State of Connecticut

REPORT

OF

The Connecticut Agricultural Experiment Station

FOR THE YEAR 1911

State of Connecticut

PUBLIC DOCUMENT No. 24

Thirty-fifth Annual Report

OF

The Connecticut Agricultural Experiment Station

Being the annual report for the year ended October 31

1911

PRINTED BY ORDER OF THE LEGISLATURE

HARTFORD
PUBLISHED BY THE STATE
1912

PUBLICATION

APPROVED BY

THE BOARD OF CONTROL.

THE TUTTLE, MOREHOUSE & TAYLOR COMPANY

CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

OFFICERS AND STAFF.

SEPTEMBER 30, 1911

BOARD OF CONTROL.

His Excellency, SIMEON E. BALDWIN, *ex officio, President.*

PROF. H. W. CONN, *Vice President*	Middletown
GEORGE A. HOPSON, *Secretary*	Wallingford
E. H. JENKINS, *Director and Treasurer*	New Haven
JOSEPH W. ALSOP	Avon
WILSON H. LEE	Orange
FRANK H. STADTMUELLER	Elmwood
JAMES H. WEBB	Hamden

STATION STAFF.

ADMINISTRATION.	E. H. JENKINS, PH.D., *Director and Treasurer.* MISS V. E. COLE, *Librarian and Stenographer.* MISS L. M. BRAUTLECHT, *Bookkeeper and Stenographer.*
CHEMISTRY.	
ANALYTICAL LABORATORY.	JOHN PHILLIPS STREET, M.S., *Chemist in Charge.* E. MONROE BAILEY, PH.D., C. B. MORRISON, B.S., R. B. ROE, A.B., C. E. SHEPARD, *Assistants.* HUGO LANGE, *Laboratory Helper.* V. L. CHURCHILL, *Sampling Agent.*
PROTEID RESEARCH.	T. B. OSBORNE, PH.D., *Chemist in Charge.* MISS E. L. FERRY, A.B., *Assistant.* MISS LUVA FRANCIS, *Stenographer.*
BOTANY.	G. P. CLINTON, S.D., *Botanist.* E. M. STODDARD, B.S., *Assistant.* MISS M. H. JAGGER, *Seed Analyst.* MISS E. B. WHITTLESEY, *Herbarium Assistant.*
ENTOMOLOGY.	W. E. BRITTON, PH.D., *Entomologist; also State Entomologist.* B. H. WALDEN, B.AGR., D. J. CAFFREY, B.S., A. B. CHAMPLAIN, *Assistants.* MISS E. B. WHITTLESEY, *Stenographer.*
FORESTRY.	SAMUEL N. SPRING, M.F., *Forester; also State Forester and State Forest Fire Warden.* W. O. FILLEY, *Assistant; also Asst. State Forester.* MISS E. L. AVERY, *Stenographer.*
PLANT BREEDING.	H. K. HAYES, B.S., *Plant Breeder.* C. D. HUBBELL, *Assistant.*
BUILDINGS AND GROUNDS.	WILLIAM VEITCH, *In Charge.*

TABLE OF CONTENTS.

REPORT OF THE BOARD OF CONTROL

OF

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

To His Excellency, Simeon E. Baldwin, Governor of Connecticut:

The Board of Control of The Connecticut Agricultural Experiment Station herewith respectfully submits its report for the year ending November 1, 1911.

The following minute regarding William Henry Brewer, for many years a member of this Board, was adopted by the Board at its meeting on December 22, 1910:

Professor William H. Brewer, Ph.D., LL.D., a member of this Board for thirty-three years, died at his home in New Haven on November 2, 1910. His manifold work as geographer, botanist, sanitarian and teacher needs no recital here.

As one of the pioneers in bringing agricultural science to the knowledge of farmers and teaching its value for practical ends, his name will be held in grateful remembrance by the farmers of this State.

Born and brought up on a farm and having personal experience of farm work, he began his studies in Yale College with the object of fitting himself for the life of a farmer. Drawn by his tastes for natural science and eagerness to follow up the studies he had begun, he finished the regular course and graduated at the Sheffield Scientific School in 1852. After studying abroad at Paris, Heidelberg and Munich, serving as a college professor at Washington College, Pennsylvania, and the University of California, and working for four years on the survey of California, he returned to the Scientific School of Yale as professor of agriculture in 1864, and held that position until his retirement as professor emeritus in 1903.

He was professor of agriculture not only within college halls but everywhere in the State. His intimate acquaintance with practical farming, his scientific attainments, the wide range of his knowledge and of his interests, together with his broad common sense, made him a welcome and effective speaker at farmers' gatherings everywhere.

He was earnest and influential in establishing this Agricultural Experiment Station and he served it wisely and effectively until he died. His last public act was to attend a meeting of this Board only a few days before his death.

Probably no one in the University during the last fifty years was called on so often and so variously for public service outside of the institution as Professor Brewer, and in all of it he was faithful, tactful and efficient.

THE MEMBERS OF THIS BOARD wish here to record their sense of personal loss, their appreciation of his rare qualities as a friend and adviser, and of his long and effective labors for the advance of agriculture.

IT IS ORDERED that this minute be entered on the records of this Station and that a copy be sent to Professor Brewer's family.

A detailed account of the work of each of the several departments of the Station will appear in the reports of individual members of the staff, which are now in preparation.

We therefore only call attention to certain facts relating to the Station welfare which will not be discussed in those publications.

The General Assembly, at the January session of 1911, appropriated $6,500 to this Station to cover the loss caused by the fire of January 10, 1910.

Chapter 192 of the Public Acts of 1911 provides for the printing of an annual report of this Station, which had been the practice for thirty years, in place of the biennial report required by statute during the last four years.

Chapter 134 of the Public Acts of 1911 requires that the net contents of all packages of food products shall be plainly marked on the outside in terms of weight, measure, or numerical count, and that the director of this Station, with the Dairy and Food Commissioner, shall establish rules and regulations as to the reasonable variations and allowances which shall be permitted. No penalty is to be enforced prior to eighteen months from the passage of this Act.

Chapter 274 forbids adulteration of turpentine or spirits of turpentine and makes it the duty of the Dairy and Food Commissioner and the director of this Station "acting jointly" to enforce this law. To the Commissioner alone is given the right of inspection. This statute, unlike any other relating to adulteration, makes the Station jointly responsible for enforcing the law. This is a departure from previous policy. Hitherto the Station's responsibility has been limited to testing suspected articles, reporting its findings to the Commissioner, and giving expert evidence in court when required.

There have been no changes of importance in the Station staff except that Mr. Walter O. Filley has been appointed assistant state forester, an office created by the last General Assembly, and Mr. A. B. Champlain, an assistant in the entomological department, resigned October 1, 1911, to accept a position in the State Laboratory of Economic Zoology of Pennsylvania.

During the fall, an exhibit illustrative of the several departments of the Station work was made at six agricultural fairs and also at the Station grounds in New Haven, the last especially for the teachers of the State who were attending a convention at the time in New Haven. Members of the Station staff were in constant attendance at all these exhibits to explain them and to answer questions. This involved the almost complete suspension of our regular laboratory work for nearly six weeks, which was a serious interruption. The large attendance, however, and the interest shown in the Station work as illustrated by the exhibits convince us that this is one of the most effective ways of diffusing information regarding our work among the farmers of the State.

The Station has bought a farm of twenty acres at Mount Carmel, not far from the city, including a small house for the caretaker, has set out an orchard of apples and peaches for experiment, has begun an experiment on the effect both on the crop and on the soil of fertilizers and manures, and another on the handling of an old and neglected orchard.

At the Centerville field, which will be given up in the spring of 1912, we have over 800,000 white pine seedlings, three years old, which are being sold at cost to citizens of this State for forest planting.

On this field also corn and tobacco breeding work, as well as other experiments, has been carried on during the present year. Hereafter this work will be concentrated on our own fields at Mount Carmel.

The Station receives one-half of the so-called Adams Fund which, by Act of Congress and the rulings of the Secretary of Agriculture, must be used wholly for scientific research, preferably in a small number of "projects" approved by the Office of

Experiment Stations. The Station's share of this fund is devoted to two projects: a study of the laws of inheritance in maize and tobacco, and a study of the composition, structure and relative nutritive value of the vegetable proteins. This last project, which has engaged Dr. Osborne's time for many years, now receives very substantial aid from the Carnegie Institution of Washington.

Bulletin 167, Inheritance in Maize, gives an account of five years' study of the subject, and Bulletin 168 is a discussion of the facts discovered which may be of immediate practical account. The results of work on the other project are published in physiological and chemical journals and in monographs of the Carnegie Institution and are not further noticed in this report.

During the year there have been issued parts of a biennial report aggregating 512 pages with 21 plates in editions of 10,000 copies, and three bulletins aggregating 174 pages with 30 plates. Nine thousand five hundred copies of one of these were printed, of another three thousand, but of the third, which was so technical as to be of value chiefly to investigators, only one thousand were printed. The spray calendar has also been revised to include the results of recent work and is mailed as requested.

Fifty-one addresses have been given by members of the staff at farm institutes, field meetings, granges and other gatherings of farmers, and the Station correspondence has involved the writing of more than 9400 letters and manuscript reports.

The following summary shows in brief the departments of the Station work and the special directions it has taken:

Entomological Department.

Inspection of all the nurseries in the State and of imported nursery stock to prevent distribution of insect and fungous pests; inspection of apiaries on request or complaint; gypsy moth control work at Stonington and Wallingford; search for the browntail moth and destruction of its winter nests in northeastern Connecticut; studies of life-histories of certain insects, preparation of exhibits; and publications in various journals on entomological subjects; also coöperation with the botanical department in the study of summer sprays, which is described below.

Botanical Department.

The preparation of artificial cultures of many fungi, most of them of economic importance, for purposes of investigation; studies on the oöspore production of the potato blight in artificial cultures and the relation of media to the stages and character of growth of fungi in artificial cultures; publication of papers on botanical subjects; studies in the field of the chestnut blight, calico of tobacco and peach yellows; tests of Millar's Cream muskmelon; and spraying experiments with melons, cucumbers and potatoes.

In coöperation with the Entomological Department, very extensive and careful tests have been made to determine the comparative value of the various summer sprays on apples, peaches, pears, plums, cherries and some other fruits. The tests were made in thirteen orchards and involved the individual examination of 93,000 apples and about 25,000 peaches.

Seed Testing.

Tests of purity and vitality of field and garden seeds and identification of weed seeds for farmers and dealers; and studies of methods of seed testing.

Forestry Department.

The care of the three Station nurseries, containing about 1,100,000 young trees for forest planting; care of the Station forest plantations, including forest planting, cleaning out worthless species and liberation cutting; a test of basket willows; a demonstration planting of red and white pine at Putnam Memorial Camp Ground; inspection of State forests and destruction of pine weevil; making fire lines and improvement thinning at the Portland forest; the careful gathering of statistics of the 828 forest fires of the year which caused damage amounting to more than $235,000. New and desirable legislation has been secured regarding forest fires and the work of the forest fire wardens further systematized. Examinations of woodland for private owners have been made and advice given regarding planting, thinning and cutting. In coöperation with the U. S. Forest Service a study is being made of the woodworking industries of the State, to get if possible a better utilization of home-grown woods and give the woodland owner information as to markets for his product.

Chemical Department.

Analyses and published reports of all commercial fertilizers sold in the State, of commercial feeds, and of human food products and drugs; examinations of foods and drugs for the Dairy and Food Commissioner, and expert evidence in court as required; study of methods of analysis; and analytical work required in connection with field experiments.

Plant Breeding.

(Supported by Adams Fund)

Studies of inheritance of characters in corn and tobacco and of the yields of first year corn hybrids.

Protein Research.

(Supported by Adams Fund)

Studies of the composition, structure and relative nutritive values of the vegetable proteins.

The above list of the important parts of the Station work illustrates how it covers the whole State and affects the interests of all its citizens, whether farmers or not.

Each session of the General Assembly adds to the State's requirements of the Station, the calls made by farmers and others for the help which it is the object of a Station to give, and the natural and inevitable expansion of its work have made the Station's income insufficient for its needs. The strictest economy will be necessary for the next year, and without a larger income than it now has the work which it is doing must thereafter be lessened and its working force cut down. For the general expenses of the Station no increase of appropriation has been made by the State since 1895.

All of which is respecctfully submitted.

George A. Hopson, *Secretary.*

REPORT OF THE TREASURER, 1911

E. H. Jenkins, in account with The Connecticut Agricultural Experiment Station for the fiscal year ending September 30, 1911.

Receipts.

Balance on hand, October 1, 1910 (State Agricultural Appropriation)		$1,655.26
State Appropriation, Agriculture	$10,000.00	
State Appropriation, Food	2,500.00	
State Appropriation, Insect Pest	3,000.00	
State Appropriation, Gypsy Moth	4,000.00	
United States Appropriation, Hatch	7,500.00	
United States Appropriation, Adams	7,500.00	
Analysis Fees	12,500.00	
Sale of Farm Products	80.79	
Miscellaneous Receipts	339.81	
From the Lockwood Estate	16,611.25	
		64,031.83
Total		$65,687.09

Disbursements.

E. H. Jenkins, director, salary	$2,800.00
E. H. Jenkins, treasurer, "	400.00
W. H. Brewer, salary	8.34
G. A. Hopson, "	75.00
V. E. Cole, "	850.00
L. M. Brautlecht, "	750.00
J. P. Street, "	2,500.00
T. B. Obsorne, "	2,400.00
E. M. Bailey, "	1,550.00
C. B. Morrison, "	1,158.34
R. B. Roe, "	1,093.75
C. E. Shepard, "	875.00
W. E. Britton, "	2,000.00
G. P. Clinton, "	2,200.00
E. M. Stoddard, "	758.32
S. N. Spring, "	2,500.00
W. O. Filley, "	1,030.73
H. K. Hayes, "	1,125.00
E. L. Ferry, "	1,033.32
H. Lange, "	925.00
V. L. Churchill, "	825.00
Wm. Veitch, "	675.00
Luya Francis, "	350.00

E. L. Avery, salary	$ 390.00	
H. W. Kiley (Labor)	728.00	
Wm. Pokrob "	728.00	
C. D. Hubbell "	728.00	
Geo. Graham "	724.00	
M. H. Jagger "	499.00	
Jos. Keating "	180.00	
L. Robinson "	475.00	
L. Nolan "	173.00	
Labor	3,842.79	
Publications	1,137.82	
Postage	357.71	
Stationery	709.31	
Telephone and Telegraph	161.69	
Freight and Express	296.30	
Gas, Kerosene and Electricity	545.28	
Coal	1,583.00	
Water	134.44	
Chemicals and Laboratory Supplies	897.82	
Agricultural and Horticultural Supplies	2,567.05	
Miscellaneous Supplies	575.76	
Fertilizers	480.51	
Feeding Stuffs	188.98	
Library and Periodicals	843.58	
Tools and Machinery	334.31	
Furniture and Fixtures	294.00	
Scientific Apparatus	218.02	
Live Stock	11.00	
Traveling by the Board	118.11	
Traveling by the Staff	1,295.91	
Traveling in connection with Adams Fund Investigations	139.71	
Fertilizer Sampling	231.60	
Food Sampling	249.25	
Insurance	65.80	
Insect Pest Appropriation to State Entomologist	3,000.00	
Contingent	572.51	
Lockwood Expenses	400.00	
Gypsy Moth Appropriation to State Entomologist	4,000.00	
New Buildings	396.90	
Betterments	1,035.39	
Repairs	337.14	
Rental of Land	105.00	
Purchase of Land	6,000.00	
		$65,634.49
Analysis Fees on hand Sept. 30, 1911		52.60
Total		$65,687.09

New Haven, Conn., Nov. 14th, 1911.

This is to Certify that we have examined the accounts of E. H. Jenkins, Treasurer of The Connecticut Agricultural Experiment Station, for the year ending Sept. 30th, 1911, have compared the same with the vouchers therefor and found them correct.

William P. Bailey,
Edward S. Roberts,
Auditors of Public Accounts.

E. H. Jenkins, in account with The Connecticut Agricultural Experiment Station for the fiscal year ending Sept. 30, 1911.

Receipts and Disbursements in connection with the rebuilding of the laboratory building destroyed by fire January 10, 1910.

Receipts.

Balance on hand Oct. 1, 1910	$141.48	
Salvage	5.89	
		$147.37

Disbursements.

Fixtures	$ 3.05	
Apparatus, Laboratory Supplies and Miscellaneous	22.97	
Part of interest on loan of $6,000	121.35	
		$147.37

This Certifies that we have examined the account which relates to loss by fire and rebuilding new building, have compared the same with the vouchers therefor and find them correct, the said account being closed and balanced by the expenditure of all moneys in the account, same being evidenced by vouchers on file and bank book.

William P. Bailey,
Edward S. Roberts,
Auditors of Public Accounts.

ERRATA.

Page 124, Stollwerck's Milk Cocoa is stated to contain glucose. This statement is an error. There is no evidence of the presence of glucose or other adulterant in this brand.

Page 200, nineteenth line from top, for henzoic read benzoic.

Page 227, "The Biles' product" mentioned under Dried Distillers' Grains refers only to rye grains, the analysis of which is given on page 250, and not at all to the other and higher grade brands of distillers' grains sold by the Biles Company.

Page 229. The manufacturers state that Husted's Steam Cooked Feed contains only whole and cracked corn and whole oats but no wheat.

PART I.

Report on Commercial Fertilizers, 1911.

By E. H. JENKINS, *Director,* and JOHN PHILLIPS STREET, *Chemist in charge of the Analytical Laboratory.*

The General Statutes require every dealer in commercial fertilizers within this state

1. To report annually to this station, with his name and address, the names of the brands which he sells.

2. To see that every package of fertilizer which he sells bears a legible and correct statement, giving the number of pounds in the package, name of the fertilizer, name and address of the manufacturer, place of manufacture and a statement of composition, expressed in a way approved by this station.

3. In case a fertilizer not hitherto sold in Connecticut is offered for sale, to file at this station, *in advance of its sale,* two certified copies of the statement above described and a sealed glass jar containing not less than a pound of the fertilizer, with an affidavit that it is a fair sample.

4. To pay to the director of the station, on or before May 1, annually, an analysis fee on every brand sold by him, which will usually be ten, twenty or thirty dollars according as one, two, or all three of the ingredients—nitrogen, phosphoric acid and potash—are contained or claimed to exist in the fertilizer.

The agent or seller is free from requirements 2, 3 and 4 only when the manufacturer or importer fulfils them instead.

The station provides blank forms for the reports of dealers and manufacturers and will send copies of the law on application.

The statutes also require this station to analyze samples of every brand of commercial fertilizer sold in the state and to prepare and publish a report on them.

OBSERVANCE OF THE FERTILIZER LAW.

During 1911, forty individuals or firms have entered for sale in this state three hundred and thirty-seven brands of fertilizers, classified as follows:

Special manures for particular crops	146
Other nitrogenous superphosphates	96
Bone manures and "bone and potash"	29
Fish, tankage, castor pomace and chemicals	66
Total	337

SAMPLING AND COLLECTION OF FERTILIZERS.

During April, May and June, Mr. V. L. Churchill, the sampling agent of this station, visited one hundred and five towns and villages in Connecticut to draw samples of commercial fertilizers for analysis. These places were distributed as follows:

Litchfield County	4
Hartford County	34
Tolland County	10
Windham County	7
New London County	13
Middlesex County	8
New Haven County	18
Fairfield County	11
	105

In these places seven hundred and twenty samples were taken.

The agent could not find the following brands which had been entered for sale in the state: American Agricultural Chemical Co.'s H. G. Sulphate, Kainit, Dried Blood, No. West. Pot. & Truck Guano, W. &. C. Royal Bone Phosphate, Bowker's H. G. Nit. Mixture, Special Crop Grower, New England Tankage, Swift's Lowell Fertz. Co.'s Nitrate Soda, Wilcox Fertz. Co.'s Steamed Bone. Therefore no analyses of them will be found in this report.

CLASSIFICATION OF THE FERTILIZERS ANALYZED.*

	Number of Samples.
1. *Containing nitrogen as the chief active ingredient.*	
Nitrate of soda	13
Dried blood	2
Cotton seed meal	273
Castor pomace	4

* The analyses of fertilizers included in this chapter have been made under the direction of Mr. Street, chemist in charge, by Messrs. Bailey, Morrison, Roe and Shepard, station chemists, and Mr. Lange. The results have been discussed by the director.

2. *Containing phosphoric acid as the chief active ingredient.*	
Basic slag phosphate	7
Precipitated bone phosphate	2
Dissolved rock phosphate or acid phosphate	15
3. *Containing potash as the chief active ingredient.*	
High grade sulphate of potash	5
Double sulphate of potash and magnesia	3
Kainit	4
Muriate of potash	17
Carbonate of potash	1
Vegetable potash	1
4. *Containing nitrogen and phosphoric acid.*	
Bone manures	28
Tankage	26
Dry ground fish	10
5. *Mixed fertilizers.*	
Acid phosphate and potash	3
Factory-mixed complete fertilizers	275
Home mixtures	13
6. *Miscellaneous fertilizers, manures and amendments*	78
Total	780

EXPLANATIONS CONCERNING THE ANALYSES.

The analyses given on the following pages show the quantities of nitrogen, phosphoric acid and potash present in the samples, and, where possible, their solubilities. These solubilities give some indication as to the probable availability to crops.

The average cost of most of the samples is calculated from the prices quoted by the sellers of the goods. In some cases quite different prices are charged by dealers for the same goods. *These quotations, therefore, should be regarded only as a general guide,* not as a basis for individual purchases.

When materials contain either nitrogen, phosphoric acid or potash as the single fertilizer ingredient, the cost per pound of that ingredient is easily calculated from the ton price and the analysis. Thus, if a sample of muriate of potash contains 50.2 per cent. of potash, which is 1004 pounds per ton, and costs $42.50 per ton, actual potash costs 4250 ÷ 1004, or 4.2 cents per pound.

Fertilizers which are mixtures of various raw materials and contain two or more of the fertilizer ingredients above named are reported with an attached valuation.

Valuation of Fertilizers.

