somewhat flattened with the upper half deeply grooved. Light in color.

Larva:—About 25 mm. (one inch) in length, about 3 mm. thick in thickest portion near middle from which it tapers slightly toward the head, and considerably toward the posterior extremity. Color light green, striped longitudinally with darker green and fine white or cream-colored lines. Head pale green, shining and hairy. True legs, pale green. There are three pairs of abdominal prolegs in addition to the anal prolegs. Each segment bears dorsally, ventrally and laterally, a number of dark hairs.

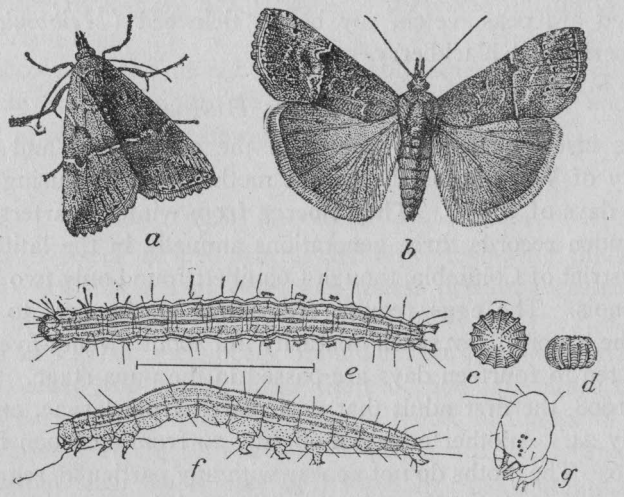

Figure 20. The green clover worm: *a*, moth in natural position with wings folded; *b*, same with wings expanded; *c*, egg from above; *d*, side view of egg; *e*, penultimate stage of larva, dorsal view; *f*, same from side; *g*, head of larva. All enlarged. (After Chittenden, Bulletin 30, Bureau of Entomology, U. S. Department of Agriculture.)

Pupa:—About 12 mm. in length, 3 mm. thick, dark brown in color. A dorsal ridge extends from the head over the thorax and first four segments of the abdomen. Some pupae occur in rolled leaves and are usually enclosed in a white silken web or cocoon of loose texture; others are in the ground in earthen cells formed by webbing together particles of soil.

Adult:—Wing-expanse from 25 to 37 mm. (one to one and one-half inches) blackish or purplish brown in color, with the outer part of the fore wing shaded with light gray, often showing a brownish tinge. The rear wings are broad and well rounded,

smoky brown and without markings. The males usually show less prominent markings than the females, but there is great variation. Body, legs and antennae brown. The palpi are prominently elongated and project in front of the head as is the case with other members of the group of snout-moths. They are also called Deltoid moths on account of the distinctly triangular shape which they assume when at rest with wings folded. The males are usually larger and more nearly of a uniform color than the females.

The appearance of all stages of this insect is shown in figure 20 and on plate XIX of this report.

Control Measures.

In order to make a few tests on controlling this insect, some small plots in Hamden, as shown on plate XVIII, were sprayed by hand on July 31, as follows:—

Arsenate of lead (paste) one ounce in one gallon of water, applied to nine rows.

Black Leaf 40, one teaspoonful, one ounce laundry soap, in one gallon of water, applied to two rows.

A few days later, practically all larvae were dead where the arsenate was applied, and only a few were living on the rows treated with nicotine solution.

In order to ascertain if the contact treatment was immediately effective, the vines were brushed over a piece of paper spread upon the ground, and the spray nozzle passed quickly over the paper on which the larvae had dropped. The three following sprays were tried in this manner:—

Black Leaf 40, one ounce soap, one gallon water.

Black Leaf 40, one-half ounce soap, one gallon water.

One ounce soap, one gallon water.

In each case, all of the younger larvae dropped in their tracks, wriggled slightly and died. The larger ones crawled a short distance, but soon died. In no case were they able to get off the paper after being hit by the spray.

In the writer's own garden, clear water from the hose was thrown with considerable force in the form of a spray against the under sides of the leaves. Most of the larvae were dislodged and I am sure that many of the smaller ones were unable to return to the plants.

LITERATURE.

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Chittenden, F. H., Bulletin 30, Bureau of Entomology, U. S. Department of Agriculture, page 45, 1901.
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PRESENT STATUS OF THE EUROPEAN CORN BORER IN THE UNITED STATES.

In the Report of this Station for 1918, page 316, is given an account of the "European Corn Borer *Pyrausta nubilalis* Hubn.," and its distribution as known at that time. Since this article was written the insect has been discovered in New York State at two widely separated points, namely, near Schenectady and in the western part near Lake Erie. This westernmost infestation also extends into the State of Pennsylvania. Its limits have not yet been definitely determined. An increased area has been found which extends northward into New Hampshire.

MASSACHUSETTS INFESTATION.

Recent examination of the infested area in Massachusetts shows that the pest has spread farther than was known to be the case a year ago. Instead of covering 300 square miles as was estimated last year, probably six times that number is more nearly the size of the present infested area. The original infestation has extended northward into New Hampshire, and has spread southward from Boston along the bay and practically the whole of Cape Cod is infested. The westernmost towns in which the pest has been found are Tyngsboro, Sudbury and Framingham. There are 111 towns, containing nearly 2,000 square miles, in the infested area.

NEW HAMPSHIRE INFESTATION.

The insect was not discovered in New Hampshire until late in the summer and at the time of this writing (November 22, 1919), information just received from the New Hampshire

authorities, states that in that state only the three towns of Seabrook, Plaistow and Kingston have been found infested by the European corn borer. Seabrook is a coast town and joins Massachusetts, but is separated from Plaistow and Kingston by two towns. Plaistow also joins Massachusetts, and Kingston joins Plaistow on the north. Apparently there is no general infestation in New Hampshire.

NEW YORK INFESTATION.

The pest was found in New York State in January, 1919, near Schenectady, where at present twenty-two towns involving the five counties of Albany, Schenectady, Montgomery, Fulton and Saratoga and an area of about 800 square miles, are infested.

Late in the fall a sparse infestation was discovered in the extreme western portion of the State, along the shore of Lake Erie, extending from Angola, Erie County to Fredonia, Chautauqua County, and southward some ten miles, nearly to Gowanda, an approximate area of perhaps 500 square miles. In all of the New York territory, the infestation is less intense, and the injury much less noticeable than in the older infestation in Massachusetts near Boston.

PENNSYLVANIA INFESTATION.

A slight and scattered infestation has been found in the town of Girard in Erie County, Pa., about two miles south of Lake Erie. Only a few larvae were found in one corn field, and these have been doubtfully identified as those of the European corn borer.

CONNECTICUT CORN BORER A DIFFERENT SPECIES.

It was mentioned in a foot note on page 316 of the last Report of this Station that borers had been found in corn stalks in Milford, Conn., which might prove to be the European species. At first the larvae seemed scarcely different from preserved material of *P. nubilalis* which the writer collected in eastern Massachusetts in September 1918. Subsequent study of larval characters, however, showed slight differences, and specimens were sent to Dr. E. P. Felt, Albany, N. Y., and to the Bureau of Entomology, Washington, D. C., where they were examined by Mr. Heinrich. Both these entomologists regarded the Con-

necticut material as belonging to the genus *Pyrausta* and probably a native species, but advised that the adults be reared so that the identification would not rest on larval characters alone. It was with considerable interest that we watched the material in the breeding cages, and when no pupae were formed the latter part of May, when adults of *P. nubilalis* should be emerging, it was another indication that our species was something else than the European Corn Borer. The first pupa was noticed on June 26, and the first adult emerged on July 7. During the next few days several other moths appeared. These resembled very closely the specimens of *Pyrausta penitalis* Grote in the Station collection. Specimens were sent to Washington and were identified as a new species since described as *Pyrausta ainsliei* by Mr. Heinrich. This species is discussed more in detail on page 173 of this Report.

Funds for Combating the European Corn Borer.

Soon after the discovery of the borers in corn at Milford, I gave a talk before the Farmers Association of the General Assembly on March 25. It was the sense of the meeting that the State should make some provision for fighting the insect in case the Milford larvae should prove to be the destructive European species. Also in case future infestations should be found it seemed wise to have some appropriation available for controlling the pest and not be obliged to wait until the convening of the next General Assembly. Consequently a bill was drawn up and passed making provisions as follows:—

Chapter 186, Public Acts of 1919.
An Act making provision for the Suppression of the European Corn Borer.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Section 1. The board of control, on recommendation of the director and entomologist of the Connecticut agricultural experiment station, at its discretion, is authorized to expend a sum not to exceed ten thousand dollars for the period ending September 30, 1921, for the suppression of the European corn borer. All expenditures authorized by the provisions of this act shall be paid from any unexpended balance in the treasury upon presentation of vouchers approved by the director of the Connecticut agricultural experiment station.

Section 2. This act shall take effect from its passage.

Approved, May 2, 1919.

So far not a dollar of this money has been expended. Nearly $200.00 was expended around Milford in the Spring, but this and the cost of the scouting throughout the State has been paid out of the general appropriation made to the Station for work with insects.

A NATIVE BORER ATTACKING CORN.

Pyrausta ainsliei Heinrich.

Many cornfields were examined during the winter months to see if any trace of the European corn borer could be found in Connecticut. On March 12, Messrs. Zappe, Chamberlain and Codding visited Milford, as this town is a seed-growing center and much seed corn is shipped out from there to all parts of the country. It seemed probable that certain varieties of corn on the ear might have been brought into this region, in order to grow it for seed, and that some of it might have come from an infested section. After examining several fields in Milford the men visited some small plantations on North Street about three-fourths of a mile from the center. Mr. Chamberlain was the first to discover larvae in the cornstalks. Mr. Zappe telephoned to the office that they had found the European corn borer, and I visited the place in the afternoon.

The larvae resembled very closely those in preservative which I had gathered in eastern Massachusetts the preceeding Autumn. In fact we were not able to separate them definitely. Mr. Codding sent specimens to Dr. F. H. Chittenden of the Bureau of Entomology at Washington, who submitted them to Mr. Carl Heinrich, a specialist.

I attended a conference at the State House, Boston, on March 14, and saw Mr. D. J. Caffrey who was in charge of the European corn borer investigations of the Bureau of Entomology, and informed him of the discovery at Milford. At my request, Mr. Caffrey and Mr. W. R. Walton also of the Bureau, visited the region on March 22. We examined some of the infested fields around Milford and they noticed some discrepancies between the injury and that caused by the European corn borer.

Under date of March 15, Mr. Walton wrote that "the specimens were submitted to Mr. Heinrich, yesterday, who examined them carefully and is quite satisfied that they are the larvae of a

species of *Pyrausta,* but he was not willing to make any statement with regard to the species, although he was inclined to believe that it was not identical with *nubilalis.*"

Mr. Walton also added:—"However, as our specialists admit that they are not able to distinguish the various species of *Pyrausta* in the larval stages, it seems advisable to proceed on the basis of the supposition that the insect which has been discovered in your State is the European corn borer, as this seems to be the only safe course. I think we all realize by this time that the only way to settle this matter definitely is to rear the adults, and of course that will not be possible for some weeks yet."

As this insect was believed to be the real European corn borer, the following information was given to the press under date of March 15:—"What appears to be a small infestation of the European corn borer was found this week just north of the village of Milford by entomologists of the Agricultural Experiment Station in New Haven. Measures have been taken to suppress the pest."

This notice was printed by many newspapers of the State on March 15 and later. A similar announcement was printed in the Journal of Economic Entomology for April, Vol. 12, page 218.

In April, specimens of the larvae were sent to Dr. E. P. Felt, State Entomologist of New York, who had been making a study of the larvae infesting corn in that State and comparing them with the larvae of other species of *Pyrausta.* Under date of April 8 he wrote as follows:—

"They resemble very closely Massachusetts and New York specimens and for the present we must assume their identity until this is disproved, if it ever is, by rearing."

In looking over Dyar's List of Lepidoptera, I find that there are twenty-five species of *Pyrausta* occurring in the eastern United States, sixteen of which are in the Station collection. As many of these species are unknown in their immature stages, it is not surprising if our specialists are not able to identify the larvae with certainty.

Evidently there was only one way to settle the identity of the Milford corn borer—rear the adults. Here again the Milford larvae did not act quite like the European species; instead of transforming in May as well-behaved European corn borers should, they kept on eating in the old stalks, and the very first

sign of a pupa did not appear until June 26,—more than a month after the time when adults of *nubilalis* should have emerged. It was a period of anxious though watchful waiting.

But meantime forces had not been idle. Preparedness was the watchword. Soon after the borers were found, men were employed to cut, rake together and burn the infested stalks. For, after all, the identity of the borer was uncertain and it might prove to be the dreaded European species. Connecticut could afford to take no chances.

Mr. George D. Stone, a trained gipsy moth scout who had fought with the American Expeditionary Forces in France, and who had been employed by Mr. Davis on gipsy moth work in the eastern part of the State, was brought here to scout for corn borers and to take charge of burning the infested stalks.

A careful scouting was therefore carried on, followed by burning infested stalks, in most cases with the full co-operation of the owner. In some cases the owners cut and burned the stalks themselves under Mr. Stone's direction or supervision. In most of the seed-growing farms in the Milford region, the soil is rather light and the season early. Some of the stalks had already been plowed under before the fields were examined. The stalks were burned in twelve fields having a combined area of about nineteen acres. The owners burned about one and one-half acres without assistance. Mr. Stone burned about four acres without help from the owners, and the remaining thirteen and one-half acres were burned by Mr. Stone and the owners co-operating.

Mr. Stone began this work on March 27 and finished on May 10, covering ground rapidly on a motorcycle. The total cost of this work including wages and expenses was $192.02. Though more attention was given to the Milford area than any other, Mr. Stone visited Wethersfield, Rocky Hill, Cromwell, Middletown, Stratford, Orange, New Haven, Woodbridge and Hamden. In some of these places the larvae were found in cornstalks, and in nearly all of these towns, the stalks of smartweed (*Polygonum*) in the cornfields contained larvae. Messrs. Zappe, Chamberlain and Walden did considerable scouting before and after the discovery of the larvae in the stalks at Milford, visiting in all eighty-five cornfields in various sections of the State; they noticed the tendency of the smartweed stalks to infestation, and finally

on visiting a cornfield, sought at once the low places or depressions where this weed commonly grows. In many cases they found the larvae in the smartweed stalks, and if the insect was abundant in that locality, some larvae were usually found in the corn.

Imagine our interest when the first moth appeared in the breeding cages on July 7, followed by profound relief, for surely it was not the European corn borer *Pyrausta nubilalis.* It was identified provisionally as a native species, *Pyrausta penitalis* Grote, and this identification was later confirmed by Mr. Heinrich at Washington. The larvae resemble very closely the European corn borer, and only an entomologist and a specialist on *Pyrausta* larvae at that, can distinguish them. But their tunnels average somewhat shorter, and there are not so many in a stalk, and so far as my observations go the tassel and ear are not attacked, or if so, not to such a degree as is the case with that destructive pest, the European corn borer.

Injury to Corn Stalks.

As has already been mentioned, no injury to tassels or ears by this insect was noticed in Connecticut. The holes were in the main stalks, usually two or three feet from the ground, and just above a node, though in some cases they were just above the first node, only a few inches from the ground. As a rule, the burrows were not more than two inches long, slanted upward from the entrance and were wider near the upper end. Evidently the larva excavated its burrow to a sufficient size so that it could turn around, for all or nearly all of the larvae were found headed downward. Sometimes there were several holes in a stalk, but usually only one. The most found in any one stalk was nine. Consequently the plants were not much injured, and their vitality and growth were unimpaired. Just why the larvae go into the corn at all is a question. If for food, one would expect them to eat larger tunnels. Possibly it is as a place to pass the winter. Yet many of them hibernate in the *Polygonum* stems, and seem to be none the worse for their rather precarious winter quarters. The appearance of the infested stalks is shown on plate XXII. In many cases the stalks had been pecked into by birds, and the burrows were empty.

Identity.

Though this species was provisionally identified as *Pyrausta penitalis* Grote and in the adult stage resembles that species in collections, recent detailed studies by Mr. Heinrich led him to conclude that heretofore two species have been confused under this name, and that the chief corn-boring species was new and undescribed. As its life history has been carefully studied by Mr. George G. Ainslie, of the Bureau of Entomology, who is stationed at Knoxville, Tenn., Mr. Heinrich has named it *ainsliei.** At the time that this paper goes to press Mr. Heinrich's description and name of the new species has just been published.

Distribution in the United States.

Apparently this species occurs throughout the eastern United States as it has been found in Massachusetts, Connecticut, New York, New Jersey, Tennessee, Illinois, Missouri and Kansas.

Distribution in Connecticut.

Undoubtedly this corn borer occurs throughout the state, but we have records of it in weeds or in corn from the following towns:—Wethersfield, Cromwell, Middletown, Durham, Meriden, Milford, Orange, Woodbridge, Hamden, New Canaan and Ellington.

Food Plants.

The larvae occur most abundantly in the stems of the larger plants of smartweed or jointweed of the genus *Polygonum,* and particularly in that species sometimes called "Lady's thumb" or "heartsease," *Polygonum Persicaria* Linn. This is the species with a dark blotch on the leaf. I am by no means satisfied that the insect is confined to that species and probably it may occur in any of the larger-growing species of *Polygonum.*

Heinrich states† that "the natural food plants of *P. ainsliei* are *Polygonum,* ragweed, and similar plants: and it is frequently

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* Note on the European Corn Borer (Pyrausta nubilalis Hübner) and its Nearest American Allies, with Description of Larvae, Pupae, and One New Species, Journal Agricultural Research, Vol. XVIII, page 171, Nov. 1, 1919.

† Ibid., Vol. XVIII, page 176, 1919.

found in corn associated with *P. nubilalis,* for which its larva is easily mistaken." In several cases, what is believed to be the same borer was found in the stems of "lamb's quarters," "goose-foot" or "pigweed," *Chenopodium album* Linn. Similar larvae were found in stems of "beggar's ticks," *Bidens frondosa,* but as the adults were not reared, it is impossible to be sure of its identity.

Life History and Habits.

The adults emerge in Connecticut the first half of July and soon mate and lay eggs. Our specimens in a large cage over corn plants at the Station Farm at Mount Carmel apparently did not lay any eggs, though there were several individuals present of each sex. Several searches were made, but no eggs could be found. Yet on August 9, small larvae were found boring in smartweed in Hamden, and Mr. Stone found them in Ellington August 11.

Some of the infested smartweed stems were placed in the cage on August 16, and some good-sized uninfested plants of smartweed were transplanted into the cage. Larvae soon left the cut stems and bored into the stems of the growing plants. In September, I noticed that the stems of the smartweed plants were well riddled and several of the larvae were at work in the corn stalks.

Apparently there is only one brood or generation each year in Connecticut, the winter being passed in the stems of plants, particularly in corn and *Polygonum.* The larvae do some feeding in the early summer, pupate late in June, and the adults emerge early in July. The eggs must hatch in July and the larvae spend the remainder of the season tunneling in the stems of plants, often leaving one stem to go to another.

The following paragraph is copied from Mr. Stone's notes:—

"Several instances were observed where the larva had left corn and entered smartweed and *vice versa.* The tunnels were noticeably much shorter where this had taken place, and if anything the borers showed a more mature development. In fields where borers were plentiful, careful observations were made and not a single instance was discovered where a larva had entered a stalk just beneath the leaves. However, many cases were seen where the borer had passed through the sheath of the leaf without entering the stalk at that point. In many cases a semi-circle was

cut in the edge of a leaf directly over the point of entrance into the stalk. The borers entered the stalks on nearly all parts from roots to tassel: the burrows usually were made between the nodes, though in a few cases they occurred directly at the nodes. In smartweed, the entrance was invariably just above the node, and in the majority of cases from two to four inches above the ground, although in a few cases, larvae were found boring in the roots."

Description.

Egg. The writer has not seen the egg-mass of this species, as none were laid by the females reared. Some eggs dissected from the body of a female were white and slightly longer than broad.

Larva. Length about 14 mm., thickness about 2.5 mm., color dirty white or gray to light brown, rather distinctly and conspicuously spotted with darker brown tubercles: dorsally, these tubercles form four longitudinal rows, and there is another row below the spiracles on each side: the tubercles are on the front of each segment forming a transverse row. Beginning with the abdominal segments there are two smaller tubercles on the rear half of each segment. There are also a number of other smaller tubercles definitely arranged. Each tubercle bears a hair. Head dark brown, legs light, unicolorous with ventrum.

Pupa. Length about 12 mm., thickness about 2.5 mm., color reddish brown, somewhat darker on dorsal than on ventral surface, head projecting distinctly beyond base of antennae and ending in a blunt projection. Dr. Edna Mosher has studied this pupa in comparison with that of *nubilalis* and the results have been published.*

Adult. Female wing-expanse about 28 mm., color buff, marked with two submarginal narrow zigzag transverse lines. There is usually a darker shading in the discal area. Head, thorax, abdomen, legs and antennae all about the same color as the wings. Male, usually a little smaller than the female, often darker with similar though usually more prominent markings.

There is great variation in the size, color and markings of both sexes of this species.

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* Journal of Economic Entomology, Vol. 12, page 387, October, 1919.

Control Methods.

The injury to corn by this insect, so far as observed in Connecticut, has not been of such extent or character as to indicate that control measures are necessary. Probably it is only during occasional seasons when the insect is unusually abundant that it attacks corn: the remaining seasons it is probably present in normal numbers in smartweed and nobody pays attention to it. However, if it should again become unusually prevalent and attack corn, the stalks should be cut into short pieces—say one-half inch in length, and put into a silo or fed directly to stock, the same as ought to be done in case of corn infested by the European corn borer. Stalks that are left in the field over winter should be burned before May 1st. The fields should be kept free from a large growth of smartweed, thus greatly reducing the probability of the corn becoming infested.

THE STALK BORER.

Papaipema nitela Guenée.

The common native stalk borer *Papaipema nitela* Guen., and its variety *nebris* Guen., is present every year in Connecticut and infests a large number of plants including corn, bean, potato, eggplant, tomato, rhubarb, spinach, dahlia, aster, chrysanthemum, gladiolus, lily, hollyhock, peony, sunflower, and most of the common vegetables and larger weeds. In fact, it will tunnel in almost any herbaceous stem. Last year I found a larva in the stem of muskmelon near its base. In 1919, of the specimens submitted to the office, one larva from Greenwich was tunneling in the new shoot of a peach tree, this shoot growing near the ground. Another lot of specimens from Putnam included one larva boring in a raspberry cane.

The stalk borer was abundant in 1918, and caused considerable damage throughout the state, but was even more abundant the past season, and did more injury. Also it seemed to attack corn more than other crops, though perhaps the extra attention paid to the corn crop and the inspections made on account of the possibility of finding the destructive European corn borer may be responsible for bringing this injury to light. Thus between June 12 and August 18, which represents the period of the

greatest activity of the larvae as borers, specimens were sent in from the following places:—

Litchfield County—Litchfield and New Hartford.
Hartford County—Hartford, East Hartford, East Windsor, Windsor, Bloomfield, Granby, Canton Center, New Britain and Southington.
Tolland County—Ellington.
Windham County—Putnam, Pomfret and Sterling.
Fairfield County—Greenwich and Stamford.
New Haven County—New Haven, Hamden (Highwood, Whitneyville and Mt. Carmel), Cheshire, Meriden and Clintonville.
Middlesex County—Saybrook Point.
New London County—Lisbon.

In addition to these localities, Mr. George D. Stone, who was employed to examine cornfields throughout the state, sent in material or observed this insect or its ravages in Litchfield, Hartford, Tolland, Windham, New Haven and New London Counties. These records show that the insect not only occurs, but has injured corn the past year in all sections of the state. Probably it was the most noticeable insect pest of the crop during 1919, and also did more damage than any other species.

The injury is of two sorts. When the young larvae attack the corn, they usually feed on the leaves at first near the whorl, eating ragged holes in them, or eating into the leaves before they unroll. This last mentioned form of injury often shows, when the leaf gets larger, as a row of holes across the blade, somewhat after the manner of "bill-bug" injury. Mr. Stone writes: "The *Papaipema* larvae were found nearly everywhere in Windham County, but not abundant. Their work seems to be very distinctive when the corn is young, and later when the leaves grow out, rows of from three to five little holes across the leaf can be observed. Investigation will invariably show that the borer is inside the developing tassel, or if the holes are far out upon the leaf it will be found boring in the stalk."

The larva later does tunnel downward in the stalk, often going quite to its base. In many cases the characteristic leaf injury was present, but on searching for the cause the larva could not be found, and the injury apparently stopped. Probably many larvae are destroyed by birds or predaceous insects before they enter the stalks. Like the army worm this larva is often found in the top of the corn plant in the whorl at the base of the

leaves, and not very well protected. The characteristic leaf injury is shown on plate XXIV.

The larva of the stalk borer is about one and one-half inches long when mature. In its earlier stages it is somewhat smaller, and is distinctly striped lengthwise with brown and white. There is a rather broad lateral white stripe on either side which is interrupted on the first four abdominal segments, thus giving the appearance of a broad transverse band or girdle of dark brown or gray. The larva is shown on plate XXIV, c. In its mature stage just before pupating, the conspicuous stripes gradually disappear, and the larva is a dirty greenish gray color.

The adult is a purplish gray moth with a wing-spread of about one and one-fourth inches. The typical form *nitela* is nearly uniform in color with a transverse submarginal lighter band shading into the darker margin on the forewings. On some specimens rather inconspicuous black spots show in the discal area. The variety *nebris* Guen., resembles the above, except that it has conspicuous white spots in the discal area, and is shown on plate XXIV, b. From the material gathered from corn and other plants in Connecticut, both forms have been reared, but variety *nebris* is much the more abundant.

There is only one generation each year, and the insect probably passes the winter in the egg stage on the stalks of pigweed, ragweed and other common weeds. These eggs hatch early in June, and the young larvae at once feed upon any suitable plant that is available. The stalk borer occurs throughout the United States and Canada east of the Rocky Mountains.

The stalk borer was strongly parasitized by dipterous larvae in 1919. Mr. Stone saw many dead larvae in Tolland County, and by August 15, could find no living ones in Hartford County. Probably by that time they had pupated. Much of the larval material which he gathered in various parts of the state never transformed, but gave up dipterous larvae, the parasites often pupating in the box in transit.

The parasites reared, were identified by Dr. J. M. Aldrich of the Bureau of Entomology at Washington, as *Masicera myoidea* Desv., and emerged from material collected in Windsor, Hartford, New Britain, and New London.

On account of the large proportion of the larvae being parasitized, a small proportion of adults were obtained from the material

gathered in the field, and this condition leads us to believe that the stalk borer may not be prominent next year in Connecticut cornfields.

Control Measures.

When the larvae are feeding upon the leaves at the tops of the corn plants, dry arsenate of lead sifted into the whorl will doubtless kill them. After the larvae have commenced to tunnel inside the stalks, there is no satisfactory or practicable method of control that can be practiced in large fields, other than destroying the infested stalks when found.

With a few choice plants in the garden, it may be possible to cut into the stem lengthwise and destroy the borer. Such methods, however, cannot be practiced under field conditions. The destroying of all the larger weeds in which the caterpillars can live will be an aid in reducing their numbers. Burning the stalks of weeds around the field in late fall or early spring to destroy the eggs is to be recommended where the stalk borer is a serious menace to field crops.

INJURY TO CORN IN CONNECTICUT BY CRAMBUS PRAEFECTELLUS ZINCK.

On July 3, Mr. L. F. Harvey, County Agricultural Agent, brought to the laboratory some corn plants from a field on Townsend Avenue, New Haven, which had been injured in a peculiar manner by a larva boring into the side of the stalk near its base. This field was only three or four miles from the center of New Haven and contained about an acre. It was in grass in 1918, and plowed in the spring of 1919 and planted to corn.

The plants began to look sickly when only a few inches high and the outer leaves turned brown and died: later the entire plant followed suit. An occasional plant escaped attack and was much larger and more vigorous than the other plants in the field. A few hills near one end of the field were not attacked, and these and occasional scattered stalks produced ears. The crop was almost a total loss.

At first we failed to notice the larva at the base of the stalks because it dropped away with the soil from the roots when the

plant was pulled up, and even after noticing its presence, it was difficult to obtain one as it would wriggle away into a crevice in the soil.