There is so much misunderstanding as to the real meaning of the term valuation as it is used in our fertilizer reports that particular attention is called to the following explanations:

The valuation of a fertilizer is the result of calculating the retail cash cost at freight centers of an amount of nitrogen, phosphoric acid and potash in high grade materials equal to the amount contained in one ton of the fertilizer. It is a valuation of only one factor which makes up the cost of a fertilizer, namely, the market cost of the three kinds of plant food in it. Valuation no more shows the fair retail price of a fertilizer than quotations of steel billets can show the fair price for small amounts of structural steel of a specified shape. If, however, the prices of steel remain fairly uniform, a comparison of these with the rates charged by different companies *in open competition* for the finished product is a help, though not a perfect guide, to the buyer in studying the bids of different manufacturers; or to borrow an illustration from the excellent discussion of this matter in the Report of the Vermont station, it is something like a determination of the cost of leather which goes into the making of a pair of shoes. Many other charges, most of them relatively small, go to make up the final cost of the finished goods.

To illustrate: Of two fertilizers, A and B, let us assume that A contains 3.5 per cent. of organic nitrogen, 4.5 per cent. of water-soluble, 3 per cent. of citrate-soluble and one per cent. of insoluble phosphoric acid and 6 per cent. of potash, and sells at retail for $35.00. B contains 2.0 per cent. organic nitrogen, 3.5 per cent. of water-soluble, 3 per cent. citrate-soluble and 4 per cent. insoluble phosphoric acid and 8 per cent. of potash, and retails for $32.00.

We assume that both are in good condition, sold by well-known and reputable manufacturers, and the prices are the best obtainable for these two brands. The question is, which is the better purchase: 70 pounds of nitrogen, 150 pounds of soluble phosphoric acid, 20 pounds of insoluble phosphoric acid and 120 pounds of potash at $35.00; or 40 pounds of nitrogen, 130 pounds of soluble phosphoric acid, 80 pounds of insoluble phosphoric acid and 160 pounds of potash for $32.00. Obviously the first thing to do is to get the approximate value of all these separate ingredients in one figure so as to have some common basis of comparison. In a ton of A are 70 pounds of organic nitrogen, which can be bought for about 20 cents a pound; 150 pounds of soluble phosphoric acid, which can be bought for 4½ cents per pound in form of acid phosphate; 20 pounds of insoluble phosphoric acid, for which we may allow 2 cents per pound; 120 pounds of potash, which can be bought in form of muriate for 4¼ cents per pound.

Calculating as follows,

$$\begin{array}{rcr} 70 \times 20 & = & 14.00 \\ 150 \times 4\tfrac{1}{2} & = & 6.75 \\ 20 \times 2 & = & .40 \\ 120 \times 4\tfrac{1}{4} & = & 5.10 \\ \hline & & 26.25 \end{array}$$

it appears that the plant food in fertilizer A can be bought, at freight centers, in raw materials, for about $26.25, and a similar calculation shows that the corresponding figure for fertilizer B is $22.25. These two figures are the "valuations" of the two fertilizers. They give a single figure to represent the trade value of the actual plant food in each of these two fertilizers, A and B, and nothing else.

Valuations do not, of course, show the agricultural value of the plant food in fertilizers. Nor do they show the cost to the manufacturer of the stock which he used in the mixture. His profit comes in part from skill and judgment in buying the plant food on the most favorable terms. The valuation shows simply what it would cost the farmer to buy the same amount of plant food as the mixed fertilizer contains, at freight centers, unmixed, in raw materials of good quality.

But the cost of the plant food contained in a mixed fertilizer is but one item, though the largest single item, in its cost. Other items are grinding and mixing, bags, freight, agents' commissions, as well as other items, overhead factory charges, losses and profits.

It cannot be stated too emphatically that the valuation does not and cannot show the fair retail price of fertilizers, but only one item—the largest item to be sure—of the cost. In fact one must add ten dollars or more to the valuation to approximate what would be, in most cases, a fair selling price.

Fertilizer A costs $35.00, and the plant food in it has a valuation of $26.25. Fertilizer B costs $32, and its plant food a valuation of $22.25. The charges for converting the raw materials into a uniform mixture and delivering it are $8.75 in A and $9.75 in B; or, in A about 33.3 per cent. of the valuation of the plant food in it, and in B, 43.9 per cent.—figures which we call percentage difference between cost and valuation. Assuming the substantial accuracy of the costs of plant food and that the nitrogen, phosphoric acid and potash are equally valuable in both brands, it is clear that A is a better purchase than B. For while the difference between cost and valuation (i. e., the cost of manufacture and selling) is only one dollar more in B than in A, in the latter it is about 44 per cent. of the value of the raw material, and in the former only about 33 per cent.

To recapitulate:

1. Valuation represents one item, and the largest item, in the cost of mixed commercial fertilizers. It is a valuation of only one factor which makes up the market price, namely, the average market cost of the untreated raw materials of high quality which enter into its composition.

2. It affords a basis for estimating, approximately, the fair selling price.

3. It affords a basis of comparing fertilizers which differ considerably in composition and price.

4. It does not represent the fair selling price.

5. It does not show the agricultural value of the ingredients in it.

The trade-values used in the calculations made in this report are only approximately correct, for market prices constantly fluctuate, but they are accurate enough to be used to compare fertilizers which are on sale at the same time.

TRADE-VALUES OF FERTILIZER ELEMENTS FOR 1911.

The average trade-values or retail costs in market, per pound, of the ordinarily occurring forms of nitrogen, phosphoric acid and potash in raw materials and chemicals, as found in New England, New York and New Jersey markets during 1911 and adopted at a conference of representatives of the New England and New Jersey Stations in March, 1911, are as follows:

	Cents per pound.
Nitrogen in nitrates	16
ammonia salts	16
Organic nitrogen in dry and fine ground fish and blood	23
in cotton seed meal and castor pomace	21
in fine* bone and tankage and in mixed fertilizers	20
in coarse* bone and tankage	15
Phosphoric acid, soluble in water	4½
citrate-soluble†	4
of fine bone and tankage	4
of cotton seed meal and castor pomace	4
of coarse bone and tankage, and ashes	3½
insoluble in water and in ammonium citrate in mixed fertilizers	2
Potash as high-grade sulphate and in mixtures free from muriate (or chlorides)	5
as muriate	4¼
in cotton seed meal and castor pomace	5

The foregoing are, as nearly as can be estimated, the prices at which, during the six months preceding March last, the respective ingredients were retailed for cash, in our large markets, in those raw materials which are the regular source of supply. The valuations obtained by use of the above figures will be found to correspond fairly with the average retail prices, at the large markets, of standard raw materials.

Method of Valuation of Bone and Tankage.

To obtain the valuation of ground bone or tankage the sample is sifted into two grades, that finer than $\frac{1}{50}$ inch, "fine," and that coarser than $\frac{1}{50}$ inch, "coarse."

The nitrogen value of each grade is separately computed by multiplying the pounds of nitrogen per ton by the per cent. of each grade, multiplying the product by the trade-value per pound of nitrogen in that grade, and taking this final product as the result in cents. Summing up the separate values of each grade

* In this report "fine," as applied to bone and tankage, signifies smaller than $\frac{1}{50}$ inch; "coarse," larger than $\frac{1}{50}$ inch.

† Dissolved from 2 grams of the fertilizer, previously extracted with pure water, by 100 cc. neutral solution of ammonium citrate, sp. gr. 1.09, in thirty minutes at 65° C., with agitation once in five minutes. Commonly called "reverted" or "backgone" phosphoric acid.

thus obtained, together with the values of each grade of phosphoric acid, similarly computed, the total is the valuation of the sample.

Method of Valuation of Mixed Fertilizers.

The organic nitrogen in mixed fertilizers is reckoned at 20 cents per pound, nitrogen of nitrates, and ammonia salts and phosphoric acid in its three forms of solubility, at the prices given above. Potash is rated at 4¼ cents, if sufficient chlorine is present in the fertilizer to combine with it to make muriate. If there is more potash present than will combine with the chlorine, then this excess of potash is reckoned at 5 cents per pound, except in certain special cases, to be noted later, where carbonate of potash has been used in the mixture.

To obtain the Valuation of a Fertilizer, multiply the pounds per ton of nitrogen, etc., by the trade-value per pound. The several products give the values per ton of the several ingredients and their sum is the total valuation per ton.

Percentage Difference shows the percentage excess of the cost price over the average retail cost, at freight centers, of the nitrogen, phosphoric acid and potash contained in the fertilizer and furnishes the best means we have for expressing the *comparative* commercial (but not *agricultural*) value of the different brands.

This information helps the purchaser to determine whether it is better economy to buy the commercial mixed fertilizers, of which so many are now offered for sale, or to purchase and mix for himself the raw materials.

THE SOLUBILITY OF ORGANIC NITROGEN.

The analyses of mixed fertilizers include determinations of the solubility of the organic nitrogen both in water and in an alkaline solution of potassium permanganate. The reasons for this and the significance of the figures require explanation.

Organic nitrogen costs four or five times as much as phosphoric acid or potash, and the forms in which it is used in mixed fertilizers differ greatly in market price as well as in agricultural value. Some method for distinguishing the forms which have real agricultural value from those which are comparatively inert is most desirable and after several years of study and experiment both here and elsewhere methods have been devised to determine the solubility of organic nitrogen and thus to distinguish between the two forms of nitrogen with enough accuracy to make their use helpful in judging of the quality of organic nitrogen. The following papers present the results of some of the experimental work done here.

It remains to explain the significance of the terms used in the tables of analyses to express the nitrogen solubility.

Water-soluble organic nitrogen is that which is soluble in water under the prescribed method of treatment.

Active insoluble brganic nitrogen is insoluble in water, but soluble in an alkaline solution of potassium permanganate.

Inactive insoluble organic nitrogen is insoluble in either of the above-named reagents.

All of these forms of nitrogen are found in every organic nitrogenous substance, but the relative quantities are quite different. In general, when more than one-half of the water-insoluble organic nitrogen in any mixture is insoluble in permanganate, the conclusion is justified that some agriculturally inferior form is present.

A MODIFICATION OF THE NEUTRAL PERMANGANATE METHOD TO DETERMINE THE SOLUBILITY OF ORGANIC NITROGEN.

By John Phillips Street.

When the neutral permanganate method was devised some years ago by the writer, series of mixtures of known composition were prepared, in which it was possible to determine the solubility of the organic nitrogen both in the raw material and when mixed with the usual phosphatic and potassic ingredients of commercial fertilizers. In these mixtures arbitrary amounts of acid phosphate and muriate of potash were used, the total weight of the mixtures always being 50 grams, the acid phosphate ranging from 10 to 34.5 grams, and the muriate being constant at 10 grams.

Each of the mixtures, with one exception, contained 1.50 per cent. of organic nitrogen in different forms. The following solubility figures were obtained. (See *Jour. Ind. Eng. Chem.*, 2, 312.)

	Percent. Solubility of Nitrogen. In original material.	In mixed fertilizer.
Dried blood	95.6	92.9
Tankage	95.1	91.8
Garbage tankage	58.9	75.1
Cotton seed meal	95.1	92.9
Dried fish	96.4	90.0
Ground bone	93.6	92.0
Peat	42.8	37.1
Dried blood and peat	89.1	86.0

The agreement in solubilities of the organic form when used alone and when mixed was considered quite satisfactory; at any rate, the figures obtained were sufficient, in the writer's estimation, to allow of a differentiation between the valuable and relatively useless forms of organic ammoniates. Further tests, however, have shown that the method as originally published may give misleading results, which in certain cases would be most unfair to high-grade materials. In other words, under certain conditions, a high-grade material like dried blood, which shows a high permanganate solubility, when mixed with acid phosphate and muriate shows solubilities which would class it with garbage tankage and only a little above peat. The cause of this discrepancy lay either with the acid phosphate or the potash. Accordingly another series of mixtures was made in which the quantity of these ingredients was varied, while the amount of organic nitrogen was kept constant at 0.0450 gm. Tests of these mixtures showed at once that the muriate of potash had no effect on the results. A sample of dried blood which, unmixed, showed a solubility of 97, when mixed with muriate, showed 95 and 96. This same blood, however, when mixed with 2 gms. of acid phosphate, showed a solubility of only 90, and with 4 gms. only 59. In three other samples of blood the presence of 4 gms. of acid phosphate reduced the solubilities from 96, 94 and 96 to 53, 70 and 67, respectively. While this discrepancy was most marked in the case of dried blood, a decreased solubility was also noted in tankage, fish, hide and skin meal, tartar pomace, solubilized organic nitrogen, and peat. With knuckle bone and cotton seed meal the acid phosphate seemed to have little effect, and with garbage tankage the solubility of the nitrogen in the mixture was, as has always been the writer's experience, considerably higher than in the raw material.

It was thought at first that the relatively large amount of acid phosphate (4 gms.), compared with the charge of dried blood (0.34 gm.), prevented complete action of the permanganate. Experiments in which the permanganate mixture was agitated much more frequently than directed in the method, however, gave no better results. Thinking that the acidity of the acid phosphate might be the determining factor, another series of tests was carried out in which one gram of sodium carbonate was added just prior to the introduction of the permanganate solution. The results obtained were most satisfactory, as the table shows. A 96 blood with 2 gms. of acid phosphate showed 96; with 4 gms., 90. A 91 tankage, with the same amounts of acid phosphate, showed 94 and 85. A 97 bone showed 93; a 93 fish, 92; a 92 cotton seed meal, 95; a 54 tartar pomace, 48; a 65 solubilized organic nitrogen, 65; a 46 peat, 42. Garbage tankage again showed a high result, the availability increasing from 47 to 68, but even this high figure is too low to mislead any one as to its value.

The writer makes no attempt to explain just what causes these discrepancies. That they exist, however, is an undoubted fact, and the simple modification, at least in the materials tested, appears to give true and reasonable results.

In using the neutral permanganate method, it must be remembered that it is not an absolute method by which the agricultural value of an organic nitrogenous material may be determined. A long series of tests, however, shows that it does differentiate between the good and the bad; materials of generally recognized value like blood, tankage, ground bone, dried fish, cotton seed meal and castor pomace, rarely showing solubilities less than 90, while leather, mora meal, tobacco stems, peat, sheep manure, garbage tankage, tartar pomace, beet root manure and fillerine show from 17 to 69. The method possesses the further advantages of simplicity of manipulation, of easy maintenance of uniform conditions (a very important matter) and of measuring a definite chemical action, namely, the amount of organic nitrogen not decomposed by a definite quantity of permanganate of potash solution of fixed and uniform strength, acting for a definite time at a uniform temperature on a definite amount of material. Every condition can be definitely controlled and the personal equation is almost negligible.

SOLUBILITY OF ORGANIC NITROGEN OF RAW MATERIALS BY THE ALKALINE PERMANGANATE METHOD.

By John Phillips Street.

During the last three years many determinations of the solubility of the organic nitrogen of the various crude fertilizer materials have been made at this station by the neutral permanganate method. Since then the directors of the New England, New York and New Jersey stations have adopted a different method, the *alkaline* permanganate method, which gives figures not strictly comparable with those obtained by the neutral method. Accordingly this year 55 samples of raw materials were tested for solubility by the alkaline method, and the results are shown in the following table.

Solubility of Organic Nitrogen.

(Alkaline Permanganate Method.)

Material	Nitrogen. In Ammonia.	In Water-soluble Organic.	In Active Insoluble Organic.	In Inactive Insoluble Organic.	Total.	Percentage Solubility of Organic Nitrogen.	Percentage Permanganate Solubility of Insoluble Organic Nitrogen.
Dried Blood	0.00	2.50	6.81	2.04	11.35	82.0	77.0
" "	0.02	0.09	9.48	3.77	13.36	71.7	71.5
Tankage	0.01	3.30	2.01	0.47	5.79	91.7	81.0
"	0.15	2.63	1.81	0.55	5.14	89.0	76.7
"	0.30	2.50	4.75	1.14	8.69	86.4	80.7
"	0.19	1.84	3.06	0.77	5.86	86.4	80.0
"	0.27	3.42	2.04	1.03	6.76	84.1	66.4
"	0.08	4.29	1.68	1.20	7.25	83.3	58.3
"	0.28	3.46	1.97	1.14	6.85	82.6	63.3
"	0.21	1.34	3.41	1.04	6.00	82.0	76.6
"	0.03	1.28	1.43	0.76	3.50	78.1	65.2
"	0.25	0.66	4.81	1.74	7.46	75.9	73.4
"	0.13	0.42	4.81	1.74	7.10	75.0	73.4
"	0.28	2.42	2.67	1.81	7.18	73.8	59.6
"	0.10	0.80	1.47	0.81	3.18	73.7	64.5
"	0.12	1.94	2.78	1.69	6.53	73.6	62.1
"	0.14	0.50	5.62	2.24	8.50	73.2	71.5
"	0.30	2.47	2.58	1.89	7.24	72.9	57.8
"	0.30	0.86	2.72	1.45	5.33	71.2	65.2
"	0.36	1.87	2.70	1.97	6.90	69.9	57.8
"	0.25	2.48	2.60	1.73	7.06	65.0	60.0
" Average......	0.20	2.03	2.89	1.32	6.44	78.3	68.1

Materials.	Nitrogen. In Ammonia.	In Water-soluble Organic.	In Active Insoluble Organic.	In Inactive Insoluble Organic.	Total.	Percentage Solubility of Organic Nitrogen.	Percentage Permanganate Solubility of Insoluble Organic Nitrogen.
Tankage (abnormal samples)	1.50	0.45	1.17	0.88	4.00	64.8	57.5
"	5.82	0.77	1.14	1.13	8.86	62.8	50.0
"	0.04	0.51	2.60	2.49	5.64	55.5	51.1
"	0.12	0.36	2.74	2.76	5.98	52.9	49.8
" (garbage tankage)	0.05	0.50	0.35	1.44	2.34	37.1	19.6
" (leather preparation)	0.00	0.26	1.44	4.31	6.01	28.3	25.0
Dried Fish	0.50	1.01	5.03	1.32	7.86	82.1	79.2
" "	0.43	0.77	5.69	1.75	8.64	78.7	76.5
" "	0.14	0.47	6.18	2.30	9.09	74.3	72.9
" "	0.58	1.06	4.51	2.20	8.35	71.7	67.2
" "	0.50	0.81	5.16	2.39	8.86	71.4	68.3
" "	1.15	2.15	2.96	2.12	8.38	70.7	58.2
" "	0.85	1.40	3.29	2.06	7.60	69.5	61.5
" "	0.55	0.96	1.24	1.17	3.92	65.3	51.5
" "	0.79	1.00	3.96	2.69	8.44	64.8	59.5
" "	0.50	0.84	3.95	2.93	8.22	62.0	57.4
" " Average....	0.60	1.05	4.20	2.09	7.94	71.1	65.2
Dissolved Bone........	0.21	1.09	0.78	0.64	2.72	74.5	54.9
Castor Pomace	0.01	0.78	1.92	1.91	4.62	58.6	50.1
" "	0.01	0.91	1.95	2.11	4.98	57.5	48.0
" "	0.01	0.82	1.97	2.23	5.03	55.6	47.0
" "	0.02	0.62	2.18	2.38	5.20	54.1	47.8
" " Average	0.01	0.78	2.01	2.16	4.96	56.5	48.2
Shoddy Waste	0.01	0.11	6.52	2.06	8.70	77.3	76.0
Pouncing or Shaving Dust	0.00	0.50	10.11	3.59	14.20	74.7	73.8
Hare's Hair	0.11	0.42	10.00	3.55	14.08	74.6	73.8
Coney Hair	0.17	0.00	8.43	2.63	11.23	76.0	76.0
Hair Sweepings	0.10	0.19	8.45	2.86	11.60	75.1	74.8
Park's Fertilizer (Hat Factory Waste) ...	0.00	0.77	8.83	2.48	12.08	79.5	78.2
Muck or Peat	0.00	0.05	0.63	0.68	1.36	50.0	48.3
" "	0.00	0.00	0.63	1.42	2.05	30.6	30.6
" "	0.00	0.04	0.45	1.33	1.82	26.9	25.1
" "	0.01	0.03	0.38	1.36	1.78	23.2	21.5
" " Average	0.00	0.03	0.52	1.20	1.75	32.7	31.4
Sheep Manure	0.42	0.33	0.48	1.15	2.38	41.3	29.2
" "	0.06	0.34	0.57	1.45	2.42	38.6	27.8
" "	*0.48	0.16	0.21	0.59	1.44	38.5	26.2
" " Average	0.32	0.28	0.42	1.06	2.08	39.5	27.7

The permanganate solubility of the water-insoluble nitrogen of the two samples of dried blood ranged from 71.5 to 77. Nineteen samples of tankage ranged from 57.8 to 81.0, with an average of

*Contains 0.43% in form of nitrates.

68.1. The six abnormal tankages ranged from 19.6 to 57.5, the lowest figure being obtained with the garbage tankage and almost as low a figure, 25.0, being given by the leather preparation. Dried fish ranged from 51.5 to 79.2 (average, 65.2), again a very wide variation. Dissolved bone gave the low figure of 54.9, and castor pomace also the low figures 47.0 to 50.1. The hat factory wastes ranged from 73.8 to 78.2, surprisingly high figures. Peat ranged from 21.5 to 48.3, and sheep manure from 26.2 to 29.2.

While in general these values are relatively similar to those obtained by the neutral method, the individual variations in the different classes of material are much wider than by that method, as is shown in the following typical materials:

	Neutral.	Alkaline.
Dried blood	94–97	72–77
Tankage	83–95	58–81
Dried fish	86–94	52–79

There is no question that either method serves as a useful means of distinguishing between such materials as blood, bone, tankage and fish on the one hand, and materials like peat and leather on the other. In such materials, however, as our sample of coney hair, the alkaline method shows a nitrogen solubility quite as high as that of high-grade blood, and therefore not distinguishable from it by this method alone. In a valuable material, such as castor pomace, the alkaline method shows an average solubility of 48.2, classing it, if judged by this figure alone, with the inferior materials. The neutral method gives castor pomace a solubility of 88, close to that obtained with other high-grade materials. In such instances as this, if the alkaline method is to be used with any certainty, strict attention must also be given to the amount of water-soluble organic nitrogen. The table shows this to average 0.78 in castor pomace, while in peat only traces are present.

POT EXPERIMENTS ON NITROGEN AVAILABILITY.

By John Phillips Street.

The constantly increasing demand for organic nitrogen and the high price of blood, fish and similar high-grade materials, have tempted some fertilizer manufacturers to use waste materials rich in nitrogen but whose fertilizing value is at least questionable.

The "wet-mixing" process, however, has come into quite general use. By this process the crude ammoniates are subjected for some hours to the action of sulphuric acid in so-called "dens." The action of the acid generates a high heat which, with the sulphuric, phosphoric and hydrofluoric acid present, thoroughly disintegrates the nitrogenous materials and destroys their original physical structure. Analysis of the residual products from this process shows that a considerable part of the organic nitrogen is made soluble in water and a part converted into compounds which yield ammonia on distillation with magnesia. While theoretically it would seem that this nitrogen should exist in a form readily available to plants, little experimental work has been done to establish this contention. The determination of the agricultural value of nitrogen thus prepared is of great importance. If manufacturers are able to convert inert nitrogen into available forms, their efforts towards conservation of our resources should be encouraged; if, on the other hand, the process is only a specious means of working-off relatively valueless material on the purchaser, words of warning can not be too loudly proclaimed.

The writer is one of a committee appointed by the directors of the Experiment Stations of New England, New Jersey and New York to study methods for determining nitrogen availability. This committee was invited by a prominent fertilizer company to witness the "wet-mixing" process as conducted commercially at its factory, and to take any samples which they chose. By the courtesy of this firm a batch of about 100 tons of base goods was made by the "wet-mixing" process in the presence of the committee. Samples were taken of each of the nitrogenous materials, the rock phosphate and the sulphuric acid used, and at the completion of the mixing process the "den" was sealed by the committee. After two days, the seals were broken in the presence of the committee, the material removed and a sample of about 1500 pounds taken. This was passed through a No. 3 screen, the tailings amounting to less than 2.5 per cent., and was treated with 5 per cent. of carbonate of lime. The following summary shows the change in character the nitrogen had undergone from the acid treatment: 100 parts of the nitrogen that went into the den contained 6.5 parts in ammonia form, 7.8 as water-soluble organic and 85.7 as water-insoluble organic, while 100 parts of the nitrogen in the finished base contained 14.3 parts in ammonia form, 57.7 as water-soluble organic and 28 as water-insoluble organic.

The nitrogenous materials used in making this "base" were hair tankage, garbage tankage, and unacidulated treated leather. Samples of each of these crude materials, as well as the finished base, were taken by the committee. In the experiments that are here reported the hair, garbage tankage, treated leather and base were the identical materials used in this "wet-mixing" test, and consequently the results secured have the increased value associated with materials whose history is known.

Fertilizers Used in the Vegetation Tests.

A sufficient quantity of the base goods was transferred to a filter and thoroughly washed with successive portions of water at room temperature. The residue was dried, reground and analyzed. The soluble-nitrogen solution was made up to a definite volume and nitrogen determined in aliquot portions. Besides the raw materials entering into the "mix" and the finished base goods, nitrate of soda was selected as a typical high-grade water-soluble form, cotton seed meal as a high-grade organic form, and peat as a form generally admitted to be inert. The nitrogen content of the materials used is shown below.

Nitrate of soda	15.80	per cent.
Cotton seed meal	6.80	"
Base	1.57	"
" water-insoluble	0.63	"
" water-soluble	.1080	gm. per 100 c.c.
Garbage tankage	2.45	per cent.
Treated leather	6.40	"
Hair waste	8.23	"
Peat	2.81	"

In addition to the nitrogenous fertilizers, all the pots received applications of sulphate of potash and acid phosphate in the quantities stated in the table. Each pot also received a uniform application of 2 gms. of calcium carbonate. In adding the lime an effort was made to use a quantity sufficient to maintain nearly neutral or slightly alkaline conditions. The greatest amount of acid applied in the fertilizer was in pots 19 to 20 and 49 to 50, where the water-soluble part of the base was used. The acidity of 140 cc. of the solution of the water-soluble base, the quantity actually applied, was equivalent to 1.485 gms. of calcium carbonate, while the acidity of the water-soluble portion of 4 gms. of acid phosphate applied was equivalent to 0.566 gm. of calcium carbonate. The maximum free acidity possible in any of the pots was, therefore, equivalent to 2.051 gms. of calcium carbonate.

A uniform application of 1.5 gms. of sulphate of potash and 4 gms. of acid phosphate was made on all the pots except Nos. 4, 5, 34 and 35, where the amount of these mineral fertilizers was increased fifty per cent. The nitrogenous fertilizers were applied in amounts equivalent to 0.15 gm. actual nitrogen, except in Nos. 9, 10, 39, 40, 14, 15, 44 and 45, where 0.25 gm. was applied.

Soil and Crops Used.

The soil used was an artificial mixture of seven parts sand and one of garden soil, the latter being dried and screened before mixing. The pots were ordinary 8-inch flower pots, coated with shellac on the inside. The pots were tared to an equal weight of 5 lbs. 2 ozs., with pieces of broken flower pots, and 13 lbs. of the mixed soil was placed in each.

The pots were filled and samples of the soil taken on March 14. On the next day the upper three inches of the soil of each pot were removed, the designated amount of fertilizer intimately mixed with it, and the mixtures returned to the pots. Seeds of Japanese millet and oats were then sown in Nos. 1 to 30, and 31 to 60 respectively. On March 30, the oats were thinned out to a uniform stand of 15 plants, except in No. 39, where there were 13, and in Nos. 52, 54 and 57, where there were 14 plants. The millet germinated very poorly and, on April 13, the pots were partially reseeded with germinated seeds to a uniform stand of 15 or 16 plants.

Throughout the whole experiment, water was added as needed, complete saturation of the soils never being reached, a slight deficiency rather than an excess of water being generally maintained.

The crops were photographed on June 19. The oats were harvested on June 20, the millet on July 5, before maturity in both cases. The plants were cut off as close to the ground as possible, air-dried, ground, and nitrogen determined. The roots and the short stubble were disregarded.

Tables I and II give the detailed results.

TABLE I.—POT EXPERIMENTS—MILLET.

Pot No.	Fertilizer applied. Grams.	Nitrogen in Fertilizer. Grams.	Green-weight of crop. Grams.	Air-dry weight of crop. Grams.	Nitrogen in air-dry matter. per cent.	Nitrogen in crop. Grams.	Nitrogen gain over pots 1-3. Grams.	Nitrogen recovered. per cent.	Average nitrogen recovered. per cent.	Nitrogen recovered (NaNO₃=100). per cent.
1	1.5 Sulphate of potash, 4 acid phosphate	......	44.5	11.5	0.44	.0506	..... (Ave.	...	....	....
2	" " " " " " ...	......	42.5	11.0	0.50	.0550	.0551)	...	....	....
3	" " " " " "	......	45.5	11.5	0.52	.0598	.....	...	....	....
4	2.25 " " 6 " "	......	40.5	10.0	0.46	.0460	.....	...	....	...
5	" " " " " "	......	43.0	10.0	0.50	.0500	.....	...	....	....
6	1.5 " " 4 " " 0.95 nitrate of soda	.1501	117.0	34.0	0.48	.1632	.1081	72.0	....	....
7	" " " " " " " " "	.1501	107.5	30.5	0.53	.1617	.1066	71.0	71.5	100.
8	" " " " " " " " "	.1501	108.0	30.0	0.48	.1440	.0889	*59.2	....	....
9	" " " " " " 1.58 " "	.2496	140.0	42.0	0.50	.2100	.1549	*62.1	....	....
10	" " " " " " " " "	.2496	149.5	42.0	0.59	.2478	.1927	77.2	77.2	....
11	" " " " " " 2.21 cotton seed meal	.1503	96.0	25.5	0.47	.1199	.0648	43.1	....	....
12	" " " " " " " " " "	.1503	90.5	24.0	0.47	.1128	.0577	38.4	39.3	55.0
13	" " " " " " " " " "	.1503	81.5	22.0	0.50	.1100	.0549	36.5	....	....
14	" " " " " " 3.68 " " "	.2502	97.0	28.5	0.58	.1653	.1102	44.0	....	....
15	" " " " " " " " " "	.2502	102.5	29.0	0.49	.1421	.0870	34.8	39.4	....
16	" " " " " " 9.55 base	.1499	98.0	27.5	0.52	.1430	.0879	58.6	....	....
17	" " " " " " " "	.1499	88.0	24.0	0.56	.1344	.0793	52.9	54.1	75.7
18	" " " " " " " "	.1499	102.0	28.5	0.46	.1311	.0760	50.7	....	...
19	" " " " " " 140 cc. base, water-soluble	.1512	96.5	26.0	0.52	.1352	.0801	53.0	....	....
20	" " " " " " " " " "	.1512	94.5	27.0	0.50	.1350	.0799	52.8	52.9	74.1
21	" " " " " " 23.81 " water-insoluble	.1500	61.5	15.5	0.52	.0806	.0255	17.0	....	....
22	" " " " " " " " "	.1500	45.5	10.5	0.55	.0578	.0027	1.8	9.4	13.2
23	" " " " " " 6.12 garbage tankage	.1499	67.5	18.0	0.51	.0918	.0367	24.5	....	....
24	" " " " " " " " "	.1499	77.0	20.0	0.54	.1080	.0529	35.3	29.9	41.9
25	" " " " " " 2.34 treated leather	.1498	54.5	15.0	0.48	.0720	.0169	11.3	....	....
26	" " " " " " " " "	.1498	54.5	15.5	0.48	.0744	.0193	12.9	12.1	16.9
27	" " " " " " 1.82 hair waste	.1498	72.0	18.5	0.49	.0907	.0356	23.8	....	....
28	" " " " " " " " "	.1498	66.5	18.0	0.49	.0882	.0331	22.1	23.0	32.2
29	" " " " " " 5.34 peat	.1501	42.0	11.0	0.45	.0495	—.0056	...	....	....
30	" " " " " " " "	.1501	48.0	13.0	0.45	.0585	—.0034	2.3	2.3	3.2

* Omitted from average.

TABLE II.—POT EXPERIMENTS—OATS.

Pot No.	Fertilizer applied. Grams.	Nitrogen in Fertilizer. Grams.	Green-weight of crop. Grams.	Air-dry weight of crop. Grams.	Nitrogen in air-dry matter. per cent.	Nitrogen in crop. per cent.	Nitrogen gain over pots 31-33. Grams.	Nitrogen recovered. per cent.	Average nitrogen recovered. per cent.	Nitrogen recovered (NaNO₃=100). per cent.
31	1.5 Sulphate of potash, 4 acid phosphate	....	21.5	7.5	0.90	.0675	....	....	....	....
32	" " " " " "	....	23.0	8.5	0.74	.0629	(Ave. .0635)	....	....	....
33	" " " " " "	....	24.0	8.0	0.75	.0600	....	....	....	....
34	2.25 " " 6 " "	....	25.5	8.5	0.81	.0689	....	....	....	....
35	" " " " " "	....	31.5	11.0	1.09	.1199	....	....	....	....
36	1.5 " " 4 " " 0.95 nitrate of soda	.1501	49.5	18.0	1.05	.1890	.1255	83.6	....	....
37	" " " " " " " " "	.1501	41.5	15.0	1.29	.1935	.1300	86.6	88.7	100
38	" " " " " " " " "	.1501	44.0	17.0	1.22	.2074	.1439	95.9	....	....
39	" " " " " " 1.58 " "	.2496	52.0	18.0	1.59	.2862	.2227	89.2	....	....
40	" " " " " " " " "	.2496	52.0	18.5	1.48	.2738	.2103	84.3	86.8	....
41	" " " " " " 2.21 cotton seed meal	.1503	40.5	13.0	0.89	.1157	.0522	34.7	....	....
42	" " " " " " " " " "	.1503	38.5	13.0	0.92	.1196	.0561	37.3	34.1	38.5
43	" " " " " " " " " "	.1503	40.5	12.0	0.91	.1092	.0457	30.4	....	....
44	" " " " " " 3.68 " " "	.2502	40.0	13.0	1.24	.1612	.0977	39.0	....	....
45	" " " " " " " " " "	.2502	43.0	14.5	1.07	.1552	.0917	36.7	37.9	....
46	" " " " " " 9.55 base	.1499	39.5	13.0	1.03	.1339	.0704	47.0	....	....
47	" " " " " " " "	.1499	49.5	14.0	1.06	.1484	.0849	56.6	54.2	61.2
48	" " " " " " " "	.1499	43.0	13.0	1.17	.1521	.0886	59.1	....	....
49	" " " " " " 140 cc. base, water-soluble	.1512	46.0	15.5	0.89	.1380	.0745	49.3	....	....
50	" " " " " " " " " "	.1512	47.0	15.5	1.02	.1581	.0946	62.6	56.0	63.3
51	" " " " " " 23.81 " water-insoluble	.1500	32.5	9.0	0.97	.0873	.0238	15.9	....	....
52	" " " " " " " " " "	.1500	27.5	8.0	1.01	.0808	.0173	11.5	13.7	15.5
53	" " " " " " 6.12 garbage tankage	.1499	29.0	8.5	0.84	.0714	.0079	5.3	....	....
54	" " " " " " " " "	.1499	31.5	10.0	0.93	.0930	.0295	19.7	12.5	14.1
55	" " " " " " 2.34 treated leather	.1498	40.5	12.5	0.89	.1113	.0478	31.9	....	....
56	" " " " " " " " "	.1498	38.5	13.0	0.85	.1105	.0470	31.4	31.7	35.8
57	" " " " " " 1.82 hair waste	.1498	36.5	11.0	0.88	.0968	.0333	22.2	....	....
58	" " " " " " " " "	.1498	34.5	11.0	0.88	.0968	.0333	22.2	22.2	25.1
59	" " " " " " 5.34 peat	.1501	24.0	8.5	0.76	.0646	.0011	0.7	....	....
60	" " " " " " " "	.1501	27.0	9.0	0.81	.0729	.0094	6.3	3.5	4.0

The larger application of minerals on Nos. 4 and 5 gave no increased crop of millet; the similar application on Nos. 34 and 35 gave only a slightly increased crop of oats. From these results it is concluded that sufficient phosphoric acid and potash were present to make the nitrogen applied the determining factor in the amount of the crop secured in every case. Again, the increased yields of both millet and oats where larger applications of nitrate of soda and cotton seed meal were supplied, indicate that in no case was the amount of nitrogen applied excessive.

With very few exceptions the parallels secured in both experiments were satisfactorily close. When considered on the basis of nitrogen actually recovered in the crop, the divergence between parallels is larger in a few cases, but in no case sufficiently wide to prevent conclusions being drawn as to the efficacy of the different fertilizers.

The no-nitrogen plots gave very uniform yields and clearly indicated the nitrogen-need of the soil used.

The Crops Secured.

The following tabulation shows the average air-dry crops secured by the various treatments, the average crop increase due to the form of nitrogen used, and the average relative crop increase, assuming the average yield from the smaller amount of nitrate of soda equals 100.

AVERAGE CROP AND AVERAGE CROP INCREASE SECURED.

Form of Nitrogen.	Amount of Nitrogen applied.	Millet. Air-dry Crop.	Millet. Increased Air-dry Crop.	Millet. Relative Increase of Crop.	Oats. Air-dry Crop.	Oats. Increased Air-dry Crop.	Oats. Relative Increase of Crop.
Minerals only, normal	..	11.3	..	..	8.0	..	..
" " 1½ normal	..	10.0	..	..	9.8	..	..
Nitrate of Soda	.15	31.5	20.2	100	16.7	8.7	100
" "	.25	42.0	30.7	..	18.3	10.3	..
Cotton Seed Meal	.15	23.8	12.5	62	12.7	4.7	54
" " "	.25	28.8	17.5	..	13.8	5.8	..
Base	.15	26.7	15.4	76	13.3	5.3	61
" water-soluble	.15	26.5	15.2	75	15.5	7.5	86
" water-insoluble	.15	13.0	1.7	8	8.5	0.5	6
Garbage Tankage	.15	19.0	7.7	38	9.3	1.3	15
Treated Leather	.15	15.3	4.0	20	12.8	4.8	55
Hair Waste	.15	18.3	7.0	35	11.0	3.0	35
Peat	.15	12.0	0.7	3	8.8	0.8	9

Before discussing the above table, it is well to consider the forms in which the nitrogen existed in the different fertilizers applied. The following tabulation shows the percentages of ammonia and water-soluble organic nitrogen found in each, and the amount of soluble nitrogen applied to each pot:

Material.	Nitrogen as Ammonia. per cent.	Nitrogen as Water-Soluble Organic. per cent.	Total Water-Soluble Nitrogen. per cent.	Water-Soluble Nitrogen in Fertilizer Applied. gms.	Per cent. of Total Nitrogen Soluble in Water. per cent.
Cotton seed meal	0.06	0.74	0.80	.018	12
Base	0.24	1.06	1.30	.124	83
" water-soluble	....	....	....	.151	100
" water-insoluble	....	....	....	.000	0
Garbage tankage	0.10	0.10	0.20	.012	8
Treated leather	0.36	0.45	0.81	.019	13
Hair waste	0.80	1.14	1.94	.035	23
Peat	0.10	0.01	0.11	.006	4

These figures may explain the relatively high crop increases obtained with the base compared with those from cotton seed meal, eighty-three per cent. of the nitrogen of the former and only twelve per cent. of the cotton seed meal nitrogen being soluble in water. The crop increase from the use of cotton seed meal is normal in both crops, but the high increases obtained with the base goods emphasize its excellence as a fertilizer. In the case of millet the water-soluble base gave a little less crop increase than the total base, while in the case of oats it gave a slightly larger return. These small differences have no practical significance, for the amount of insoluble nitrogen in the base is so small that pots 16-20 and 46-50 might almost be considered parallel tests. The excellence of the nitrogen of the base as an increased crop producer is apparent with both the crops grown.

The water-insoluble base and the peat show almost no power of increased crop production. The results with the other forms of nitrogen are variable with the two crops. With millet, garbage tankage and hair waste show about half the crop-producing power of the base goods, while treated leather is only about one-fourth as good. With oats, treated leather gives a much higher return, nearly equalling the base goods, while hair waste gives about one-half and garbage tankage about one-fourth as much as the base. Why, with oats, treated leather should give such a high return, actually higher than that secured with cotton seed meal, is one of the anomalies of pot experiments for which we can offer no explanation.

The Availability of the Nitrogen to the Crop.

While from a practical point of view the amount of crop secured is of prime importance, the purpose of these experiments was chiefly to determine to what extent the plants could utilize the different forms of nitrogen supplied. The tabulation below shows the relative amounts of nitrogen recovered in the crops, the nitrogen recovery from the smaller application of nitrate of soda being assumed to be 100:

	Per cent. Nitrogen Recovered			Per cent. Nitrogen Recovered	
	Millet.	Oats.		Millet.	Oats.
Nitrate of soda	100	100	Garbage tankage	42	14
Cotton seed meal	55	39	Treated leather	17	36
Base	76	61	Hair waste	32	25
" water-soluble	74	63	Peat	3	4
" water-insoluble	13	16			

The relative nitrogen recovery differs in no essential from the relative crop-producing power of the different fertilizers. Averaging the recovery from the two crops on the basis of nitrate of soda equals 100, the total base and water-soluble base show an availability of 69, cotton seed meal 47, hair waste 29, garbage tankage 28, treated leather 27, insoluble base 15 and peat 4.

It is of interest to note how little influence the form of fertilization had on the percentage content of nitrogen in the air-dry crop of millet. It ranged from 0.44 to 0.59 per cent., the kind of fertilizer apparently having but little effect. In the oats, however, the nitrogen ranged from 0.74 to 1.59 per cent., nitrate of soda giving not only the largest crops but the crops richest in nitrogen.

Conclusions.

Definite conclusions cannot be drawn from a limited number of pot experiments. The experiments here reported, however, indicate that the "wet-mix" acid treatment of materials, like hair waste, treated leather and garbage tankage, yields a fertilizer of high crop-producing power with millet and oats, and one whose nitrogen availability to these crops is superior to that of cotton seed meal, and from sixty to seventy-five per cent. of that of nitrate of soda. Furthermore, in these tests, the value of the base-goods nitrogen rested almost entirely on the portion which is soluble in water, this portion showing an availability of from sixty-three to seventy-four per cent. of that of nitrate of soda with millet and oats.

I. RAW MATERIALS CHIEFLY VALUABLE FOR NITROGEN.

NITRATE OF SODA OR SODIUM NITRATE.

Nitrate of soda is mined in Chili and purified there before shipment. As offered in the Connecticut market this year, it contains about 15.42 per cent. of nitrogen, equivalent to 93.6 per cent. of pure sodium nitrate. The other usual constituents are moisture and small quantities of common salt and Glauber's salt (sodium sulphate).

Shipments differ somewhat in composition, as is shown by the thirteen samples which have been analyzed, as follows:

26403. Sold by Armour Fertilizer Works. Sampled from stock of A. Grulich, Meriden.

26217. Sold by Coe-Mortimer Co. Sampled from stocks of W. O. Goodsell, Bristol and Spencer Bros., Suffield.

26269. Sold by Wilcox Fertilizer Co. Sampled at factory.

26201. Sold by Sanderson Fertilizer and Chemical Co. Sampled at factory.

26202. Sold by L. T. Frisbie Co. Sampled from stock of Lightbourn & Pond Co., New Haven.

26273. Sold by American Agricultural Chemical Co. Sampled from stock of J. A. Glasnapp, West Cheshire.

26570. Sold by German Kali Works. Sampled from stock of E. A. Standish, Andover.

26402. Sold by Bowker Fertilizer Co. Sampled from stock of W. H. Burr, Westport.

26343. Sold by Nitrate Agencies Co. Sampled from stock of C. R. Treat, Orange.

26200. Sold by Nitrate Agencies Co. Sampled from stocks of L. M. Benham, Highwood, and Andrew Ure, Highwood.

26203. Sold by Rogers Manufacturing Co. Sampled from stock of S. A. Flight, Highwood.

26482. Sold by C. M. Shay Fertilizer Co. Sampled from stock of Farmers' Association, Leonard's Bridge.

26424. Sampled from stock of Connecticut School for Boys, Meriden.

The nitrogen contained in these samples was in every case as much as or more than was guaranteed.

The per cent. of nitrogen in these samples ranges from 15.16 to 15.64 and averages 15.42.

The retail cost of nitrogen ranges from 15.5 to 17.4 cents per pound, the average being 16.4.