Mr. Zappe with Mr. Harvey examined the plants and collected more material. Later, on July 10, the writer visited the field, which had the appearance shown on plate XXV, a.

Each stalk attacked had a hole eaten into one side at or just above the surface of the ground, as shown on plate XXV, d. Apparently there was only one larva in a stalk. The larva causing the injury was nearly always enclosed in a case formed by webbing together particles of soil as is shown on plate XXV, c. At the time this insect was supposed to be the corn web-worm *Crambus caliginosellus* Clem., a common species which causes considerable injury to corn in the middle and southern Atlantic States.

From the material gathered and placed in the insectary, four adults were reared about the first of September, and proved to be *Crambus praefectellus* Zinck., a native species, which has not heretofore been recorded as causing injury to corn.

The larva is about 12 mm. long, 2.5 mm. thick, dirty white to ash-gray in color, rather prominently marked with darker tubercles. Each abdominal segment bears eight: six in a transverse line near the front margin of the segment, the outer ones being below the spiracles: two transversely elongated ones just back of the middle two, but more widely separated. Prothoracic shield whitish and shiny marked with several small dark gray spots. Anal shield peppered with dark gray spots. Head whitish, shiny, mottled dorsally with brown. Legs, prolegs and ventral surface whitish. Each tubercle bears one or more hairs. Appearance of the larva is shown on plate XXV, b.

The adult is a Pyralid moth, having a wing-expanse of from 20-24 mm.: fore wings brown with a longitudinal white band narrowing to a point before reaching the margin. There is also a brown dash nearly bisecting the apical angle of the fore wing, formed by white markings on each side, but this dash is usually darker than the ground work of the wing. There is a narrow, wavy submarginal transverse line of darker brown; between this line and the margin is a row of five black elongated dots or short dashes. The terminal fringe is light brown. Rear wings white, with a brownish tinge in some individuals. Legs and antennae light brown. Adult is shown on plate XXV, b.

Mr. George G. Ainslie of the Bureau of Entomology, Cereal and Forage Crop Insect Investigations, stationed at Knoxville, Tenn., who has studied this and allied Pyralids, informs me that he has records of *praefectellus* being taken on corn from Florida, Arkansas and Tennessee, and on wheat from Indiana, but in no case was the injury of any extent or of any real importance.

Professor C. H. Fernald in "The Crambidae of North America," published in 1896, states that the early stages and food plants are unknown.

There are few references in literature to this species, and most of them are systematic rather than economic. Apparently this is one of the first instances, if not the first, of any serious injury being caused by this insect.

THE ARMY WORM.

Cirphis (Heliophila) unipuncta Haw.

In certain seasons the army worm is present and attacks corn. During the outbreaks, like that of 1896 and 1914 in Connecticut, the larvae may injure any grain, grass or corn crop, but in many other seasons when there is no particular outbreak, a few larvae here and there are found feeding on corn. The larvae feed on the leaves at their base, and are often found in the whorl in the top of the plant. Mr. Stone found some on corn in Tolland County, July 31, and in Hartford County, August 14, but they were not very abundant in cornfields.

There was a local outbreak, however, in the town of Woodbury, where a field of oats was infested with larvae. Mr. Chamberlain visited the place on August 19 in company with the Litchfield County Agent, who reported the case to this office. On that date the oats had been cut and raked into windrows. There were many full-grown larvae beneath the straw, and many pupae were found in the soil. An adult moth was also received from Southport on September 24.

The army worm has two or possibly three broods each season, the eggs being laid on the leaves of grass or grain. The larvae reach maturity in from twenty to thirty days.

Crosby and Leonard* state that the insect passes the winter as a partially grown caterpillar. The full-grown larva is about

* Manual of Vegetable-Garden Insects, page 289, 1918.

one and one-half inches in length, ground color greenish black, striped lengthwise with dark mottled broad and fine white lines. The appearance of the caterpillars is shown on plate XXVI.

A more extended account of the army worm may be found in the Report of this Station for 1914, page 157. In case of an outbreak, it is often necessary to plow a deep furrow with perpendicular side opposed to the line of advance; to plow and harrow the soil just after the caterpillars transform to kill the pupae; arsenical poisons may be applied to any crops not used for food or forage in order to insure them against injury.

THE SMEARED DAGGER MOTH.

Acronycta (Apatela) oblinita S. & A.

The first larva of this species found feeding on corn was collected at Brooklyn, July 8, by the writer, in company with Messrs. Irving W. Davis and George D. Stone. Mr. Stone sent specimens to the office, later, as follows:—Windham County, July 17: New London County, July 23: Tolland County, July 31: Hartford County, August 14.

This caterpillar is brown and hairy. The young ones resemble those of the fall web-worm, though somewhat lighter and more yellow in color. As it passes through its molting stages, it soon takes on a different appearance. In one of these stages—perhaps next to the final one—it has broad longitudinal brown stripes with a narrow dorsal stripe and two broader lateral stripes of yellow. In its final larval stage it is simply a brown hairy caterpillar about one and one-half inches in length and somewhat resembles the larva of *Diacrisia* which is called the "woolly bear."

The adult is a pretty gray moth measuring rather more than two inches from tip to tip of fore-wings, shown on plate XXVII, b. The fore-wings are gray, marked lengthwise with black dashes, and the rear wings are white except for a marginal row of small black dots.

One of the immature caterpillars feeding upon corn is shown on plate XXVII, c. They devour the leaves and are usually near the base of the topmost leaves at the time the tassel first begins to show. Later they may feed anywhere on the upper part of the plant. This insect is probably not a serious pest of corn in this part of the country, but attacks the crop occasionally and causes slight injury.

The caterpillars have a long and varied list of food plants including smartweed *(Polygonum)*, cat-tail flag, willow, poplar, peach, apple, pear, strawberry, raspberry, blackberry, grape, bean, cotton, asparagus, buckwheat, wheat, oak, hazel, elm, alder, butternut, pine, button-bush, soft-maple, lilac, canna, honeysuckle, clover, corn and grasses. Forbes* records two broods in a season in Illinois, but states that it is single brooded in Canada. A specimen in the Station collection was reared from a larva feeding on white pine in Norwich, collected July 19, 1916, and the adult emerged May 26, 1917. A larva was collected on cat-tail flag, East Haven, July 19, 1908.

This species occurs throughout the eastern United States and Canada, and the larva is sometimes called "the smartweed caterpillar." It is not sufficiently abundant in Connecticut to require treatment.

THE LINED CORN BORER.

Hadena semicana Walk.

Early in the season, a circular letter was received from Dr. E. P. Felt, State Entomologist, Albany, N. Y., stating that the lined corn borer *Hadena fractilinea* Grote had been found in a number of fields in New York state. Consequently we were watching for it and on June 16, one larva was received from Farmington, which seemed to answer the description of *H. fractilinea.* This larva was less than an inch long, and striped lengthwise with brown and white as shown on plate XXI, a. Another was found on corn in Bloomfield June 19. In both cases these larvae were feeding upon the leaves and had not begun to tunnel in the stalk. From the Bloomfield specimen an adult emerged August 9, which seems to resemble *Hadena semicana* more closely than *H. fractilinea,* as it does not have the pale color all along the inner margins of the fore-wings.

H. semicana Walker is mentioned in the Yearbook, U. S. Department of Agriculture for 1905, page 634, as follows:—"*Hadena semicana* Walk. usually classed among the rarer cutworms, occurred in destructive abundance in Mercer County,

* Twenty-third Report Illinois State Entomologist, page 170, 1905.

Pa., during June. A similar outbreak occurred in 1893, in an adjoining county in Ohio."

THE CORN EAR WORM.

Heliothis obsoleta Fabr.

This is the same insect that is so common in the southern states where it is known as the "cotton boll worm," and the "tomato boll worm," because it eats holes into cotton bolls and ripening tomatoes.

It occurs nearly every year in Connecticut, and feeds upon the tips of the immature ears of late maturing sweet corn and field corn late in the season. Sometimes it is locally abundant, and considerable damage results from its attack, but in general the injury is much less severe in Connecticut, which approximates the northern limits of the species, than farther south, where several generations occur. Apparently there is only one brood annually in Connecticut.

That it occurs throughout the state is evidenced by material received from the following localities:—New Haven, Cheshire, Bethany, Northford, Westport, Wilton, Kensington, Rockville, Colchester and New London.

This insect was formerly known as *Heliothis armigera* Hbn., and it is treated under this name in much of the literature of the species.

In Connecticut the moth lays its eggs on the silk of the corn plant, and the young caterpillars feed upon the silk and soon work their way through the husk and devour some of the unripe kernels at the tip of the ear. Sometimes the injury may extend half way down the ear or even to its base, but this is unusual, and in most cases is limited to the tip of the ear. Many eggs are doubtless laid on the silk, and sometimes five or six caterpillars begin to feed there, but they devour each other, so that finally not more than one or at most two remain on an ear. This insect attacks both sweet corn and field corn, but seems to prefer the former and injures it more severely. On October 8, the writer observed sweet corn on sale in the market of Washington, D. C., nearly every ear of which contained a large caterpillar.

The corn ear worm much resembles a cutworm to which it is closely related. When fully-grown it is one and one-half inches

or more in length, and in color it varies widely from light green to a rather dark brown. It is usually striped lengthwise with lighter and darker stripes, but the markings also vary greatly and the most conspicuous stripe is a pale lateral one in the region of the spiracles or breathing pores.

When mature the larva goes into the ground, and in a burrow a few inches below the surface transforms to a smooth brown pupa, slightly less than an inch long. In Connecticut the winter is passed in the pupa stage, but in the southern states where several broods occur, the pupal period varies from two to three weeks.

The adult moth has a wing-spread of about one and one-half inches, ground color of fore-wings buff, with darker brown markings. The markings usually consist of a discal spot and sub-terminal bands, but there is great variation; fringe buff or light brown. The rear wings are cream-color with a broad cross band of dark brown next to the cream-colored fringe. Head, thorax, abdomen, legs and antennae buff like ground color of the fore-wings.

The appearance of an infested ear and the adult moth are shown on plate XXVIII.

There is no good method of controlling the corn ear worm on field corn, but experiments in New Jersey show that on sweet corn it may be held in check by dusting the silk soon after it appears with powdered arsenate of lead and fine sulphur, equal parts. Early planted fields and early maturing varieties usually escape injury. Fall plowing of badly infested fields is to be advised.

OTHER INSECTS ATTACKING CORN IN 1919.

THRIPS.

On June 24, some corn plants were received from Mr. A. G. Davis, Litchfield County Agent, which had been injured by thrips. Some of the insects had been collected and mounted on a microscope slide, and submitted with the plants. This mounted material was divided and a part sent to the Bureau of Entomology at Washington, D. C., where it was identified by Mr. A. C. Morgan, who stated that the slide contained two species,—"two

females of the grass thrips *Anaphothrips striatus* Osborn, and one female of *Plesiothrips (Thrips) perplexus* Beach. Practically nothing is known concerning the habits of the last named species." Apparently all the other specimens from Litchfield represent the grass thrips, which is doubtless the species responsible for the injury on corn.

Similar injury to corn caused by thrips was received from Putnam, June 28, and from West Hartford, July 5; it was observed many times by members of the staff in examining cornfields in various sections of the state. As a rule the injury was not very severe, but confined to a few of the lower or outer leaves on a plant here and there. The surface of the leaf was grooved in white lines in the manner shown on plate XXIX, a, and the injured leaves withered and died very quickly. Treatment would not be practicable in the field, but in the home garden a spray of soap and nicotine solution would rid the plants of these minute insects.

Wireworms.

Corn plants were received on June 27 from Bristol which had been injured by wireworms, as shown on plate XXIX, b. The base of the stalk had been hollowed out and two larvae were present. The species has not been identified. Wireworm injury is occasionally serious and difficult to control, the only practicable measures being cultural ones such as crop rotation, fall plowing and thorough harrowing.

Noctuid Caterpillars.

When examining a cornfield in Hamden, June 30, a green rather stout larva about one inch long with white stripe along each side was taken on corn. No description was made at the time, but it was placed in the insectary and from it was reared on July 9 an adult of *Autographa falcigera* Kirby var. *simplex* Guen. The larva feeds on a great variety of plants chiefly of the cabbage family.

Mr. Stone collected on corn another pale green larva mottled with darker green in Tolland County, July 31, and from it was reared on August 23, an adult of *Mamestra subjuncta* Gr. & Rob. The larva is a general feeder, especially on grasses and weeds.

The writer found in Bloomfield, June 19, a partially grown slender green larva feeding at the base of the corn leaves in the whorl. Its length was about 15 mm., thickness about 2.5 mm., general color grass-green, granular, each segment margined posteriorly on the dorsum with a tinge of yellow. A narrow yellowish stripe extends along each side from head to anal prolegs just below the spiracles. Head, legs and prolegs, green. The body bears a few scattered hairs, which are most pronounced laterally: dorsum almost smooth. Shown on plate XXIX, c.

The same or a similar species was taken by the writer at Brooklyn, July 8, and Mr. Stone observed and sent in specimens from Windham, Tolland, Hartford and Litchfield Counties. Mr. Stone writes that the green larva can nearly always be found upon the upper surface of the leaf and the holes which it eats are irregular. It eats the tender leaves chiefly, and seldom injures the tassel. This larva is somewhat different from that collected in Bloomfield, but may represent a later instar of the same species. Each is about 25 mm. long, 4 mm. thick, and there are faint longitudinal green lines of lighter and darker shades on the dorsum. The lateral stripes also vary from yellow to white and some even show a pinkish tint.

Though some of these larvae went into the ground in July to pupate, no adults have yet been reared, so the identity of the species is unknown.

Some small zebra caterpillars, *Mamestra picta* Harris, were found feeding upon corn at the Station farm Mount Carmel, June 20, by Mr. Zappe. They were brought to the insectary and adults emerged August 25. These caterpillars feed in clusters when young. When mature they are about two inches long, black or dark brown, strikingly marked with yellow. The adult has a wing-spread of one and one-half inches. The thorax and fore wings are reddish brown without prominent markings. The rear wings are nearly white, margined with light brown.

This insect is a general feeder and we may expect to find the caterpillars feeding upon almost any garden or field crop.

THE PARSNIP WEB WORM.

Depressaria heracliana Linn.

On June 23, Mr. G. M. Codding brought to the laboratory some stems of cow parsnips collected in the vicinity of Danbury by Fairfield County Agent L. A. Bevan. The stems had been hollowed out by the larvae burrowing in them, and when received contained several pupae as shown on plate XXX, c.

On July 16 several adult moths emerged: thay have a wing-spread of about one inch, with fore-wings of buff or light brown marked by short longitudinal dashes of dark brown or black: rear wings lighter brown, but with a suffused darker shade near the distal margin. Shown on plate XXX, b.

This insect passes the winter as an adult under loose bark and in other sheltered places, and the eggs are laid in May or June on the leaves. The young greenish yellow caterpillars web together the leaves and devour the unfolding blossom buds. This is quite a serious pest in fields where parsnip and carrot seeds are grown. The mature caterpillar is slightly over half an inch in length, greenish yellow in color, somewhat paler laterally and ventrally, with head, legs and cervical shield shining black. Each thoracic and abdominal segment bears black tubercles, with a hair arising from each. Shown on plate XXX, b.

When nearly mature, the larva leaves the web and enters the stalks, usually through the axil of a leaf and for the rest of its larval existence tunnels inside the stem. The pupa is about half an inch long, with dark brown thorax and light brown abdomen, and is formed inside the stalks. The moths emerge in about three weeks, and there is only one generation each year.

The native food plants are wild carrot, wild parsnip, cow parsnip and other plants of the family Unbelliferae. Messrs. Zappe and Chamberlain collected this insect in stems of wild parsnip in Goshen, July 6. Mr. Zappe observed it on seed parsnips in his garden in Hamden, and from a letter I am sure that the same pest was injuring plants in a garden in Stratford, though the infested plants had been removed prior to a visit by Mr. Walden on June 30.

The only control methods are to remove and destroy occasional infested plants, and after blossoming, the plants may be sprayed or dusted with arsenate of lead.

MOSQUITO WORK IN 1919.

By B. H. Walden.

In 1919 the ditches on the salt marshes which have been drained to eliminate mosquito breeding were maintained as in 1918. This includes approximately 5,000 acres located in the towns of Madison, Guilford, Branford, East Haven, New Haven, Orange and Fairfield. In most of the towns it was possible to obtain the same men that were employed in 1918, although it was necessary in certain cases to pay somewhat higher wages.

The ditches were all gone over in April and May and obstructions removed and the necessary cleaning done to provide good circulation of the water.

During the first half of the season the marshes were comparatively dry and free from breeding. Conditions throughout the latter half of the season, however, were extremely favorable for mosquito breeding. Frequent rains and high tides kept the depressions in the marshes filled with water for periods sufficient to produce extensive mosquito breeding.

An attempt to control this breeding by the means of additional ditching and oiling would have increased the cost of maintenance to more than one dollar per acre, which is the maximum amount that can be expended under the law.

Legislation. Under the law passed in 1917 providing for the elimination of mosquito breeding places,* some of the towns have objected to paying three-fourths of the supervision charges in addition to three-fourths of the labor for maintenance. Furthermore, it has been more or less of a question as how to divide these expenses among the various towns as the amount of supervision in a town depends upon the character of the marshes and the judgment of the men employed in carrying out the work. It was undoubtedly the intentions of those drafting the bill for this law that the cost of supervision be paid directly by the State.

Section 2410 of the General Statutes was therefore amended by the 1919 Legislature to read as follows:—

* Seventeenth Report Connecticut State Entomologist, page 345, 1917.

Chapter 21.

An Act concerning Mosquito Breeding Areas.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Section 1. Whenever any swamp, marsh or other land has been drained to the approval of said director, he shall keep the same in repair and free from obstruction, and construct or repair tide gates or otherwise treat such areas so as to make such work effective. The cost of such maintenance or treatment, not exceeding in any year one dollar per acre, shall be paid by the state, and the town, city or borough within which such place or area is located shall reimburse the state for three-fourths of the amount so expended. Said director shall certify to the comptroller the amount due from any town, city or borough under the provisions of this section, and the treasurer of such town, city or borough, as the case may be, shall pay to said comptroller such amount. All amounts so collected shall be available for expenditures under the provisions of this section. Said director may appoint one or more deputies to supervise the work done under the provisions of this and the preceding section, who may exercise the authority granted to such director, and the expense of said director and said deputies for supervision and inspection shall be included in computing the cost of any such work, but the actual cost of making preliminary inspections and surveys and for the supervision and inspection of the construction and maintenance by the said director or his deputies shall be borne wholly by the state and paid from the funds appropriated for the purpose. The comptroller may advance to said director such amounts, within the appropriation therefor, as are necessary to meet the current expenses for labor authorized under the provisions of this and the preceding section. Any person obstructing the work of examining, surveying or ditching or otherwise treating such mosquito breeding areas, or obstructing any ditch, canal or drain, or the natural outlet of any marsh forming, mosquito breeding areas, shall be fined not more than one hundred dollars or imprisonment not more than ninety days or both.

Section 2. This act shall take effect from its passage.

Approved March 19, 1919.

Report of Work by Towns.

Madison. The selectmen as in 1918 transferred Mr. Russell Bartlett from the road work to mosquito maintenance from April 14 to September 12. The ditches were cleaned in the spring and attention given them as needed throughout the summer. It was necessary to reopen the outlets of the creeks along Madison Beach at frequent intervals.

Guilford. The ditches were cleaned in the spring by Mr. Frank Blatchley, who has been furnished by the selectmen for the past two seasons. Although the ditches were gone over two or three times during the season, more labor than was available was needed during portions of the season. The tide gate installed on the Great Harbor marsh in 1918 greatly improved the conditions on the marsh during the past season.

Branford. Mr. L. E. Rice was again in charge of the mosquito work in Branford. Owing to insufficient labor to thoroughly clean the ditches on some of the marshes in 1918, an extra amount of work was necessary this season. The ditches on the Hotchkiss Grove marsh were considerably damaged by musk rats and required extra work to put them in shape.

East Haven. The maintenance work in this town was done in connection with the New Haven work.

New Haven. Laborers were hired by the writer to clean the ditches in the spring. Mr. Draper, after finishing his college work in June, was again employed on the work for the remainder of the season.

The city of New Haven is constructing new tide gates on the West River at Congress Avenue bridge, and a new sewer is being laid in Westville, two improvements which should greatly improve the mosquito breeding conditions in the western part of the city. The tide gates which are nearly completed have the abutments and frame work of reinforced concrete with gates of double three-inch tongue and grooved planks and hung with special hinges. These gates control the water on about 130 acres of marsh between Congress Avenue and Chapel Street ditched in 1917,* which has been flooded much of the time during 1918 and 1919.

The new sewer in Westville will receive the pollution from several factories which for a number of years has been emptied into the upper portion of the West River, causing extensive breeding of *Culex pipiens*†.

Orange. The maintenance work in Orange was continued under the direction of Dr. Phelps. In addition to cleaning the

* Seventeenth Report Connecticut State Entomologist, page 349, 1917.

† Thirteenth Report Connecticut State Entomologist, page 245, 1913.

ditches, the creek that runs into the cove marsh was cleaned for several hundred feet to the north, thus draining a semi-fresh water swamp that was a possible malarial mosquito breeding area.

Fairfield. Mr. Nicholas Matiuck was continued in charge of the mosquito work in Fairfield. The large amount of fresh water mosquito work which is being done in the town requires more attention than the twelve hundred and fifty acres of salt marsh. To adequately handle this problem requires a larger appropriation than has been available in the past.

In the western part of the village of Fairfield is a section known as the Thorpe estate, a low area which was divided into building lots and a number of houses have been built by laborers. The natural drainage was cut off by three streets across the area, and by property owners filling in portions of the main ditch. *Anopheles* larva have been found in the water that collected in rainy weather, and the only method of preventing mosquito breeding was by oiling.

During the past season the old ditch was re-opened and deepened throughout this area and for several hundred feet beyond where it joined a creek in the salt marsh. Tile drains were placed across the three streets: 50 feet of eighteen inch and 140 feet of 12 inch tile was used. A gate was placed on the outer culvert to prevent high tides from flooding the area.

No new mosquito control work was done under the state law during the year, although the writer by request examined marsh areas and made recommendations regarding mosquito elimination in the towns of Westbrook and Groton. In the latter town plans have been made and funds are being raised to drain fifty or sixty acres of salt marsh at Groton Long Point during next season.

Cost of Maintenance Work for 1919.

Madison	$505.38
Guilford	432.28
Branford	409.22
East Haven	25.62
New Haven	804.97
Orange	200.97
Fairfield	1,217.32
Total	$3,595.76
Average cost per acre	.727
Expenses in connection with proposed new work	$15.07

ENTOMOLOGICAL FEATURES OF THE SEASON.

The winter of 1918-1919, unlike the preceding, was unusually mild. There was little snow and the temperature was seldom below zero. Honey bees and native bees which winter-killed severely in 1917-1918, came through the winter nicely and scarcely needed the protection which most of the beekeepers gave their colonies on account of the losses the preceding winter.

The planting season opened late and cold, and plant development and consequently insect development was some two weeks behind that of normal seasons. During June the rainfall was somewhat below normal, but from the middle of July until the end of October, heavy and frequent rains kept the soil soaked with water and many crops needed sunlight. The total rainfall for the season was about six inches more than normal.

Orchard aphids caused considerable injury throughout the state.

Canker worms were present in some localities, but the tent caterpillar was scarce, only a few nests being observed.

The white-marked tussock moth was present, but this and other tussock moths were much less abundant than in 1918.

The potato flea-beetle was abundant and caused considerable damage as in 1918.

The potato aphid was present in small and in moderate numbers on potato and tomato plants, but it did not seem to cause much injury and most owners did not spray to control it.

Aphids attacked peas and injured them considerably. The turnip aphis was also present and injured many small turnip plantings.

The elm leaf beetle was present in injurious numbers and in several towns the trees were sprayed where this practice has been abandoned for several years.

Two of the most conspicuous entomological features of the season were the severe attack on beans everywhere by the green clover worm, and the unusual prevalence of corn borers and other insects attacking corn.

A native borer *Pyrausta ainsliei* Hein., which we may call the smartweed borer, was found in corn stalks in Milford in March, and was thought to be the European corn borer, until the adults were reared in July when it was identified. The stalk borer was very abundant especially in corn and was present in all parts of the state and caused considerable injury.

Crambus praefectellus Zinck. attacked and ruined a small field of corn in New Haven, this being the first instance on record of any real damage being caused by this insect.

The corn ear-worm was responsible for a moderate amount of injury to corn. Specimens were received from various parts of the state, and it was observed in many other localities.

A search was made for larvae and injury of the oriental peach moth *Laspeyresia molesta* Busck, in Stamford where it was found in 1918, but no trace of it was discovered.

The brown-tail moth, though slightly more abundant than in 1918, is still scarce.

The gipsy moth has been well held in check. The number of infestations is now less than half that of a year ago, and if there is no wind-spread the coming spring, it is expected that the number of infestations will again be materially reduced.

On account of the excessive rainfall, it was difficult to prevent the breeding of mosquitoes, and there were some complaints, even where the salt marshes have been ditched. The rain barrel or house mosquito was particularly troublesome and had a chance to breed in pools and receptacles everywhere, as the constant rains prevented these breeding places from becoming dry.

MISCELLANEOUS INSECT NOTES.

Enchenopa binotata Say, Reported as Injuring Beans:—On July 16, specimens of this peculiar bug were received for identification from Stamford, where it was said to be causing injury to garden beans. This species commonly occurs on "bittersweet" *Celastrus scandens,* and is occasionally found on black locust.

Poultry Food Infested with Mites:—On August 22, a sample of poultry food was received from Winsted, which was thoroughly infested with mites. This mite was identified by Dr. Philip Garman of this department as *Tyroglyphus farinae* Deg., a species often occurring in food products.

A Weevil Breeding in Stems of Pigweed and Ragweed:—Stems of red-root pigweed, *Amarantus retroflexus,* and ragweed, *Ambrosia artemisaefolia,* infested with larvae were collected in

Wethersfield February 7. On June 12 a large number of weevils emerged from the stems and were identified as *Baris scolopacea* Germ.

Borers in Stems of Evening Primrose:—Mr. Walden collected stems of evening primrose, *Œnothera biennis,* in Orange, February 20, which contained in the pith a large number of small yellow larvae. On July 17, a number of small white and brown moths emerged from the stems. These were identified as *Mompha eloisella* Clem.

Plum Curculio in Peaches:—Mr. Zappe gathered some unripe peaches at Sound Beach, Stamford, on June 23, which were infested by small larvae. Several infested fruits were also received from Mr. Stancliff Hale, South Glastonbury, on June 16. Adults of the plum curculio, *Conotrachelus nenuphar* Herbst, emerged July 23 from the Glastonbury material.

Leopard Moth in Hartford:—On July 9, a girdled and broken elm branch was received from the Superintendent of trees in the city of Hartford. Without question this was the work of the leopard moth, *Zeuzera pyrina* Linn., which though common enough along the coast has never before been found so far inland in Connecticut, or I think elsewhere in this country.

The Potato Aphid:—So much damage was caused in 1918 by the potato aphid, *Macrosiphum solanifolii* Ashm., that we expected recurring injury in 1919. The species could be found in small numbers in many fields, of potatoes and tomatoes, but in most cases it was not sufficiently abundant to do much damage, and the writer did not learn of a single case where fields were sprayed on account of it.

The Gladiolus Aphid:—On June 17, some gladiolus corms infested with immature aphids, were received from Bristol. These corms had been stored over winter. One of them was planted in a pot in the insectary and soon began to grow, but the aphids multiplied so rapidly that the plant was soon killed. Plate XXXII, a, shows the appearance of the plant when literally covered with aphids. This is known as the gladiolus aphid, *Aphis gladioli* Felt.

Abundance of the Pea Aphid:—On June 6 and 13, pea vines were brought to the office from the vicinity of New Haven, infested by the pea aphid, *Macrosiphum pisi* Kalt., with the report that this aphid was doing great damage to garden peas. In the large truck fields, no treatment is usually practiced in Connecticut. In the home garden, spraying the vines, especially the under sides of the leaves, with nicotine solution and soap will hold this pest in check. Even a forceful spray of water from the hose will knock them off and many will fail to get back to the leaves. If this is repeated every few days, little harm to the plants will result.