The nitrogen of nitrate of soda is unquestionably the most quickly and fully available form which is accessible, and this year it has been the cheapest. For quick action, particularly on such crops as grain, grass and potatoes, which make a large part of their growth when the soil is still too cold for the active decay and nitrification of organic forms of nitrogen, nitrate of soda is especially valuable.

ANALYSES OF NITRATE OF SODA.

Station No.	**26403**	**26217**	**26269**	**26201**	**26202**	**26273**	**26570**
Percentage amount of							
Nitrogen found	15.52	15.50	15.40	15.44	15.36	15.52	15.26
Nitrogen guaranteed	14.81	15.00	15.00	15.00	15.00	15.00	15.00
Cost per ton	$48.00	50.00	49.50	50.00	50.00	52.00	52.00
Nitrogen costs cents per pound	**15.5**	**16.1**	**16.1**	**16.2**	**16.3**	**16.8**	**17.0**

Station No.	**26402**	**26343**	**26200**	**26203**	**26482**	**26424**
Percentage amount of						
Nitrogen found	15.24	15.16	15.30	15.44	15.44	15.64
Nitrogen guaranteed	15.00	15.00	15.00	15.00	15.00	15.65
Cost per ton	$53.00	.....	.....	.....	.....	.....
Nitrogen costs cents per pound	**17.4**	.....	.....	.....	.....	.....

DRIED BLOOD.

Two samples from the stock of the station, used in fertilizer experiments, **26307** and **26416**, contained 11.35 and 13.36 per cent. of nitrogen, respectively. The solubility of the organic nitrogen in these samples, see page 12, was 82.0 and 71.7 per cent.

COTTON SEED MEAL.

Much more cotton seed meal is used in this state as a tobacco fertilizer than as a dairy feed. Two hundred and seventy-three samples have been analyzed, representing nearly as many car lots, and approximately 6,100 tons. For this the buyers have paid more than $195,000. But little dependence can be placed at present on the guaranteed composition of cotton seed meal. It is bagged and tagged at a large number of mills, widely scattered in the Southern States. Many of these mills have no regular tests made of their mill run, but state to the commission men what they believe is the content of nitrogen of the meal they put out. The commission house sends tags bearing its name and address with the guaranty, and orders car lots shipped to fill orders. When the car arrives in this state, if the meal is found to be inferior to the guaranteed quality, the dealer in Connecticut is liable under the pure food law to criminal prosecution. If such action was begun it would be a perfect defense to show a valid guaranty from the house outside the state, of whom the meal was bought. Then the case would be transferred to the United States authorities, who would prosecute either the commission house or the manufacturer. Rigid enforcement of the law would no doubt, in time, force manufacturers to give in all cases correct guaranties.

The following table shows that more than one-fifth of the samples fall below their guaranties in respect to nitrogen. Inasmuch, however, as the Connecticut dealer has to pay for his meal before it is tested, and as neither he nor the firm which sold it to him had any knowledge of the quality of the meal other than that which the manufacturer's label gives, an attempt at strict enforcement of the law would result in hardship to Connecticut dealers, restriction of the supply, and probably increased cost to the buyer. To meet these conditions one firm, at least, gives with the guaranty on every bag a promise to make a specified reduction in the price for every unit of nitrogen that is lacking.

Samples of much of the meal which comes into the Connecticut valley are analyzed here, and buyers of this meal can therefore obtain a rebate for any deficiency of quality, by making demand on the dealer, provided they place their orders with a firm which agrees to refund for low grade meal. The fairest way to deal in such materials is to buy by the analysis; let us say, for illustration, $32.00 for 7 per cent. meal, which means twenty-three cents per pound for nitrogen. Allow a variation of 0.2 per cent. either side of the 7 per cent. for errors and discrepancies in samples and analyses, etc. Then for every 0.1 per cent. less than 6.89 per cent. of nitrogen found in the goods let the seller deduct forty-six cents from the ton price, and for every 0.1 per cent. more than 7.2 per cent. let him add the same amount.

Of the 273 samples examined 59 were below their guaranty. The percentage of nitrogen ranged from 5.68 to 7.82 and the average was 6.97. Prices varied not only with the time of shipment but with the quality of the meal and averaged $32.11 per ton, making the average cost of nitrogen in cotton seed meal 20.4 cents per pound.

The average cost of nitrogen to the buyer has been the same for all samples having over 6½ per cent. of nitrogen, but the average cost of nitrogen in samples having less than 6½ per cent. has been considerable higher. It should be said that the prices in the table are those originally charged, but that in the case of Humphrey-Godwin's goods, and possibly of others, wherever the meal fell below the guaranty, the price was correspondingly reduced.

Those who wish to have the meal examined at the station must bear in mind that proper sampling is no less important than accurate analysis, and that careless sampling makes the analysis worse than useless. The seller will not, and should not, accept an analysis unless he has proof that the sample was properly drawn. At least twenty bags should be opened in every car lot, and about a pint taken from each by thrusting the hand or a cup down into the meal. These samples should then be mixed carefully, and two samples drawn from the mixture, one to be sent to the station and the other held for the manufacturer in case it is called for. The one who samples should be prepared to make affidavit as to the date, No. of car, number of bags opened, etc. The sample sent to the station should be fully described on a blank, which will be furnished on application.

This information should be given to the station before the analysis is undertaken, for the station has no right to do work with state funds unless it has some assurance that the work, when done, will be of value to the public. Frequently we receive samples with no marks to identify them, broken packages from which a part or all the sample has run out over the mail matter, samples quite too small to be representative, and samples not of stock delivered in the state, but of what some shipper *proposes* to supply. These, of course, are worthless, but they are not positively harmful, whereas a sample of meal on sale in the state, which is apparently all right, but has not been carefully drawn, may do great injustice either to buyer or seller.

Analyses of Cotton Seed Meal, 1911.

Station No.	Dealer, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
	American Cotton Oil Co.					
26004	84000	J. E. Phelps	6.69	6.18	$32.00	20.6
26003	105000	" "	6.37	6.18	32.00	21.7
26652		T. J. Coleman	6.24	6.18	29.50	20.2
	F. W. Brode and Co.					
26338	44037	R. H. Ensign	7.00	6.50	29.50	17.9
26619	6146	Conn. Tobacco Corporation	6.90	....	....	....
26616	4771	" " "	6.86	....	....	....
26615	38943	" " "	6.83	....	....	....
26614	29029	" " "	6.83	....	....	....
26608	25556	" " "	6.82	....	....	....
26606	70497	" " "	6.80	....	....	....
26612	17200	" " "	6.75	....	....	....
26620	83632×6641	" " "	6.74	....	....	....
26618	3493	" " "	6.66	....	....	....
26613	15796	" " "	6.64	....	....	....
26607	13421	" " "	6.62	....	....	....
26604	23536	" " "	6.62	....	....	....
26158	13506	N. J. Trench and others	6.60	....	30.50	19.8
26125	8188	Spencer Bros. and others	6.56	6.50	30.00	19.5
26611	82835	Conn. Tobacco Corporation	6.55	....	....	....
26605	17759	" " "	6.53	....	....	....
26373	No. 1	W. M. Hinson	6.53	....	30.25	19.8
26335	93786	R. H. Ensign	6.51	6.50	32.00	21.2
26610	6972	Conn. Tobacco Corporation	6.50	....	....	....
26374	No. 2	W. M. Hinson	6.50	....	36.25	24.5
26337	43632	R. H. Ensign	6.49	6.50	32.00	20.8
26617	83578	Conn. Tobacco Corporation	6.40	....	....	....
26609	60993	" " "	6.35	....	....	....

ANALYSES OF COTTON SEED MEAL, 1911.—*Continued.*

Station No.	Dealer, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
	T. H. Bunch Co.					
26340	No. 2	B. C. Fuller	6.39	6.50	$30.00	20.1
	S. P. Davis.					
26088	59945	N. J. Trench, C. H. Eno	7.54	6.50	30.50	17.3
26336		R. H. Ensign	7.48	6.50	31.00	17.7
26174		Amos D. Bridge's Sons	7.44	....	31.00	17.9
26175		" " "	7.41	....	31.00	18.1
25990	K	W. B. Whitlock and others	7.32	6.50	31.50	18.5
26550		James Price	6.60	6.59	30.00	19.4
26551		William Tromley	6.08	6.59	31.75	22.5
	Rodney J. Hardy and Sons.					
26177	9861	Arthur Sikes and others	7.52	7.00	31.00	17.7
26176	9960	" " "	7.48	7.00	32.00	18.4
26000	9444	" " "	7.37	....	31.75	18.5
26394	10221	" " "	7.36	6.50	30.00	17.4
26332	10167	" " "	6.89	6.50	30.00	18.6
26157	9949	" " "	6.64	6.50	30.50	19.7
	Humphreys, Godwin and Co.					
26529	72934	Olds and Whipple	7.82	7.82	34.00	18.9
26505	35540	" "	7.82	7.76	34.00	18.9
26506	43918	" "	7.69	7.65	33.50	18.9
26417	48655	Loomis Bros. and others	7.68	6.50	30.00	16.7
26448	83217	Olds and Whipple	7.66	7.69	36.00	20.6
26180	28443	" "	7.63	7.61	36.50	21.0
26303	26931	" "	7.59	7.57	36.50	21.1

Analyses of Cotton Seed Meal, 1911.—*Continued.*

Station No.	Dealer, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
26371	88722	Olds and Whipple	7.57	7.49	$36.00	20.9
26530	304252	" "	7.56	7.65	33.50	19.2
26446	107084	" "	7.55	7.53	36.00	20.9
26419	67771	" "	7.55	7.53	33.00	18.9
26299	95825	" "	7.54	7.36	36.00	21.0
26155	102907	" "	7.54	7.49	36.00	21.0
26447	83983	" "	7.54	7.69	36.00	21.0
26302	70209	" "	7.52	7.53	36.50	21.3
26300	105439	" "	7.51	7.49	36.00	21.0
26212	84931	" "	7.51	7.41	35.50	20.7
26507	30302	" "	7.50	7.53	33.00	19.1
26059	26689	" "	7.48	7.49	35.50	20.9
26116	25979	" "	7.44	7.49	35.50	20.9
26179	22084	" "	7.44	7.37	35.50	20.9
26115	26418	" "	7.43	7.49	35.50	20.9
26420	65765	" "	7.42	7.41	32.50	18.9
26087	16565	" "	7.34	7.37	35.00	20.8
26238	24125	" "	7.33	7.12	35.00	20.9
26142	206435	" "	7.31	7.32	35.00	20.9
26086	65576	" "	7.30	7.28	35.00	21.0
26117	23690	" "	7.28	7.49	35.50	21.4
26239	33849	" "	7.27	7.24	35.50	21.4
26153	92823	" "	7.27	7.12	34.50	20.7
26118	20848	" "	7.26	7.28	35.00	21.1
26163	60525	" "	7.26	7.32	35.00	21.1
26305	34959	" "	7.26	7.32	35.50	21.6
26306	61066	" "	7.24	7.28	35.50	21.5
26133	30047	" "	7.22	7.08	34.50	20.9
26130	43957	" "	7.22	7.36	35.50	21.5

Analyses of Cotton Seed Meal, 1911.—*Continued.*

Station No.	Dealer, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
26350	26229	Spencer Bros. and others	7.22	6.50	$30.50	18.1
25967	22456	Olds and Whipple	7.21	7.24	36.00	21.9
25944	2284	" "	7.19	7.20	35.00	21.3
25975	93837	" "	7.18	7.24	36.00	22.0
26215	44533	" "	7.17	7.20	35.00	21.3
25933	19808	" "	7.17	7.20	36.00	22.0
25998	67894	" "	7.16	7.16	34.50	21.0
26131	27759	" "	7.16	7.16	35.00	21.4
26154	34639	" "	7.14	7.24	35.00	21.4
26472	2199	Arthur Sikes and others	7.12	6.50	30.00	18.0
25953	6727	H. K. Brainard and others	7.12	7.00	33.00	20.1
25973	2110	Olds and Whipple	7.10	7.00	33.00	20.2
26304	27408	" "	7.08	7.08	35.00	21.6
26351	18913	C. G. Lawton	7.08	6.56	30.00	18.1
26141	60504×10914	Spencer Bros., C. Michel	7.06	6.50	30.00	18.1
26028	682249	Spencer Bros., Bissell-Graves Co.	7.04	7.00	32.00	19.6
26178	60519	Olds and Whipple	7.04	7.20	35.00	21.7
25980	62002	" "	7.04	7.00	33.00	20.3
25974	3862	" "	7.03	7.00	33.00	20.4
26082	68703	Spencer Bros., Bissell-Graves Co.	7.03	....	31.25	19.1
26369	17348	H. K. Brainard and others	7.03	7.00	31.00	18.9
26083	1010	" " "	7.02	7.00	32.50	20.0
25964	21174	Olds and Whipple	7.00	7.00	33.00	20.4
25999	25909	" "	6.99	7.00	34.00	21.2
25965	20603	" "	6.99	7.00	33.00	21.2
26084	46337	H. K. Brainard and others	6.98	7.00	32.75	20.3
26167	44908×27473	Spencer Bros. and others	6.98	6.50	30.25	18.5
26349	26832	" " "	6.98	6.50	30.50	18.7
26134	91340×131048	" " "	6.98	7.00	31.25	19.2

Analyses of Cotton Seed Meal, 1911.—*Continued.*

Station No.	Dealer, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. of Nitrogen.		Cost per ton.	Nitrogen costs cents per pound.
			Found.	Guaranteed.		
25981	559285	Broad Brook Lumber and Coal Co.	6.98	....	$31.65	19.5
26032	6819	Olds and Whipple	6.98	7.00	33.50	20.9
26008	88190	" "	6.98	7.00	34.00	21.2
26007	76090	" "	6.97	7.00	34.00	21.2
26025	68249	Spencer Bros., Bissell-Graves Co.	6.97	....	31.25	19.3
26006	35975	Olds and Whipple	6.95	7.00	34.00	21.3
25966	71419	" "	6.94	7.00	33.00	20.7
26079	68703	Spencer Bros., Bissell-Graves Co.	6.94	7.00	31.25	19.4
26122	131048	" " " "	6.93	....	31.25	19.4
25957	42037	Olds and Whipple	6.92	7.00	33.00	20.7
26171	48151	Spencer Bros. and others	6.91	6.50	30.50	18.9
26161	285	Loomis Bros. Co., C. Sandman	6.90	6.50	30.50	18.9
26370	2128	Arthur Sikes and others	6.90	6.50	30.00	18.6
26224	60818	Spencer Bros., H. Zera	6.89	6.50	....	....
26135	13224	Spencer Bros., Bissell-Graves Co.	6.89	7.00	31.25	19.5
25959	98578	" " and others	6.89	6.50	32.50	20.4
26208	2234	Loomis Bros. Co. and others	6.88	6.50	30.00	18.6
26333	17348	H. K. Brainard, S. H. Neelans	6.88	7.00	31.00	19.3
25970	18358	Spencer Bros. and others	6.88	6.50	31.50	19.7
25988	526461	Olds and Whipple	6.87	7.00	34.00	21.6
26062	90641×27575	Spencer Bros., John Sullivan	6.87	6.50	31.00	19.4
26085	63386	H. K. Brainard, H. Russell	6.87	6.50	31.00	19.4
26214	122576	Olds and Whipple	6.86	7.00	31.00	19.4
26219	41221	Spencer Bros. and others	6.85	6.50	31.50	19.8
26026	28	Spencer Bros.	6.84	....	31.00	19.4
26015	10582	" " and others	6.84	6.50	31.25	19.6
25972	4289	Loomis Bros. Co.	6.84	6.50	32.50	20.6
26301	35334	Olds and Whipple	6.84	6.58	30.00	18.7
25994		F. M. Thompson	6.82	6.56	30.75	19.3

Analyses of Cotton Seed Meal, 1911.—*Continued.*

Station No.	Dealer, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. of Nitrogen.		Cost per ton.	Nitrogen costs cents per pound.
			Found.	Guaranteed.		
26099	15429	Spencer Bros. and others	6.82	6.50	$31.00	19.5
26097	17477	" " "	6.81	6.50	31.25	19.7
25968	95864	" " C. F. Whittemore	6.81	7.00	31.50	19.9
26124	13224	Spencer Bros., Bissell-Graves Co.	6.80	....	31.25	19.7
25984	5152	" " and others	6.79	6.50	31.50	20.0
25930	87469	" " "	6.79	6.50	31.50	20.0
25924	41403	" " "	6.78	7.00	31.50	20.0
25960	3966	" " "	6.78	6.50	30.50	19.3
26221	47065	" " "	6.78	6.50	32.00	20.4
26091	14650	Loomis Bros. Co. and others	6.78	6.50	31.00	19.6
25943	7635	Olds and Whipple	6.78	7.20	35.00	22.6
26166	75718	" "	6.78	6.58	29.50	18.5
25986	16141	Spencer Bros., L. A. Kent	6.76	7.00	31.50	20.1
26504	134143	" "	6.76	6.50	31.00	19.7
26241	30878	H. K. Brainard, C. T. Remington,	6.76	7.00	33.00	21.2
26074	1382	Loomis Bros. Co.	6.76	6.50	31.00	19.7
26220	47625	Spencer Bros., J. E. Hastings	6.75	6.50	30.00	19.0
26126	74963	" " and others	6.74	7.00	30.50	19.4
26096	39613	" " "	6.74	6.50	30.50	19.4
26001	1490	Arthur Sikes and others	6.74	....	31.50	20.1
26658	33671	Olds and Whipple	6.74	6.58	31.00	19.8
26372	14144	" "	6.74	6.58	29.50	18.6
26182	63924	" "	6.74	6.58	30.00	19.0
26123	32696	Spencer Bros., Bissell-Graves Co.	6.73	....	31.25	20.0
26169	1004	" " C. A. Harmon	6.72	6.50	29.75	18.9
26136	32696	" " Bissell-Graves Co.	6.72	7.00	31.25	20.0
26162	17070	Loomis Bros. Co. and others	6.72	6.50	30.50	19.4
26222	79606	Spencer Bros., L. Boroski	6.71	6.50	29.50	18.7
26075	8607×18969	" " and others	6.71	6.50	32.00	20.6

ANALYSES OF COTTON SEED MEAL, 1911.—*Continued.*

Station No.	Dealer, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
25985	5592	Spencer Bros. and others	6.71	7.00	$31.50	20.2
26022	1584	Arthur Sikes, E. S. Seymour	6.71	7.00	31.75	20.4
26183	579400	Olds and Whipple	6.71	6.58	30.00	19.1
25951	25045	" "	6.70	7.00	35.00	22.9
26501	12861	Spencer Bros. and others	6.70	6.50	30.00	19.1
26109	11307	A. W. Burrows	6.69	6.50	31.75	20.5
26092	14852	Loomis Bros. Co., C. G. Sandman	6.69	6.50	30.50	19.5
26253	27728	Olds and Whipple	6.68	6.50	30.00	19.2
26121	16690	" "	6.68	6.58	30.50	19.6
25950	13248	" "	6.68	7.00	35.00	22.9
26223	60818	Spencer Bros., H. Zera	6.68	6.50	....	....
25949	36677	" " and others	6.68	7.00	31.50	20.3
26061	64255	" " John Sullivan	6.67	6.50	31.00	20.0
26368	18811	H. K. Brainard	6.66	6.50	30.00	19.2
26181	48109	Olds and Whipple	6.65	7.00	32.50	21.2
26147	15846	" "	6.64	6.50	29.50	18.9
26060	84638	Spencer Bros. and others	6.64	6.50	32.50	21.2
26500	26446×34202	" " "	6.63	6.50	30 00	19.3
26172	60818	" " "	6.63	6.50	30.50	19.7
26209	H. W. M.	F. M. Thompson, H. W. Mohn	6.63	6.18	30.50	19.7
26623	80698	H. K. Brainard, A. H. Brainard	6.62	7.00	31.25	20.3
26185	36165	F. M. Thompson	6.62	6.50	30.75	19.9
26098	28176	Spencer Bros. and others	6.62	6.50	32.00	20.9
25983	6371	" " "	6.60	6.50	31.50	20.6
25907	Dark	" " "	6.60	....	....	....
26156	510231	Olds and Whipple	6.60	7.00	32.50	21.3
26148	10124	" "	6.60	6.50	29.50	19.0
26002	1496	Arthur Sikes and others	6.60	....	31.75	20.7
26034	2094	Loomis Bros. Co., C. Sandman	6.60	6.50	31.50	20.6

ANALYSES OF COTTON SEED MEAL, 1911.—*Continued.*

Station No.	Dealer, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. of Nitrogen.		Cost per ton.	Nitrogen costs cents per pound.
			Found.	Guaranteed.		
26089	51490	Loomis Bros. Co. and others	6.60	6.50	$31.00	20.4
26298	33917	Amos D. Bridge's Sons, E. E. Thompson	6.60	....	31.00	20.2
26090	5055	Loomis Bros. Co. and others	6.59	6.50	31.00	20.4
26056	(?)	J. B. Parker	6.59	....	32.00	21.0
26334		Loomis Bros. Co., R. H. Ensign	6.57	6.18	31.00	20.3
25992	36509	The Coles Co.	6.57	6.56	33.00	21.8
25939	61945	Olds and Whipple	6.57	7.00	31.50	20.7
25971	301377	Spencer Bros. and others	6.56	6.50	31.50	20.7
26502	21650	" "	6.56	6.50	30.00	19.5
26095	25502×24036	" " and others	6.55	6.50	31.00	20.3
26168	42665	" " "	6.54	6.50	30.25	19.8
25945	8052	Olds and Whipple	6.54	7.00	35.00	23.4
26165	22527	" "	6.53	7.00	32.50	21.5
25946	98314	" "	6.53	6.58	28.70	18.6
26225	60818	Spencer Bros., H. Zera	6.53	6.50	....	....
26035	20049	Loomis Bros. Co., C. Sandman	6.53	6.50	31.50	20.8
25940	28366	Olds and Whipple	6.52	7.00	31.50	20.8
26017	4026	Spencer Bros., Mrs. M. Doughney	6.52	6.50	31.50	20.8
26128	120372	" " and others	6.52	7.00	30.50	20.0
26173	42973	" " J. Barnett	6.51	6.50	29.25	19.1
26019	93506	" " and others	6.51	6.50	31.50	20.8
25922	33462	" " "	6.51	7.00	31.50	20.8
25920	8576	Olds and Whipple	6.51	6.58	30.00	19.9
26445	2155	Arthur Sikes and others	6.51	....	30.00	19.7
26012	11667	Broad Brook Lumber and Coal Co.	6.51	....	31.25	20.7
26005	12637	" " " " "	6.50	6.50	30.65	20.2
26659	18513	Olds and Whipple	6.50	6.58	31.00	20.5
25923	535492	Spencer Bros. and others	6.49	7.00	31.50	20.9
26170	82799	" " "	6.49	6.50	29.75	19.6