Swarms of White Moths:—For two or three nights about September 19, there were great numbers of large white moths with dotted black markings, around the electric lights in New Haven, and doubtless in other towns and cities of Connecticut. This is called the "chain-dotted geometer," *Cingilia catenaria* Drury, and the larvae feed upon the leaves of sweet fern and bayberry. The larvae were very abundant in 1903, and again in 1919, especially in Windham County, where many sweet fern and bayberry bushes were stripped.

Pink Grasshoppers:—A pink form of one of the so-called angular winged grasshoppers or katydids, *Amblycorypha rotundifolia* Scudder, was brought to the Station on August 20, from Orange where it was collected by Mrs. George D. Bathgate. The specimen was a female. On August 12, 1918, a pink female of *Amblycorypha oblongifolia* Deg., was received from New Haven, collected by Miss Molly Hart. On September 21, 1914, two specimens of *Scudderia furcata* Bruner, were received from Derby and a note regarding them was printed in the Report of this Station for 1914, page 187. The adults of these species are normally green, but occasionally the pink forms occur.

Larch Case Bearer:—On August 14, Dr. G. P. Clinton, botanist of this Station, handed the writer some larch twigs which he had collected in Greenwich. The leaves had been mined at the tips by the larvae and had turned brown. There were several of the characteristic cases on the leaves. The insect is an European species known as the larch case bearer, *Coleophora laricella* Hubner, and it has been recorded from different parts of New England at various times as causing considerable injury. There is only one generation each year, and the adult is a small gray moth which emerges early in June and July. The winter is passed by the larvae which rest in their cases attached to the bark of the twigs. This insect can doubtless be controlled by spraying with arsenate of lead which has been found effective against the closely allied case-bearers on fruit trees.

The Pine Tube-Moth:—While inspecting nursery stock in Hartford in October, Mr. Zappe observed some large white pines growing near the nursery with many of the leaves fastened together to form cases or tubes inside of which the larva feeds. This is the work of the pine tube builder, *Eulia pinatubana* Kearfott. The larva is about one-third of an inch long, pale green with light brown head. The adult is a small moth with a wing-expanse of slightly more than half an inch, and with fore-wings of a dull rust-red color, crossed by two oblique parallel paler bands: rear wings are silky gray. The tube is formed of about fifteen needles fastened together with silk threads as shown on plate XXXII, b. There is probably one brood each season. The insect is not of great economic importance, but if it should prove injurious to choice ornamental trees, spraying with lead arsenate will doubtless be effective in holding it in check.

The Clover Seed Chalcid:—On August 4, Mr. Pelton of the Station Staff brought to the laboratory some seed of a choice hardy variety of clover, which had been procured from Ohio, for seeding in Connecticut. Nearly all of the seeds had a small hole in one side, where some insect had emerged. Many of these seeds were examined and in some were found the dead bodies of a small chalcid fly, which Mr. Walden identified as the clover seed chalcid *Bruchophagus funebris* How. The eggs are laid on the clover heads in the field, the larvae feed inside the seeds and the adults emerge after the seeds are ripe. This insect occurs wherever clover is grown, and there are three broods each year in Illinois. Early cutting of clover is a remedy. The seeds with exit holes are shown on plate XXX, a.

Swarms of Cotton Moths:—On October 5, on Chapel and other business streets of New Haven, there were large numbers

of brown moths resting with folded wings on the plate glass store windows. They flew around the lights the preceding evening and in a few days had all disappeared. Specimens were received from Bridgeport, and Dr. Felt informed the writer that swarms appeared in various sections of New York state at about the same time. This is the cotton moth, *Alabama (Aletia) argillacea* Hubner, which occurs in great numbers in the cotton belt of the southern states, and migrates northward in the fall. Occasionally the swarms reach Connecticut before they are dissipated. Such a swarm appeared in New Haven in 1911, and was mentioned in the Report of this Station for that year, page 339.

Elm Leaf Beetle Again Abundant:—This insect was formerly very destructive to elm trees in southern Connecticut, but for the past few years has not been much in evidence as a pest. Beginning in 1917, it has increased each year and did enough damage in 1918, so that some communities decided to spray their trees in 1919. Trees were sprayed in West Haven and in Clinton, which were not sprayed the preceding year. Possibly the moist weather during the latter part of July and afterward may have induced the growth of the fungus which attacks the pupae, but it came rather late in the season for the best results, and all communities where trees are menaced should prepare to spray the foliage in 1920.

Beans Injured by Gray Hair-Streak Butterfly:—Green slug-like larvae were received from two correspondents in Hartford, on September 15 and 22, respectively, in both cases reported as feeding upon Lima beans. These are the larvae of one of our small butterflies called the gray hair-streak, *Uranotes melinus* Hubner. As a rule, this is not considered a pest in Connecticut, but further south the species is regarded as a minor pest of beans and peas. The butterfly has a wing-spread of one and one-fourth inches, and the wings are blackish with blue-gray tints. Near the tips of the rear wings is a row of bluish spots, with a large orange spot in the center surrounding a small black one, and the rings terminate in slender tail-like processes. There are two broods each year in the north and three in the South. Wherever abundant, this insect may be kept in check by spraying with lead arsenate.

The White Blotch Oak Leaf-Miner:—Several complaints were received regarding an insect attacking the leaves of white oak trees, especially in the central portion of the state, and specimens were received from Cromwell and New Haven. Some of the leaves had been crumpled and possibly attacked by more than one insect, but the samples submitted all showed the presence of the white blotch oak leaf-miner, *Lithocolletis hamadryadella* Clemens. This insect makes a whitish blotch-like mine on the upper surface of the leaf, and attacks different kinds of oaks. The larva is very small, flat, and without feet, and brownish yellow in color. It transforms within the mine, and the adult is a small silvery white moth with a wing-expanse of about a quarter of an inch. There are said to be five or six annual broods in the vicinity of Washington, D. C. There is no method of control known, except to gather and destroy the infested leaves.

Swarms of Aphids:—On June 23, the writer's attention was called to the swarms of green winged aphids which had for a few days been present on Chapel Street and in other parts of the city. The tops of automobiles and the clothes of persons were literally covered. There were many inquiries at a local seed store, and some persons thought they were seventeen-year locusts. One of the Station employees stated that when riding his bicycle into New Haven on Dixwell Avenue, his clothes were fairly covered with these aphids. Assistants were sent to Chapel Street to collect specimens, and found them to be aphids with heavily-marked wing-veins. Some were mounted on microscope slides and sent to Dr. Edith M. Patch, Agricultural Experiment Station, Orono, Me., who identified the species as *Calaphis betulaecolens* Fitch. This aphid feeds upon birch, is supposed to remain on its host throughout the season, and was extraordinarily abundant all over Connecticut in 1919. Of course there are few birches in the city, but there are many acres of gray or bobbin birches, *Betula populifolia,* in Orange only three or four miles from the center of New Haven, and with the prevailing winds blowing from the southwest, this section was probably their source. Possibly they became so abundant that they were obliged to leave their hosts in search of food. There were a number of newspaper accounts of the incident, some being more startling than accurate.

Flea Beetle on Swiss Chard:—On June 28, one larva feeding on swiss chard was received from Salisbury, with the statement that the insect was causing considerable injury in gardens in that vicinity. The larva was about a quarter of an inch long, and covered with black spines which are white at the tips. An adult emerged July 21, and proved to be the spinach flea beetle, *Disonycha xanthomelaena* Dalman. It feeds upon pigweed, beet, swiss chard and spinach, the larvae occurring on the under side of the leaves. When young the larvae feed in clusters, but separate when they are partly grown. They often drop to the ground when disturbed. At first they eat only the epidermal layer, but later eat holes through the leaves. The adult is about one-fifth of an inch long, greenish black with yellow prothorax, and hibernates as an adult. In the vicinity of Washington, D. C., there are two broods annually.

Of course it is not safe to apply poison to any foliage which is to be used for food. Therefore on swiss chard and spinach, it may be possible to spray the under surface with strong soap and water, or to brush the plants just before cultivating. The adults can be caught like the flea beetles by passing over the rows a box lined with tanglefoot.

An Outbreak of Book Lice in a House at Milford:—On August 6th, a telephone communication was received at the Station from Milford regarding some very small insects infesting a dwelling house, and from the description, the identity of the insect could not be established. Therefore the writer was sent to investigate. The insect found proved to be a species of book louse, *Atropos pulsatoria* Linn., belonging to the order Corrodentia. The individuals were numerous, being present in all parts of the house, in the cracks of the floors, on the stairs, under rugs, behind pictures, and some were also found on the furniture.

The owner of the house thought that the pest might have been brought into the house on baskets of eggs from the hen houses, which on examination were found also infested.

The injury caused by the insects was more imaginary than real; the housewife was worried because she did not know what the insects were, or how to get rid of them. The only place where they seemed to be doing any damage was on the under side of the

dining room chairs. The chair seats were made of strips glued together, and many book lice were present on the under side, together with some very fine white dust, which the members of the family declared was not there when the chairs were purchased a short time before. There is still some doubt whether the book lice were responsible or whether the wood was powder posted before or soon after being made into chairs.

The treatment advised for the control of this insect was to wash floors and woodwork with hot water and soap and to wipe over the furniture and pictures, etc. with the same. The house was again visited on December 1, and the family reported that the book lice had then all disappeared, but that they were present until the cold weather set in, and probably were not all killed by the treatment. It is probable that the insects may appear again in the spring, and if so, the house will be fumigated with hydrocyanic acid gas.—M. P. Zappe.

A Tobacco Warehouse Infested by the Cigarette Beetle:—On December 31, 1918, there was brought to the Station a handful of choice shade-grown wrapper-leaf tobacco infested with larvae and adults of the cigarette beetle, *Lasioderma serricorne* Fabr. This tobacco came from a large tobacco storehouse, where on the fourth floor several hundred bales of the 1917 crop were stored. The writer visited this storehouse on January 2nd, 1919. Some bales were rather badly infested around the edges and butts.

A local contractor had tried to kill the insects by fumigating with carbon disulphide, first by fumigating the whole room (which was a failure) and, second, by putting a dose on the top end or side of each opened bale. The second method killed some of the insects but did not penetrate sufficiently to prove effective, and those inside were alive after the treatment. Moreover, there was the disagreeable odor of the carbon disulphide discernible in several of the bales, and there was some apprehension that it might affect seriously the quality of the tobacco, which would obviously be ruined for wrapper purposes if the insects were not killed promptly. The storage room was said to contain 93,000 cubic feet.

After a general survey of the situation, I advised heat as the most practical method of treatment. A sweating room opening

out of the large storeroom was at a temperature of 96° F. at the time of my visit. Only two pipes had steam in them and ten more were available. Additional steam coils could be installed if needed to bring the temperature up to the required point.

On January 10th, I made another visit to the warehouse. The heat had been given a trial. Additional pipes were added and the temperature was raised to 148° F. The tobacco bales were placed in the room January 8th and left there over night: they were stacked flatwise with 2 x 4 inch scantling between them to allow for circulation. A thermometer placed inside one of the bales registered 130° F.

Though most of the insects had apparently been killed, there were a few still alive, and one of the owners seemed to regard the treatment as a failure. Considerable material was gathered and brought to the laboratory and examined with the following results:—

	Dead	Living
Larvae	273	7
Pupae	3	0
Adults	62	0
Total	338	7

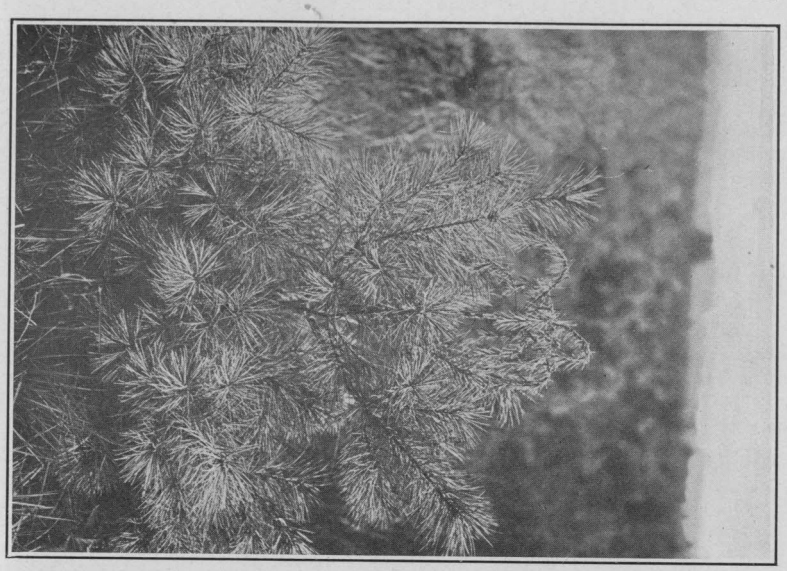
These figures show that 2.56 per cent. of the larvae, or 2.1 per cent. of all stages came through alive. In spite of the fact that some were not killed, this seemed to me by far the best possible method of treatment, and it is probable that if the temperature could have been kept for a few hours longer to allow the bales of tobacco to become thoroughly heated through, it would have killed all the insects. A communication to this effect was sent to the owners, who later were asked about the matter and replied as follows:—"Our treatment to rid ourselves of the cigarette beetle consisted in putting the entire tobacco in one of our sweatrooms and running the heat up to 130° F. At this temperature we left the tobacco in the room for five hours. A day or two later we took all of the packages out of the sweatroom and put them in a building without heat. It so happened that the days following were extremely cold. We have examined any number of the packages from time to time and have found no trace of living beetles or larvae. The bulk of the tobacco has been shipped to the various customers and we have not had a single complaint regarding it."

INDEX

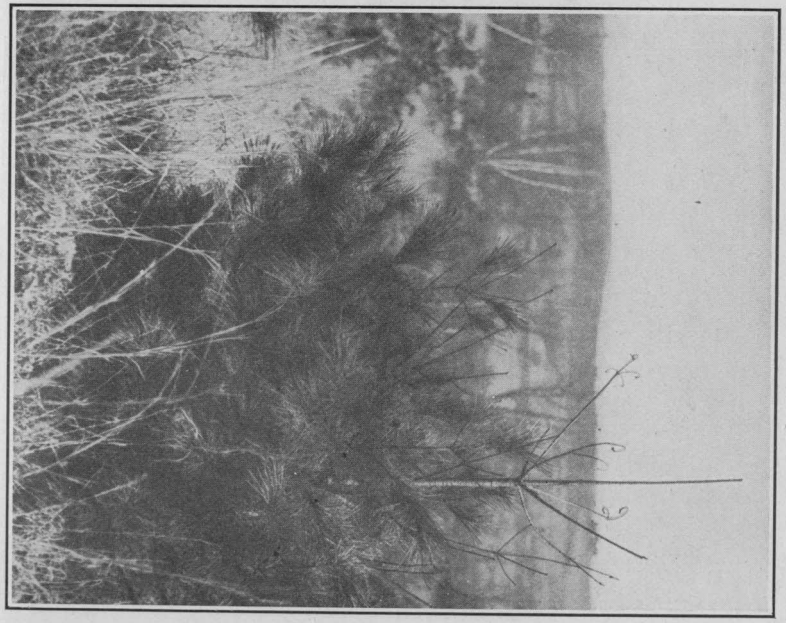
ILLUSTRATIONS.

All plates are from photographs from the following sources:—Plates IX, a, X, b, and the right half of Plate XVI, by W. O. Filley; Plate XI, a and b, by Professor Samuel J. Record; Plate XIII, c, by Harry A. Doty; left half of Plate XVI, by D. B. Pangburn; Plate XIII, b, by Harry B. Kirk; Plates XIV, b, XVIII, a, XIX, b, XX, a, by W. E. Britton; Plates XVIII, b, XXI, a, XXII, b, XXIII, a, XXIV, a, XXV, a, c and d, XXVII, a and c, XXIX, a, b and c, XXX, a and c, by K. F. Chamberlain. All others by B. H. Walden. The text figures are from drawings as follows:—Figure 16 prepared from map by Mr. Walden; figures 17 and 18 by A. B. Champlain; figure 19 by Dr. Philip Garman. Figure 20 from Bureau of Entomology, U. S. Department of Agriculture.

a. Young white pine tree with leader killed by weevil.

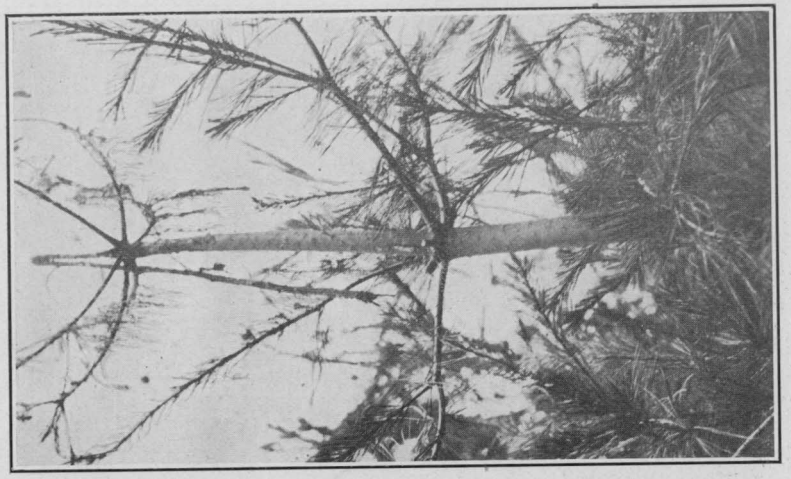


b. Young pine tree with leader and some of the lateral branches killed by weevil.

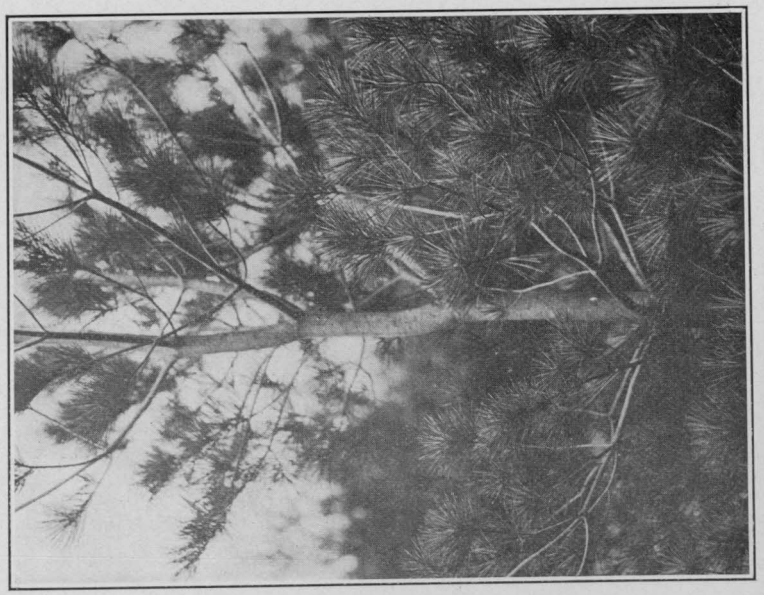


WHITE PINE WEEVIL.

PLATE X.



b. Leader killed by weevil and bark torn away by birds, to get at the grubs.



a. Result of weevil injury. This tree has lost its leader several times.

WHITE PINE WEEVIL.

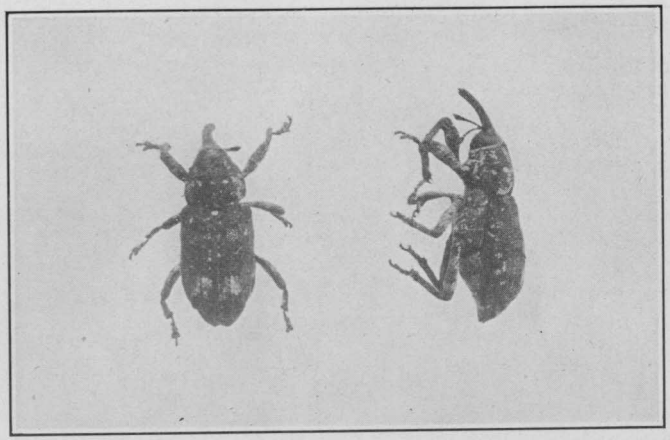
PLATE XI.

a. All laterals removed except this one, to induce a stronger growth.

b. A forked tree resulting from the loss of the leader by weevil injury.

WHITE PINE WEEVIL.

PLATE XII.

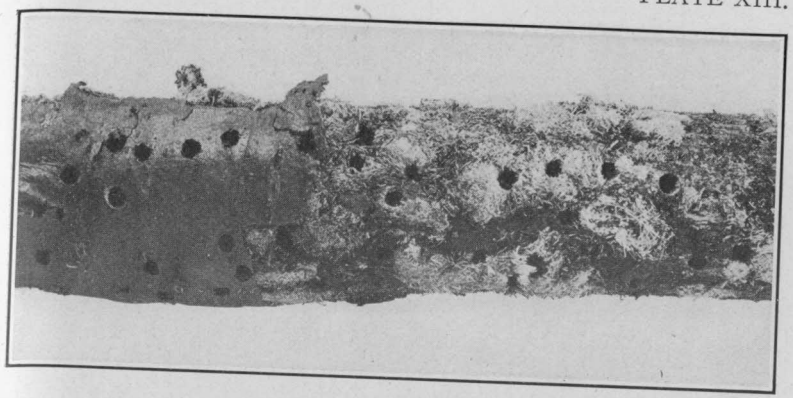


a. The white pine weevil. Adult beetles, four times enlarged.

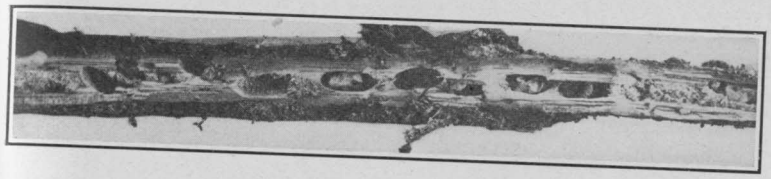
b. Weevil punctures and resin exudation from them. Natural size.

WHITE PINE WEEVIL.

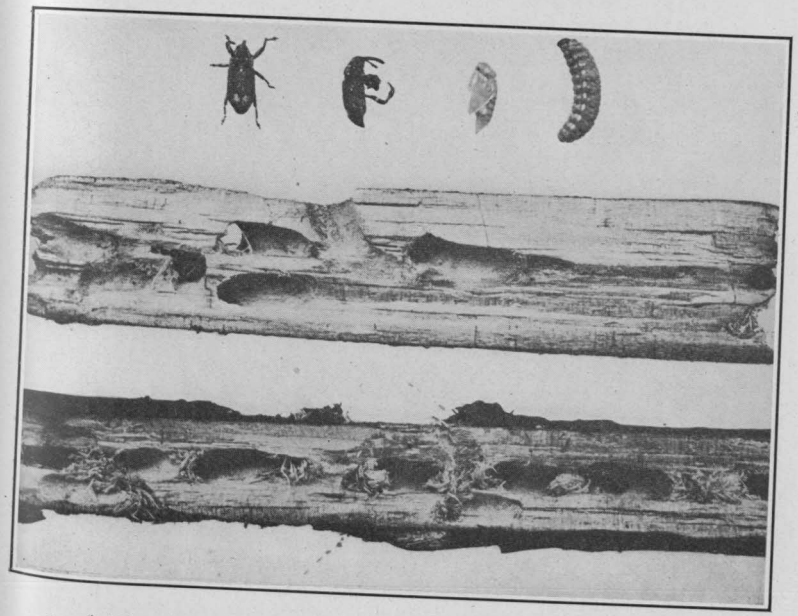
PLATE XIII.



a. Exit holes of white pine weevil. Natural size.



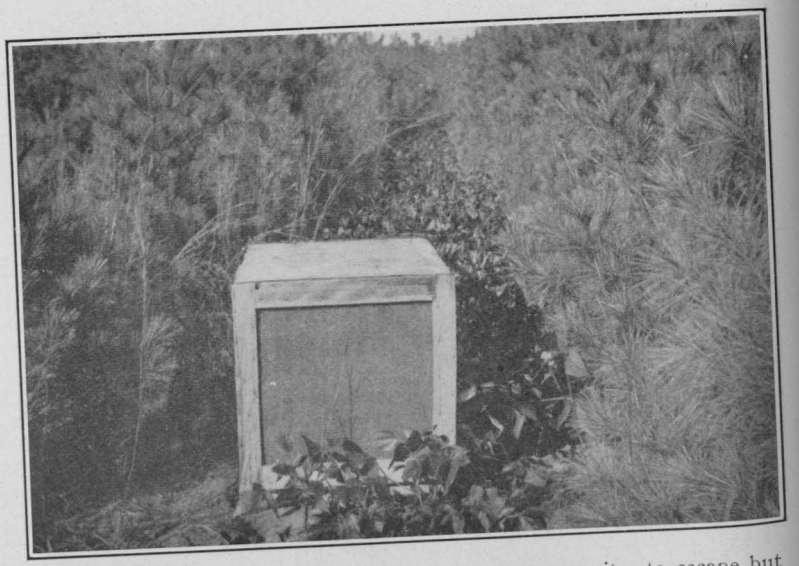
b. Larval cells in pine leader. Natural size.



c. Adults, larva, pupa and cells in pine leader. Slightly enlarged.

WHITE PINE WEEVIL.

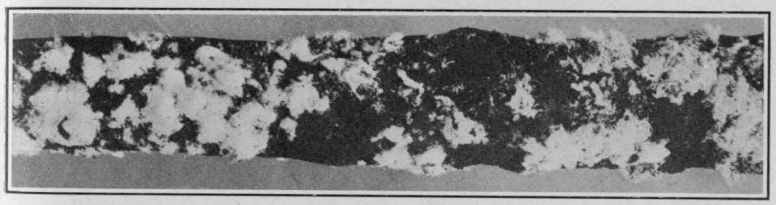
a. Method of collecting weevils in white pine plantations.



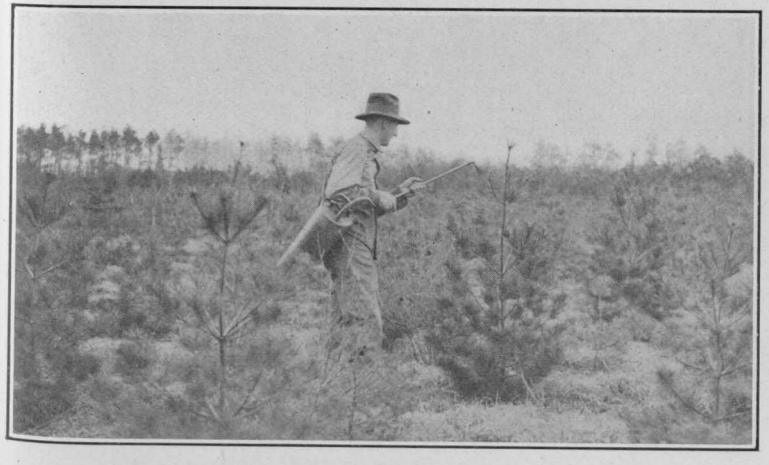
b. Box to hold cut leaders. Wire screen allows parasites to escape but weevils are imprisoned.

WHITE PINE WEEVIL.

a. The pine bark aphid in small tufts on twigs and leaves. Natural size.