Analyses of Cotton Seed Meal, 1911.—*Continued.*

Station No.	Dealer, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
26164	536297	Olds and Whipple	6.49	7.00	$32.50	21.7
26132	60615	" "	6.49	6.50	30.00	19.8
26144	3112	" "	6.47	6.58	30.50	20.2
26621	131259	" "	6.46	6.58	31.00	20.6
25941	14326	" "	6.45	7.00	31.50	21.0
25937	70391	" "	6.45	7.00	31.50	21.0
25925	Dark	Spencer Bros.	6.45	....	31.50	21.0
26127	39476	" " and others	6.45	6.50	30.50	20.3
26027	11322	" " "	6.45	6.50	31.00	20.7
26016	2138	" " D. Barron	6.44	6.50	30.00	19.9
25935	94227	Olds and Whipple	6.44	7.00	35.00	23.8
26119	4868	" "	6.44	6.58	30.50	20.3
26622	38712	" "	6.44	6.58	31.00	20.7
25942	20479	" "	6.43	6.58	30.00	19.9
26094	10495	Spencer Bros. and others	6.43	6.50	30.00	19.9
25921	107466	" " "	6.42	7.00	31.50	21.1
26110		G. W. Agee	6.42	....	....	....
26033	14518	Olds and Whipple	6.42	6.58	31.00	20.8
25938	51486	" "	6.42	7.00	31.50	21.1
25926	61180	Spencer Bros.	6.41	....	32.50	22.0
26120	37417	Olds and Whipple	6.40	6.58	30.50	20.4
25947	77214	" "	6.40	6.58	28.22	18.6
26213	17546	" "	6.38	6.50	29.50	19.7
25934	42088	" "	6.37	7.00	35.00	24.1
26143	13792	" "	6.34	6.50	29.50	19.8
25987	578584	Spencer Bros. and others	6.34	7.00	31.50	21.4
26011	85584	Arthur Sikes and others	6.29	7.00	32.00	22.0
25948	Stray 70	Spencer Bros.	6.28	6.50	31.50	21.6
25954	134090	H. K. Brainard, G. A. Douglas	6.28	6.18	32.00	22.0

Analyses of Cotton Seed Meal, 1911.—*Concluded.*

Station No.	Dealer, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
26139	140347	Olds and Whipple, A. E. Holcomb	6.24	6.50	$31.50	21.8
26103	12490	Spencer Bros.	6.10	....	....	....
26018	12490	" " L. P. Bissell	6.09	7.00	32.00	22.7
26023	12490	" " Bissell-Graves Co.	6.04	7.00	31.25	22.3
25969	63963	" " and others	6.01	6.50	32.50	23.4
26009	19716	H. K. Brainard, S. Alden	5.84	6.50	32.50	24.1
25995	19716	" " and others	5.81	6.50	32.50	24.2
26010	61791	" " F. Ponchot	5.73	6.50	32.50	24.6
25906	37107	Spencer Bros	5.68	6.18	....	....
	George B. Robinson, Jr.					
26240		E. N. Austin	6.56	....	28.00	18.0
25961	2259	Broad Brook Lumber and Coal Co.	6.55	....	30.00	19.6
25952	50317	" " " "	6.45	....	31.65	21.2
25996	42065	" " " "	6.43	....	30.65	20.4
25993	21380	" " " "	6.41	6.50	30.50	20.4
26418	14608	E. N. Austin	6.10	6.58	28.20	19.6
	W. Newton Smith.					
26503	514801	Spencer Bros., E. C. Holdridge	6.62	6.50	31.00	20.1
26444	24152	Arthur Sikes and others	6.35	7.00	31.00	21.0
	J. R. Soper Co.					
26339		B. C. Fuller	6.62	6.50	30.00	19.4
	Jobber unknown.					
26113		C. C. Graves	6.56	6.50	....	....
26114		" " Mrs. Tobin	6.74	6.50	....	....
26210	Graves	" "	6.94	6.50	....	....
26211	D. King	" "	6.85	6.50	....	....

CASTOR POMACE.

Castor pomace, a residue from the manufacture of castor oil, and extremely poisonous to stock, which will eat it greedily if they have the chance, is used more or less as a fertilizer for tobacco. The following four samples have been examined:

26399. Sold by American Agricultural Chemical Co. Sampled from stock of C. F. Brewer, East Hartford.

26697. Sold by American Agricultural Chemical Co. Sampled and sent by A. B. Phelps, Granby.

26277. Sold by Baker Castor Oil Co. Sampled from stocks of F. S. Bidwell & Co., Windsor Locks, and Spencer Bros., Suffield.

26276. Sold by Olds & Whipple. Sampled at factory.

ANALYSES OF CASTOR POMACE.

Station No.	26399	26697	26277	26276
Percentage amounts of				
Nitrogen, in form of ammonia	0.01	0.01	0.01	0.02
" organic, water-soluble	0.91	0.82	0.78	0.62
" " active insoluble	1.95	1.97	1.92	2.18
" " inactive insoluble	2.11	2.23	1.91	2.38
" total, found	4.98	5.03	4.62	5.20
" " guaranteed	4.53	....	4.50	5.00
Cost per ton	$24.00	25.00	25.00	25.00
Nitrogen costs cents per pound	21.5	22.3	24.3	21.6

Castor pomace also contains, on the average, 1.95 per cent. of phosphoric acid and 0.95 per cent. of potash. These are taken into account in computing the cost of the nitrogen.

The cost of nitrogen in castor pomace ranges from 21.5 to 24.3 cents and averages 22.4 cents per pound, two cents higher than in cotton seed meal.

The solubility of the organic nitrogen ranges from 54.1 to 58.6; average, 56.5 per cent. The significance of nitrogen solubility is discussed on page 8.

II. RAW MATERIALS CHIEFLY VALUABLE FOR PHOSPHORIC ACID.

BASIC SLAG PHOSPHATE OR THOMAS SLAG.

This material is a by-product of the steel manufacture. The highest grade on the market contains from 17 to 19 per cent. of phosphoric acid and 35 to 50 per cent. of lime in finely divided form. There are, however, very inferior grades offered for sale at prices which the farmer cannot afford to pay and against which he should be on his guard. The lime is in efficient form for correcting soil acidity. The phosphoric acid is fairly available to plants, though showing small "availability" by the conventional method described on page 7 of this report. In most cases it will probably be found less quick in its action as a source of phosphoric acid, but more lasting in its effects than acid phosphate. For top-dressing grass land and for fruit trees it has given very satisfactory results.

Five samples of Basic Slag of standard quality were analyzed, as follows:

26476. Sold by American Agricultural Chemical Co. Sampled from stock of Connecticut Valley Orchard Co., Berlin.

26199. Sold by Coe-Mortimer Co. Sampled from stocks of L. M. Benham, Highwood, and Lightbourn & Pond Co., New Haven.

26453. Sold by Sanderson Fertilizer and Chemical Co. Sampled at factory.

26449. Sold by Sanderson Fertilizer and Chemical Co. Sampled and sent by A. E. Plant, Branford.

26270. Sold by Wilcox Fertilizer Co. Sampled at factory.

The usual guaranty for this material is from 17 to 19 per cent. of phosphoric acid, of which from 15 to 16 per cent. is "available" by Wagner's method of extraction, with from 35 to 50 per cent. of lime.

All the samples tested contained the guaranteed amount of phosphoric acid.

ANALYSES OF BASIC SLAG.

Station No.	26476	26199	26453	26449	26270
Percentage amount of					
Phosphoric acid	17.35	17.86	17.80	17.14	18.66
Cost per ton	$19.00	19.00	18.00	16.00	19.00

Inferior Basic Slag.

In October, a sample was sent by Dr. F. Milton Smith, who stated that it represented two tons of basic slag bought of the Fertilizer Materials Supply Co., 80 Wall St., New York. The firm wrote him that it was 16 to 18 per cent. slag, although it would be tagged 14 per cent. The station analysis showed only 10.59 per cent. of phosphoric acid soluble in acid. The station agent later drew a sample from seven bags of this material at Dr. Smith's farm, at Darien. This sample contained 9.98 per cent. of acid-soluble phosphoric acid, thus confirming the gross inferiority of this Basic Slag. The Fertilizer Materials Supply Company stated that other analyses had justified the guaranty given on the goods, but as they handle four different grades of basic slag, one of which contains 10-12 per cent. of phosphoric acid, by some mistake this lower grade must have been shipped. The Company returned its check to Dr. Smith to make good the deficiency.

PRECIPITATED BONE PHOSPHATE.

This is a manufacturing by-product, stated to be made by adding some form of lime to solutions of phosphoric acid, which throws down the acid in a form which dries to a fine, white powder, containing phosphoric acid combined with lime. This phosphate is mostly insoluble in water, but apparently readily available to plants. It is an excellent form for use in tobacco fertilizer. Both samples analyzed were sold by Olds & Whipple.

26216. Sampled and sent by Connecticut Tobacco Corporation, Tariffville, and **26375** sampled and sent by W. M. Hinson, Hazardville. The cost per ton in each case was $36.40.

	26216	26375
Water-soluble phosphoric acid	1.65	1.52
Citrate-soluble phosphoric acid	34.75	34.21
Citrate-insoluble phosphoric acid	4.64	1.71
Total phosphoric acid	41.04	37.44

"Available" phosphoric acid in this form costs about 5 cents per pound.

DISSOLVED ROCK PHOSPHATE OR ACID PHOSPHATE

This material is made by treating mineral phosphate with oil of vitriol. Several grades are on the market, guaranteed to contain 14, 16 or 20 per cent. of "available" phosphoric acid.

Analyses of Acid Phosphate.

Station No.	26566	26274	26477	26525	26401	26149	26267	26242
Percentage amount of								
Water-soluble phosphoric acid	11.41	10.98	12.43	10.83	11.89	2.02	14.58	14.94
Citrate-soluble phosphoric acid	2.66	5.70	2.87	4.01	2.02	18.53	1.83	1.05
Citrate-insoluble phosphoric acid	2.62	1.28	0.88	1.61	1.56	1.77	0.63	1.20
Total phosphoric acid	16.69	17.96	16.18	16.45	15.47	22.32	17.04	17.19
Sum of water-soluble and citrate-soluble phosphoric acid found	14.07	16.68	15.30	14.84	13.91	20.55	16.41	15.99
"Available" phosphoric acid guaranteed	14.00	14.00	14.00	14.00	12.00	20.00	14.00	16.00
Cost per ton	$13.00	16.00	15.00	15.00	14.50	22.00	17.50	18.00
"Available" phosphoric acid costs cents per pound	4.6	4.8	4.9	5.1	5.2	5.4	5.3	5.6
Station No.	26398	26423	26342	26197	26481	26627	26759	....
Percentage amount of								
Water-soluble phosphoric acid	11.46	11.35	10.55	11.65	15.12	10.52	10.27	....
Citrate-soluble phosphoric acid	2.29	3.56	3.96	3.31	2.18	4.77	5.09	....
Citrate-insoluble phosphoric acid	0.83	1.66	1.00	0.75	0.46	1.47	1.50	....
Total phosphoric acid	14.58	16.57	15.51	15.71	17.76	16.76	16.86	....
Sum of water-soluble and citrate-soluble phosphoric acid found	13.75	14.91	14.51	14.96	17.30	15.29	15.36	....
"Available" phosphoric acid guaranteed	14.00	14.00	14.00	14.00	14.00	16.00	16.00	...
Cost per ton	$18.00	....	....	....	....	....	....	....
"Available" phosphoric acid costs cents per pound	6.6	....	....	....	....	....	....	....

26566. Star Phosphate. Sold by Armour Fertilizer Works. Sampled from stock of A. Grulich, Meriden.

26274. Sold by American Agricultural Chemical Co. Sampled from stock of S. D. Woodruff & Sons, Orange.

26477. Atlantic Dissolved Phosphate. Sold by Atlantic Fertilizer Co. Sampled from stock of J. E. Fagan, Bloomfield.

26525. Sold by Fertilizer Materials Supply Co. Sampled and sent by W. A. Simpson, Wallingford.

26401. Sold by L. T. Frisbie Co. Sampled from stock of Lightbourn & Pond Co., New Haven.

26267. Sold by Wilcox Fertilizer Co. Sampled at factory.

26242. Sold by Baugh Chemical Co. Sampled and sent by E. Manchester & Sons, Winsted.

26149. Sold by Olds & Whipple. Sampled and sent by C. B. Sheldon, West Suffield.

26398. Sold by Bowker Fertilizer Co. Sampled from stock of C. F. Brewer, East Hartford.

26423. Sold by Fertilizer Materials Supply Co. Sampled from stock of Connecticut School for Boys, Meriden.

26342. Sold by Patron's Exchange. Sampled from stock of C. R. Treat, Orange.

26197. Sold by Nitrate Agencies Co. Sampled from stocks of L. M. Benham and Andrew Ure, Highwood.

26481. Sold by C. M. Shay Fertilizer Co. Sampled from stock of Farmers' Association, Leonard's Bridge.

26627. Sold by Rogers Manufacturing Co. Sampled at factory.

26759. Sold by Rogers Manufacturing Co. Sampled at factory.

COST AND VALUATION.

The retail cash cost of acid phosphate has ranged from $13.00 to $22.00 per ton, making "available" phosphoric acid cost 5.3 cents per pound. This is the average figure. In mixed car lots "available" phosphoric acid has been bought by farmers for from 4.2 to 4.6 cents per pound.

The range in retail prices quoted is very large.

The Rogers Manufacturing Company objected that the analysis of **26627** did not at all agree with other analyses which had been made of this stock, and requested that another sample be tested. This was done, with the result given in **26759,** which does not differ substantially from the first sample.

III. RAW MATERIALS OF HIGH GRADE CONTAINING POTASH.

HIGH-GRADE SULPHATE OF POTASH.

(ANALYSES ON PAGE 43.)

This chemical should contain about 90 per cent. of pure potassium sulphate (sulphate of potash), equivalent to about 49 per cent. of potassium oxide ("potash"), and it should be nearly free from chlorides. The five samples analyzed were of good quality and met their guaranties.

The average cost of potash in high-grade sulphate in these samples is 5.18 cents per pound.

DOUBLE MANURE SALT.

(ANALYSES ON PAGE 43.)

This material is frequently sold on a guaranty of "48-50 per cent. sulphate," which is equivalent to 25.9-27.0 per cent. of potassium oxide (actual potash). Besides some 46-50 per cent. of potassium sulphate, it contains over 30 per cent. of magnesium sulphate, chlorine equivalent to 3 per cent. of common salt, a little sodium and calcium sulphates, and varying quantities of moisture.

The three samples analyzed were of average composition.

The cost of potash per pound in double manure salt was 5.6 cents, in the average of the two samples, somewhat higher than in high-grade sulphate. In mixed car lots it was bought for 4.1 cents.

KAINIT.

(ANALYSES ON PAGE 43.)

Kainit contains from 11 to 15 per cent. of potash, more than that quantity of soda, and rather less magnesia. These "bases" are combined with chlorine and sulphuric acid. It usually contains more water than either the sulphate or muriate of potash and is sold on a guaranty of from 12 to 15 per cent. of potash.

The four samples analyzed were of average composition.

The average cost of potash per pound in kainit was 5.63 cents, but in mixed car lots it was bought for 4.8 cents.

Misbranded Muriate of Potash.

26526 was stated to have been sold by the Fertilizer Materials Supply Company of New York as muriate of potash for $42

Potash Salts. Percentage Composition and Cost per Pound of Potash.

Station No.	Drawn from Stock in possession of	Sampled and sent by	Potash soluble in water. Found.	Potash soluble in water. Guaranteed.	Cost per ton	Potash costs cents per pound.
	High-Grade Sulphate of Potash.					
26251	John Merrill, Suffield, from Nitrate Agencies Co.	Station Agent..........	50.74	48.0	$50.00	4.9
26271	Wilcox Fertilizer Co..........................	Station Agent..........	51.52	48.0	51.50	5.0
26218	Apothecaries Hall Co., Waterbury, Spencer Bros., Suffield, from German Kali Works..........	Station Agent.........	50.66	48.0	53.00	5.2
26355	Rogers Mfg. Co..............................	Station Agent..........	48.81	48.0	52.00	5.3
26150	C. B. Sheldon, W. Suffield, from Olds & Whipple	C. B. Sheldon..........	49.45	48.7	54.00	5.5
	Double Manure Salt.					
26426	Conn. School for Boys, Meriden, from Fert. Materials Supply Co.......................	Station Agent..........	28.30	27.0	.....	....
26527	W. A. Simpson, Wallingford, from Fert. Materials Supply Co..............................	W. A. Simpson.........	27.32	....	29.00	5.3
26626	E. Halladay, Suffield, from Amer. Agr. Chem. Co.	Station Agent..........	27.35	26.0	32.00	5.9
	Kainit.					
26567	A. Grulich, Meriden, from Armour Fert. Works	Station Agent..........	14.13	12.0	13.00	4.6
26571	E.A. Standish, Andover, from German Kali Works	Station Agent..........	13.85	12.0	17.00	6.1
26573	E. White, Rockville, from Nitrate Agencies Co.	Station Agent..........	12.80	12.0	16.00	6.2
26421	Conn. School for Boys, Meriden..............	Station Agent..........	13.32	12.0	.....	...
	Muriate of Potash.					
26354	Rogers Mfg. Co..............................	Station Agent..........	52.96	50.0	43.00	4.1
26450	A.E. Plant, Branford, from Sanderson F. & C. Co.	A. E. Plant............	50.81	50.0	42.00	4.1
26250	John Merrill, Suffield, from Nitrate Agencies Co.	Station Agent..........	50.96	50.0	43.00	4.2

POTASH SALTS. PERCENTAGE COMPOSITION AND COST PER POUND OF POTASH.—*Continued.*

Station No.	Drawn from Stock in possession of	Sampled and sent by	Potash soluble in water. Found.	Potash soluble in water. Guaranteed.	Cost per ton.	Potash costs cents per pound.
	Muriate of Potash, continued.					
26206	Sanderson Fert. & Chem. Co.	Station Agent	52.62	50.0	$45.00	4.3
26268	Wilcox Fertilizer Co.	Station Agent	51.06	50.0	44.00	4.3
26352	D. L. Clark, Milford, from Amer. Agr. Chem. Co.	Station Agent	51.40	49.0	46.00	4.5
26569	L. A. Gowdy, Somerville, from Coe-Mortimer Co.	Station Agent	53.83	48.0	48.00	4.5
26982	J. J. Copp, Groton, from Shay Fertilizer Co.	J. J. Copp	49.50	....	46.00	4.6
26205	Lightbourn & Pond Co., New Haven, from L. T. Frisbie Co.	Station Agent	48.58	50.0	46.00	4.7
26532	F. R. Jennings, Fairfield, from Amer. Agr. Chem. Co.	F. R. Jennings	49.80	49.0	43.00	4.3
26533	F. R. Jennings, Fairfield, from Amer. Agr. Chem. Co.	F. R. Jennings	50.44	49.0	43.00	4.2
26452	G. H. Hale, Glastonbury, from Bowker Fert. Co.	Station Agent	51.22	49.0	.....	....
26425	Conn. School for Boys, Meriden, from Fert. Materials Supply Co.	Station Agent	51.39	50.5	.....	....
26204	L. M. Benham & Andrew Ure, Highwood, German Kali Works	Station Agent	51.12	50.0	.....	....
26483	Farmers' Asso., Leonard's Bridge, from C. M. Shay Fert. Co.	Station Agent	46.78	50.0	.....	....
26295	Station	Station Agent	47.27	....	.....	....

per ton. The sample sent by W. A. Simpson, Wallingford, was not commercial muriate of potash but contained only 10.89 per cent. of potash and 36.47 per cent. of chlorine.

The sample, it was later found, was taken from only one bag, and appeared to be some low-grade potash salt or possibly sweepings from broken bags of such salts. Whether the two tons were like this sample cannot now be determined. The selling company states that it was bought by them as high-grade muriate, that other lots sold by them were of standard grade as appears in the table, and they believe that through some carelessness or mistake a single bag of sweepings was included in the shipment made to them.

MURIATE OF POTASH.

(ANALYSES ON PAGES 43 AND 44.)

Commercial muriate of potash contains about 80 per cent. of muriate of potash (potassium chloride), equivalent to 50.5 per cent. of actual potash, 15 per cent. or more of common salt and 4 per cent. or more of water.

26205 was 1.42 per cent. and **26483** 3.22 per cent. below its guaranty.

The other fourteen samples were of average composition.

The average cost per pound of potash in the muriate (excluding 26526) was 4.37 cents. In mixed car lots it has cost from 3.7 to 4.06.

CARBONATE OF POTASH.

Commercial carbonate of potash has been a popular form of potash fertilizer for tobacco. During the past year, however, only one sample was sent for analysis.

26376. Sold by Olds & Whipple. Sent by W. M. Hinson, Hazardville.

Percentage amount of	
Potash found	63.84
Cost per ton	$90.00
Potash costs cents per pound	7.0

VEGETABLE POTASH.

This material is understood to be the ashes of beet residues from the manufacture of beet sugar, and is considerably used as a source of potash in tobacco formulas. One sample was analyzed.

26353. Sold by Olds & Whipple. Sampled from their stock and that of E. T. Hurlbut, Somerville.

Percentage amount of	
Potash calculated as muriate	2.29
" " " sulphate	1.43
" " " carbonate	22.82
Total water-soluble potash	26.54
Cost per ton	$44.50
Potash costs cents per pound	**8.4**

ANALYSES OF

Station No.	Manufacturer and Brand.	Dealer or Purchaser.
	Sampled by Station Agent:	
26731	Amer. Agric. Chem. Co., Bone Meal	H. M. Kent Co.
26730	Amer. Agric. Chem. Co., Fine Ground Bone	G. L. Dennis
26732	Armour Fertilizer Co., Bone Meal	Brower & Malone
26733	Berkshire Fertilizer Co., Fine Ground Bone	Hotchkiss & Templeton
26734	Valentine Bohl, Self Recommending Fertilizer	Apothecaries Hall Co.
26736	Bowker Fertilizer Co., Fresh Ground Bone	Lightbourn & Pond Co.
26735	Bowker Fertilizer Co., Market Bone	M. M. Hansen
26737	Buffalo Fertilizer Co., Bone Meal	A. D. Bridge's Sons
26738	Coe-Mortimer Co. XXX Ground Bone	W. O. Burr, R. H. Morgan
26739	Peter Cooper's Glue Factory, Pure Bone Dust	Apothecaries Hall Co.
26740	Essex Fertilizer Co., Ground Bone	W. K. Ackley
26741	L. T. Frisbie Co., Fine Bone Meal	W. O. Goodsell, L. T. Frisbie Co.
26743	National Fertilizer Co., Ground Bone	F. T. Blish Hardware Co.
26744	New England Fertilizer Co., Ground Bone	A. Grulich
26745	Parmenter & Polsey, Ground Bone	Pring Bros.
26746	Rogers & Hubbard Co., Knuckle Bone Flour	H. W. Andrews
26747	Rogers & Hubbard Co., Strictly Pure Fine Bone	F. S. Platt Co.
26749	Rogers Mfg. Co., Fine Ground Bone	Meeker Coal Co., C. P. Beach
26748	Rogers Mfg. Co., Knuckle Bone Flour	L. M. Benham
26750	Sanderson Fert. & Chem. Co., Ground Bone	R. H. Hall
26751	C. M. Shay Fertilizer Co., Ground Bone	F. O. Brown
26752	M. L. Shoemaker & Co., Swift-Sure Bone Meal	Olds & Whipple
26753	Swift's Lowell Fertilizer Co., Ground Bone	C. W. Lines Co.
26754	Wilcox Fertilizer Co., Ground Bone	E. A. Stiles
26755	Wilcox Fertilizer Co., Ground Bone	I. W. Dennison & Co.
	Sampled by Purchasers and others.	
26057	Buffalo Fertilizer Co., Ground Bone	E. C. Warner
26451	Buffalo Fertilizer Co., Bone Meal	A. E. Plant
26742	E. L. James, Warrenville, Ground Bone	Sent by manufacturer

IV. RAW MATERIALS CONTAINING NITROGEN AND PHOSPHORIC ACID.

BONE MANURES.

The terms "Bone Dust," "Ground Bone," "Bone Meal" and "Bone" sometimes signify material made from dry, clean and pure bones; in other cases these terms refer to the result of crushing fresh or moist bones, which have been cooked in steam tanks to recover grease, and the product sometimes sold as "tank-

BONE MANURES.

Dealer's cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.	Chemical Analysis.				Mechanical Analysis.	
			Nitrogen.		Phosphoric Acid.		Finer than 1-50 inch.	Coarser than 1-50 inch.
			Found.	Guaranteed.	Found.	Guaranteed.		
$32.00	$20.11	59.1	2.11	1.7	16.17	13.0	66	34
32.00	27.58	16.0	2.42	2.5	24.20	22.0	71	29
.....	29.76	....	3.00	2.5	25.30	22.0	49	51
27.00	32.53	17.0*	2.53	2.5	28.70	20.0	90	10
32.00	31.96	0.1	4.15	3.4	21.78	22.0	67	33
33.00	28.29	16.7	2.42	2.5	25.80	22.0	59	41
30.00	23.37	28.4	2.36	1.9	19.88	18.7	55	45
31.00	27.15	14.2	2.84	2.9	21.88	22.0	66	34
33.00	29.52	11.8	2.84	2.5	25.04	23.0	65	35
30.00	26.92	11.4	2.00	2.1	26.56	22.0	50	50
33.00	30.86	6.9	2.48	2.5	28.02	22.0	72	28
31.50	31.57	0.2*	3.73	3.3	24.20	18.0	56	44
32.00	19.17	66.9	1.75	1.6	16.94	13.7	60	40
33.00	31.66	4.2	2.68	2.5	27.82	23.0	76	24
32.50	30.00	8.3	2.65	2.5	26.23	20.0	70	30
38.00	33.75	12.6	3.86	3.8	25.41	24.7	69	31
38.00	28.53	33.2	3.50	2.9	22.32	22.0	42	58
34.00	34.64	1.9*	3.58	3.0	26.66	22.0	84	16
35.00	32.30	8.3	3.80	3.5	25.46	24.0	49	51
32.00	21.28	50.3	1.50	2.5	21.36	20.0	51	49
31.00	29.06	6.7	2.53	2.0	25.20	25.0	76	24
35.00	36.70	4.6*	5.56	4.5	23.13	20.0	49	51
33.00	30.38	8.6	2.90	2.5	26.10	23.0	62	38
32.00	29.98	6.7	2.86	2.5	26.74	22.0	49	51
33.00	29.40	12.2	2.96	2.5	24.64	22.0	61	39
.....	.....	....	2.99	2.0	22.95	22.0	57	43
.....	.....	....	3.10	...	24.18	....	50	50
.....	.....	....	4.24	3.0	20.00	20.0	7	93

* Valuation exceeds cost.

age"; or they apply to bone from which a large share of the nitrogenous substance has been extracted in the manufacture of glue. When they are equally fine, the nitrogen of all these varieties of bone probably has about the same fertilizing value. But the agricultural value of bone depends very largely on its fineness. It is a matter of common observation that a whole bone may lie in the ground for a good while without going to pieces. Fine grinding increases enormously the surface which plant roots and the disintergrating forces of the soil can act upon, and by so doing make the nitrogen and phosphoric acid available. Much of the bone now sold is dry, free from grease, and could be easily ground finer than it usually is. More attention should be paid, both by manufacturers and purchasers, to the fineness of this material. Increased demand for a fine bone dust will soon make it more common in the market.

The table of analyses of bone manures contains a column "Valuation per ton." Full explanation of the meaning of this term, and the method of calculation will be found on pages 4 to 8.

Bone Manures Sampled by the Station Agent.

In the tabels on pages 46 and 47 are tabulated analyses of twenty-five samples.

The samples satisfied their guaranties in all cases but one. **26750**, Sanderson's Ground Bone, contained only 1.50 per cent. of nitrogen, 1.00 per cent. below guaranty.

Three of these bone manures, **26750**, Sanderson's; **26743**, National Fertilizer Co.'s, and **26731**, American Agricultural Chemical Co.'s, contained considerable saline matter, chlorides and sulphates of soda, added, no doubt, as dryers and preservatives.

The average cost of the twenty-five samples examined was $32.62 and the average valuation $29.03.

Sampled by Others than the Station Agent.

In the tables on pages 46 and 47 are included three analyses of samples drawn by others than the Station Agent. The station is responsible only for the analyses, not for the correctness of the sampling of these.

SLAUGHTER-HOUSE TANKAGE.

(ANALYSES ON PAGES 50 AND 51.)

After boiling or steaming various slaughter-house wastes, fat rises to the surface and is removed, the soup is run off and the settlings are dried and sold as tankage. In general, it contains more nitrogen and less phosphoric acid than bone, but both ingredients probably have about the same agricultural value as bone, and their valuation is calculated on the same basis.

Sampled by the Station Agent.

The analyses of ten samples are given in the table. In nitrogen these range from 3.18 to 8.69 per cent., and in phosphoric acid from 8.48 to 17.96 per cent.

The solubility of the organic nitrogen of ten samples ranges from 69.9 to 89.0, with an average of 79.1 per cent.

Three analyses call for special notice:

26341. The buyer states that this was bought on the unit basis, with a guaranty of 7.67 per cent. of ammonia, which is the equivalent of 6.31 per cent. of nitrogen, being 0.31 per cent. more than was found by analysis.

26266. The Wilcox Fertilizer Company objected that this analysis, showing nitrogen far above the guaranty, and phosphoric acid somewhat below it, did not fairly represent the stock they were putting out, and asked that another sample be drawn and analyzed. This was done and is shown in **26655.**

26196. The percentage of nitrogen in this tankage is quite below what is guaranteed.

Sampled by Others than the Station Agent.

The analyses of ten samples are given in the table; in some samples only a partial analysis was made.

25624 is a waste product from a glue factory, sold for $3.25 a ton, the cost of the freight. The percentage of nitrogen is low, the material contained over 53 per cent. of water, but the solubility of the nitrogen is high and its fertilizing value is probably good.

26078 is the product of a sausage factory. The percentage of nitrogen is low and of phosphoric acid high, as compared with the tankage made at rendering establishments.

ANALYSES OF TANKAGE.

Station No.	Manufacturer.	Dealer or Purchaser.
	Sampled by Station Agent.	
26454	American Agr. Chem. Co.	H. M. Kent Co., Stamford
26341	Buffalo Fertilizer Co.	C. R. Treat, Orange
26653	Buffalo Fertilizer Co.	A. D. Clark, Orange
26195	L. T. Frisbie Co.	Lightbourn & Pond Co., New Haven
26478	Lister's Agr. Chem. Works (Ground Bone and Tankage)	D. H. Carrier; John Foster
26194	C. M. Shay Fertilizer Co.	L. M. Benham; H. D. Johnson; Andrew Ure
26266	*Wilcox Fertilizer Co.	Manufacturer
26655	Wilcox Fertilizer Co.	Manufacturer
26196	Not known	L. P. Kling, Highwood
26248	Not known No. 1	S. D. Woodruff & Sons, Orange
	Sampled by Purchasers and others.	
25624	Residue from Glue Manufacture	W. O. Burr, Fairfield
26261	C. H. Davis & Co.	G. H. Selcer, Norwich
26151	Olds & Whipple	C. B. Sheldon, W. Suffield
26243	C. M. Shay Fertilizer Co.	E. Manchester & Sons, Winsted
26137	C. M. Shay Fertilizer Co.	C. R. Burr & Co., Manchester
26474	Springfield Rendering Co.	Somerville Mfg. Co., Somerville
26078		W. E. Coe, Stamford
25892		S. D. Woodruff & Sons, Orange
25904	No. 1	S. D. Woodruff & Sons, Orange
25905	No. 2	S. D. Woodruff & Sons, Orange

* See note on page 49.

Analyses of Tankage.

Dealers' cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.	Chemical Analysis.								Mechanical Analysis.	
			Nitrogen.						Phosphoric Acid.			
			Ammonia.	Water-Soluble Organic.	Active Insoluble Organic.	Inactive Insoluble Organic.	Total found.	Total guaranteed.	Found.	Guaranteed.	Finer than 1-50 inch.	Coarser than 1-50 inch.
$28.00	$28.93	3.2*	0.30	0.86	2.72	1.45	5.33	4.94	13.89	13.73	48	52
34.00	31.18	9.0	0.19	1.84	3.06	0.77	5.86	6.15	14.35	....	49	51
34.00	31.84	6.8	0.21	1.34	3.41	1.04	6.00	6.35	14.58	....	49	51
33.00	31.37	5.1	0.15	2.63	1.81	0.55	5.14	4.94	17.96	15.00	49	51
28.00	21.09	32.7	0.10	0.80	1.47	0.81	3.18	2.67	12.98	12.00	55	45
33.75	28.92	16.7	0.27	3.42	2.04	1.03	6.76	6.59	9.27	....	28	72
.....	.....	...	0.14	0.50	5.63	2.23	8.50	6.59	9.58	10.00	60	40
.....	.....	...	0.13	0.42	4.81	1.74	7.10	6.59	10.31	10.00	...	...
.....	.....	...	0.30	2.50	4.75	1.14	8.69	9.10	8.48	....	46	54
.....	.....	...	0.36	1.87	2.70	1.97	6.90	...	10.52	....	30	70
.....	.....	...	0.00	1.72	1.05	0.25	3.02	...	....	....	...	...
30.00	.....	...	0.25	0.66	4.81	1.74	7.46	...	10.02	....	...	...
34.00	28.96	17.4	0.12	1.94	2.78	1.69	6.53	5.76	8.34	8.00	48	52
34.00	29.33	15.9	0.28	3.46	1.97	1.14	6.85	7.00	9.34	12.00	29	71
....	.....	...	0.29		6.71		7.00	...	9.34	....	...	...
35.00	31.68	10.4	0.08	4.29	1.68	1.20	7.25	8.00	8.85	13.05	46	54
30.00	.....	...	0.03	1.28	1.43	0.76	3.50	...	22.45	....	...	...
.....	.....	...	0.25	2.48	2.60	1.73	7.06	...	10.71	....	...	...
.....	.....	...	0.28	2.42	2.67	1.81	7.18	...	10.58	....	...	...
.....	.....	...	0.30	2.47	2.59	1.88	7.24	...	10.52	....	...	...

*Valuation exceeds cost.

Spurious Tankage.

Various articles have been sold, or offered for sale, in Connecticut this year as tankage which were not tankage, but mixtures containing inferior forms of nitrogen of low solubility, in some cases reinforced with sulphate of ammonia to bring the total nitrogen up to the amount found in genuine tankage. Their analyses are as follows:

SPURIOUS TANKAGE.

Station No.	Manufacturer or Dealer.	Nitrogen.						Phosphoric Acid.	
			Organic.			Total.			
		As Ammonia.	Water-soluble.	Active insoluble.	Inactive insoluble.	Found.	Guaranteed.	Found.	Guaranteed.
26422	Fertilizer Materials Supply Co., N. Y.	0.12	0.36	2.74	2.76	5.98	5.76	5.22	6.8
26524	Fertilizer Materials Supply Co., N. Y.	0.04	0.51	2.60	2.49	5.64	5.76	5.83	6.8
26565	Armour Fertilizer Works	1.50	0.45	1.17	0.88	4.00	4.12	14.44	16.0
25211	Manufacturer unknown	*...	0.26	1.44	4.31	6.01	5.7	...	6.8
26249	" "	0.05	0.50	0.35	1.44	2.34	...	2.03	...
25629	" "	5.82	0.77	1.14	1.13	8.86	...	...	...

26565. Made by Armour Fertilizer Works. Sampled from stock of A. Grulich, Meriden.

26524 and **26422.** Sold by Fertilizer Materials Supply Co., N. Y. One sample of stock bought by Conn. School for Boys, Meriden, the other by W. A. Simpson, Wallingford. The Fertilizer Materials Supply Co. states that this tankage was bought of a reputable rendering establishment in Chicago and was understood by them to be genuine slaughter house tankage, and that the Chicago establishment, in reply to a later inquiry, stated in a general way that no inferior material was used, but not with satisfactory definiteness regarding this particular shipment.

25629. Sent by the E. B. Clark Co., Milford. **25211** and **26249.** Sent by S. D. Woodruff & Sons, Orange. The manufacturer's names are unknown.

The three samples at the bottom of the table were sent for examination by prospective buyers, who stated that the tankages were offered for sale, but were suspected of being inferior.

The sample, **26565,** sold by Armour Fertilizer Works contains 1.5 per cent. of nitrogen as ammonia. No such amount is ever found in a straight tankage, as will be seen from the table on page 12, the highest percentage found in those examined being 0.36.

Practically all of the nitrogen in a tankage (from 4.5 to 8 per cent.) is in organic form. The above sample has but 2.50 per cent. in this form. The solubility of its organic nitrogen is also lower than the average of slaughter-house tankage. On the other hand, the percentage of phosphoric acid is higher than in most tankages. It has evidently been treated with acid and is in fact a nitrogenous superphosphate and not a tankage.

Of the organic nitrogen in the two samples sold by the Fertilizer Materials Supply Company, 47.1 and 44.5 per cent., respectively, are classed as inactive insoluble nitrogen as defined on page 9.

In genuine tankages, tabulated on page 12, only 21.7 per cent. of the organic nitrogen is in this class, as the average, the highest figure being 28.8. The percentage of phosphoric acid is little more than half what is usually found in tankages which have between 5 and 6 per cent. of nitrogen.

The determinations show quite conclusively that these two samples are not genuine tankage but nitrogenous matters of low solubility and probably inferior fertilizing value.

The same conclusion is warranted regarding **25211,** which has only 1.7 per cent. of nitrogen that can be considered of good agricultural value. **26249** is a garbage tankage, also of small agricultural value.

25629 is another sample sold as tankage, but containing 5.82 per cent. of ammonia, probably added as sulphate to some inferior stuff (as shown by the low solubility of its nitrogen), to make it "analyze" like a high-grade tankage.

It is a misnomer, and works deception, to call any of these materials "tankage," a word which has long had in the trade the meaning given on page 49.

Farmers are warned against buying "tankage" which the seller does not guarantee to be genuine slaughter-house tankage. As the above statements show, nitrogenous matters of small fertilizer value are now being sold under the misleading, if not directly fraudulent, name of tankage.

It will later appear that in a few cases they have also been found in mixed fertilizers.

DRY GROUND FISH AND ACIDULATED FISH.

(Analyses on following page.)

This is a by-product from the manufacture of fish oil, a process which removes from the fish little that is of value as a fertilizer. The fresh fish are cooked by steam, pressed to remove the oil, and dried either in the air or by steam. The scrap is sometimes sprinkled with diluted oil of vitriol to check putrefaction, whereby the bones are softened and to some extent dissolved.

The analyses of ten samples appear in the table: **26510** is below its nitrogen guaranty.

The solubility of the organic nitrogen ranges from 62.0 to 82.1, with an average of 71.1 per cent.

The samples of dry ground fish have on an average 8.48 per cent. of nitrogen and 7.06 per cent. of phosphoric acid, at an average cost of $43.75.

All are of good quality.

MIXTURES OF PHOSPHATES WITH POTASH SALTS.

26535. Wheeler's Grass and Oats Manure. Sampled from stocks of R. H. Hall, East Hampton, J. C. Nettleton, Madison, and T. Richmond, New Milford.

26568. American Agricultural Chemical Co.'s Grass and Oats. Sampled from stock of Alvah Morgan, East Lyme.

Both of these brands are made by the American Agricultural Chemical Company.

26572. National Soluble Bone and Potash. Sampled from stock of Gallagher Bros., Wallingford.

ANALYSES OF DRY GROUND FISH AND ACIDULATED DRY FISH.

Station No.	Manufacturer and Dealer.	Nitrogen. Ammonia.	Nitrogen. Water-Soluble Organic.	Nitrogen. Active Insoluble Organic.	Nitrogen. Inactive Insoluble Organic.	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.	Cost per ton.	Valuation per ton.	Percentage difference between cost and valuation.
	DRY GROUND FISH.														
	Sampled by Station Agent.														
26275	American Agric. Chem. Co. Stock of Spencer Bros., Suffield	0.50	0.84	3.95	2.93	8.22	8.23	0.74	5.59	1.38	7.71	7.00	$45.00	$42.79	5.2
26400	Bowker Fertilizer Co. Stock of C. F. Brewer, East Hartford	0.50	0.81	5.16	2.39	8.86	8.23	0.79	5.10	1.43	7.32	6.00	45.00	45.42	0.9*
26654	National Fertilizer Co. Stock of W. E. Burbank, Suffield	0.43	0.77	5.69	1.75	8.64	8.23	0.47	5.33	1.20	7.00	6.00	46.00	44.31	3.8
26534	Niantic Menhaden O. & G. Co. Stock of Spencer Bros., Suffield	1.15	2.15	2.96	2.12	8.38	8.25	0.87	5.82	1.29	7.98	6.00	45.00	42.90	4.9
26397	Olds & Whipple. Stock of manufacturer	0.58	1.06	4.51	2.20	8.35	7.40	0.79	4.80	1.23	6.82	6.00	40.00	42.64	6.2*
26198	Sanderson Fertilizer and Chemical Co. Stock of manufacturer	0.50	1.01	5.03	1.32	7.86	6.0	0.54	4.92	2.55	8.01	6.00	43.00	40.91	5.1
26511	Wilcox Fertilizer Co. Stock of Spencer Bros. and M. E. Thompson	0.14	0.47	6.18	2.30	9.09	8.50	0.48	3.81	1.63	5.92	6.00	44.00	45.75	3.8
	Sampled by Purchaser.														
26528	Fertilizer Materials Supply Co. Sampled by W. A. Simpson, Wallingford	0.79	1.00	3.96	2.69	8.44	8.23	2.08	3.33	0.32	5.73	5.40	42.00	42.38	0.9*
	ACIDULATED DRY FISH.														
26480	Niantic Menhaden O. & G. Co. Stock of F. H. Rolf, Guilford	0.55	0.96	1.24	1.17	3.92	3.30	0.29	2.40	3.95	6.64	3.50	26.00	21.02	23.7
26510	Wilcox Fertilizer Co. Stock of manufacturer	0.85	1.40	3.29	2.06	7.60	7.81	1.79	3.77	0.72	6.28	5.00	42.50	38.69	9.8

* Valuation exceeds cost.

ANALYSES.

	26535	26568	26572
Water-soluble phosphoric acid	8.76	9.77	9.19
Citrate- " " "	2.49	1.83	2.14
Citrate-insoluble " "	1.02	1.24	0.99
Total phosphoric acid found	12.27	12.84	12.32
Total phosphoric acid guaranteed	12.0	12.0	12.0
Water-soluble potash found	2.17	2.41	2.19
Potash guaranteed	2.0	2.0	2.0
Cost per ton	$22.50	25.00	20.00
Valuation per ton	$12.13	12.80	12.24
Percentage difference between cost and valuation.	85.5	95.4	63.4

NITROGENOUS SUPERPHOSPHATES AND GUANOS.

(ANALYSES ON PAGES 62 TO 85.)

Here are included all the commercial mixed fertilizers containing nitrogen, phosphoric acid and potash which have been analyzed in 1911, tabulated under the names of their manufacturers, alphabetically arranged. The names and addresses of the agents from whom the samples were taken are omitted because of the restrictions placed on the station printing, and the additional analytical data, which must be printed in the table. These data concern the value of the organic nitrogen, a matter which has been under discussion and study for a long time.

THE SOLUBILITY OF THE ORGANIC NITROGEN IN MIXED FERTILIZERS.

The discussion on pages 8 to 22 shows that of all forms of nitrogenous organic matter which are considered to be readily available to crops, a part, usually a small part, dissolves in water. Of the remainder, a part, *and the larger part,* is soluble in potassium permanganate solution, when used in the way described. There remains the smaller part of the nitrogen which is insoluble in either water or permanganate, and this we call "inactive" organic nitrogen.