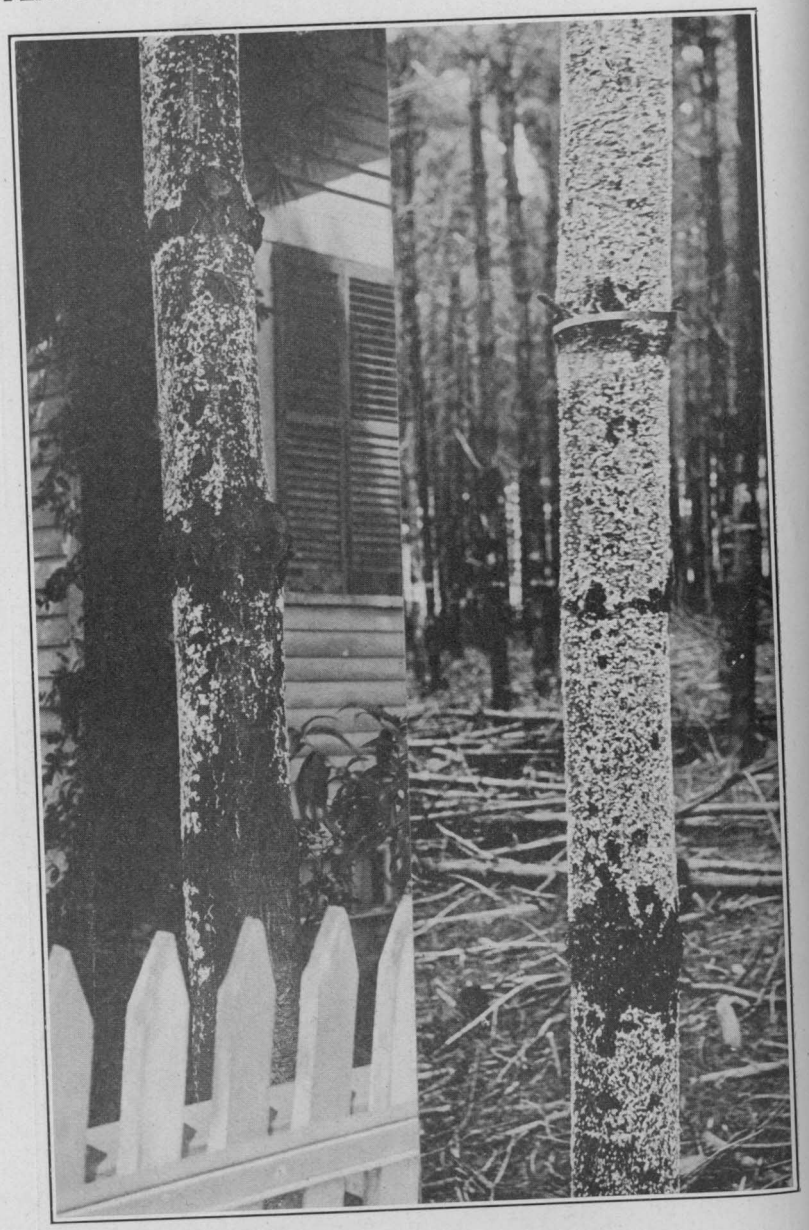


b. Pine bark aphids in larger tufts on twig. Natural size.



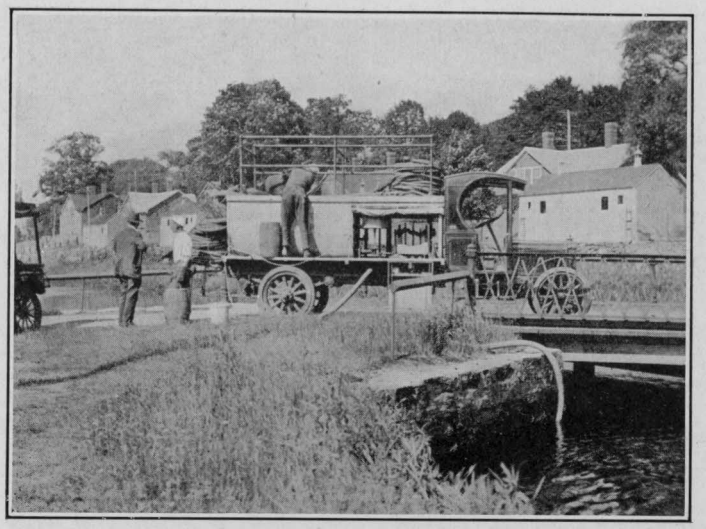
c. Method of hand spraying pine trees.

PINE BARK APHID.



The pine bark aphid on trunks of trees.

PINE BARK APHID.



a. Automobile truck power sprayer taking water from canal.

b. Spraying woodland trees with automobile truck power sprayer.

GIPSY MOTH WORK.

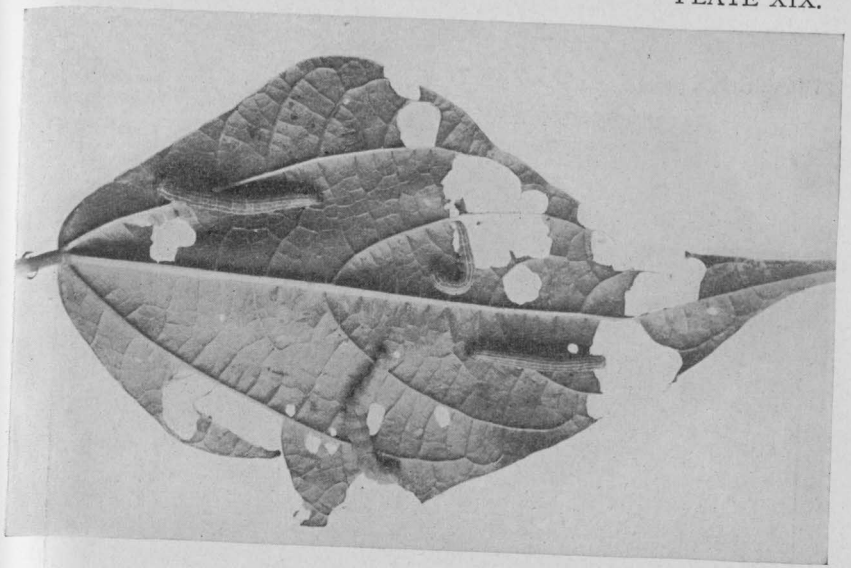
PLATE XVIII.

a. Underspraying beans with nicotine solution and soap.

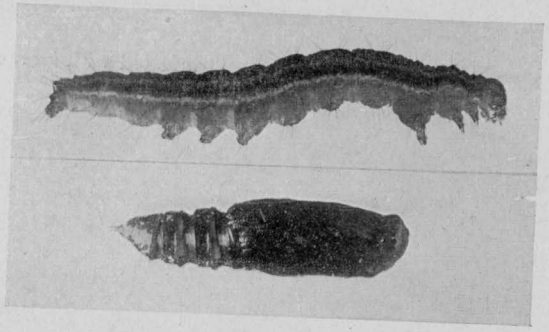
b. Patch of beans in a garden showing injury by the caterpillars.

GREEN CLOVER WORM.

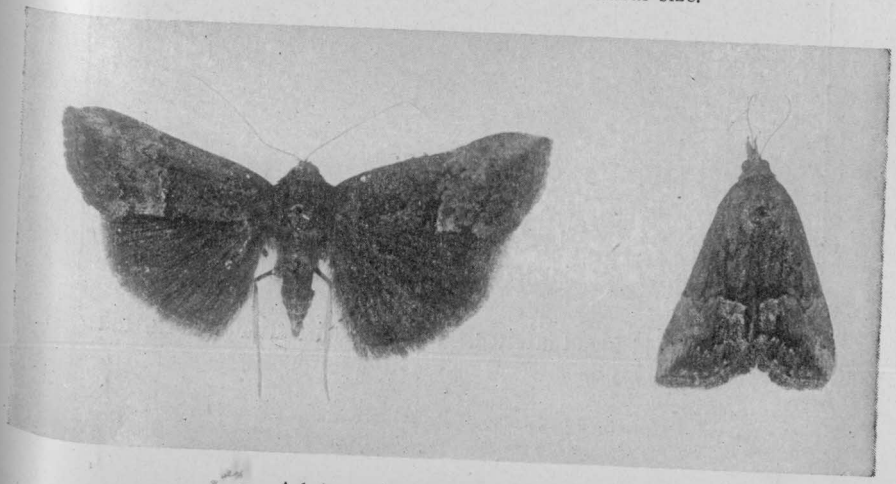
PLATE XIX.



a. Larvae feeding upon bean. Natural size.



b. Larva and pupa. More than twice natural size.



c. Adult moths. Twice natural size.

GREEN CLOVER WORM.

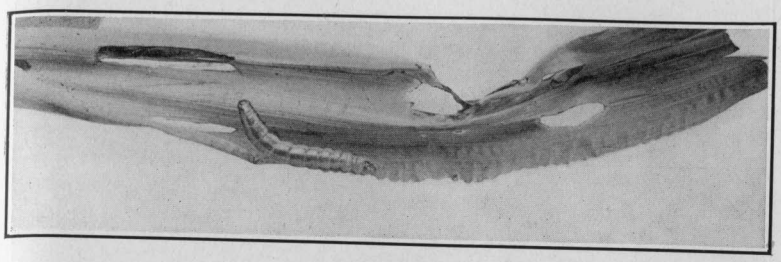
PLATE XX.

a. Cornfield in Milford, first found infested with larvae.

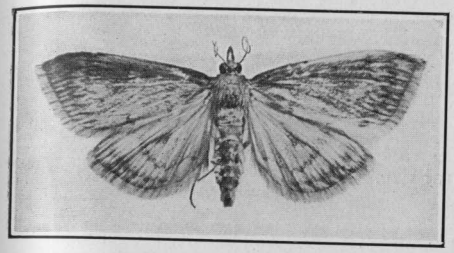
b. Second field found infested. This is a short distance north and across the street from the field shown above.

A NATIVE CORN BORER, PYRAUSTA AINSLIEI.

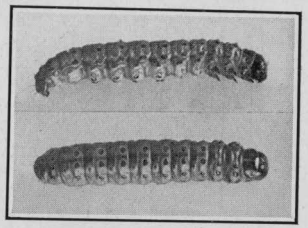
PLATE XXI.



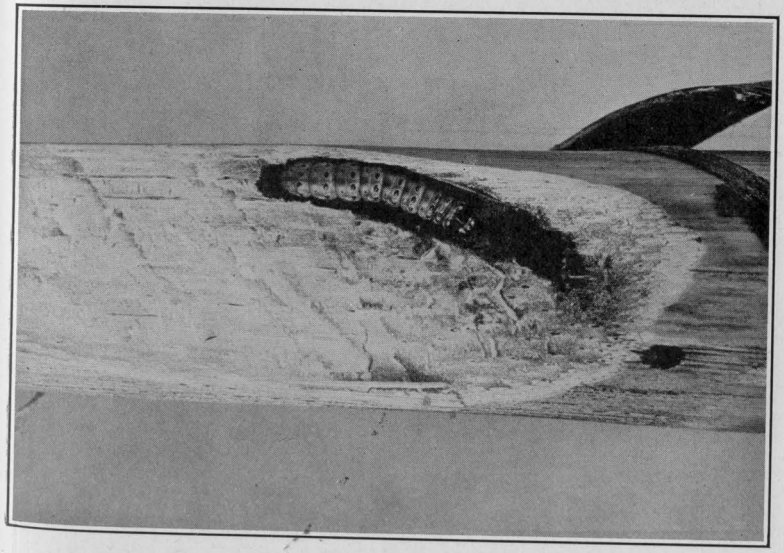
a. The lined corn borer, *Hadena fractilinea*. Larva, natural size.



b. *Pyrausta ainsliei* Hein. Adult twice enlarged.

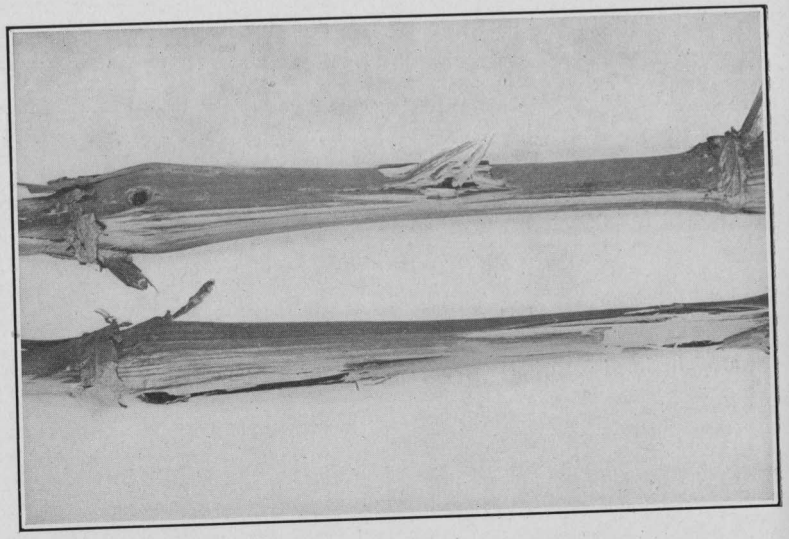


c. *Pyrausta ainsliei*, lateral and dorsal view of larva. Twice enlarged.

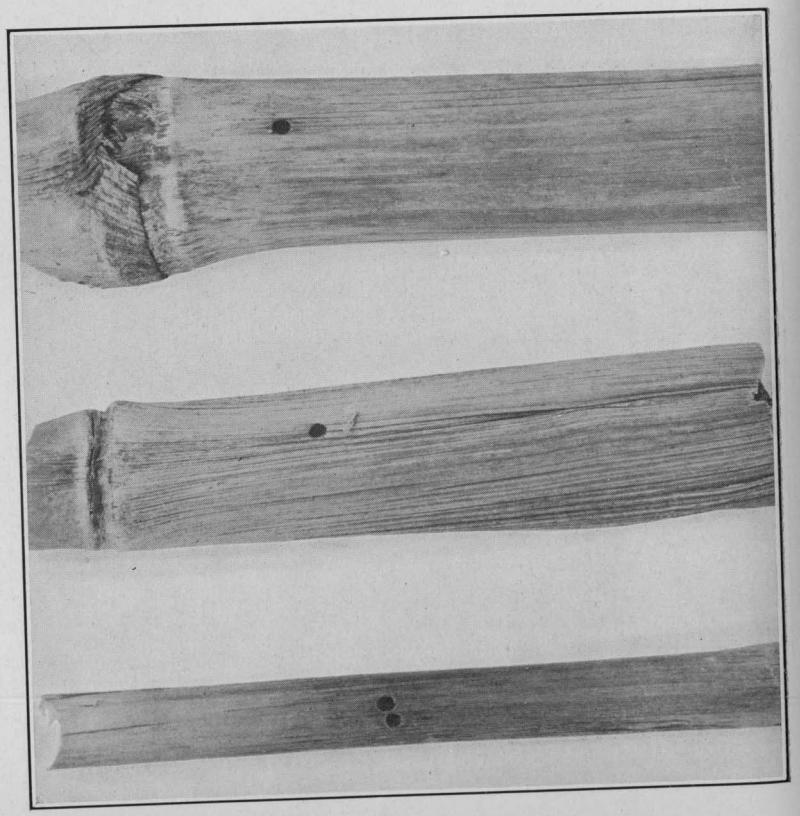


d. Larva of *Pyrausta ainsliei* in burrow in cornstalk. Twice enlarged.

THE LINED CORN BORER, HADENA FRACTILINEA.
A NATIVE CORN BORER, PYRAUSTA AINSLIEI.

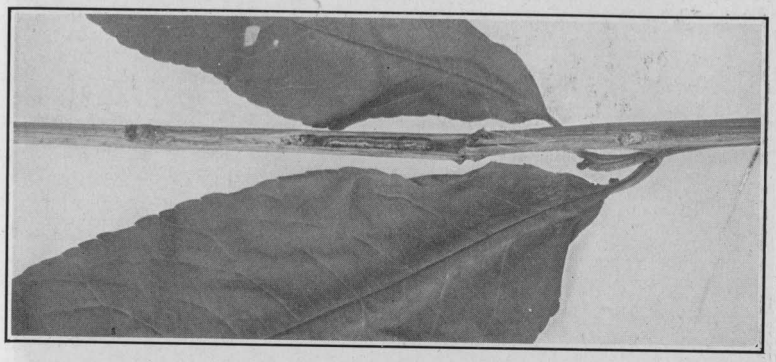


a. Burrows in smartweed, torn open by birds to get at the larvae. Natural size.

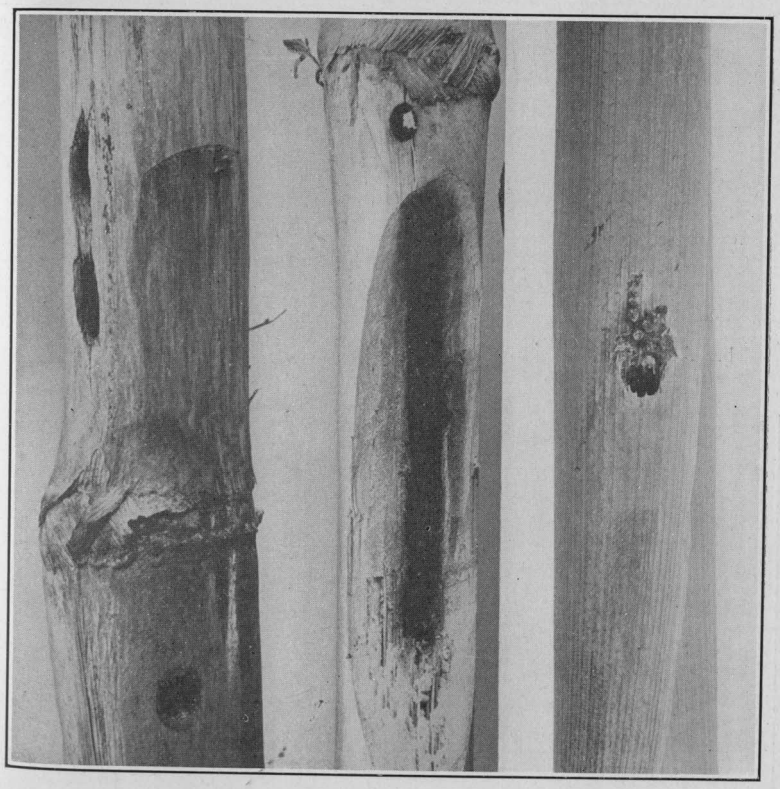


b. Entrance holes in corn stalks. Natural size.

A NATIVE CORN BORER, PYRAUSTA AINSLIEI.

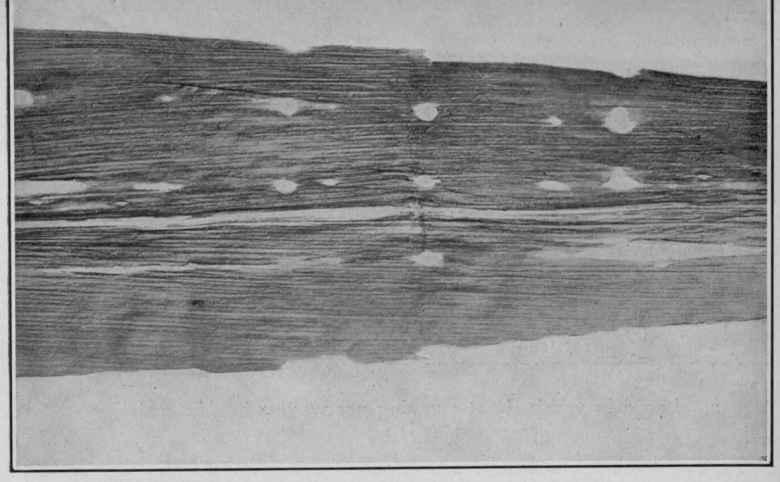


a. Larva in peach shoot growing near ground. Natural size.

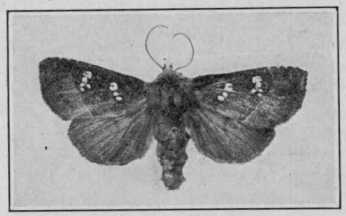


b. Burrows in corn stalks. Natural size.

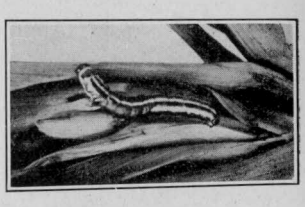
THE STALK BORER.



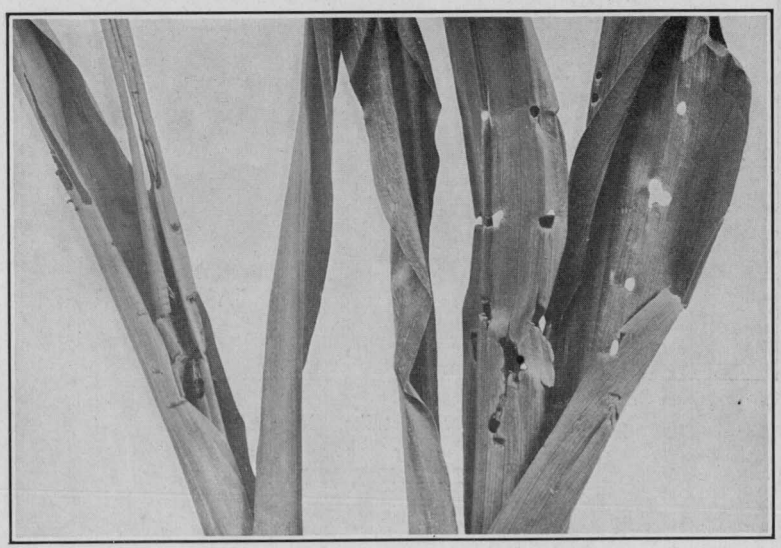
a. Characteristic injury near tip of blade. Holes eaten by larva before leaf unrolled. Natural size.



b. Adult of stalk borer. Natural size.

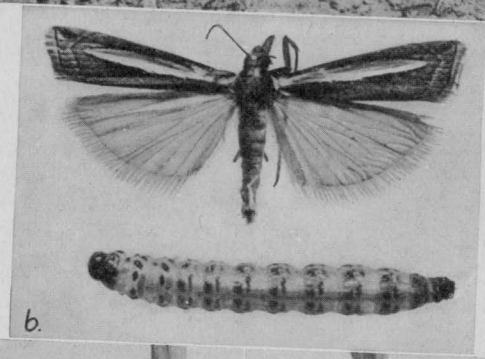


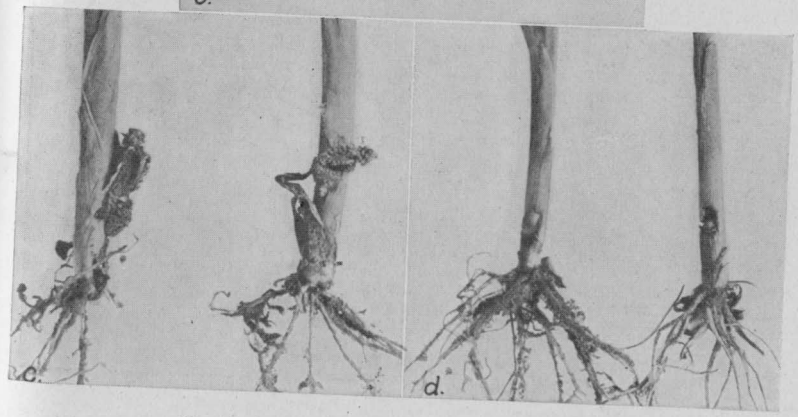
c. Immature stalk borer in corn. Natural size.



d. Characteristic form of injury caused by the young larvae feeding on the unrolled leaves at the whorl. Reduced.

THE STALK BORER.

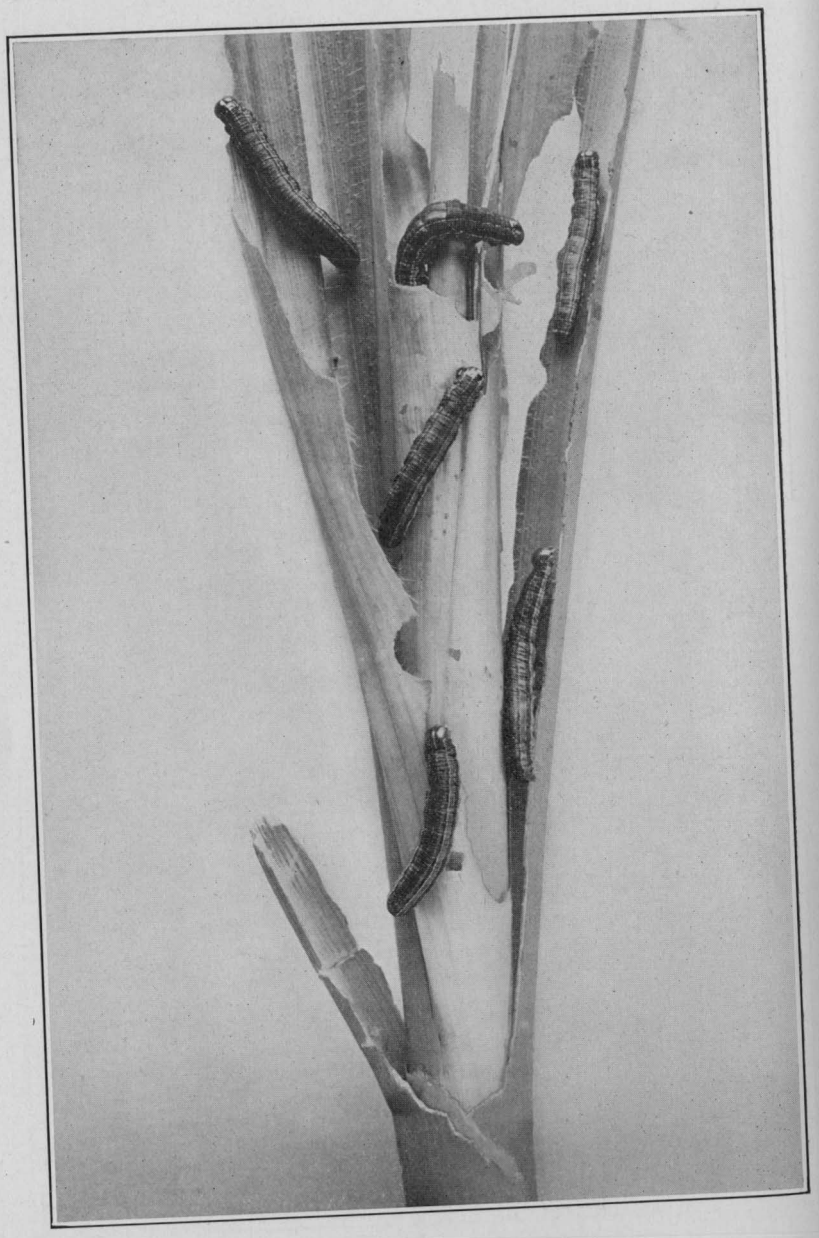




a. Cornfield ruined by the attacks of the larvae.
b. Larva and adult. Four times enlarged.
c. Larval cases on base of stalks. Reduced.
d. Injury to stalks, cases removed. Reduced.

CRAMBUS PRAEFECTELLUS.

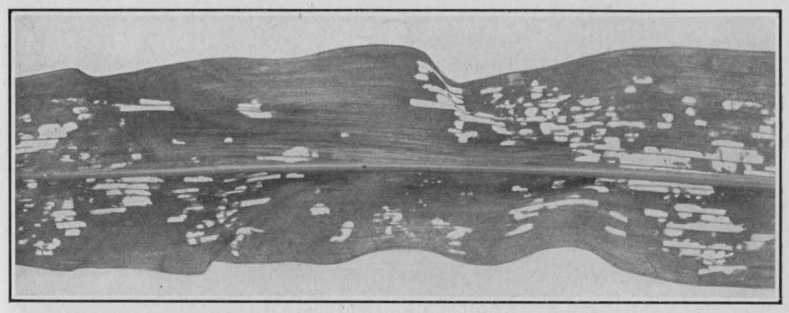
PLATE XXVI.



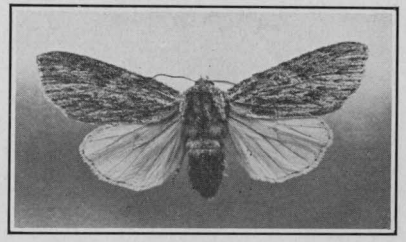
Larvae feeding on corn. Natural size.

THE ARMY WORM.

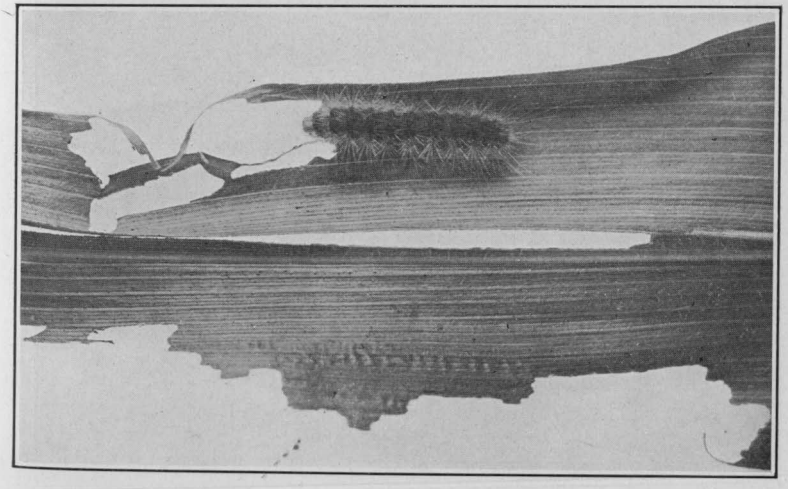
PLATE XXVII.



a. Work of young larvae on corn blade. Much reduced.