It is not contended that this insoluble nitrogen is wholly inert and does not become, in time, available to crops; but our own vegetation tests, as well as more extensive tests made by others, justify the belief that it is distinctly inferior in immediate fertilizing action to the soluble portions, and that it is reasonable to call it "inactive."

The discussion above referred to also shows that most of the forms of organic nitrogen so far tested, which are commonly considered to have inferior trade and farm values, such as wool waste, leather preparations, garbage tankage, peat, etc., contain very little, if any, nitrogen soluble in water. A part, differing with the nature of the material, is soluble in permanganate solution, while the rest, *and the larger part,* is insoluble or "inactive." In a word, it is possible to judge whether the organic nitrogen in a mixture is in an active or an inferior form, by determining its solubility.

All the nitrogenous superphosphates this year analyzed have been tested as to the solubility of their organic nitrogen. Our study of the whole matter forces us to look with suspicion on samples in which the inactive nitrogen makes up one-half or more of the organic nitrogen which is insoluble in water. The presence of inferior forms, however, does not *always* condemn the fertilizer as inferior. To illustrate:

In a previous report, 1909-10, p. 76, we have discussed the use of inferior forms of nitrogen, such as peat or garbage tankage, as a "conditioner." A small amount of either, added to a mixture of chemicals which, without this addition, cakes or hardens on storage, will keep it fine and soft indefinitely. In some cases a "conditioner" may be absolutely necessary and defensible if the nitrogen which it contains is not included in the manufacturer's guaranty, i. e. if he furnishes enough soluble nitrogen to meet his guaranty without counting this inactive form. But where the organic nitrogen makes a very considerable part of the total nitrogen and more than a half or more of it is inactive we consider the mixture to be inferior.

The fertilizers named in the following table as a rule contain little or no water-soluble organic nitrogen and the percentage of "inactive" organic nitrogen is in most cases considerably larger than the percentage of active-insoluble organic nitrogen. They are, for these reasons, open to strong suspicion of containing comparatively inert forms of nitrogen.

In some of them, however, the percentage of nitrogen guaranteed is supplied *without taking account of the "inactive" nitrogen.* No objection is made to its use under these circumstances.

The others, which do not meet their guaranty after deducting the "inactive" nitrogen, are printed in full face type.

(All figures refer to nitrogen alone and are percentage amounts.)

	Inactive Insoluble Organic per cent. of Total N.	In Nitrates.	In Ammonia.	Organic, water-soluble.	Organic, active-insoluble.	Organic, inactive-insoluble.	Total.	Guaranty.	Per cent. of the water-insoluble nitrogen which is inactive.*	Active nitrogen exceeds, +, or is less than, −, the guaranty.
Williams and Clark Potato Manure	29	0.71	0.20	0.33	0.33	0.63	2.20	2.06	65.6	− .49
Armour All-Soluble	21	1.42	0.23	0.00	0.56	0.59	2.80	2.88	51.3	− .67
" Ammoniated Bone with Potash	15	1.95	0.14	0.12	0.39	0.45	3.05	2.47	53.6	+ .13
Armour's Complete Potato	30	0.76	0.10	0.00	0.35	0.51	1.72	1.65	59.3	− .44
" **Fish and Potash**	23	1.33	0.20	0.00	0.28	0.53	2.34	2.06	65.4	− .25
" **Fruit and Root Crop**	19	1.17	0.06	0.07	0.19	0.35	1.84	1.65	64.8	− .16
" **H. G. Potato**	22	1.17	0.05	0.00	0.22	0.40	1.84	1.65	64.5	− .21
" **Bidwell's Formula**	15	1.56	0.41	0.07	0.27	0.40	2.71	2.47	59.7	− .16
Berkshire Grass Special	18	3.30	0.12	0.00	0.66	0.89	4.97	5.0	57.4	− .92
Buffalo Farmers' Choice	33	.....	0.34	0.10	0.20	0.31	0.95	0.80	60.8	− .16
Clark Special for General Use	8	1.44	1.68	0.00	0.21	0.27	3.60	3.30	56.2	+ .03
" Special 10% Brand	7	1.55	1.66	0.00	0.14	0.27	3.62	3.30	65.9	+ .05
Coe-Mortimer's Gold Brand	20	0.10	1.42	0.27	0.37	0.53	2.69	2.47	58.9	− .31
Mapes Average Soil Complete	6	2.35	1.70	0.00	0.12	0.26	4.43	4.1	68.4	+ .07
" Cereal Brand	19	0.84	0.56	0.05	0.[illegible]6	0.39	2.10	1.69	60.0	+ .02
" **"A" Brand**	11	1.44	0.69	0.00	0.18	0.30	2.61	2.47	62.5	− .16
" **Corn Manure**	16	1.02	0.88	0.08	0.23	0.43	2.64	2.47	65.2	− .26
" Economical Potato	9	1.86	1.14	0.11	0.16	0.31	3.58	3.29	66.0	− .02
" Fruit and Vine	17	1.55	0.10	0.03	0.22	0.39	2.29	1.65	63.9	+ .25
" Potato Manure	7	2.08	1.28	0.12	0.13	0.27	3.88	3.69	67.5	− .08
" Tobacco Starter, Imp.	10	3.60	0.13	0.00	0.37	0.48	4.58	4.1	56.5	± .00
" Vegetable Manure	7	2.99	1.40	0.08	0.26	0.34	5.07	4.9	56.7	− .17
Woodruff's Home Mixture	25	1.60	0.09	0.41	0.63	0.92	3.65	3.29	59.4	− .56

* See definition, p. 9.

I. SAMPLED BY STATION AGENT.

Analyses Requiring Special Notice.

26228 and **26437**. Bowker's Lawn and Garden Dressing. The first analysis showed considerably less potash than was guaranteed and somewhat less phosphoric acid. A second sample, **26437**, contained the full percentage of potash and rather more phosphoric acid. Neither fully meets the guaranty in either nitrogen or total phosphoric acid.

26323. Bowker's Market Garden Fertilizer. The sample contained less than the guaranteed amount of potash. It was composed of three samples, one of which, it was learned after the analysis was done, might have been last year's stock. It was not possible to get another sample of this brand, but nitrogen and potash were determined in each of the three samples to see whether some one of them might be totally different from the others. The results were:

Nitrogen ..	3.08, 2.30, 2.50	Average.. 2.63	Guaranteed.. 2.47
Potash	8.63, 10.29, 9.18	" .. 9.36	" .. 10.00

These figures show no close agreement, but no such wide divergence as proves confusion with another brand.

26542. Bowker's Tobacco Ash Elements. This analysis was made on a mixture of two samples drawn by the station agent, one from stock of E. A. Root, East Granby, the other from G. N. Thompson, Suffield. The potash is 0.83 per cent. below guaranty and the "available" phosphoric acid 2.11 per cent. above.

Another sample, **26760**, drawn by our agent from Bissell-Graves Co., had 15.26 per cent. of potash. Two others, **26395** and **26396**, drawn by the Bissell-Graves Co., contained 14.95 and 14.77 per cent., and finally, a sample sent by Seth Viets, West Suffield, **26989**, contained 14.41 per cent. Two other samples, **26629** and **26289**, of which the full analyses are given on pages 82 and 83, showed 14.24 and 15.97 per cent. of water-soluble potash respectively.

It is obvious that this brand contains, on the average, very nearly the guaranteed amount of water-soluble potash, but the nature of the mixture, and probably the mechanical separation of the ingredients of the fertilizer, make a very accurate sampling difficult.

26640. Stockbridge Manure for Seeding Down. This analysis shows a per cent. less of potash than is guaranteed. It was made on a mixture of two samples which contained 8.74 and 9.39 per cent. respectively. Another sample, **26981**, was then drawn of another dealer, the analysis of which, as appears in the table, differs from the first, chiefly in a higher per cent. of potash, which does not, however, meet the guaranty.

26283. Stockbridge Top Dressing and Forcing. This analysis made on a mixture of two samples showed a serious deficiency in nitrogen. A second sample, **26436**, drawn from stock of another dealer, fully met the guaranty.

26641, 26643, 26465, 26645 and **26642** are Special Potato, Gold Brand Excelsior Guano, New Englander Corn and Potato, Peruvian Vegetable Grower and Red Brand Excelsior Guano, made by the Coe-Mortimer Co. All showed a deficiency of potash. Second samples of each were drawn, in some cases from other dealers, which in all but two cases met the manufacturer's guaranty.

26230. Essex Fertilizer Co.'s Complete for Potatoes, Roots and Vegetables. In identical samples the company's chemist found 3.15 per cent. of nitrogen, while the station found 3.02 per cent. Repetition of our work did not change this figure.

26231. Frisbie's Vegetable Grower. The analysis was made on a single sample and showed a deficiency of both nitrogen and potash. The manufacturer protested that the analysis did not represent the stock he was shipping and asked that another sample be drawn. Two other samples were therefore taken and the analysis of a mixture of them is given in the table, **26386.** This analysis shows the full amount of nitrogen guaranteed, but a deficiency of one per cent. of potash.

26681, National Fertilizer Co.'s Complete Root Fertilizer, showed a deficiency of both nitrogen and potash. A second sample was therefore drawn from the stock of the same dealer, which, as appears in the table, **27019,** met the manufacturer's guaranty. This second sample does not represent the same shipment of stock as the first.

26287. Rogers & Hubbard Co.'s Potato Phosphate. As this analysis showed slightly less nitrogen than was guaranteed, the manufacturers asked that a second sample be drawn. This was done, from stock of another dealer, and is represented by **26715.** This shows somewhat more nitrogen and less potash than the first analysis.

Guaranties.

Of the 255 samples, 56, or nearly one-fifth of the number, did not in all respects meet their guaranties: 25 were deficient in potash, 17 in nitrogen, 5 in phosphoric acid, and 9 in two or more ingredients.

In most cases the deficiency was not large and was balanced by a corresponding surplus of another ingredient, so that the buyer got an amount of plant food fully equivalent to what was guaranteed.

In two brands, however, the deficiency was not thus balanced by excess of other ingredients. These are 26438, Buffalo Top Dressing, and 26664, Chittenden's Potato Manure.

Cost.

An effort is made to get a statement of cash retail price from each dealer from whom a sample is taken and these statements are in all cases submitted to the manufacturer for criticism. In general an average of the quoted prices forms the basis of comparison between cost and valuation.

Valuation.

The method and meaning of valuation is explained on page 8. The schedule of trade-values is given on page 7. The organic nitrogen in mixed fertilizers is reckoned at 20 cents per pound. Citrate-insoluble phosphoric acid is rated at 2 cents per pound. Potash is rated at 4¼ cents, if sufficient chlorine is present in the fertilizer to combine with it to make muriate. If there is more potash present than will combine with the chlorine, then this excess of potash is reckoned at 5 cents per pound, except in those cases where carbonate of potash has been used in the mixture. But if carbonate of potash is claimed, the per cent. of potash required to combine with both the chlorine and the soluble sulphuric acid is subtracted from the whole amount of potash present and the remainder is calculated as carbonate.

In most cases the valuation of the ingredients in superphosphates falls considerably below the retail price. The difference between the two figures represents the manufacturer's charges for converting raw materials into manufactured articles and selling them. The charges are for grinding and mixing, bagging or barreling, storage and transportation, commission to agents and dealers, long credits, interest on investments, bad debts, and, finally, profits. This matter has been discussed on page 4. The following statement, given by a manufacturer, serves to show in a general way what these items are and their approximate amount:

Final mixing, bagging and loading	$1.50
Bags (100 lb.)	1.50
Shrinkage, 5 per cent.	1.00
Interest 12 months, average	2.00
Commissions for warehousing, selling and collecting, average 5 per cent.	2.00
Freight 2.50 to 3.50 or more	3.00
	$11.00

Nitrogenous Superphosphates.

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.
	Sampled by Station Agent:				
	The American Agricultural Chemical Co., New York City.				
26430	Complete Manure with 10% Potash.	Milford, Meriden	$38.25	$26.06	46.8
26536	Complete Tobacco Manure (from Sulphate)	Hazardville, Windsor Locks, New Milford	38.75	27.95	38.6
26356	Complete Tobacco Manure (from Carbonate)	Glastonbury	37.00	29.74	24.4
26357	Grass and Lawn Top Dressing	New Haven, Wapping	35.50	20.24	75.4
26308	H. G. Fertilizer, 10% Potash	Norwich Town, Rockville.	38.25	23.66	61.7
26592	H. G. Tobacco Manure	Wapping	48.00	34.87	37.7
26706	H. G. Tobacco Manure	Broad Brook	48.00	37.22	29.0
26591	Tobacco Starter and Grower	Hazardville, New Milford	38.50	24.81	55.2
	Bradley Branch.				
26312	Complete Manure for Potatoes and Vegetables	Norwich Town, Milford, Stafford Springs	37.50	26.19	43.2
26513	Complete Manure for Top Dressing, Grass and Grain	Hazardville, Andover	38.50	23.72	62.3
26630	Complete Manure with 10% Potash	Burnside	39.00	26.07	49.6
26310	Corn Phosphate	Norwich Town, Milford, So. Coventry	29.00	17.67	64.1
26559	Eclipse Phosphate	Milford, Putnam	28.00	14.33	95.4
26404	Farmers' New Method Fertilizer	Middletown, Stafford Springs, Putnam	30.00	17.17	74.7
26311	Niagara Phosphate	Middletown, Milford, So. Coventry	27.75	12.58	120.6
26309	Potato Fertilizer	Middletown, Milford, So. Coventry	30.25	19.07	58.6
26313	Potato Manure	Suffield, Milford, Stafford Springs	33.00	20.56	60.5
26380	Superphosphate	Suffield, Thompsonville, Windsor Locks	33.25	19.72	68.6
	Church Branch.				
26278	Fish and Potash	Hazardville, Middletown	30.00	16.46	82.3
	Great Eastern Branch.				
26460	General	East Lyme, Madison, Torrington	29.25	15.20	92.4
26560	H. G. Vegetable, Vine and Tobacco Fertilizer	East Hampton, Madison	32.50	20.94	55.2
26593	Northern Corn Special	East Hampton	32.00	19.97	60.2
	North Western Branch.				
26537	Fish, Bone and Potash	New Haven, Bristol, Suffield	30.00	17.70	69.5
26595	Market Garden Phosphate	Southport, New Milford	33.75	22.48	50.1

ANALYSES AND VALUATIONS.

Nitrogen.							Phosphoric Acid.							Potash.		
					Total.					Total.		"Available."				
In Nitrates.	In Ammonia.	Organic, water-soluble.	Organic, active insoluble.	Organic, inactive insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Station No.
...	2.43	0.11	0.36	0.41	3.31	3.3	5.25	1.19	0.51	6.95	7.0	6.44	6.0	10.45	10.0	26430
...	0.23	0.81	2.10	1.34	4.48	4.5	1.18	3.82	1.65	6.65	4.0	5.00	3.0	[1] 5.61	5.5	26536
0.15	0.13	1.24	1.89	1.11	4.52	4.5	0.19	5.40	2.87	8.46	4.0	5.59	3.0	[2] 5.57	5.5	26356
2.37	0.16	0.16	0.65	0.51	3.85	3.9	3.99	1.62	0.36	5.97	6.0	5.61	5.0	2.16	2.0	26357
0.68	0.90	0.09	0.47	0.28	2.42	2.5	4.65	2.64	1.29	8.58	7.0	7.29	6.0	9.91	10.0	26308
...	3.20	0.14	1.82	0.65	5.81	5.8	4.76	1.59	0.26	6.61	6.0	6.35	5.0	[3] 8.73	10.0	26592
0.36	3.16	0.08	1.59	0.77	5.96	5.8	4.04	1.37	0.35	5.76	6.0	5.41	5.0	[4] 11.51	10.0	26706
0.06	1.88	0.36	0.86	0.44	3.60	3.3	6.94	1.83	0.58	9.35	9.0	8.77	8.0	[5] 4.11	4.0	26591
0.65	1.42	0.20	0.68	0.32	3.27	3.3	7.17	2.11	1.06	10.34	9.0	9.28	8.0	7.31	7.0	26312
2.27	1.93	0.13	0.39	0.26	4.98	4.9	3.31	1.89	1.04	6.24	6.0	5.20	5.0	2.65	2.5	26513
0.09	2.68	0.03	0.38	0.27	3.45	3.3	4.46	2.08	0.70	7.24	7.0	6.54	6.0	10.03	10.0	26630
0.64	0.59	0.19	0.49	0.33	2.24	2.1	5.87	2.75	1.45	10.07	9.0	8.62	8.0	1.92	1.5	26310
...	0.20	0.34	0.29	0.37	1.20	1.0	5.84	2.54	1.66	10.04	9.0	8.38	8.0	2.05	2.0	26559
0.20	0.75	0.18	0.48	0.34	1.95	1.7	6.51	2.32	1.19	10.02	9.0	8.83	8.0	3.21	3.0	26404
0.09	0.24	0.24	0.22	0.29	1.08	0.8	5.77	2.17	1.04	8.98	8.0	7.94	7.0	1.38	1.0	26311
0.43	0.60	0.16	0.60	0.37	2.16	2.1	6.32	2.54	1.37	10.23	9.0	8.86	8.0	3.51	3.0	26309
0.36	1.24	0.17	0.54	0.37	2.68	2.5	5.39	1.53	0.77	7.69	7.0	6.92	6.0	5.58	5.0	26313
0.09	1.31	0.25	0.56	0.30	2.51	2.5	7.32	2.14	1.34	10.80	10.0	9.46	9.0	2.31	2.0	26380
0.15	0.36	0.37	0.61	0.62	2.11	2.1	4.50	2.34	0.90	7.74	7.0	6.84	6.0	2.53	2.0	26278
...	0.15	0.27	0.24	0.29	0.95	0.8	6.03	2.56	1.54	10.13	9.0	8.59	8.0	4.02	4.0	26460
...	1.00	0.40	0.29	0.41	2.10	2.1	6.35	2.17	1.59	10.11	9.0	8.52	8.0	6.16	6.0	26560
...	1.43	0.32	0.54	0.31	2.60	2.5	7.00	2.34	1.59	10.93	10.0	9.34	9.0	2.23	2.0	26593
0.34	0.48	0.46	0.65	0.59	2.52	2.5	2.69	2.32	0.68	5.69	5.0	5.01	4.0	4.38	4.0	26537
...	1.56	0.09	0.51	0.44	2.60	2.5	6.60	2.30	1.16	10.06	9.0	8.90	8.0	5.99	6.0	26595

[1] 1.20% as muriate, 4.41% as sulphate.
[2] 1.73% as muriate, 2.29% as sulphate, 1.55% as carbonate.
[3] 1.30% as muriate, 7.43% as sulphate.
[4] 1.25% as muriate, 10.26% as sulphate.
[5] 0.65% as muriate, 3.46% as sulphate.

NITROGENOUS SUPERPHOSPHATES.

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.
	Sampled by Station Agent: North Western Branch (Continued).				
26226	10% Potato Fertilizer	Waterbury, New Haven	$37.00	$23.64	56.5
26594	Universal Fertilizer	So. Meriden	33.00	22.03	49.8
	Packers' Union Branch.				
26597	Animal Corn Fertilizer	Waterford	32.00	19.79	61.7
26596	Gardeners' Complete Manure	Riverton, East Granby	37.00	26.49	39.7
26561	Potato Manure	Waterford, East Hampton	32.00	21.03	52.2
	Quinnipiac Branch.				
26514	Climax Phosphate	Plainfield, Andover	24.75	14.03	76.4
26515	Corn Manure	Wallingford, Plainfield, Andover	28.00	17.31	61.8
26432	Market Garden Manure	Southport, Norwalk	36.50	26.17	39.5
26279	Phosphate	Wallingford, New London	32.00	19.73	62.2
26431	Potato Manure	New London, Southport, Norwalk	31.75	18.20	74.5
26314	Potato Phosphate	Wallingford, New London, Southport	29.75	18.99	56.7
	Read Branch.				
26433	Practical Potato Special	Hazardville, Plantsville, New Canaan	30.00	14.86	101.9
26434	Standard Superphosphate	Plantsville, Ellington, So. Meriden	31.25	14.84	110.6
26598	Vegetable and Vine Fertilizer	East Canaan	33.00	21.86	51.0
	Wheeler Branch.				
26538	Corn Fertilizer	Torrington, Riverton, East Granby	29.75	16.28	82.7
26599	Havana Tobacco Grower	Riverton, East Granby	36.50	26.41	38.2
26539	Potato Manure	Torrington, Riverton, East Granby	31.00	18.13	71.0
	Williams and Clark Branch.				
26600	Americus Ammoniated Bone Superphosphate	Waterbury, Hillstown	33.50	20.15	66.3
26461	Americus Corn Phosphate	Milford, Ellington, Wallingford	30.75	16.18	90.0
26601	Americus H. G. Special Fertilizer	Plainville, Wapping	38.75	25.89	49.7
26562	Americus Potato Manure	Wapping, Ellington	32.25	19.04	69.4
26462	Potato Phosphate	Waterbury, Ellington, Wallingford	33.75	19.38	74.1
	The Armour Fertilizer Works, Baltimore, Md.				
26435	All Soluble	New Haven, Bridgeport, Norwalk	33.25	21.49	54.7
26488	Ammoniated Bone with Potash	Danielson, Norwalk, Willimantic	29.00	18.75	54.7

ANALYSES AND VALUATIONS—*Continued.*

Nitrogen.							Phosphoric Acid.							Potash.		
					Total.					Total.		"Available."				
In Nitrates.	In Ammonia.	Organic, water-soluble.	Organic, active insoluble.	Organic, inactive insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Station No.
0.10	0.63	0.26	0.42	0.44	1.85	1.7	6.02	2.98	1.27	10.27	9.0	9.00	8.0	10.01	10.0	26226
...	1.22	0.14	0.70	0.54	2.60	2.5	7.71	2.06	0.49	10.26	9.0	9.77	8.0	4.49	4.0	26594
...	1.27	0.31	0.60	0.30	2.48	2.5	6.88	2.78	1.09	10.75	10.0	9.66	9.0	2.40	2.0	26597
0.10	1.51	0.25	0.36	0.41	2.63	2.5	5.27	1.97	1.05	8.29	7.0	7.24	6.0	[1] 10.67	10.0	26596
...	0.85	0.43	0.40	0.37	2.05	2.1	6.35	2.40	1.28	10.03	9.0	8.75	8.0	6 30	6.0	26561
0.06	0.25	0.26	0.38	0.28	1.23	1.0	5.32	2.64	1.61	9.57	9.0	7.96	8.0	2.14	2.0	26514
0.52	0.50	0.23	0.61	0.34	2.20	2.1	5.49	2.98	1.66	10.13	9.0	8.47	8.0	1.59	1.5	26515
...	1.72	0.29	0.93	0.47	3.41	3.3	7.40	1.19	0.60	9.19	9.0	8.59	8.0	7.13	7.0	26432
0.82	0.53	0.13	0.54	0.44	2.46	2.5	5.71	3.78	2.09	11.58	10.0	9.49	9.0	2.32	2.0	26279
0.45	1.05	0.08	0.48	0.37	2.43	2.5	4.76	2.24	0.97	7.97	7.0	7.00	6.0	5.08	5.0	26431
0.49	0.56	0.24	0.52	0.31	2.12	2.1	6.44	2.77	1.37	10.58	9.0	9.21	8.0	3.27	3.0	26314
...	0.12	0.21	0.26	0.31	0.90	0.8	2.55	1.89	0.79	5.23	5.0	4.44	4.0	8.51	8.0	26433
...	0.16	0.26	0.28	0.30	1.00	0.8	5.99	2.05	0.81	8.85	9.0	8.04	8.0	4.26	4.0	26434
...	1.03	0.42	0.42	0.41	2.28	2.1	6.42	2.28	1.68	10.38	9.0	8.70	8.0	6.22	6.0	26598
...	0.75	0.33	0.30	0.28	1.66	1.7	6.36	2.58	1.51	10.45	9.0	8.94	8.0	2.19	2.0	26538
0.10	1.51	0.28	0.42	0.31	2.62	2.5	5.38	1.89	1.07	8.34	7.0	7.27	6.0	[2] 10.52	10.0	26599
...	1.15	0.25	0.31	0.34	2.05	2.1	6.22	2.61	1.34	10.17	9.0	8.83	8.0	3.08	3.0	26539
...	1.33	0.22	0.61	0.44	2.60	2.5	7.69	1.89	1.05	10.63	10.0	9.58	9.0	2.31	2.0	26600
0.44	0.69	0.22	0.41	0.36	2.12	2.1	6.35	2.51	1.78	10.64	9.0	8.86	8.0	1.90	1.5	26461
0.06	2.27	0.11	0.54	0.46	3.44	3.3	7.12	1.69	0.70	9.51	9.0	8.81	8.0	7.01	7.0	26601
0.71	0.20	0.33	0.33	0.63	2.20	2.1	6.79	1.82	1.24	9.85	9.0	8.61	8.0	3.41	3.0	26562
0.24	1.05	0.15	0.64	0.40	2.48	2.5	4.94	1.99	0.87	7.80	7.0	6.93	6.0	4.82	5.0	26462
1.42	0.23	0.00	0.56	0.59	2.80	2.9	6.48	1.83	0.75	9.06	8.5	8.31	8.0	4.75	4.0	26435
1.95	0.14	0.12	0.39	0.45	3.05	2.5	4.60	1.97	0.93	7.50	6.5	6.57	6.0	2.51	2.0	26488

[1] 1.00% as muriate, 9.67% as sulphate. [2] 0.51% as muriate, 10.01% as sulphate.