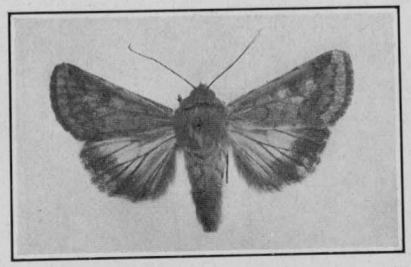
b. Adult moth. Natural size.



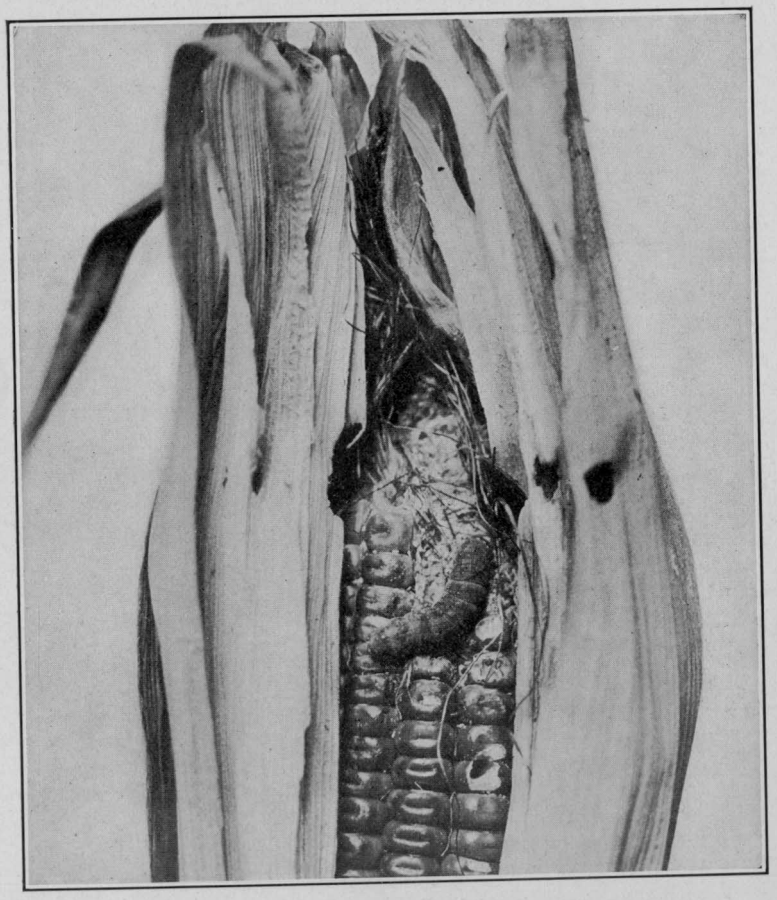
c. Partially grown larva feeding upon corn leaf. Natural size.

THE SMEARED DAGGER MOTH.

PLATE XXVIII.



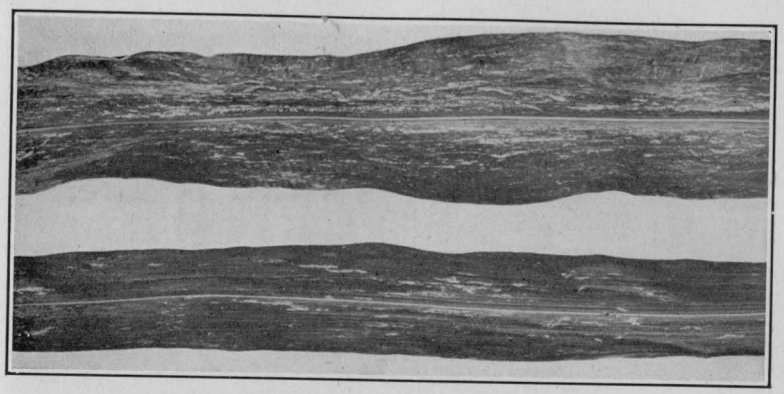
a. Adult moth. Natural size.



b. Larva feeding at tip of ear of corn. Natural size.

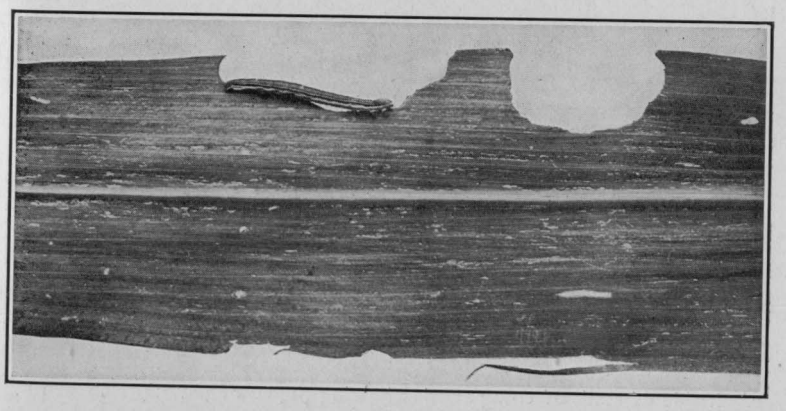
CORN EAR WORM.

PLATE XXIX.



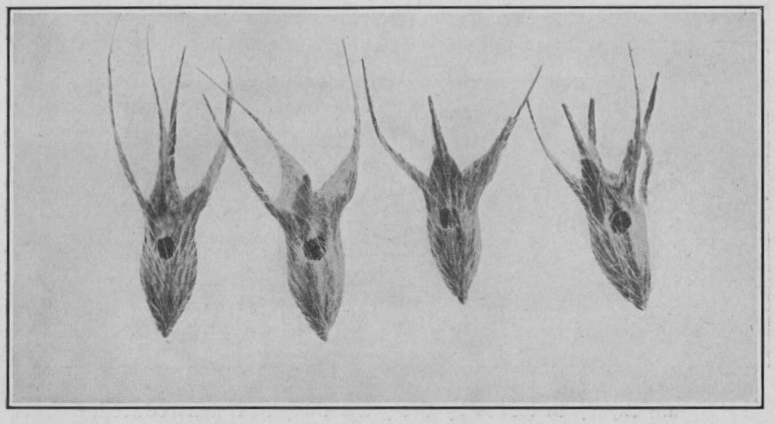
a. Injury to leaves by the grass thrips. Much reduced.

b. Injury by wire worms. Natural size.

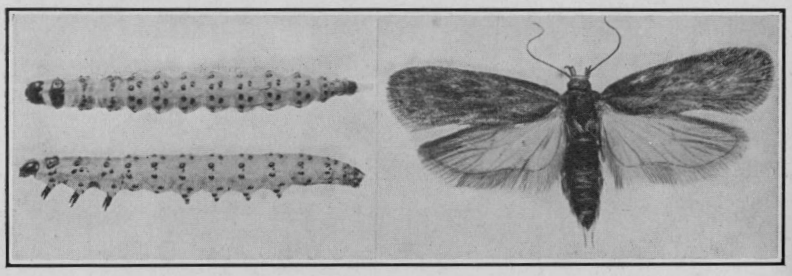


c. A slender green larva feeding upon corn. Unidentified. Natural size.

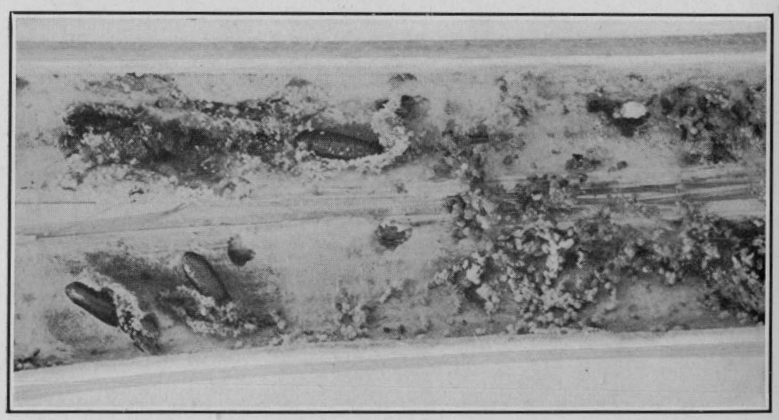
CORN INSECTS.



a. Clover seeds showing exit holes of the clover seed chalcid. Four times enlarged.

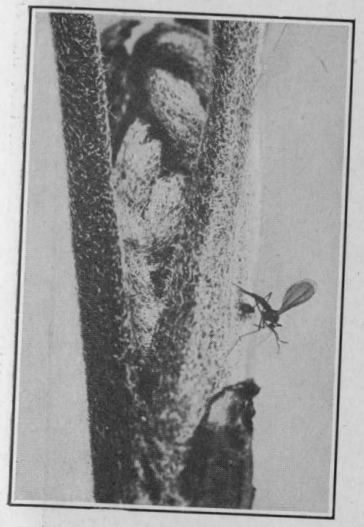


b. Lateral and dorsal view of larva, and adult of parsnip web worm. Twice natural size.

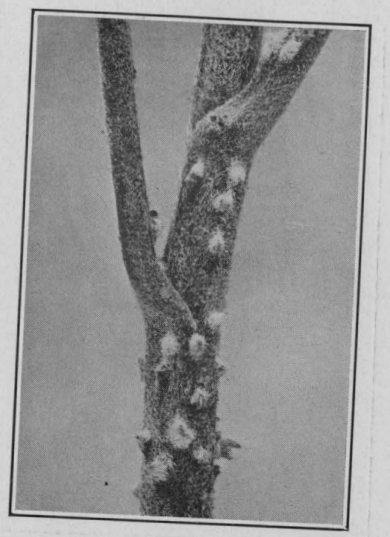


c. Inside of stalk of cow parsnip showing pupae of parsnip web worm. Natural size.

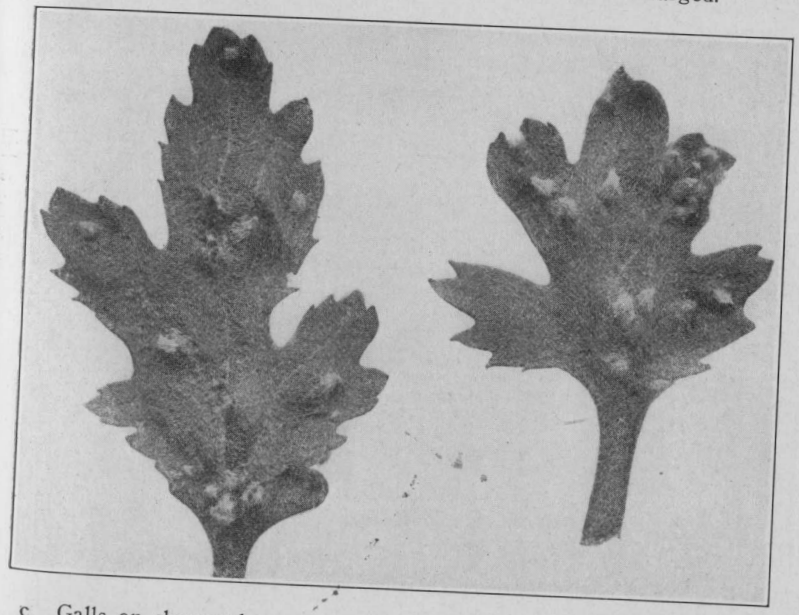
CLOVER SEED CHALCID AND PARSNIP WEB WORM.



a. Adult fly laying eggs. Three times enlarged.



b. Galls on new shoot. Twice enlarged.



c. Galls on chrysanthemum leaves caused by the chrysanthemum gall midge. Twice natural size.

CHRYSANTHEMUM GALL MIDGE.

PLATE XXXII.

b. Characteristic work of the pine tube builder. Twice enlarged.

a. Gladiolus plant overcome by gladiolus aphid. Natural size.

PINE TUBE BUILDER AND GLADIOLUS APHID.

Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

BULLETIN 219 DECEMBER, 1919

BEING THE

Twenty-Fourth Report

ON

Food Products

AND

Twelfth Report on Drug Products.

PART I.

By E. M. BAILEY.

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CONTENTS.

FOODS.

DRUGS.

The Twenty-fourth Report on Food Products and the Twelfth Report on Drug Products, 1919.

PART I.

BY E M. BAILEY.

The work here discussed and summarized comprises the results of food and drug inspection during the past year. Practically all of this work is called for by statute requirement. In addition, however, it is our aim and purpose to do, each year, something of an investigative nature which shall be of interest and value and which is outside of the immediate field of police duty. In harmony with this idea considerable attention has been given during the past year to a resurvey of the diabetic food market and approximately one hundred diabetic preparations have been examined. These are chiefly commercial products, but include also several types of preparations of direct interest and application in the treatment of diabetic patients. The results of this investigation will be published later as Part II of this report.

Of chief interest in control work has been the inspection of ice cream carried on under the act pertaining to the manufacture and sale of ice cream which was passed by the last Legislature.

At the Farmers' Week Fair held in Hartford in January 1919 the food work done by this Station was represented by an exhibit made by this laboratory.

The chemist in charge has been called upon during the year for attendance at legislative and other hearings in connection with proposed food laws on the administration of those now in force; he has continued to act as expert on diabetic foods for the American Medical Association, also as A. O. A. C. referee on tea; and, by appointment of the Governor dated August 4th, 1919, as a state chemist.

The resignation of Mr. Street, formerly chemist in charge, and of Messrs. Morison and D'Esopo will be duly noted in the annual report of this Station. To them and to the remaining members of the staff acknowledgment is made of their contributions to the work herein reported.

I. FOODS.

ICE CREAM.

Legislation. Chapter 260 of the Public Acts of 1919 concerning the manufacture and sale of ice cream fixes the standard for milk fat in plain ice cream at not less than eight per cent.; and in fruit and nut ice creams at not less than six per cent. The act prohibits in the manufacture of this product the use of boric acid, salicylic acid, formaldehyde, saccharin or any substance deleterious to health, or any coloring matters deleterious to health; but the use of harmless colors permitted to be used in foods, and harmless imitation flavors is allowed, provided that the presence of the same is declared.

Preliminary Inspection. A preliminary survey of the State was made by the Dairy and Food Commissioner and four hundred and sixty-nine samples were collected from forty-five towns. Two hundred and forty-eight samples were examined in this laboratory and the remainder of the tests were made by inspectors of the Dairy and Food Department who hold licenses to test milk and cream, and who used methods approved by this laboratory.

Of the total number of samples examined one hundred and seventy-three or 36.9 per cent. were found to be below the required standard for ice creams of their respective types.

On the basis of these results the Commissioner held hearings in those cases where deficiencies were found, to call attention to the law now provided, and to suggest, if necessary, ways and methods for meeting its requirements.

It was found that, as might be expected, the larger manufacturers were well informed as to the fat content of the ingredients entering into the mix, but, in the majority of cases, smaller dealers were ignorant both of the fat content of the ingredients composing the mix and of that of the finished product.

The point was also raised that the fat content in ice cream dispensed in bulk from one, three or five gallon cans would show a variable composition according to whether the sample was taken from the top, middle or bottom of the container.

It can readily be understood that ice cream which has softened or "weakened" will lose uniformity of composition. The extensive study of ice cream making carried on at the Vermont Station[1] has shown the possibilities in this direction. It appeared however that the product held for a week in a thoroughly frozen condition showed no difference in fat content in portions taken from the top, middle and bottom zones.

Uniformity of fat distribution in bulk ice cream. Several of the larger ice cream manufacturers in New Haven cooperated by supplying us with ice cream as it would be delivered to the consumer or retailer, in gallon and two and a half gallon lots.

When received the containers were warmed just enough to permit the cream to be removed from the can in a solid mass, and cross sections were taken from the top, middle and bottom zones. The several portions were melted at room temperature, well mixed and tested for fat by the Babcock method as modified by Grigsby.[2]

A. This was a one gallon can of chocolate ice cream thoroughly frozen when received. The tests on the several portions were as follows:

Top	9.1%
Middle	9.1%
Bottom	9.2%

B1. This was a two and one half gallon sample of vanilla cream in a hard condition when received and tested.

B2. This was a two and one half gallon sample of vanilla cream held over night in the container as delivered before tests were made. The cream had softened to such an extent that it could not be removed from the can intact; the middle portion was hard but the top and bottom portions were considerably softened. Tests on the two samples were as follows:

	B1	B2
Top	9.9%	9.6%
Middle	9.6%	9.3%
Bottom	9.4%	9.4%

The results on sample B2 show greater uniformity than would be predicted with the mechanical condition of the sample in mind. The explanation is that the product is homogenized, or

[1] Vermont Agr. Exp. Sta., Bull. 155 (1910).
[2] Jour. A. O. A. C., 2, 4, p. 242.

made from homogenized materials, and therefore the stratification of fat is very markedly prevented.

C. This was a one gallon can of vanilla cream. The non-uniformity of the product was apparent as soon as it was removed from the container. Melting the sample representing the top portion at room temperature, a frothy liquid resulted which separated a creamy layer on standing and which it was very difficult to effectively mix either by stirring or pouring. After considerable manipulation a mixture was obtained which was reasonably uniform. The middle and bottom portions were not so troublesome but were sampled with difficulty. The results obtained on the three portions were as follows:

Top	15.2%
Middle	11.5%
Bottom	12.4%

The results show what was quite evident in the beginning, viz., that the product was very ununiform as regards fat distribution. They cannot be accepted as proving that only homogenized products will show uniformity because sample A was not homogenized; but it is no doubt true that homogenized products will remain uniform longer than unhomogenized products. This sample was quite different from any met with either in the preliminary survey or the official inspection, which included twenty or more samples from this same source.

Altogether the results indicate that there is but little variation in fat distribution in ice cream kept in a thoroughly frozen condition. Uneven distribution of fat will result if the cream becomes "weakened," i. e. soft; but this is much less pronounced in homogenized products.

In taking the official samples under the ice cream law the mechanical condition of the cream, i. e. hard, soft, partially melted, etc., should be noted as well as the relative position in the container, i. e. top, middle or bottom, from which the sample was drawn.

Methods of testing ice cream. In testing ice cream the preparation of the sample is of the greatest importance. Samples which had liquified and which had been held for several days gave unsatisfactory tests which were attributed to difficulties in sampling. Creams delivered in a fresh, frozen condition, with

no opportunity to churn were found to yield uniformly satisfactory results. If the cream has separated fat by churning or otherwise, gentle heat must be applied to melt the fat and it must then be evenly mixed by pouring or stirring.

The Roese-Gottlieb method for the determination of fat is regarded as the standard method for such products as condensed milk, ice cream and other milk products, but for rapid work of routine inspection some of the modified Babcock methods are necessarily employed. Besides the Grigsby method already mentioned we have used one described by Lichtenberg[1] with generally satisfactory results. When, occasionally, we have found disagreement in results we have used the Roese-Gottlieb procedure as the deciding test. A few unexplained disagreements have occurred but in case of fresh, well frozen creams, tested promptly, we have found good agreement between the three above mentioned methods.

Official Inspection. Eighty-two samples were collected by agents of the Dairy and Food Commissioner's Department. Arranged on the basis of milk fat content the samples may be classified as follows:

	Samples.	Per cent.
Fat 8 to 9 per cent.	15	18.3
9 to 10 per cent.	10	12.2
10 to 12 per cent.	26	31.7
12 to 14 per cent.	15	18.3
14 to 20 per cent.	13	15.8
below 8 per cent.	3	3.7

The samples showing fat deficiencies were as follows: **16025** Chocolate, Joe Crudo, So. Norwalk, 4.16 per cent.; **15988** Vanilla, Geo. Costeine, Bridgeport, 4.56 per cent.; **15987** Chocolate, Wm. H. Whitney, Bridgeport, 5.70 per cent.

Of eighteen samples sent by individuals only one was found below 8 per cent. of fat.

BAKING POWDER.

The following definition and standard for baking powder has been adopted:

Baking powder is the leavening agent produced by the mixing of an acid reacting material and sodium bicarbonate, with or without starch or flour.

[1] Jour. Ind. Eng. Chem., 5, 9, p. 786 (1913).

TABLE I.—ANALYSES OF

No.	Brand and Manufacturer.	Dealer.
		BRIDGEPORT:
11487	Howco; made for Howland's, Bridgeport	Howlands
11481	Gold Seal; New York Baking Powder Co., New York City	Logan Bros Co.
11486	Cleveland's Superior; Cleveland Baking Powder Co., New York City	Mohican Co.
11482	Purity; Boston Baking Powder Co., Boston, Mass.	Public Market
		HARTFORD:
11472	Imperial; Manhattan Baking Powder Co., New York City	Brown Thompson & Co.
11474	Princine; Southern Manufacturing Co., Richmond, Va.	Hartford Market Co.
11492	Purity; made for the Hartford Market Co., Hartford	Hartford Market Co.
		NEW HAVEN:
11462	Red Front; The Great Atlantic & Pacific Tea Co., Jersey City, N. J.	Atlantic & Pacific Tea Co.
11458	Reliable; made for Chas. S. Bernstein, New Haven	C. S. Bernstein
11468	Ryzon; General Chemical Co., New York	M. C. Dingwall
11457	Benefit, Direct Importing Co., Boston	Direct Importing Co.
11246	Davis O. K.; R. B. Davis Co., Hoboken, N. J.	Logan Co.
11499	Our Own; Loveday's, New Haven	Loveday's Tea Store
11244	Rumford; Rumford Chemical Works, Providence, R. I.	Mohican Co.
11242	Van Dyke Pure; Jas. Van Dyke Co., 50 Barclay St., New York City	Van Dyke Co.
11249	Snow Ball; W. A. Higgins, New York	D. M. Welch & Son
		NEW LONDON:
11488	Grand Union; Grand Union Tea Co., Brooklyn, N. Y.	Grand Union Tea Co.
		NORWICH:
11491	Disco; made for Disco Bros., Norwich	Disco Bros.
11490	Mohican Cream of Tartar; The Mohican Co., New York City	Mohican Co.

BAKING POWDER.

No.	Ingredients Claimed.	Net Weight.		Available carbon dioxide.
		Claimed.	Found.	
		oz.	oz.	%
11487	Acid phosphate of calcium, bicarbonate of soda and corn starch	16.0	16.0	14.61
11481	Acid phosphate of calcium, bicarbonate of soda, carbonate of magnesia and corn starch	4.0	3.9	5.45
11486	Cream of tartar, bicarbonate of soda, tartaric acid (the acid of grapes) and corn starch	8.0	7.9	10.39
11482	Bicarbonate of soda, phosphate of calcium, calcined sulphate of alumina and corn starch	8.0	8.6	11.31
11472	Acid phosphate of calcium, bicarbonate of soda, sodium aluminum sulphate and corn starch	8.0	8.5	11.65
11474	Granular bicarbonate of soda, refined granular phosphate and refined and redried corn starch	8.0	8.7	12.41
11492	Acid phosphate of calcium, sodium aluminum sulphate, bicarbonate of soda and corn starch	8.0	7.8	8.79
11462	Acid phosphate, bicarbonate of soda and corn starch	8.0	8.5	12.06
11458	Acid phosphate of calcium, bicarbonate of soda, sodium aluminum sulphate and corn starch	16.0	17.0	13.66
11468	Monosodium phosphate, sodium bicarbonate and starch	4.0	4.6	9.50
11457	Bicarbonate of soda, carbonate of magnesia, acid phosphate of calcium and best refined corn starch	4.0	4.1	8.65
11246	Acid phosphate, bicarbonate of soda, sodium aluminum sulphate and corn starch	6.0	6.1	11.94
11499	Acid phosphate of calcium, bicarbonate of soda, sodium aluminum sulphate and corn starch	16.0	15.7	9.52
11244	Phosphate, bicarbonate of soda and starch	8.0	8.5	12.52
11242	Phosphates of soda and lime, bicarbonate of soda and corn starch	8.0	8.1	10.20
11249	Sodic aluminic sulphate, phosphate of calcium, bicarbonate of soda and corn starch	8.0	7.9	12.31
11488	Mono-calcium phosphate, basic aluminum sulphate, bicarbonate of soda, corn starch	16.0	15.7	13.07
11491	Acid phosphate of calcium, bicarbonate of soda, sodium aluminum sulphate and corn starch	16.0	15.9	14.32
11490	Cream of tartar, tartaric acid (the acid of grapes), bicarbonate of soda and corn starch	8.0	8.0	11.02

It yields not less than twelve per cent. (12%) of available carbon dioxide.

The acid reacting materials in baking powder are: (1) tartaric acid or its acid salts, (2) acid salts of phosphoric acid, (3) compounds of aluminum, or (4) any combination in substantial proportions of the foregoing.

Announcement of the amounts of calcium sulphate and salts of phosphoric acid which react in baking powder, and of the limits for impurities (arsenic, lead, zinc and fluorides) is reserved pending further investigation.[1]

The modern baking powder is an elaboration of the sour milk—saleratus combination used in the earlier days for "raising" biscuits, bread or cake. Sour milk has been replaced by more convenient materials such as cream of tartar, acid phosphates or alums, while the saleratus (bicarbonate of soda) remains.

The leavening power of baking powder is due to the evolution of carbon dioxide gas which results from the action of the acidic element of the powder upon the bicarbonate. This action does not take place except in the presence of moisture. It follows then that baking powders tend to depreciate in leavening capacity because it is difficult to protect them completely from atmospheric moisture. It is to protect them so far as possible from deterioration from this source that starch, flour or other moisture-absorbing material is generally found as a third ingredient of commercial baking powders.

Low available carbon dioxide content may be the result of faulty preparation of the powder originally, but is more likely due to subsequent deterioration occasioned by long storage or storage under unfavorable conditions. Moisture, once having gained access to a preparation, causes it to decompose rapidly.

Nineteen brands have been examined in the past year and the results appear in Table 1.

Eleven samples contained less than 12 per cent. of available carbon dioxide; in seven of these the deficiency exceeded 10 per cent. of the standard.

Excessive amounts of arsenic have been cited in food products by British and other food journals during the past year. These have been attributed to impurities in the baking powder ingredients resulting from the pressure of greatly increased production of chemicals during the war period.

[1] Food Inspection Decision 174.

We have not found arsenic in excess in any baking powder examined, none of them containing more than one part per million of this impurity.

GELATIN.

The standard for edible gelatin is as follows:

Gelatin (edible gelatin) is the purified, dried, inodorous product of the hydrolysis, by treatment with boiling water, of certain tissues, as skin, ligaments and bones, from sound animals, and contains not more than two (2) per cent. of ash and not less than fifteen per cent. of nitrogen.

In addition to these requirements good gelatin should be clear in water solution; it should show appreciable jelly strength in 2 per cent. solution; it will not show ordinarily more than 1 part of arsenic in 700,000; and the fat and keratin content should not greatly exceed 0.08 per cent. each. Last-run gelatins have been found to average 0.39 per cent. fat and 0.30 per cent. keratin while first-run glues average 1.00 per cent. fat and 0.69 per cent. keratin.[1]

Gelatin is not a tissue builder but it is of indirect value in the diet on account of its protein-sparing power which is greater than that of carbohydrates.

Gelatin is sold as such for domestic jelly making; and it is largely used in commercial jelly powders and as a stabilizer in ice cream.

The method[1] used for the determination of fat and keratin is as follows:

Digest a 10 gram sample for three or four hours in a mixture of 100 cc. of water and 10 cc. of conc. HCl, cool, introduce into a separatory funnel and extract with 50 cc. of ether. The substance insoluble in dilute acid and in ether (so-called keratin) will separate completely from the acid solution, and will collect as an apparent emulsion in, or below, the ether layer. Discard the clear acid solution. Filter the ether through a dried and weighed filter paper, into a weighed beaker. Wash the residue in the separatory with ether and filter into the same tared beaker. Evaporate the ether and dry the beaker for one hour in a water oven. Weigh the fat.

Wash the "keratin" from the separatory funnel with HCl of about 2%

[1] Information furnished by A. F. Seeker, Chief, New York Station, U. S. Bureau of Chemistry.

TABLE II.—ANALYSES OF GELATIN.

Station No.	Brand and Manufacturer.	Net weight of package.	Price of package.	Price per oz.	Water.	Ash.	Nitrogen.	Gelatin (N. x 5.55)	Fat.	Keratin.	Undetermined.	Gelatinizing power, 2% solution at 10° C.	Arsenic, parts per million.	Copper.	Appearance and odor of hot water solution.
		ozs.	cts.	cts.	%	%	%	%	%	%	%				
11477	Baker's. Baker & Co., Washington, D. C.	1.25	10	8.0	14.54	1.66	15.12	83.91	0.08	0.05	+0.19	positive	2—	trace	Slightly cloudy; faint odor.
11455	Benefit. Direct Importing Co., Boston, Mass.	1.32	9	6.8	14.44	0.71	15.38	85.36	0.06	0.04	+0.57	positive	1	trace	Slightly cloudy; faint odor.
11454	Cooper's. Peter Cooper's Gelatin, Gowanda, N. Y.	1.53	15	9.8	15.15	1.55	15.02	83.36	0.09	0.05	+0.15	positive	1	trace	Slightly cloudy; faint odor.
11459	Crystal. Crystal Gelatine Co., Boston, Mass.	1.08	13	12.0	16.25	1.17	15.08	83.69	0.12	0.05	+1.23	positive	1	trace	Slightly cloudy; faint odor.
11460	Grandmother's. The Great Atlantic & Pacific Tea Co., Jersey City, N. J.	1.52	10	6.6	14.85	1.31	15.24	84.58	0.22	0.06	+0.96	positive	1	trace	Slightly cloudy; faint odor.
11471	[1]Knox. Chas. B. Knox Co., Johnstown, N. Y.	1.44	20	13.8	15.03	1.58	15.06	83.58	0.05	0.04	+0.24	positive	2—	trace	Clear; faint odor.
11456	[1]Minute. Minute Tapioca Co., Orange, Mass.	1.22	10	8.2	15.42	0.96	15.24	84.58	0.06	0.04	+1.02	positive	1	trace	Slightly cloudy; faint odor.
11461	Plymouth Rock. Plymouth Rock Gelatine Co., Boston, Mass.	1.14	15	13.1	15.32	0.67	15.40	85.47	0.07	0.03	+1.53	positive	1	trace	Clear; faint odor.
11470	[2]Swampscott. Swampscott Gelatine Co., Boston, Mass.	1.06	15	14.1	15.37	1.47	15.04	83.47	0.19	0.07	+0.50	positive	2+	trace	Cloudy; faint odor.
11476	[2]Williams	1.69	10	5.9	13.75	2.15	15.08	83.69	0.16	0.09	—0.25	positive	2—	trace	Cloudy; faint odor.

[1] Color accompanying package was a harmless lichen color.
[2] Color accompanying package was a permitted coal tar color, amaranth.

strength, running the washings through the weighed filter. Wash the filter thoroughly with the dilute HCl and dry to constant weight in a water oven.

The results of analyses of ten samples of commercial gelatins examined in the past year are given in Table II.

The analyses show that all samples satisfy the standard requirements as regards nitrogen and ash with the exception of **11476** which exceeds the ash limit by 0.15 per cent. The gelatins in hot water solution were generally not entirely clear; they also possessed a faint odor but it was not in any case offensive. Neither arsenic nor copper were found in objectionable quantities. Judging by the fat and keratin figures, most of the samples may be regarded as first grade products; none can be classed as distinctly inferior.

TEA.

In the course of the work done on tea last year methods for the determination of caffein were studied, the Stahlschmidt and Fendler-Stuber methods being compared.[1] Further results have

[1] Conn. Agr. Exp. Station, Bull. 210, p. 184 (1918).

been obtained this year by the same methods and a modification[2] of the Fendler-Stuber method has also been tried. The U. S. Standard teas of 1918-1919 have been employed.

The complete data, including results previously obtained, are given in Table III.

TABLE III.—CAFFEIN IN TEA.

Kind of tea.	Modified Stahlschmidt method. By wt.	Modified Stahlschmidt method. From N.	Fendler-Stuber method. By wt.	Fendler-Stuber method. From N.	Modified Fendler-Stuber method. By wt.	Modified Fendler-Stuber method. From N.
	%	%	%	%	%	%
Formosa Oolong, 1	2.20	2.03	2.16	2.12	....	....
Foochow Oolong, 2	2.54	2.44	2.57	2.54	....	....
Congou, 3	1.97	1.89	1.97	1.93	....	....
Ceylon, 4	2.96	2.77	2.81	2.79	....	....
Gunpowder Green, 5	1.86	1.73	1.81	1.76	....	....
Young Hyson Green, 6	1.68	1.54	1.65	1.63	....	....
Pan Fired Japan, 7	2.00	1.94	2.07	2.00	2.11	2.11
Basket Fired Japan, 8	2.07	2.01	2.13	2.11	2.15	2.13
Japan Dust, 9	2.09	1.94	2.18	2.13	....	....
Scented Orange Pekoe, 10	2.71	2.63	2.82	2.73	....	....
Scented Canton, 11	2.93	2.81	2.96	2.91	....	....
Canton Oolong, 12	3.10	2.96	3.27	3.20	....	....

[2] Due to H. A. Lepper, A. O. A. C., Referee on Coffee.

The modifications made in the Fendler-Stuber method are chiefly to correct errors due to evaporation of chloroform during the manipulation.

Further work with these and other methods for caffein will be done during the coming year.

CEREAL PRODUCTS.

Breakfast Foods, etc.

Three samples of Sunseal Brand Cereals have been analyzed, viz., **13163**, Sunseal Sunny Corn; **13164**, Sunseal Cream Corn Meal; and **13165**, Sunseal Improved Hominy Grits.

The analyses are as follows:

Station No.	13163	13164	13165
	%	%	%
Water	12.25	12.02	11.60
Ash	0.38	0.54	0.54
Protein	8.31	8.94	8.50
Fiber	0.35	0.37	0.42
Nitrogen-free extract	78.30	77.10	77.71
Fat	0.41	1.03	1.23

Two samples of corn meal were submitted by the Stoddard Gilbert Co., New Haven for determination of moisture and fat. The products were intended for overseas shipment. **12153**, yellow meal, contained 11.42 per cent. of moisture and 2.55 per cent. of fat. **12154**, white meal, contained 11.22 per cent. of moisture and 3.68 per cent. of fat.

Bread.

Four samples of bread have been submitted by individuals for examination as to their suitability for the dietary of a diabetic patient. The samples were **12884**; **12426**, Loeb's Gluten Bread; **12425**, Loeb's Casein Bread; and **12604**, Health Food Co.'s Glutosac Bread.

The analyses are as follows:

Station No.	12884	12426	12425	12604
	%	%	%	%
Water	34.46	7.85	39.73	23.10
Ash	1.94	1.80	4.35	1.95
Protein (N x 6.25)	26.49	46.65	41.05	32.62
Fiber	0.22	0.22	0.09	0.84
Fat	2.28	11.14	11.07	2.57
Nitrogen-free extract	34.61	32.34	3.71	38.92
Starch	26.81	27.71	trace	29.53

The Casein bread, **12425**, is practically starch-free, and the carbohydrate (nitrogen-free extract) content of the other products is considerably lower than in ordinary wheat bread; but whether or not bread containing from 25 to 30 per cent. of starch is suitable for a diabetic patient is entirely a question of the patient's carbohydrate tolerance.

Prepared and Other Flour.

As stated in the discussion of baking powders, excessive amounts of arsenic have been reported in leavening materials due to faulty manufacture. Nine samples of prepared or self-raising flours have been examined with this feature in mind, but the tests for arsenic in all cases were either negative or inconsiderable, no sample showing in excess of one part per million.

The brands examined were the following:

Station No.	Brand.	Manufacturer.
11245	Aunt Jemima,	Aunt Jemima Mills Co., St. Joseph, Mo.
11247	D. & C.,	D. & C. Co., New York City.
11250	Hecker's,	The Hecker Cereal Co., New York City.
11251	Jim-Dandy,	The D. & C. Co., New York City.
11483	Kaple-Quality,	Cobleskill Milling Co., Cobleskill, N. Y.
11252	Mohican,	Mohican Co., New York City.
11478	Presto,	The H. O. Co., Buffalo, N. Y.
11463	Reliable,	Reliable Flour Co., Boston, Mass.
11453	Victory,	Reliable Flour Co., Boston, Mass.

Seven samples of various flours, sent by individuals, were examined to identify the type of flour or to detect suspected adulteration. None of the samples require particular comment.

FATS AND OILS.

Olive Oil.

Four samples of olive oil submitted by the Dairy and Food Commissioner have been examined. Two were passed and two were adulterated.

The adulterated samples were **14565**, Brand Termini Imerese, sold by Angelo Bergano, 191 Hamilton St., Waterbury and **14579**, no brand, sold by Chas. Barber, 909 E. Main St., Waterbury. Both contained cotton seed oil.

Two samples submitted by individuals were found to be genuine.

Cooking Fats.

A number of cooking fats were examined last year and the analyses were published.[1] One product of this class, viz., *Covo*, has been examined this year as follows:

Halphen test (for cottonseed oil)	Positive
Baudouin test (for sesame oil)	Negative
Refraction at 15.5°, Butyro-refractometer degrees	72.3
Refractive index at 15.5°	1.4737
Reichert-meissel number	0.14
Iodine number	103.2
Renard's test for peanut oil	Positive

The amount of crude arachidic acid obtained from Covo was about 44 per cent. of the amount obtained from a sample of pure peanut oil. The melting point of the arachidic acid as obtained from Covo was 71°-72° and that from pure peanut oil 71°-71.5°. The neutralization value in both cases was 331.

Covo appears to be essentially a mixture of peanut and cotton-seed oils.

Butter.

Twenty seven samples of butter have been examined. Of these twenty-one were sold for butter and were found to be as represented. Six were either misrepresented or sold without proper display of notice as to their nature and quality. These samples are as follows:

D. C. No.	Sold for.	Dealer.	Remarks.
		Ansonia	
15111	Sweet Butter	M. Divorkin, 421 Main St.	Renovated butter
		Bridgeport	
14409	Cooking Butter	Bridgeport Public Market, 110 State St.	Renovated butter
		Greenwich	
14402	No. 2 Process Butter	Finklestein's Butter and Egg Store, 255 Greenwich Ave.	Renovated butter
		New Britain	
14430	Print Butter	Frank Mantner, 54 Rockwell St.	Renovated butter

[1] Conn. Agr. Exp. Station, Bull. 210, p. 200.

D. C. No.	Sold for.	Dealer.	Remarks.
		South Norwalk	
013	Butter	Standard Butter and Egg Co., 12 North Main St.	Renovated butter
14403	Process Butter	H. Scherer, 27 South Main St.	Renovated butter

Of two samples submitted by individuals, one was found to be renovated and the other genuine.

Oleomargarine.

One sample of oleomargarine was submitted and found to be illegal. It was colored with annatto. It was sold by H. C. Tracy, 161-167 Albany Ave., Hartford.

MARKET MILK.

Eleven hundred and ninety-seven samples of milk submitted by the Dairy and Food Commissioner have been examined. The results of analyses permit the following classification:

Not found adulterated	730	61.0%
Adulterated by dilution with water	138	11.5
Adulterated by skimming	22	1.8
Adulterated by reason of being below standard, in solids and solids-not-fat	207	17.3
in solids and fat	7	0.6
in solids, fat and solids-not-fat	93	7.8
Total	1,197	100.0

One hundred and nineteen samples have been received from individuals. Nine were found to be watered, four were skimmed and six were below standard.

We have commented before upon the dangerous practice of diluting milk with water. Both the substance and quality of the milk are lowered from the standpoint of food value; and the danger of introducing the germs of disease, through the medium of a doubtful water supply, into otherwise clean and wholesome milk is too apparent to need elaboration.

The following quotation taken from a very valuable paper[1] on

[1] The Food Value of Milk, by Edna L. Ferry, Conn. Agr. Exp. Sta., Reprint from the Thirty-eighth Report of the Conn. Dairymen's Association (1919).

the food value of milk is a forceful commentary on the practice of watering milk.

"Undiluted milk contains all the vitamine necessary for young animals, but in feeding babies it is the practice to dilute cow's milk with water and to reinforce the mixture with milk sugar. By this procedure the vitamine content of the original mik is so far reduced that the bottle fed baby may get enough of this essential food factor only when it takes a liberal quantity of the food. Whenever appetite fails, the food intake and consequently the vitamine intake is reduced. The effect of this is to further reduce the appetite because the amount of food eaten depends on the vitamine content of the diet. It is thus evident that under such circumstances the child goes from bad to worse and all the endless troubles so familiar to mothers ensue."

This refers to the practice of preparing modified milk for infant feeding which is done on the theory that the modified mixture more closely approximates the composition of human milk. The reduction in vitamine content can perhaps be compensated by increased consumption in some cases. But in families where the supply of milk is kept at a minimum on account of its cost, the seriousness of feeding milk containing 15 to 30 per cent. or more of added water is strikingly apparent, and watchfulness over our milk supply by State and other food officials should in no wise be abated.

In Table IV will be found those official samples of milk found to be adulterated, exclusive of those which were below standard.

TABLE IV.—ADULTERATED MILK.

No.	Dealer.	Solids.	Fat.	No.	Dealer.	Solids.	Fat.
	Containing Added Water.				*Containing Added Water —continued.*		
	BETHEL.				COLLINSVILLE.		
12724	W. H. Boardman	11.00	3.5	16287	G. A. Codaire	11.35	3.8
15065	R. Edmunds	10.27	2.7	16370	G. A. Codaire	11.45	3.7
13567	G. Finke	10.62	3.2	16371	G. A. Codaire	11.18	3.5
15725	F. K. Wood	11.35	3.7	16372	G. A. Codaire	11.08	3.6
15726	F. K. Wood	10.51	2.9	16373	G. A. Codaire	11.09	3.4
15727	F. K. Wood	11.37	3.8				
	BLOOMFIELD.				DANBURY.		
16378	John Conrey	11.65	3.8	15763	J. G. Abbott	10.51	3.3
15826	D. Miselli	10.93	3.5	16299	Hotel La Bate	3.90	1.1
	BRANFORD.			15753	W. N. Durgy	11.12	3.4
14905	Lewis Sparico	11.06	3.3	15752	W. N. Durgy	10.65	3.0
				15094	C. C. Hatch	13.68	5.6
	BRIDGEPORT.			15758	C. H. Heck	11.86	4.1
14382	Frank Hatch	10.37	3.1	15737	K. F. Kaidy	10.26	2.9
14375	B. Kitain	10.89	3.3	15099	Edwin H. Kellogg	11.98	4.2
14373	William Schatz	10.40	3.1	16296	Robert V. Lears	12.57	6.5
				15769	H. S. Rogers	10.83	3.5
	BROOKFIELD.			16293	W. R. Smith	11.14	3.4
14934	Robt. Folliott	10.81	3.3	15331	Universalist Church	11.38	3.9
14126	John Hoachman	9.54	2.8	15779	E. K. Wood	10.50	3.1
14936	Paul Kanmack	10.51	2.9	15759	P. G. Woodin	10.55	3.1
14133	Star Kustoss	10.48	3.0				
14147	Steve Piskura	10.32	3.1		DERBY.		
14148	Steve Piskura	10.19	3.2	14104	Peter Zabouski	11.93	4.1
12535	Alex Tiburski	10.75	3.5				
12536	Alex Tiburski	10.99	3.8		EAST BERLIN.		
12538	C. S. Williams	10.95	3.5	15014	G. Menthi	10.40	3.6
14931	Edward Waldo	8.92	3.0	15015	G. Menthi	10.41	3.5
14932	Edward Waldo	7.36	2.4	15016	G. Menthi	9.80	2.9
14933	Edward Waldo	8.46	2.7				
					EASTON.		
	CANAAN.			14334	William J. Burr	10.84	3.3
14495	S. Barbieri	11.90	4.2	14308	Ernest E. Ferry	10.00	3.0
14498	B. Frink	11.30	3.7	14309	Ernest E. Ferry	10.65	3.0
15601	S. Sirlin	7.88	2.4	14310	Ernest E. Ferry	10.05	2.8
				14311	Ernest E. Ferry	10.25	3.1
	CHESHIRE.			14312	Ernest E. Ferry	10.29	3.0
14370	Pasquale Guarino	10.87	3.6	14336	G. E. Finke	9.39	2.7
14371	Pasquale Guarino	10.00	3.0	13562	S. Kochis	10.72	3.2
14351	Wm. Pavieck	9.89	2.8	13563	S. Kochis	10.47	3.2
				15446	Homer Logan	11.05	3.5
	CLINTONVILLE.			15445	Homer Logan	10.35	3.1
16375	Michael Adinolfi	8.79	2.7				
16376	Michael Adinolfi	9.45	2.6		FAIRFIELD.		
16377	Michael Adinolfi	9.91	2.9	14372	John Vayor	11.01	3.3

TABLE IV.—ADULTERATED MILK.—*Continued.*

No.	Dealer.	Solids.	Fat.
	Containing Added Water —continued.		
	GUILFORD.		
14969	Gustave Anderson	6.79	2.2
14970	Gustave Anderson	8.40	3.4
	HAMDEN.		
14348	Antone Pascarelle	9.41	3.4
14916	John Skapnit	10.39	2.8
14917	John Skapnit	11.68	4.4
	HAWLEYVILLE.		
15922	H. J. Galpin	9.74	3.1
15923	H. J. Galpin	10.01	2.9
15924	H. J. Galpin	10.13	3.4
15925	H. J. Galpin	9.89	3.2
	HOTCHKISSVILLE.		
15461	Howard E. Dayton	10.47	3.1
	LONG HILL.		
14982	Miss H. B. Wells	10.90	3.6
	MELROSE.		
15946	C. A. Thompson	11.00	3.5
15947	C. A. Thompson	11.26	3.6
	MERIDEN.		
15839	Chas. Greenbacker	10.81	3.3
15840	Chas. Greenbacker	11.19	3.4
14944	Ryan & Forrest	11.19	3.8
	NEW BRITAIN.		
13986	T. S. McMahon	11.10	3.5
13994	T. S. McMahon	11.24	3.5
	NEW HAVEN.		
14120	Apens Lunch	9.82	2.6
14354	Diamond Resturant	12.21	4.5
	NEWTOWN.		
14298	Michael Fesch	6.29	1.7
14300	L. W. Whitehead	12.56	4.6
	NORTH HAVEN.		
14918	Antonio Sanzo	10.48	3.4
14919	Antonio Sanzo	9.91	3.0
	OXFORD.		
14349	Louis Perot	6.76	2.7
	Containing Added Water —continued.		
	PATTERSON, N. Y.		
15730	E. T. Haviland	10.73	3.2
	REDDING.		
14328	L. O. Peck	11.23	3.7
14329	L. O. Peck	11.83	4.2
14330	L. O. Peck	11.96	4.1
14325	Geo. P. Williams	12.08	4.2
14326	Geo. P. Williams	10.86	3.4
14327	Geo. P. Williams	9.88	2.5
15742	G. P. Williams	10.91	3.4
15743	G. P. Williams	10.75	3.5
15744	G. P. Williams	10.27	3.2
15745	G. P. Williams	9.74	2.7
	SANDY HOOK.		
14980	Sam Goldstein	11.18	3.6
14981	Sam Goldstein	10.11	2.9
	SIMSBURY.		
16271	R. H. Robertson	12.36	4.6
	SOUTH MERIDEN.		
15843	Wm. Raven	10.82	3.8
15842	Wm. Raven	10.75	3.5
	SOUTHINGTON.		
15717	Mrs. A. E. Vincent	11.96	4.1
	SUFFIELD.		
15948	A. G. Hinkley	10.84	3.3
15949	A. G. Hinkley	10.96	3.4
16252	A. G. Hinkley	10.35	3.0
16253	A. G. Hinkley	10.11	2.8
16254	A. G. Hinkley	10.50	3.1
16255	A. G. Hinkley	10.02	2.7
16256	A. G. Hinkley	10.62	3.2
16257	A. G. Hinkley	10.91	3.3
	TORRINGTON.		
15039	Thomas Hogan	11.23	3.7
15800	W. J. Twining	11.69	3.9
15803	W. J. Twining	11.68	4.1
	TRUMBULL.		
15524	Leonard Pabelke	11.79	3.9
15085	John Treadwell	9.61	2.9
15086	John Treadwell	10.60	3.1

TABLE IV.—ADULTERATED MILK.—*Concluded.*

No.	Dealer.	Solids.	Fat.
	Containing Added Water —concluded.		
	WALLINGFORD.		
15422	Alex Paskiewicz	11.38	3.6
	WATERTOWN.		
16352	T. E. Parker	10.95	3.6
	WEST HARTFORD.		
15846	Egan and Williams	10.74	3.3
15848	George LaRose	9.38	5.8
	WESTPORT.		
16390	W. G. Wakeman	11.81	4.0
16391	W. G. Wakeman	10.45	3.5
16392	W. G. Wakeman	9.98	3.0
	WOODBURY.		
15454	Chas P. Brown	11.13	3.5
15296	Austin Isham	10.76	3.8
15451	Albert P. Olsen	11.47	3.9
15452	Albert P. Olsen	11.09	3.8
15453	Albert P. Olsen	11.49	3.9
	NO ADDRESS.		
14350	Antone Pascarelle	8.22	2.6
X500		11.12	3.4
	Skimmed Milk.		
	DANBURY.		
16353	Presto Restaurant	9.64	1.7
16300	Star Restaurant	10.32	2.1
	Skimmed Milk— concluded.		
	FABYON.		
14610	Wilfred Bissonnette	10.75	2.1
14611	Wilfred Bissonnette	12.01	3.1
	HARTFORD.		
13886	Crown Restaurant	11.82	2.9
13889	Crystal Lunch	10.44	1.8
13888	Hartford Lunch	9.96	1.8
15849	W. E. Johnson	10.57	2.2
13890	Middlesex Lunch	10.85	2.1
	NEW BRITAIN.		
13893	Arcade Lunch	10.19	1.7
	NEW HAVEN.		
15324	Louis Allison	10.53	2.4
14362	Busy Bee Lunch	9.80	1.6
14592	Heinrich's	10.74	2.3
14367	Longley Lunch, Elm St.	10.38	2.0
14595	Longley Lunch, Church St.	10.02	1.7
14108	J. F. Markham	11.31	2.5
14357	Restaurant, 421 State St.	10.93	2.4
14353	Restaurant, 209 State St.	10.46	1.8
14352	Restaurant, 190 State St.	10.53	2.0
15325	Tony Rollio	10.93	2.5
15316	B. Smirnoff	9.59	1.2
14599	Tien Tsin	10.37	2.2

CONDENSED MILK.

Fourteen samples of condensed milk have been examined and the results are included in a special bulletin[1] from this laboratory.

CREAM.

Seventeen samples of cream sent by individuals to be tested for milk fat or for thickeners require no particular comment.

[1] Conn. Agr. Exp. Station, Bull. 213. Economy in Feeding the Family, V.

Twelve samples were submitted by the Dairy and Food Commissioner to check candidates for a testers' license.

HUMAN MILK.

Twelve samples of breast milk, submitted chiefly by physicians and the Visiting Nurse Association of New Haven, have been examined. The value of these analyses is entirely dependent upon whether or not the samples are representative. That is to say the composition of the first portion drawn by the breast pump may be very different from that of the last portion, so that an adequate idea of the milk elaborated by the mother can only be obtained by drawing all of the supply available at one time and properly mixing the same before sampling.

The analyses are given in Table V together with the maximum, minimum and average of two hundred samples as given by Leach.[1]

TABLE V.—ANALYSES OF HUMAN MILK.

Station No.	Solids.	Protein (N. x 6.38).	Fat.	Milk Sugar.	Ash.
	%	%	%	%	%
11815	12.92	1.28	4.5	6.91	0.23
12030	11.65	1.75	2.4	7.27	0.23
12175	10.64	1.12	2.6	6.70	0.22
12179	13.82	1.67	4.7	7.19	0.26
12489	10.12	0.97	2.3	6.71	0.14
12498	....	0.84	1.4	....	....
12789	12.05	0.97	4.0	6.94	0.14
12904	11.90	1.28	2.8	7.57	0.25
13242	12.72	1.25	4.0	7.27	0.20
13340	12.32	1.17	3.7	....	....
13377	10.37	1.66	2.2	6.24	0.27
M. L. D.	10.07	1.44	1.4	7.03	0.20
ANALYSES ACCORDING TO LEACH.					
Maximum	18.91	4.70	6.8	8.34	1.90
Minimum	8.60	0.69	1.4	3.88	0.12
Average	12.59	2.29	3.8	6.21	0.31

[1] Food Inspection and Analysis, p. 127.

SOUPS, BOUILLONS, ETC.

The food value of soups, broths and similar preparations is qualitative rather than quantitative; they are valuable not for the actual amount of food material they contain but rather for their palatability, the stimulation they give to the production and flow of digestive juices and the desirable water-soluble constituents of meats and vegetables which they may include. Quantitatively their food value rarely exceeds from 25 to 100 calories per serving.

In our analyses of these products the nitrogenous matter has been expressed as protein, but it is understood that considerable non-protein nitrogen may be present. Smith's[1] analyses of meat broths, which suggest the distribution of nitrogen in products of this type, show protein, extractive and amino nitrogen in varying proportions.

The undetermined constituents, otherwise called nitrogen-free extract, include carbohydrates if present, but except in those products prepared from vegetables or reinforced with cereals or legumes the amounts of such material are very small. Glycogen, a carbohydrate resembling starch, is present in oysters and probably also in clams and other mollusks.

Analyses of twenty-two samples of products of this class, including two samples of beef cubes and one of clam extract, have been made. The composition of the cubes and extract is given both as purchased, and as prepared for serving.

The analyses are given in Table VI.

The clam extract, **13100**, is made by the Gorton-Pew Fisheries Co., and said to be the juice of steamed clams of the finest quality, concentrated in glass-lined containers in vacuum at reduced temperature to retain the original flavor, and to contain no preservative other than the natural salt of the juice, no extra salt being added.

The beef cubes and clam extract when prepared as directed contain but a small amount of actual nutrients, resembling in this respect thin soups and bouillons, but the clam extract was particularly palatable.

Rex Brand Clam bouillon, **13145**, bore no declaration of net weight.

[1] Joslin, E. P., Treatment of Diabetes Mellitus, p. 272.

TABLE VI.—ANALYSES OF

Station No.	Brand.
	Soup.
13123	Consomme, Campbell's. Jos. Campbell Co., Camden, N. J.
13140	Consomme, Crest. Edw. D. Depew & Co., New York City, Distr...
13120	Consomme, Benefit. Direct Importing Co., Boston, Mass., Distr...
13127	Consomme, Readymaid. Franco-Amer. Food Co., Jersey City, N. J.
13124	Mock Turtle, Franco-Amer. Food Co., Jersey City, N. J.
13153	Mock Turtle, Mohican. The Mohican Co., New York City, Distr.
13109	Mock Turtle, Van Camp's. The Van Camp Packing Co., Indianapolis, Ind.
13139	Mock Turtle, Epicure. John T. Sills & Sons, New York City
13133	[1]Ox Tail, Campbell's. Jos. Campbell Co., Camden, N. J.
13121	[1]Ox Tail, Benefit. Direct Importing Co., Boston, Mass., Distr.
13125	[2]Ox Tail, Clear. Franco-Amer. Food Co., Jersey City, N. J.
	Beef Bouillon.
13119	Benefit. Direct Importing Co., Boston, Mass., Distr.
13138	Crest. Edw. D. Depew & Co., New York City, Distr.
13135	Frank's Beef Broth with Barley. L. Frank & Son Co., Milwaukee, Wis.
13134	Campbell's. Jos. Campbell Co., Camden, N. J.
	Clam Bouillon.
13110	Moose-a-Bec, with Clams. Wm. Underwood Co., Boston, Mass.
13145	Rex. The Cudahy Packing Co. South Omaha, Neb.
13122	Campbell's. Joseph Campbell Co., Camden, N. J.
13126	Readymaid. Franco-Amer. Food Co., Jersey City, N. J.
	Beef Cubes.
13136	In bulk. As purchased
	Prepared as usually directed[4]
13128	In bulk. Steero. As purchased
	Prepared as usually directed[4]
	Clam Extract.
13100	Gorton-Pew Fisheries Co., Gloucester, Mass. As purchased
	Prepared as directed

[1] 97.8% edible, 2.2% waste (bone). Analysis is of edible portion.
[2] 96.7% edible, 3.3% waste (bone). Analysis is of edible portion.

JAMS AND JELLIES.

Nine samples of jams and fifteen samples of jellies have been examined with reference to total acidity, total ash, and phosphoric acid content of the ash. It is common practice in the manufacture of jellies of the cheaper grades to use certain acids

SOUPS, BOUILLONS, ETC.

Station No.	Weight of contents. Declared.	Weight of contents. Found.	Cost per can.	Cost per lb.	Water.	Ash.	Ether extract.	Protein (N. x 6.25).	Nitrogen-free extract.	Salt (NaCl).	Nitrogen.
	ozs.	ozs.	cts.	cts.	%	%	%	%	%	%	%
13123	10.5	11.2	10.0	14.4	94.52	1.65	0.07	3.31	0.45	1.50	0.53
13140	10.5	10.2	10.0	15.5	97.23	2.11	0.06	0.44	0.16	1.98	0.07
13120	10.5	10.7	10.0	14.9	96.72	2.25	0.09	0.63	0.31	2.08	0.10
13127	10.5	10.7	13.0	19.4	96.22	2.00	0.03	1.25	0.50	1.82	0.20
13124	10.5	11.1	12.0	17.3	91.56	1.38	0.42	2.94	3.70	1.10	0.47
13153	10.5	10.4	10.0	15.4	87.76	2.73	0.88	3.25	5.38	2.24	0.52
13109	10.5	10.0	10.0	16.0	85.61	2.23	1.38	3.94	6.84	2.01	0.63
13139	10.5	11.4	10.0	14.0	86.43	3.41	1.18	2.00	6.98	3.14	0.32
13133	10.5	11.4	12.0	16.8	82.85	2.78	0.96	3.81	10.60	2.24	0.61
13121	10.5	11.2	10.0	14.4	83.36	3.20	1.35	3.13	8.96	2.64	0.50
13125	8.0	8.6	12.0	22.4	91.48	1.41	1.07	4.06	1.98	0.67	0.65
13119	10.5	10.4	10.0	15.4	97.10	2.14	0.18	0.75	+0.17	1.70	0.12
13138	10.5	9.4	10.0	17.0	97.56	1.98	0.14	0.38	+0.06	1.77	0.06
13135	12.0	11.0	12.0	17.4	92.85	1.87	0.03	1.06	1.94	1.76	0.17
13134	10.5	10.9	12.0	17.6	93.94	2.24	0.03	3.31	0.48	2.05	0.53
13110	10.0	10.7	13.0	19.4	88.13	1.31	1.01	7.06	2.49	0.51	1.13
13145	....	11.2	10.0	14.4	94.52	4.13	0.06	0.88	0.41	3.68	0.14
13122	10.5	11.1	10.0	14.4	94.75	3.01	0.07	1.31	0.86	2.32	0.21
13126	10.5	10.7	13.0	19.4	96.64	2.17	0.02	0.81	0.36	2.05	0.13
13136	....	1.6	20.0[5]	200.0	5.99	77.48	1.29	7.69	7.55	74.72	1.23
	....	....	....	....	98.51	1.23	0.02	0.12	0.12	1.18	0.02
13128	....	1.0	14.9[5]	238.4	9.13	69.68	2.16	15.06	3.97	65.60	2.41
	....	....	....	....	98.56	1.10	0.03	0.24	0.07	1.04	0.04
13100	2.0	2.0	....	....	35.83	29.00	0.19	23.19	11.79	20.80	3.71
	....	....	....	....	98.67	0.60	trace	0.48	0.25	0.43	0.08

[3] One dozen cubes weighed 1.6 ozs. and cost 20 cents.
[4] One average cube weighs 3.8 gms. and a cup of broth is taken to weigh 240 gms.
[5] One cube cost 2 cents; 1 oz. cost 14.9 cents.

to give body or stiffness to the products. Sulphuric, phosphoric, citric or tartaric acids may be used for this purpose but phosphoric acid is said to be preferred. The use of phosphoric acid results in an excess of phosphorus in the ash. According to

TABLE VII.—ANALYSES OF JAMS AND JELLIES.

Station No.	Material.	Manufacturer or Distributor.	Total acidity, as sulphuric acid.	Total ash.	Total phosphoric acid, P_2O_5.	Proportion of P_2O_5 in ash.
	Jam.		%	%	%	%
11530	Apple and Raspberry	Jos. Middleby, Jr., Boston, Mass. ..	0.22	0.374	0.031	...
11531	Apple and Strawberry	Jos. Middleby, Jr., Boston, Mass. ..	0.31	0.334	0.030	...
11535	Cherry, pure red	Francis H. Leggett & Co., N. Y. City	0.53	0.275	0.026	...
11536	Currant, pure red	Francis H. Leggett & Co., N. Y. City	0.73	0.366	0.047	...
11523	Grape Fruit Marmalade ...	Commercial Groves Co. of Florida, Orlando, Fla.	0.15	0.151	0.007	...
11532	Raspberry and Apple Juice	Humbert & Andrews, Brookl'n, N. Y.	0.30	0.145	0.022	...
11533	Strawberry and Apple Juice	Humbert & Andrews, Brookl'n, N. Y.	0.29	0.172	0.019	...
11529	Strawberry and Apple	Kelley-Clark Co., New York City ..	0.35	0.255	0.032	...
11954	Strawberry and Apple	Jos. Middleby, Jr., Boston, Mass. ..	0.27	0.380	0.035	...
	Jelly.					
11539	Apple	Armour & Co., Chicago, Ill.	0.62	0.155	0.008	5.2
11541	Apple	P. J. Ritter Conserve Co., Phila., Pa.	0.25	0.180	0.009	5.0
11956	Apple	The Whipple Co., Natick, Mass.	0.31	0.260	0.009	4.2
11524	Apple and Currant	Wilson & Co., Chicago, Ill.	0.60	0.140	0.009	6.4
11528	Crabapple and Apple	Humbert & Andrews, Brookl'n, N. Y.	0.27	0.175	0.013	7.4
11540	Crabapple	P. J. Ritter Conserve Co., Phila., Pa.	0.22	0.175	0.009	5.1
11537	Currant, red	Francis H. Leggett & Co., N. Y. City	1.12	0.340	0.022	6.5
11527	Currant and Apple	Humbert & Andrews, Brookl'n, N. Y.	0.49	0.160	0.013	8.1
11526	Grape and Apple	Humbert & Andrews, Brookl'n, N. Y.	0.25	0.180	0.013	6.6
11957	Grape and Apple	Armour & Co., Chicago, Ill.	0.75	0.140	0.015	10.7
11534	Grape and Apple Pectin ...	Dawson Bros. Mfg. Co., Lynchburg, Va.	0.22	0.082	0.005	6.1
11525	Grape, Concord	Pacific Coast Syrup Co., San Francisco, Cal.	0.51	0.410	0.022	5.4
11538	Raspberry and Apple	Armour & Co., Chicago, Ill.	0.76	0.130	0.009	6.9
11955	Raspberry Flavor Apple ...	The Whipple Co., Natick, Mass.	0.48	0.380	0.032	8.4
11958	Strawberry and Apple	Armour & Co., Chicago, Ill.	0.69	0.158	0.012	7.6

Condon,[1] the proportion of phosphorus pentoxide in the ash of jellies made from pure fruit juices should not exceed 5 to 6 per cent. Analyses by Tolman, Munson, and Bigelow[2] show the acidity and ash content of pure fruit jams and jellies.

Our analyses are given in Table VII.

The results for acidity and total ash appear to be within the usual limits for products of the respective kinds. The proportion of phosphorus pentoxide in the ash of the jellies generally

[1] No. Dakota Agr. Exp. Sta., Special Bull., 3, 8 (1914).
[2] Jour. Am. Chem. Soc., 23, 5, 349-351 (1901).

exceeds the limits defined above. The actual amounts of each are so small in some cases that comparatively slight variations in either result in marked changes in the relative proportion, but figures approximating 10 per cent. would seem to be suggestive of added phosphoric acid.

As regards labels, several require particular criticism.

The law requires descriptive matter upon the label to be free from any statement, design, or device regarding the article, or the ingredients thereof, which shall be false or misleading in any particular.[1] This does not permit an article containing a mixture of food products to be named after one of them, even if it be labeled "compound."[2] It does permit prominence to be given to the preponderating ingredient by naming it first on the label;[3] but undue prominence is clearly outside the intent and letter of such regulations.

In case of sample **11532**, a conspicuous legend around the neck of the jar states "Raspberry" while the main label further declares the contents to consist of raspberry and apple juice. Sample **11533** is similar, substituting the word "Strawberry" in place of raspberry.

Samples **11526, 11527,** and **11528,** are jellies composed of grape and apple, currant and apple, and crabapple and apple respectively; but in each case the words grape, currant and crabapple are emphasized by larger and different colored type in a prominent position.

All these are products of the same manufacturer, viz., Humbert & Andrews, Brooklyn, N. Y.

NON-INTOXICATING CEREAL BEVERAGES OR NEAR BEERS.

Seventeen so-called near beers collected by this Station and nine by the Dairy and Food Commissioner were examined for alcohol content. The brands and manufacturers are as follows:

[1] Conn. General Statutes, Chap. 128, Sec. 2439.
[2] Conn. Regulation 16, par. d.
[3] Conn Regulation 17.

SAMPLED BY STATION AGENT.

Sta. No.	Brand.	Manufacturer.
13115	*Anzac.*	Anzac Co., Boston, Mass.
13117	*B. B.*	American Beverages Co., Canandaigua, N. Y.
13105	*Bevo.*	Anheuser-Busch Brew. Assoc., St. Louis, Mo.
13132	*Bunny Dry.*	Ropkins & Co., Hartford.
13161	*Cerva.*	Lemp, St. Louis, Mo.
13152	*Colda.*	St. Louis Brewing Assoc., St. Louis, Mo.
13112	*Delphia.*	Anzac Co., Boston, Mass.
13104	*Eblings Extra.*	Ebling Brewing Co., New York City.
13151	*E-Moh.*	The Home Brewing Co., Bridgeport.
13106	*Fifty-Fifty.*	The Fifty-Fifty Corp., Bridgeport.
13166	*Hormo.*	Rubsam & Harrmann Brew. Co., New York City.
13144	*Kovar.*	Piel Bros., East New York.
13142	*Mello.*	John Eichler, New York City.
13131	*Moro.*	The Moro Co., Bridgeport.
13130	*Nebco.*	The New England Brewing Co., Hartford.
13116	*Pablo.*	Pabst, Milwaukee, Wis.
13113	*Sterling.*	Evansville Brewing Co., Evansville, Ind.

SAMPLED BY THE DAIRY AND FOOD COMMISSIONER.

D. C. No.		
15903	*Bevo.*	Anheuser-Busch Brew. Assoc., St. Louis, Mo.
14686	*Bunny Dry.*	Ropkins & Co., Hartford.
15564	*Bunny Dry.*	Ropkins & Co., Hartford.
14687	*Bunny Dry.*	Ropkins & Co., Hartford.
15442	*Fifty-Fifty.*	Fifty-Fifty Corp., Bridgeport.
15906	*Fifty-Fifty.*	Fifty-Fifty Corp., Springfield, Mass.
15905	*Kovar.*	Piel Bros., New York City.
14688	*Nebco.*	The New England Brewing Co., Hartford.
1400	*We-No.*	F. & M. Schaefer B. Co., New York City.

None of these products contained alcohol in excess of 0.5 per cent. except **13151**, *E-Moh,* which contained 0.53 per cent.

B.B., **13117**, *Bunny Dry,* **13132**, **14686**, **14687**, **15564**, and *Pablo,* **13116** are declared to be non-alcoholic. *B.B.* contained 0.15 per cent. alcohol and *Bunny Dry* contained in the 4 samples 0.05, 0.35, 0.44 and 0.40 per cent. respectively. No alcohol was found in *Pablo.* However it is not reasonable to expect beverages of this type to be without traces of alcohol and the declaration "non-intoxicating," which is usually made, is more correct. The manufacturers of *Bunny Dry,* Ropkins & Co., Hartford have changed their declaration to "non-intoxicating."

Two samples of home made beers sent by individuals to be examined for alcohol were found to contain 1.57 per cent. and 1.54 per cent. of alcohol by volume.

CARBONATED SOFT DRINKS.

One hundred carbonated soft drinks submitted by the Dairy and Food Commissioner have been examined for saccharin.

Twelve such products collected by the Station agent and one sent by Miss Bixby of the Bridgeport Health Department have been examined for the same substance.

State Regulation 7 prohibits the use of saccharin in normal foods even if its presence is declared on the label.

Saccharin was found in nineteen samples, all collected by the inspectors of the Dairy and Food Commissioner's Department, as follows:

D. C. No.	Brand.	Dealer or Manufacturer.
15580	Cream Soda.	Harry Owens, Myrtle Ave., Ansonia.
15376	Cream Soda.	Jos. Kent & Son, Elmville.
14657	Cream Soda.	Morris Alterwitz, 20 Court St., Stamford.
15104	Ginger Ale Soda.	G. Luippold, 285 Pembroke St., Bridgeport.
14685	Lemon Soda.	Hamilton Bot. Wks., Hamilton St., New Haven.
14676	Lemon Soda.	New York Bot. Wks., 55 Silver St., New Haven.
14658	Lemon Soda.	Morris Alterwitz, 20 Court St., Stamford.
15105	Lemon Soda.	Morris Alterwitz, 159 Franklin St., Stamford.
15368	Orange Soda.	N. P. White, Danielson.
15109	Orange Soda.	Shanbron Bottling Works, New Haven.
15100	Sarsparilla Soda.	Grey & Lights, Bridgeport.
14659	Sarsparilla Soda.	Morris Alterwitz, 20 Court St., Stamford.
15578	Soda, plain.	I. Dworkin & H. Bogrod, 51 Front St., Ansonia.
14664	Strawberry Soda.	Standard Bottling Works, Bridgeport.
15557	Strawberry Soda.	Chas. Gunning, 19 Grand St., Hartford.
15110	Strawberry Soda.	Golden Eagle Bottling Works, New Haven.
14675	Strawberry Soda.	New York Bottling Works, New Haven.
14666	Strawberry Soda.	I. Silver Bottling Works, Stamford.
15575	Strawberry Soda.	B. H. Godwin, Terryville.

CIDER.

Eleven samples of cider were submitted by individuals and by the Dairy and Food Commissioner. Ten of these were examined for alcohol and one for poisonous or injurious substances. The latter contained no toxic material so far as our examination could discover. Alcohol, by volume, in the other samples ranged from 1.8 to 7.97 per cent.

WINE.

Six samples of wine were examined, chiefly for alcohol content in connection with suspected illegal sales of alcoholic liquors. One of these which was sold at the rate of $70.00 per gallon, contains only 0.47 per cent. of alcohol by volume. Another sample was artificially colored with amaranth.

VINEGAR.

Twenty-five samples of cider vinegar were sent by individuals for examination. Eleven met the requirements of the state standard, viz., 1.6 per cent. of solids and 4 per cent. acidity. Fourteen were below standard in one or both particulars.

Twelve samples were submitted by the Dairy and Food Commissioner. Nine of these were passed and three found to be below standard.

CHOCOLATE AND COCOA.

One sample of chocolate and two of cocoa were examined for the Dairy and Food Commissioner and found to meet the requirements of State Regulation 37 which defines the substance and quality of these products.

MISCELLANEOUS MATERIALS.

FOODS, ETC.

13137. *Orangeade Paste.* Prepared by Emma Curtis, Melrose, Mass. Fruit flavor for beverages, jellies, frostings and sauces. Artificially colored.

The preparation had the flavor of natural fruit and contains 77.95 per cent. of solids of which 62.11 per cent. was sugar, calculated as cane and invert sugar. The color was Orange 1, a permitted color, and no preservative was found.

11522. *Borden's Coffee* with milk and sugar. Borden's Condensed Milk Co., New York. Stated to contain a small amount of chicory to improve color and flavor.

This is really a sweetened condensed milk with coffee and chicory added. A similar sample labeled Borden's Condensed Coffee, Eagle Brand, is noted in an earlier report.[1]

[1] Conn. Agr. Exp. Station, Bull. 200, p. 140 (1917).

Analyses of both these products are as follows:

Station No.	11522	1917 sample
	%	%
Water	34.02	30.12
Ash	2.19	2.25
Protein (N. x 6.38)	6.83	6.76
Fat	5.70	6.38
Lactose	8.09	9.24
Sucrose	43.17	45.25
Caffein	0.35	0.37

The caffein in both cases is about one third the amount found in ordinary coffee.

13234. *Baking Powder.* The sample contained 10.45 per cent. of available carbon dioxide whereas 12 per cent. is required by the federal standard.

Candy. Caramels, **12751**, were suspected of containing paraffin but no evidence of paraffin was obtained. Tango Kisses, **13407**, were thought to contain considerable amounts of alcohol, but only a trace was found, probably due to the flavoring extract used.

12788. *Canning Compound.* Mrs. Price's Compound, made by the Price Compound Company, Minneapolis, Minn. Other analyses have shown this preparation to consist chiefly of boric acid with a small amount of common salt. The sample submitted to us was tested qualitatively and found to contain boric acid. The sale of this compound itself, as a drug, involves some technical points of law; but clearly the use of such a preservative in food would make such food illegal if sold or offered for sale.[1]

Coffee. Two samples were examined. One, **11672**, was not found to be adulterated. The other, **13406**, was found to consist largely of chicory and cereal products. It was sold as "combination coffee" but later was labeled to show its true composition.

Concentrated Fruit Products. Four samples of concentrated fluid preparations were examined, viz., **11964**, Ideal Concentrated Pineapple Cider; **11965**, Ideal Concentrated Orangeade; **11966**, Ideal Concentrated Grape Cider; and **11967**, Ideal Concentrated Lemonade. The preparations were put up by the American

[1] Conn. General Statutes, Chap. 128, Sec. 2438; Rules and Regulations, Reg. 7, p. 10, par. 3.

Fruit Products Co., New Haven, and stated to be pure fruit products with added coloring.

Examination and partial analyses showed the products to be essentially colored solutions of organic acid or acids, largely or entirely citric acid.

Citric acid is a fruit acid to be sure, but the substance and quality of these preparations is not that indicated by their labels and they are in violation of Chapter 128, Section 2439 of the General Statutes and various State Regulations in connection therewith.

The colors were of the permitted class except that in the case of orangeade, **11965,** the tests were not wholly satisfactory for the permitted orange shade.

It should be noted that these products were not secured in the open market but were sample packages, our information being at that time that they were not in the general trade.

12176. *Condensed Milk.* The sample was examined to explain, if possible, the deep violet color produced when the milk was added to tea. It was found that fresh, whole milk to which a little iron in the form of chloride or sulphate had been added gave a similar color with tannin solutions. This is a recognized reaction between tannins and iron salts in presence of certain phosphates. This sample of condensed milk appeared to have an unexplained excess of iron which combined with the tea tannins to produce the color noted.

13032. *Dried Egg.* The sample contained moisture 8.94 per cent., ash 3.85 per cent., protein 45.56 per cent., and fat 35.87 per cent. It had the appearance and general composition of genuine dehydrated egg.

13232. *Fish* was examined for preservatives but none were detected.

12475. *Honey,* said to be buckwheat honey, was found to be of normal composition.

13211. *Ice Cream Powder* contained no starch and little if any gelatin. Sugar was present and probably vegetable gums.

13627. *Molasses* was of normal sugar content and contained only a small amount (15 milligrams per kilo.), of sulphur dioxid.

12989. *Peanut Oil.* Clarke's Virgin Peanut Oil was examined. It had a refractive index of 1.4723 at 15.5°C. and no foreign oils were detected.

12131. *Prunes* were examined to identify a white deposit on surface which proved to be sugar.

12416. *Salt.* This was sent as an unknown substance for identification. It was practically pure sodium chloride or common salt.

13554, *Soap,* and **13341,** *Washing Powder,* were both submitted for examination for free alkali. The soap contained 0.02 per cent. of alkali (as Na_2O) and the washing powder contained none.

13496. *Sugar* which showed nearly 100 per cent. sucrose, but was not sufficiently refined to make it pure white.

13384. *Syrup,* Rock Candy. The syrup contained 68.77 per cent. of solids of which 65.81 per cent. was sucrose. There was no evidence of glucose.

15551, *Maple Syrup,* was found to be of standard quality.

FOODS SUSPECTED OF CONTAINING POISON.

Six samples of various food products were submitted to be examined for poisonous substances. One of these was candy, **11819,** which was found to contain bichloride of mercury.

MATERIALS OTHER THAN FOOD EXAMINED FOR POISON.

Nine samples, chiefly stomachs or stomach contents, were examined. The samples were submitted by individuals, health or other authorities to explain, if possible, the sickness or death of animals.

In one case considerable amounts of strychnine and another distinct traces of copper and arsenic were found. In the remaining cases the results of analyses did not indicate the probable cause of death.

II. DRUGS.

SPIRIT OF CAMPHOR.
(*Spiritus Camphorae.*)

"One hundred mils of Spirit of Camphor yield not less than 9.5 gm. nor more than 10.5 gm. of camphor."—*U. S. Pharm. IX.*

Seventeen samples, collected by the Dairy and Food Commissioner, were examined as follows:

TABLE VIII.—ANALYSES OF SPIRIT OF CAMPHOR.

D. C. No.	Dealer.	Grams camphor per 100 mils.
14819	W. J. Madden, Bristol	8.78
14847	Barnum Pharmacy, Danbury	9.55
14875	W. B. Noble, East Hartford	8.41
13882	T. Sisson & Co., Hartford	10.39
14561	H. F. Ruby & Co., Hartford	9.64
14722	S. S. Nelson, Hartford	10.12
14788	Balch & Brown, Manchester	10.79
14777	W. H. Sill, Rockville	5.04
14785	Thomas Pharmacy, Rockville	7.60
14817	A. V. Oxley, Southington	10.61
14799	Thompsonville Drug Co., Thompsonville	14.46
14857	Apothecaries Hall Co., Waterbury	9.27
14752	Bay State Drug Co., Willimantic	10.00
14758	J. W. Lavallie & Co., Willimantic	10.66
14766	Wilson Drug Co., Willimantic	9.54
14773	J. H. Lockwood, Willimantic	9.83
14805	R. J. Keefe, Windsor Locks	9.09

The above samples are quite unsatisfactory. There are few drug preparations of simpler manufacture than spirit of camphor, and yet we find seventeen samples ranging from 5.04 to 14.46 gms. per 100 mils, and ten of these outside the U. S. P. limits. Nos. **14819, 14875, 14777, 14785, 14857,** and **14805** are below the minimum limit, while **14817, 14788,** and **14758** are slightly above, and **14799** very much above, the maximum. No. **14785** was labeled "Tr. Camphor." There is no such U. S. P. preparation and if this was intended to represent a product different from the official article its strength should have been declared on the label.

TINCTURE OF IODINE.

(*Tinctura Iodi.*)

"An alcoholic solution of iodine and potassium iodide. One hundred mils contains not less than 6.5 gm. nor more than 7.5 gm. of I (126.92) and not less than 4.5 gm. nor more than 5.5 gm. of KI (166.02)."—*U. S. Pharm. IX.*

Seventeen samples, collected by the Dairy and Food Commissioner, have been examined as follows:

TABLE IX.—ANALYSES OF TINCTURE OF IODINE.

D. C. No.	Dealer.	Grams per 100 mils. I	K I
14820	W. J. Madden, Bristol	7.89	5.78
14848	Barnum Pharmacy, Danbury	6.96	5.35
14874	W. B. Noble, East Hartford	7.41	6.94
13883	T. Sisson & Co., Hartford	6.22	4.54
14560	H. F. Ruby & Co., Hartford	5.87	3.89
14720	S. S. Nelson, Hartford	6.74	4.68
14787	Balch & Brown, Manchester	6.85	5.09
14776	W. H. Sill, Rockville	6.79	5.64
14784	Thomas Pharmacy, Rockville	7.19	5.21
14791	Geo. R. Steele Est., Thompsonville	7.06	4.94
14798	Thompsonville Drug Co., Thompsonville	8.03	4.91
14856	Apothecaries Hall Co., Waterbury	7.46	4.85
14751	Bay State Drug Co., Willimantic	7.22	5.02
14761	J. W. Lavallie & Co., Willimantic	6.78	4.76
14764	Wilson Drug Co., Willimantic	7.06	5.04
14774	J. H. Lockwood, Willimantic	6.78	5.05
14806	J. R. Keefe, Windsor Locks	6.96	4.76

These samples were fairly satisfactory, twelve satisfying the U. S. P. requirements in both respects. The iodine content ranged from 5.87 to 8.03, and the potassium iodide from 3.89 to 6.94 gms. per 100 mils. No. **14820** showed an excess of both ingredients, **14874** an excess of potassium iodide, **13883** a deficiency in iodine, **14560** a deficiency in both ingredients and **14798** an excess of iodine. No. **14560** is the only sample of marked inferiority.

TINCTURE OF FERRIC CHLORIDE.

(*Tinctura Ferri Chloridi.*)

"A hydro-alcoholic solution containing ferric chloride [$Fe Cl_3 = 162.22$] (about 13 per cent.), corresponding to not less than 4.48 per cent. of Fe."—*U. S. Pharm. IX.*

Twelve samples, collected by the Dairy and Food Commissioner, were examined as follows:

TABLE X.—ANALYSES OF TINCTURE OF FERRIC CHLORIDE.

D. C. No.	Dealer.	Iron. %
14822	W. J. Madden, Bristol	4.48
14876	W. B. Noble, East Hartford	4.74
13884	T. Sisson & Co., Hartford	4.78
14562	H. F. Ruby & Co., Hartford	3.68
14790	Balch & Brown, Manchester	4.86
14783	Thomas Pharmacy, Rockville	4.65
14792	Geo. R. Steele Est., Thompsonville	4.66
14855	Apothecaries Hall Co., Waterbury	4.83
14765	Wilson Drug Co., Willimantic	5.00
14753	Bay State Drug Co., Willimantic	5.00
14762	J. W. Lavallie & Co., Willimantic	4.80
14775	J. H. Lockwood, Willimantic	4.56

All of the above are satisfactory except No. **14562**, which contains only 3.68 per cent. of iron, or 82 per cent. of minimum U. S. P. strength.

WITCH HAZEL WATER.
(*Aqua Hamamelidis.*)

"A saturated aqueous liquid obtained by distilling with steam or water the bark, twigs, smaller stems or the entire shrub of *Hamamelis virginiana* Linne, collected in the autumn, and adding 150 mils of alcohol to each 850 mils of the distillate. It contains not less than 14 per cent. of absolute alcohol by volume."—*U. S. Pharm. IX.*

Fourteen samples, collected by the Dairy and Food Commissioner, were tested for alcohol as follows:

TABLE XI.—ANALYSES OF WITCH HAZEL WATER.

D. C. No.	Manufacturer or Dealer	Spec. gr. @ 15.6° C.	Ethyl alcohol by vol.
14821	E. E. Dickinson & Co., Essex	.9821	13.88*
14846	E. E. Dickinson & Co., Essex	.9825	13.80*
14767	E. E. Dickinson & Co., Essex	.9823	14.10
14558	E. E. Dickinson & Co., Essex	.9830	13.70*
14854	E. E. Dickinson & Co., Essex	.9819	14.24
14877	E. E. Dickinson & Co., Essex	.9826	13.76
14754	Gould Witch Hazel Co., Boston, Mass.	.9817	14.56
14719	S. S. Nelson, Hartford	.9824	15.36*
14801	Wm. J. O'Brien, Thompsonville	.9824	13.94
14793	Pond's Extract Co., New York City	.9804	15.10†
14816	A. V. Oxley, Southington	.9823	13.84*
14810	Riker Laboratories, New York City	....	13.88
14804	Sisson Drug Co., Hartford	.9824	13.80
13881	T. Sisson & Co., Hartford	.9825	14.18*

* 15 per cent. claimed. † 16 per cent. claimed.

No wood alcohol was found in any of the samples, and the content of grain alcohol corresponds well with the U. S. P. requirements.

ACETYLSALICYLIC ACID.
(*"Aspirin."*)

Until within a few years this useful and valuable drug was a trade-mark preparation and was best known by its proprietary name "aspirin." The German originators of the drug by an extensive advertising campaign continue in their attempt to make consumers believe that "aspirin, Bayer" possesses virtues not shared by other brands. As a matter of fact "aspirin" is simply pure acetylsalicylic acid and has no virtues not equally common to other pure preparations of this acid, and the latter are generally sold at a much lower price.

Twenty-three samples of the 5 grain tablets, collected by the Dairy and Food Commissioner, have been examined.

TABLE XII.—ACETYLSALICYLIC ACID (ASPIRIN) TABLETS.

Station No.	Manufacturer.	No. of tablets in sample.	Acetylsalicylic acid. Per cent.	Maximum.	Minimum.	Average.
				grs.	grs.	grs.
14721	The Bayer Co., New York City	12	78.96	5.18	4.79	4.97
14729	The Bayer Co., New York City	12	81.90	5.41	4.92	5.18
14756	The Bayer Co., New York City	12	79.12	5.17	4.87	5.01
14772	The Bayer Co., New York City	12	80.00	5.16	4.70	4.99
14818	The Bayer Co., New York City	12	77.50	4.97	4.70	4.82
14879	The Bayer Co., New York City	12	78.68	5.44	4.78	5.04
14832	Bristol Myers Co., Brooklyn, N. Y.	12	83.56	5.09	4.81	4.90
14750	Dusal Chem. Co., New York City	12	78.10	5.00	4.38	4.79
14807	Lehn and Fink, New York City	*8	87.22	5.17	4.81	4.93
14839	Lehn and Fink, New York City	12	80.44	4.96	4.74	4.83
14878	Lehn and Fink, New York City	12	84.20	5.10	4.88	4.99
14782	Eli Lilly, Indianapolis, Ind.	12	78.84	5.31	4.97	5.01
14802	Eli Lilly, Indianapolis, Ind.	10	74.32	4.88	4.63	4.70
14853	Eli Lilly, Indianapolis, Ind.	12	74.06	4.98	4.82	4.90
14780	The Merrill Chem. Co., Cincinnati, Ohio	12	75.84	5.00	4.78	4.91
14781	The Norwich Pharmacal Co., Norwich, N. Y.	12	78.64	5.03	4.85	4.93
14728	Preston Chem. Co., Brooklyn, N. Y.	12	84.84	4.75	3.86	4.31
		12	84.82	4.47	3.87	4.19
14771	Preston Chem. Co., Brooklyn, N. Y.	12	82.92	5.85	4.74	5.18
14800	Smith, Klein & Clough, Phila, Pa.	12	76.74	5.07	4.83	4.95
14826	Smith, Kline & French Co., Phila., Pa.	12	75.20	5.34	4.50	4.82
14794	United Drug Co., Boston, Mass.	12	79.92	4.94	4.70	4.81
14838	United Drug Co., Boston, Mass.	12	80.68	4.92	4.21	4.66
14858	United Drug Co., Boston, Mass.	12	80.62	5.10	4.57	4.84

* In the same package with these eight tablets were four of quite different size and composition but yielding about the same amount of the drug. These contained 79.74 per cent., or from 4.85 to 4.98, average 4.90 grs. per tablet.

While there is a general tendency towards a slight deficiency in the drug, with the exception of No. **14728,** made by *Preston Chemical Co.,* the samples are quite satisfactory. The twenty-four tablets in this sample all showed a deficiency, ranging from 0.25 to 1.44 grs. per tablet.

TOILET PREPARATIONS.

Seventy-five samples, collected by the Dairy and Food Commissioner, have been examined solely as regards their alcohol content. The quantity of alcohol has been determined, and in all cases tests made for wood alcohol. The amounts of alcohol are expressed in terms of per cent. by volume.

The following contain no alcohol:

14718. *A. D. S. Liquid Shampoo,* American Druggists Syndicate, New York.

14578. *Witch Hazel Face Lotion,* E. A. & W. E. Child, East Hampton.

The following contain alcohol approximately as declared:

14824. *A. D. S. Almond Cream Compound,* American Druggists Syndicate, New York. Claimed 7, found 7.48 per cent.

14779. *Ayer's Hair Vigor,* J. C. Ayer Co., Lowell, Mass. Claimed 15, found 14.50 per cent.

14851. *Barry's Tricopherous for the Hair,* A. C. Barry, New York. Claimed 81, found 80.70 per cent.

14829. *Colgate's Cashmere Bouquet,* Colgate & Co., New York. Claimed 79, found 77.15 per cent.

14830. *Colgate's Shampoo Mixture,* Colgate & Co., New York. Claimed 34, found 31.16 per cent.

14563. *Danderine,* Knowlton Danderine Co., Chicago. Claimed 9, found 8.10 per cent.

14717. *Danderine Hair Tonic,* Knowlton Danderine Co., Chicago. Claimed 9, found 8.78 per cent.

14827. *Dearco Scalp and Hair Tonic,* Davies, Rose & Co., Boston. Claimed 20, found 20.18 per cent.

14725. *Gill's Lustro for Growth of Hair.* Claimed 40, found 37.40 per cent.

14726. *Guilmartin's Violet Toilet Water,* T. F. Guilmartin, Hartford. Claimed 40, found 40.60 per cent.

14797. *Hobson's Dandruff Remedy,* Pfeiffer Chemical Co., New York. Claimed 3.50, found 4.06 per cent.

14835. *Ilasol,* Riker-Hegeman, New York. Claimed 15, found 14.84 per cent.

14833. *Jergen's Benzoin & Almond,* Andrew Jergen Co., New York. Claimed 10, found 11.86 per cent.

14831. *Jergen's Violet Glycerine Shampoo,* Andrew Jergen Co., New York. Claimed 9, found 8.90 per cent.

14769. *Kickapoo Sage Hair Tonic,* The Kickapoo Indian Medicine Co., Clintonville. Claimed 25, found 24.96 per cent.

14576. *Merton's Hair Tonic,* The Bonheur Co., Syracuse, N. Y. Claimed 48, found 50.25 per cent.

14841. *Nyal's Hirsutone,* Nyal Co., Detroit, Mich. Claimed 8, found 7.46 per cent.

14840. *Nylotis Shaving Lotion,* Nyal Co., Detroit, Mich. Claimed 16, found 15.04 per cent.

14778. *Parisian Sage Hair Tonic,* The Giroux Mfg. Co., Buffalo, N. Y. Claimed 12, found 11.80 per cent.

14755. *Parke, Davis & Co.'s Larkspur Lotion,* Parke, Davis & Co., Detroit, Mich. Claimed 13, found 13.34 per cent by weight, 16.44 by volume.

14825. *Phoebe Snow Eau Vegetal,* Phoebe Snow Laboratories, New York. Claimed 50, found 50.88 per cent.

14843. *Pinaud's Eau de Quinine Hair Tonic,* Ed Pinaud, Paris. Claimed 68, found 66.65 per cent.

14849. *Pompeian Hair Massage,* Pompeian Mfg. Co., Cleveland, Ohio. Claimed 17, found 16.56 per cent.

14770. *Rexall Hair Tonic,* United Drug Co., Boston. Claimed 24, found 23.90 per cent.

14814. *Rexall Tooth Wash,* United Drug Co., Boston. Claimed 35, found 32.46 per cent.

14763. *Royal Ibis Hair Tonic,* Associated Pharmacies, New York. Claimed 16, found 14.40 per cent.

14789. *San-Tox Scalp Wonder,* De Pree Chem. Co., Chicago. Claimed 10, found 10.06 per cent.

14844. *Schieffelin's Florida Water,* Schieffelin & Co., New York. Claimed 60, found 57.75 per cent.

14573. *Seidman's Carnation Hair Tonic,* Nathan Seidman, Hartford. Claimed 10, found 9.70 per cent.

14577. *Seidman's Genuine Sage Head Tonic,* Nathan Seidman, Hartford. Claimed 20, found 21.70 per cent.

14812. *Whitman's Quinine Hair Tonic,* Whitman Chem. Co., Boston. Claimed 30, found 29.00 per cent.

14768. *Wildroot Dandruff Remedy,* Wildroot Chem. Co., Buffalo, N. Y. Claimed not over 40, found 33.06 per cent.

The following contain wood alcohol:

14724. *Gill's Sage Lotion,* sold by T. F. Guilmartin, Hartford. Claimed 50 grain alcohol, found 48.48 per cent. total alcohol, 30.30 per cent. of which is wood alcohol.

14723. *Guilmartin's Eau de Quinine Hair Tonic,* Compound, T. F. Guilmartin, Hartford. Claimed 50 grain alcohol, found 40.58 per cent. total alcohol, 15.50 per cent. of which is wood alcohol.

The following contain alcohol in amounts varying widely from claims:

14842. *Colgate's Quinol Hair Tonic,* Colgate & Co., New York. Claimed 35, found 29.16 per cent.

14813. *DeWitt's Toilet Cream,* E. C. DeWitt & Co., New York. Claimed 6, found 2.64 per cent.

14850. *Graham's Hair Color,* Mrs. Gervaise Graham, Chicago. Claimed 25, found 14.02 per cent.

14796. *Hale's Ton-A-Quin Hair Tonic,* H. R. Hale Co., Hartford. Claimed 29, found 32.46 per cent.

14811. *Hall's Vegetable Sicilian Hair Renewer,* R. P. Hall, Nashua, N. H. Claimed 15, found 13.16 per cent.

14852. *Hay's Cocoanut Oil Shampoo,* Philo Hay Specialties Co., Newark, N. J. Claimed 10, found 1.20 per cent.

14867. *Hoffman's Hair Tonic,* F. J. Mangini, Waterbury. Claimed 45, found 40.30 per cent.

14828. *Hudnut's Liquid Green Soap,* Richard Hudnut, New York. Claimed 20, found 16.10 per cent.

14837. *Jayne's Denteen,* Jaynes Drug Co., Boston. Claimed 27, found 22.40 per cent.

14759. *Lavallie's Special Pine Needle Shampoo,* J. W. Lavallie & Co., Willimantic. Claimed 4, found 0.20 per cent.

14559. *Lowe's Liquid Green Soap,* Willis H. Lowe Co., Boston. Claimed 10, found 1.43 per cent.

14873. *Newbro's Herpicide,* The Herpicide Co., Detroit, Mich. Claimed 40, found 35.31 per cent.

14823. *Packer's Liquid Tar Soap,* The Packer Mfg. Co., New York. Claimed 10, found 8.02 per cent.

14757. *Qban Hair Tonic,* Hessig-Ellis Drug Co., Memphis, Tenn. Claimed 25, found 20.96 per cent.

14836. *Riker's Septone Soap,* Riker-Hegeman, New York. Claimed 20, found 17.40 per cent.

14862. *Royal Pearl,* The H. R. Hale Co., Hartford. Claimed 29, found 32.52 per cent.

14786. *San-Tox Hair Tonic,* The De Pree Chem. Co., Chicago. Claimed 15, found 12.66 per cent.

14572. *Seidman's Eau de Quinine Compound Hair Tonic,* Nathan Seidman, Hartford. Claimed 30, found 25.38 per cent.

14574. *Seidman's Compound Hair Tonic,* Nathan Seidman, Hartford. Claimed 30, found 26.80 per cent.

14575. *Seidman's Germicide Famous Hair Tonic.* Nathan Seidman, Hartford. Claimed 30, found 18.70 per cent.

14863. *Toiletine,* The Toiletine Co., Greenfield, Mass. Claimed 15, found 12.84 per cent.

14815. *Vernas Lotion,* Vernas Chem. Co., New York. Claimed 10, found 8.26 per cent.

14834. *Vivandon Lotion Vegetole,* sold by Louis K. Liggett Co., New Britain. Claimed 76, found 70.60 per cent.

14760. *Wyeth's Sage & Sulphur Compound,* Wyeth Chem. Co., New York. Claimed 5, found 4.36 per cent.

14795. *Westphal's Auxiliator,* Paul Westphal, New York. Claimed 55, found 46.30 per cent.

The following contain alcohol without declaration:

14872. *Colgate's Lily of the Valley Toilet Water,* Colgate & Co., New York. Found 67.65 per cent.

14727. *Gill's Lilac Toilet Water,* sold by T. F. Guilmartin, Hartford. Found 33.70 per cent.

14861. *Highby's Witch Hazel and Almond Lotion,* Higby Lotion Co., New Haven. Found 5.86 per cent.

14870. *Ideal Face Cream,* Mark W. Allen, Detroit, Mich. Found 12.78 per cent.

14860. *Kelton Emulsified Cocoanut Oil Shampoo.* Found 3.74 per cent.

14869. *Mangini's Bay Rum,* F. J. Mangini, Waterbury. Found 33.02 per cent.

14865. *Mangini's Lavender Toilet Water,* F. J. Mangini, Waterbury. Found 30.10 per cent.

14866. *Mangini's Lilac Toilet Water,* F. J. Mangini, Waterbury. Found 33.42 per cent.

14845. *Palmer's Violet Toilet Water,* Palmer, New York. Found 92.35 per cent.

14803. *Robertson's Velvet Skin Lotion,* Robertson, Hartford. Found 13.10 per cent.

14808. *San-Tox Liquid Green Soap,* De Pree Chem. Co., Chicago. Found 0.76 per cent.

13885. *Sisson's Quinine Hair Tonic,* T. Sisson & Co., Hartford. Found 51.55 per cent. Quinine present.

14859. *Virginia Clover Toilet Water,* Leigh, New York. Found 69.25 per cent.

14871. *Williams' Khush-Amadi Toilet Water,* The J. B. Williams Co., Glastonbury. Found 72.71 per cent.

Of the 75 samples 2 contained no alcohol, 32 contained grain alcohol in approximately the amounts claimed, 2 contained wood alcohol, 25 contained grain alcohol in amounts at variance with the claims of the label, while 14 contained grain alcohol when none was declared. There is some question as to the necessity of a declaration of alcohol in preparations not making specific curative claims, and probably these samples come within the law.

Gill's Sage Lotion and *Guilmartin's Eau de Quinine Hair Tonic* are distinctly dangerous preparations to use because of their content of wood alcohol and their sale is illegal in this State.

PROPRIETARY REMEDIES.

11518. *Capudine.* (Hicks' Capudine Liquid). Capudine Chemical Co., Raleigh, N. C. For headaches, neuralgia, sciatic rheumatic and periodic pains, sea sickness, train nausea, colds, grippe and nervousness from the use of tobacco.

Examination and analysis showed the following composition:

A brown liquid with a sweet saline taste and the odor of menthol and aromatics. Specific gravity at 15.6° 1.1861; alcohol none; solids 32.46 per cent.; ash 9.16 per cent., containing potassium 2.61 per cent., sodium 0.64 per cent., bromine 5.14 per cent., carbon dioxide present; salicylic acid 2.26 per cent.; caffein 0.71 per cent.; cane sugar 19.10 per cent.; total nitrogen 0.30 per cent.; nitrogen as ammonia 0.08 per cent.

The preparation is essentially a non-alcoholic syrupy liquid containing caffein, bromides and salicylates.

11521. *Diabetina.* Diabetina Company Inc., 3785 Broadway, New York City. Price $2.00 per bottle; contents 8 ounces. Literature accompanying the preparation states: "It is made chiefly from the leaves of certain plants indigenous to South America; contains no habit-forming drug, and only as much alcohol as is absolutely necessary for its preparation. As regards its physiological effects it may be said that it contains one of the very best liver stimulants known to medical science, and is not irritating to the kidneys." Weekly examinations of the urine are recommended and the patient advised to consult a physician at once on the appearance of any sudden increase in sugar elimination. It is suggested that the best way to begin treatment with Diabetina is to live one week on a strict diet of meat soup, beef tea, fish of all kinds, butchers' meat (no liver), poultry, game, eggs, approved green vegetables (a diet list is appended), salads, milk, cream, butter, cheese, cream cheese, tea, coffee, and mineral waters, excluding sugar. Diabetina is to be taken simultaneously as directed and the urine examined for sugar at the end of one week. If the sugar excretion is low carbohydrates may be taken sparingly. It is claimed that while taking Diabetina, carbohydrates may be indulged in moderately and with great benefit in preserving the body albumin and in markedly diminishing acetonuria.

The diet recommended above must, of itself, result in decreased sugar elimination if rigidly adhered to; and the patient looking for evidence as to the merits of Diabetina will want to compare the results of the diet alone with those obtained together with the supplementary treatment.

Examination and analysis showed the following composition:

A dark brown fluid of bitter and astringent taste. Specific gravity at 15.6° 1.1047; alcohol 8.24 per cent.; glycerin none; total solids 27.80 per cent.; reducing sugar as dextrose, before inversion 6.96 per cent., after inversion 7.17 per cent.; total nitrogen 0.257 per cent.; ash 3.14 per cent. (includes calcium oxide 0.15 per cent.; magnesium oxide 0.20 per cent.; sodium oxide 0.22 per cent.; potassium oxide 1.31 per cent.; sulphates, chlorides, and phosphates, traces; carbon dioxide, much); acetates none; citrates trace; ether extract from acid soln. 1.28 per cent. (includes bitter and astringent principles but no emodin-like substances); alkaloid or alkaloids present, unidentified; tannins relatively high.

11519. *Freezone.* The Edward Wesley Co., Distributors, Cincinnati, Ohio. For corns, calluses and warts. Stated to contain alcohol 20 per cent. and ether 300 minims per fluid ounce.

Qualitative examination showed the following ingredients:

Ethyl alcohol; ether; collodion; zinc chloride; salicylic acid.

11514. *Iro-Nux.* Manufacturer not stated. Sold by The Gillespie Drug Co., New Haven, Conn. A laxative iron. Seventy-five tablets cost 75 cents.

Examination and analysis showed the following composition:

Uncoated tablets with bitter taste. Average weight tablet 6.08 grains. Loss at 100° 2.38 per cent.; ash 18.38 per cent. (contains talc 4.78 per cent., iron oxide 10.39 per cent., aluminum oxide 0.37 per cent., calcium oxide 0.64 per cent., and small amounts of potassium, phosphates, chlorides, sulphates and carbonates); ash of water soluble solids 1.28 per cent.; water soluble iron equivalent to 0.22 per cent. Fe_2O_3; total nitrogen 0.09 per cent.; invert sugar 1.80 per cent.; cane sugar 58.14 per cent.; total alkaloids 0.21 per cent. (strychnine and brucine identified); emodin-like substances present, rhubarb identified.

The medicament in these tablets appears to be chiefly saccharated ferrous carbonate, nux-vomica and vegetable cathartics. There is not enough nitrogen to indicate any considerable amount of iron as peptonate.

11513. *Ki-moids.* Scott and Browne, Bloomfield, N. J. For indigestion. Thirty tablets cost 25 cents.

Examination and analysis showed the following composition:

Oval, black tablets with wintergreen odor. Average weight per tablet 4.94 grains. Loss at 100° C. 29.96 per cent.; ash 53.16 per cent.; ash insoluble in acid 0.24 per cent.; total sodium (Na_2O) 30.38 per cent.; sodium bicarbonate 80.64 per cent.; methyl salicylate and rhubarb present.

Protein-digesting power was tested for, using egg albumin in 1 per cent. salt solution as substrate. Ten cc. of this solution were found to contain 0.1044, 0.1024, average 0.1034 gm. protein.

A. Ten cc. egg white solution digested at 80° C. for 15 min. Total nitrogen in coagulum equivalent to 0.1038 gm. protein.

B. Ten cc. egg white solution + 0.3202 gm. tablet powder (equivalent to average weight of one tablet) digested as in A, the enzyme being previously killed by heat. Total nitrogen in coagulum equivalent to 0.1044 gm. protein.

C. Same as B except that enzyme was not destroyed. Total nitrogen in coagulum equivalent to 0.1063 gm. protein.

D. Same as C except that 0.6404 gm. of tablet powder (equivalent to two tablets) was used. Total nitrogen in coagulum equivalent to 0.1088 gm. protein.

We find no evidence that the tablets possess any protein-digesting capacity.

9906. *Tescum Powders.* H. J. Brown Medicine Co., Cleveland, Ohio. A treatment for the liquor habit. Fourteen powders cost $1.00.

Examination and analysis showed the following composition:

Average weight per powder 6.74 grains. Total nitrogen 4.55 per cent.; total chlorine 11.30 per cent.; lactose 76.00 per cent.; gold none found; alkaloid trace, unidentified.

Milk sugar and ammonium chloride constitute over 93 per cent. of each powder.

11520. *Tongaline and Quinine Tablets.* Mellier Drug Company, St. Louis. For malarial conditions and especially those of rheumatic and neuralgic character, etc. Fifty tablets cost 55 cents.

Examination and analysis showed the following composition:

Average weight per tablet 5.78 grains. Loss at 100° 5.09 per cent.; ash 30.12 per cent.; ash insoluble in hydrochloric acid 10.65 per cent.; acid-soluble ash contains mixed iron and aluminum oxides 0.53 per cent.; calcium oxide 1.35 per cent., magnesium oxide 1.61 per cent., potassium oxide 1.01 per cent., sodium oxide 1.43 per cent., sulphate (SO_4) 10.10 per cent. and carbonate small amount; salicylic acid 3.31 per cent.; quinine 4.66 per cent.; emodine-like substances present.

The tablets contain salicylates and quinine. The name suggests, and the tablets probably contain tonga, a mixture of various barks, or an extract thereof, long since recognized as therapeutically inert. The ash constituents are attributable largely to the vegetable drugs present.

11515. *Vitalitas.* Vital Remedies Co., Houston, Texas. "Exclusively produced from our deposit of natural vitalitas mineral." Eight ounces cost $1.00. Stated to be a family remedy for rheumatism, chronic indigestion, impoverished blood and many other disorders.

Examination and analysis showed the following composition:

A light brown liquid with astringent, ferruginous taste. Specific gravity at 15.6° 1.0390; alcohol, glycerin, alkaloids or vegetable extractives none; total iron (Fe) 0.51 per cent., of which 0.42 per cent. is ferrous, and 0.09 per cent. is ferric iron; aluminum (Al) 0.34 per cent.; total sulphate (SO_4) 2.85 per cent.; lime, magnesium, sodium, and potassium slight amounts.

The preparation is an aqueous solution of ferrous, ferric and aluminum sulphates.

11515. B. *Vitalitas Laxatives.* A package of six chocolate coated tablets was included in the carton with the liquid vitalitas described above. Examination showed them to contain vegetable cathartics, cascara being identified. No phenolphthalein was present.

MISCELLANEOUS DRUGS, ETC.

Seven samples of miscellaneous drug preparations were submitted by physicians or individuals for examination.

13369. *Welch's Aegopodium,* was examined for alcohol and found to contain 12.10 per cent. by volume.

13486. *Elixir of Catnip and Fennel Compound.* This is not a U. S. P. or National Formulary preparation but as usually prepared it contains fennel, spearmint, catnip and bicarbonate of soda. Qualitatively the sample appeared to be normal except as regards color and a pronounced peppermint odor.

12574. *Citrate of Magnesia.* The preparation contained 1.29 grams of magnesium oxide and 7.13 grams of citric acid per 100 cc. and had therefore only 86 per cent. of the magnesia and 75.6 per cent. of the citric acid required by the U. S. Pharmacopoeia.

13414, *Goldine, Formula No. 1,* and **13415,** *Goldine, Formula No. 2.* The Goldine Mfg. Co., Buffalo, N. Y., Albany, N. Y. and Bridgeburg, Canada.

Examination and analysis showed the following results:

13414. A brown liquid with sweet vinous odor and a bitter after taste. Specific gravity at 15.6° 1.0295; alcohol by volume 10.95 per cent. The following constituents are in grams per 100 cc.: total solids 11.44; total sugars 9.74; ash 0.32 (contains only slight amount of iron); total nitrogen 0.018; ether extract 0.0576 (contains yellow coloring matter and a bitter principle resembling *coptis* or golden thread); chloroform extract 0.0052 (faint test for alkaloids but no specific alkaloid identified. Tests for strychnine and quinine negative.)

13415. A dark brown liquid with aromatic odor and a sweet vinous taste suggesting wintergreen and sarsaparilla. Specific gravity at 15.6° 1.0225; alcohol by volume 10.92 per cent. The following constituents are in grams per 100 cc.; total solids 9.02; total sugars 7.38; ash 0.34 (contains only slight amount of iron); total nitrogen 0.024; ether extract 0.146 (contains oil of wintergreen, sarsaparilla, coloring matter and bitter principle resembling *coptis*), chloroform extract 0.0116 (alkaloids present but no specific alkaloid identified; tests for strychnine and quinine negative).

According to information on the cartons there are some twenty-five diseases or disorders for which each of these preparations "has been used with success." We find nothing to convince us of their efficacy against such an array of diseases and believe the chief results will be derived from the alcohol and from the laxative pills with which they are directed to be used.

12653. Medicine sent for identification if possible. The preparation was a pale reddish solution with an orange odor and a saline taste. It contained sugar and the bromides of ammonium, sodium and potassium. Quantitatively it corresponded closely, and was probably intended to be, the National Formulary preparation known as Elixir of Three Bromides.[1]

12586. A white odorless powder with faintly sweet taste. It consisted of 97.6 per cent. of milk sugar but no evidence of mineral or vegetable medicament could be obtained. The powder may have been treated with some of the dilutions of the homeopathic pharmacopoeia.

Seven samples of drugs were sent by physicians, or prosecuting attorneys for identification or analysis, none of which require particular comment.

Other miscellaneous materials, eleven in number, were as follows:

13350, identified as arsenate of lead. **12675,** arsenate of lead, contained 32.11 per cent. of arsenic oxide and 63.17 per cent. of lead oxide. **11771,** bricketts used for fuel, contained moisture 2.54 per cent., volatile and combustible matter 9.56 per cent., fixed carbon 70.70 per cent., and ash 17.20 per cent. **12963** lime-sulphur concentrate, contained lime and sulphur in normal proportions for a solution of high density. **12964** was arsenate of lead which was low in water-soluble arsenic and not excessive in water soluble impurities.

Three samples of water were examined for chlorine content: **13245** was spring water and contained 0.0025 gram of chlorine per litre. **13246** was well water and contained 0.0800 gram per litre. This high chlorine was thought to be due to drainage from road treated with chloride of lime. **13247** was well water

[1] National Formulary, 4th edition, p. 39.

which showed no appreciable chlorine content (0.0025 gram per litre), and the water from which was unobjectionable.

A compound called *"Carbokill,"* **13396,** for use in gasoline to give increased power and prevent carbon accumulation, appeared from the analysis to be commercial naphthaline. The powdered tablets melted at 79°C. and the picric acid derivative melted at 150°C. These figures are in accord with those given by Allen, Mullikin and Scudder and others for pure naphthaline.

Two samples of linseed oil were examined and not found to be adulterated.

SUMMARY.

Materials.	Sampled by			From all sources.	Found adulterated, below standard or otherwise illegal.
	Station Agent.	Dairy and Food Commissioner.	Individuals.		
Foods.					
Baking powder	19	....	...	19	11
Beverages:					
Non-intoxicating	17	9	...	26	6
Home-made beer	...	....	2	2	...
Soft drinks	12	100	1	113	19
Cider	...	1	10	11	...
Wine	...	....	6	6	...
Cereal products:					
Breakfast foods	3	....	2	5	...
Bread	...	....	4	4	...
Flour	9	....	7	16	...
Chocolate and cocoa	...	3	...	3	...
Fats and Oils:					
Olive oil	...	4	2	6	2
Cooking fats	1	....	...	1	...
Butter	...	27	2	29	6
Oleomargarine	...	1	...	1	1
Gelatin	10	....	...	10	...
Ice cream	...	330	18	348	35
Jams and jellies	24	....	...	24	5
Milk and Milk Products:					
Market milk	...	1,197	119	1,316	486
Condensed milk	14	....	...	14	...
Cream	...	12	17	29	...
Human milk	...	....	12	12	...
Soups and bouillons	22	....	...	22	...
Vinegar	...	12	25	37	17
Miscellaneous	6	1	32	39	...
Total	137*	1,697	259	2,093	588
Drugs.					
Aspirin	...	23	...	23	1
Proprietary remedies	9	....	...	9	...
Spirit of Camphor	...	17	...	17	10
Tincture of Ferric Chloride	...	12	...	12	1
Tincture of Iodine	...	17	...	17	5
Toilet preparations	...	75	...	75	27
Witch Hazel	...	14	...	14	...
Miscellaneous	...	....	25	25	...
Total	9	158	25	192	44
Total, foods and drugs	146	1,855	284	2,285	632

* Exclusive of diabetic food products examined.