NITROGENOUS SUPERPHOSPHATES.

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.
	Sampled by Station Agent: **The Armour Fertilizer Works Baltimore, Md.** *(Continued).*				
26381	Bidwell's Formula for all Crops....	Windsor Locks	$30.00	$21.52	39.4
26632	Bone, Blood and Potash..........	Bridgeport, Rockville	38.50	28.83	33.5
26602	Complete Potato	Danielson	28.00	19.56	43.1
26631	Corn King	Silver Lane, Waterbury...	32.50	21.35	52.2
26405	Fish and Potash Mixture	Meriden, Branford, Danielson	25.00	16.48	51.7
26563	Fruit and Root Crop Special	Meriden, Danielson	26.50	19.03	39.3
26406	H. G. Potato	New Haven, Bridgeport, Danielson.	32.75	23.84	37.4
26633	Market Garden	New Haven, Rockville ...	37.00	25.81	43.4
	Berkshire Fertilizer Co., Bridgeport, Conn.				
26634	Ammoniated Bone Phosphate......	Waterbury, Staffordville ..	28.50	15.68	81.8
26541	Complete Fertilizer	Waterbury, Burnside, Granby................	34.75	22.64	53.5
26280	*Grass Special	Waterbury, Norwich Town	36.50	24.57	48.6
26382	Long Island Special..............	Milldale, Wethersfield....	34.50	26.56	29.9
26540	Potato and Vegetable Phosphate ...	Waterbury, Staffordville, Granby................	31.75	17.32	83.3
26635	Tobacco Special with Carbonate....	Hillstown	38.00	32.00	18.7
	F. E. Boardman, Middletown, Conn.				
26315	Complete Fertilizer	Middletown	34.00	29.38	15.7
	Bowker Fertilizer Co., New York City.				
26227	Bone and Wood Ash Fertilizer	New Haven..	20.00	14.86	34.6
26636	Complete Alkaline Tobacco Grower	E. Hartford, East Granby.	34.50	27.86	23.8
26637	Complete Alkaline Tobacco Grower, with Carbonate	Suffield	34.50	29.05	18.8
26321	Corn Phosphate	New London, Norwich, Rockville	32.00	15.90	101.3
26464	Early Potato Manure..............	Milldale, Wethersfield, Yalesville	37.50	24.02	56.1
26543	Farm and Garden Phosphate.......	East Berlin, East Granby .	29.50	17.22	71.3
26316	Fisherman's Brand Fish and Potash	Waterbury, New London, East Berlin	29.25	17.76	64.7
26281	Gloucester Fish and Potash........	New Haven, Norwich	27.00	12.62	113.9
26639	Hill and Drill Phosphate	Waterbury, Norwich	35.00	20.18	73.4
26228	*Lawn and Garden Dressing	New Haven	36.00	18.63	93.2
26437	* " " " "	Bridgeport..............	36.00	20.18	78.4
26323	†Market Garden Fertilizer	Norwich, Milldale, East Hartford	37.25	23.82	56.4
26322	Potato and Vegetable Fertilizer	E. Glastonbury, Yantic, East Berlin	32.75	21.60	51.6

* See note on page 58. † See note on page 59.

ANALYSES AND VALUATIONS—*Continued.*

Nitrogen.							Phosphoric Acid.							Potash.		
					Total.					Total.		"Available."				
In Nitrates.	In Ammonia.	Organic, water-soluble.	Organic, active insoluble.	Organic, inactive insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Station No.
1.56	0.41	0.07	0.27	0.40	2.71	2.5	6.43	2.07	1.34	9.84	8.5	8.50	8.0	[1] 5.22	5.0	26381
1.29	1.00	0.15	1.04	0.37	3.85	4.1	7.01	1.51	1.15	9.67	8.5	8.52	8.0	8.57	7.0	26632
0.76	0.10	0.00	0.35	0.51	1.72	1.7	5.95	2.10	1.46	9.51	10.0	8.05	7.0	6.77	6.0	26602
1.54	0.18	0.04	0.53	0.47	2.76	2.5	6.41	1.93	0.96	9.30	8.5	8.34	8.0	4.69	4.0	26631
1.33	0.20	0.00	0.28	0.53	2.34	2.1	4.64	1.79	1.23	7.66	6.5	6.43	6.0	2.63	2.0	26405
1.17	0.06	0.07	0.19	0.35	1.84	1.7	6.24	2.30	1.46	10.00	8.5	8.54	8.0	5.44	5.0	26563
1.17	0.05	0.00	0.22	0.40	1.84	1.7	6.55	2.23	1.24	10.02	8.5	8.78	8.0	[2] 10.36	10.0	26406
1.67	0.53	0.12	0.83	0.40	3.55	3.3	6.85	1.25	0,28	8.38	8.5	8.10	8.0	7.16	7.0	26633
...	0.02	0.16	0.50	0.64	1.32	0.8	5.16	3.76	0.91	9.83	9.0	8.92	8.0	2.84	2.0	26634
...	1.10	0.22	0.58	0.69	2.59	2.5	5.64	2.94	0.46	9.04	9.0	8.58	8.0	6.53	6.0	26541
3.30	0.12	0.00	0.66	0.89	4.97	5.0	2.04	2.63	0.63	5.30	5.0	4.67	4.0	3.81	2.0	26280
0.08	1.76	0.20	0.96	0.73	3.73	3.3	3.70	3.04	0.92	7.66	7.0	6.74	6.0	8.21	7.0	26382
...	0.06	0.24	0.78	0.75	1.83	1.7	3.68	2.91	1.20	7.79	7.0	6.59	6.0	4.62	4.0	26540
1.05	0.12	0.81	1.60	1.63	5.21	4.5	0.87	1.85	0.20	2.92	4.0	2.72	3.0	[3] 6.57	5.5	26635
0.84	1.28	0.04	0.77	0.63	3.56	2.9	3.10	3.81	0.38	7.29	..	6.91	7.0	12.75	10.0	26315
0.05	0.10	0.23	0.67	0.48	1.53	1.7	2.35	4.24	2.52	9.11	7.0	6.59	6.0	2.76	2.0	26227
1.20	0.14	0.29	1.66	0.98	4.27	4.1	1.13	5.79	2.11	9.03	5.0	6.92	4.0	[4] 5.44	5.0	26636
1.07	0.07	0.44	1.69	0.99	4.26	4.1	1.03	5.27	1.79	8.09	5.0	6.30	4.0	[5] 5.43	5.0	26637
0.40	0.50	0.15	0.42	0.25	1.72	1.7	5.92	2.35	1.68	9.95	9.0	8.27	8.0	2.19	2.0	26321
0.48	0.95	0.35	0.84	0.49	3.11	3.3	6.01	1.67	0.69	8.37	8.0	7.68	7.0	6.69	7.0	26464
...	0.87	0.44	0.36	0.36	2.03	1.7	6.37	1.93	0.81	9.11	9.0	8.30	8.0	2.60	2.0	26543
0.16	0.72	0.30	0.78	0.45	2.41	2.5	3.59	1.88	1.02	6.49	5.0	5.47	4.0	4.34	4.0	26316
0.23	0.10	0.19	0.24	0.18	0.94	0.8	6.10	2.62	1.19	9.91	9.0	8.72	8.0	1.23	1.0	26281
...	1.32	0.44	0.55	0.31	2.62	2.5	7.09	2.44	1.20	10.73	10.0	9.53	9.0	2.29	2.0	26639
0.67	1.20	0.08	0.87	0.35	3.17	3.3	2.26	1.56	0.73	4.55	8.0	3.82	4.0	4.57	5.0	26228
0.84	1.12	0.03	0.80	0.31	3.10	3.3	2.73	1.56	0.87	5.16	8.0	4.29	4.0	6.22	5.0	26437
...	1.25	0.27	0.82	0.32	2.66	2.5	5.08	1.62	0.73	7.43	7.0	6.70	6.0	9.44	10.0	26323
0.28	1.21	0.33	0.48	0.34	2.64	2.5	6.85	2.28	1.33	10.46	9.0	9.13	8.0	4.36	4.0	26322

[1] 1.00% as muriate, 4.22% as sulphate.
[2] 7.18% as muriate, 3.18% as sulphate.
[3] 0.40% as muriate, 0.76% as sulphate, 5.41% as carbonate.
[4] 0.53% as muriate, 4.91% as sulphate.
[5] 0.25% as muriate, 2.40% as sulphate, 2.78% as carbonate.

NITROGENOUS SUPERPHOSPHATES.

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.
	Sampled by Station Agent: **Bowker Fertilizer Co., New York City** *(Continued).*				
26383	Potato and Vegetable Phosphate ...	New London, Norwich, Meriden	$29.70	$16.80	75.6
26463	Sure Crop Phosphate...............	Yantic, East Berlin, Yalesville	28.00	14.56	92.3
26542	*Tobacco Ash Elements	East Granby, Suffield.....	32.00	23.10	38.5
26544	Tobacco Starter	East Hartford, East Granby	32.50	21.55	50.8
26320	Stockbridge Sp'l Complete Manure for Corn and all Grain Crops. ...	Yantic, Milldale, Meriden	38.50	27.71	38.9
26282	Stockbridge Sp'l Complete Manure for Potatoes and Vegetables	New Haven, East Glastonbury, Milldale	39.25	26.08	50.5
26640	*Stockbridge Sp'l Complete Manure for Seeding Down, etc.	Yantic, Yalesville........	38.00	23.20	63.8
26981	*Stockbridge Sp'l Complete Manure for Seeding Down, etc.	Newington	35.00	24.06	45.5
26283	*Stockbridge Sp'l Complete Manure for Top Dressing and for Forcing.	New Haven, New Britain.	40.50	26.07	55.4
26436	†Stockbridge Sp'l Complete Manure for Top Dressing and for Forcing.	Stamford, New Canaan...	45.00	29.11	54.6
26638	Stockbridge Sp'l Complete Manure for Tobacco	Rockville, New Milford ..	48.50	33.15	46.3
	The Buffalo Fertilizer Co., Buffalo, N. Y.				
26325	Celery and Potato Special	Hazardville, West Cheshire, Ansonia	33.75	22.01	53.3
26384	Farmer's Choice	Branford, Norwich Town, Ansonia...............	24.75	15.54	59.3
26385	Fish Guano......................	Colchester, Manchester, Westville..............	24.50	14.19	72.7
26326	High Grade Manure...............	Plainville, West Cheshire, Westport	36.00	25.98	38.6
26284	New England Special	Plainville, Hazardville, West Cheshire	28.75	18.82	52.8
26545	Tobacco Producer	Hazardville, Windsor Locks, West Suffield ...	39.50	26.48	49.2
26438	Top Dresser.....................	West Cheshire, Manchester, New Canaan........	40.75	27.71	47.1
26324	Vegetable and Potato.............	Plainville, Norwich Town, Colchester............	33.50	21.86	53.2
	The E. D. Chittenden Co., Bridgeport, Conn.				
26663	Complete Tobacco and Onion Grower	Broad Brook	34.50	25.09	37.5
26665	Connecticut Tobacco Grower	Broad Brook (2)..........	46.00	31.06	48.1
26661	Fish and Potash	Broad Brook	28.00	16.12	73.7

* See note on page 59. † See note on page 60.

ANALYSES AND VALUATIONS—*Continued.*

Nitrogen.							Phosphoric Acid.							Potash.		
					Total.					Total.		"Available."				
In Nitrates.	In Ammonia.	Organic, water-soluble.	Organic, active insoluble.	Organic, inactive insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Station No.
0.36	0.45	0.29	0.45	0.25	1.80	1.7	6.44	2.54	1.46	10.44	9.0	8.98	8.0	2.16	2.0	26383
0.06	0.16	0.25	0.26	0.29	1.02	0.8	7.04	2.31	1.61	10.96	10.0	9.35	9.0	2.15	2.0	26463
...	...	...	...	...	0.24	..	0.50	7.61	3.99	12.10	...	8.11	6.0	[1] 14.17	15.0	26542
0.59	1.21	0.08	0.46	0.42	2.76	2.5	6.76	2.04	0.47	9.27	9.0	8.80	8.0	[2] 4.14	3.0	26544
0.68	1.30	0.13	0.89	0.38	3.38	3.3	8.22	2.13	0.87	11.22	11.0	10.35	10.0	7.43	7.0	26320
0.93	0.65	0.26	0.85	0.48	3.17	3.3	4.96	2.01	0.78	7.75	7.0	6.97	6.0	9.74	10.0	26282
0.46	1.03	0.26	0.60	0.25	2.60	2.5	4.65	2.12	1.16	7.93	9.0	6.77	6.0	8.99	10.0	26640
0.11	1.02		1.53		2.66	2.5	4.72	2.00	0.83	7.55	9.0	6.72	6.0	9.59	10.0	26981
0.40	1.00	0.21	1.64	0.57	3.82	4.9	4.19	1.41	0.73	6.33	6.0	5.60	4.0	7.90	6.0	26283
0.77	0.91	0.00	2.51	1.02	5.21	4.9	3.05	1.53	0.67	5.25	6.0	4.58	4.0	6.33	6.0	26436
1.43	3.06	0.17	0.53	0.39	5.58	5.8	3.14	2.13	0.60	5.87	5.0	5.27	4.0	[3] 9.90	10.0	26638
0.92	0.08	0.08	0.22	0.25	1.55	1.6	5.48	3.36	1.00	9.84	9.0	8.84	8.0	10.10	10.0	26325
...	0.34	0.10	0.20	0.31	0.95	0.8	4.92	3.59	1.02	9.53	9.0	8.51	8.0	5.06	5.0	26384
...	0.23	0.13	0.27	0.31	0.94	0.8	4.19	5.31	1.57	11.07	10.0	9.50	9.0	2.30	2.0	26385
1.50	1.66	0.00	0.26	0.13	3.55	3.3	5.23	2.23	0.64	8.10	8.0	7.46	7.0	8.89	10.0	26326
0.83	0.60		0.20		1.63	1.6	6.76	3.21	0.87	10.84	10.0	9.97	9.0	5.22	5.0	26284
0.18	2.84	0.00	0.71	0.56	4.29	4.5	3.15	4.02	1.11	8.28	6.0	7.17	5.0	[4] 5.34	5.5	26545
3.32	1.12	0.14	0.37	0.35	5.30	5.7	3.92	2.66	0.74	7.32	7.0	6.58	6.0	4.83	5.0	26438
0.82	1.16	0.00	0.21	0.13	2.32	2.4	5.77	2.86	0.75	9.38	9.0	8.63	8.0	7.52	7.0	26324
...	1.90	1.10	0.21	0.15	3.36	3.3	6.84	1.71	1.79	10.34	10.0	8.55	8.0	[5] 5.01	5.0	26663
0.69	2.25	0.38	1.09	0.63	5.04	5.0	4.32	0.79	1.11	6.22	6.0	5.11	4.0	[6] 8.37	8.0	26665
1.68	0.10	0.15	0.48	0.35	2.76	2.5	3.95	1.05	1.04	6.04	6.0	5.00	...	1.98	4.0	26661

[1] 1.14% as muriate, 13.03% as sulphate.
[2] 0.60% as muriate, 3.54% as sulphate.
[3] 1.70% as muriate, 8.20% as sulphate.
[4] 0.73% as muriate, 4.61% as sulphate.
[5] 0.57% as muriate, 4.44% as sulphate.
[6] 0.53% as muriate, 7.84% as sulphate.

NITROGENOUS SUPERPHOSPHATES.

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.
	Sampled by Station Agent:				
	The E. D. Chittenden Co., Bridge-Port, Conn. *(Continued).*				
26662	Potato and Grain	Broad Brook	$32.50	$24.11	34.8
26664	Potato Manure	Broad Brook	28.50	18.36	55.2
26660	Tobacco Special	Broad Brook	34.50	26.27	31.3
	The Everett B. Clark Seed Co., Milford, Conn.				
26255	Special Mixture for General Use	Milford	31.00	26.12	18.7
26254	Special 10% Brand	Milford	34.00	27.23	24.9
	The Coe-Mortimer Co., New York City.				
26641	*Celebrated Special Potato Fertilizer	West Hartford, Torrington	32.00	17.17	86.4
26967	* " " " "	Torrington	33.00	16.36	101.7
26666	Complete Manure 10% Potash	Torrington	37.00	21.92	68.8
26643	*Gold Brand Excelsior Guano	West Hartford	32.00	21.92	46.0
26965	* " " " "	Bridgeport	32.00	22.06	45.1
26466	H. G. Ammoniated Bone Superphosphate	West Hartford, Norwich, Torrington	31.75	17.48	81.6
26465	*New Englander Corn and Potato Fertilizer	West Hartford, Torrington, Winsted	29.25	12.04	142.9
26966	*New Englander Corn and Potato Fertilizer	Torrington	28.00	13.35	109.7
26646	Peruvian Tobacco Fertilizer	Somerville, Hillstown	49.00	33.47	46.4
26645	*Peruvian Vegetable Grower	West Cheshire	43.00	28.81	49.3
26963	* " " "	Greenwich	36.00	28.13	28.0
26642	*Red Brand Excelsior Guano	W. Cheshire, Somerville	38.50	25.09	53.4
26964	* " " " "	Bridgeport	37.50	24.39	53.8
26644	Tobacco and Onion Special	Somerville	38.00	27.50	38.2
	Conn. Valley Orchard Co., Berlin, Conn.				
26327	H. G. Complete Fertilizer	Berlin	27.00	21.60	25.0
	T. H. Eldredge, Norwich, Conn. *(Made for)*				
26263	Special Fish and Potash	Norwich	30.00	17.05	76.0
26262	Special Superphosphate	Norwich	28.00	14.23	96.8
	Essex Fertilizer Co., Boston, Mass.				
26649	Complete Manure for Corn, Grain and Grass	Plainville, East Hartford	40.50	26.05	55.5

* See note on page 60.

Analyses and Valuations—*Continued.*

Nitrogen. In Nitrates.	In Ammonia.	Organic, water-soluble.	Organic, active insoluble.	Organic, inactive insoluble.	Total. Found.	Total. Guaranteed.	Phosphoric Acid. Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total. Found.	Total. Guaranteed.	"Available." Found.	"Available." Guaranteed.	Potash. Found.	Potash. Guaranteed.	Station No.
0.26	2.60	0.26	0.19		3.31	3.3	7.06	1.04	0.91	9.01	10.0	8.10	8.0	6.61	6.0	26662
0.31	0.29	0.85	0.25	0.20	1.90	2.0	5.19	1.97	1.77	8.93	10.0	7.16	8.0	5.04	6.0	26664
0.17	3.21	0.31	0.63	0.42	4.74	4.3	3.67	0.61	0.68	4.96	5.0	4.28	3.0	[1] 6.05	5.5	26660
1.44	1.68	0.00	0.21	0.27	3.60	3.3	6.77	1.98	0.79	9.54	...	8.75	8.0	7.32	7.0	26255
1.55	1.66	0.00	0.14	0.27	3.62	3.3	5.09	1.82	0.73	7.64	...	6.91	6.0	10.58	10.0	26254
0.86	0.49	0.11	0.23	0.24	1.93	1.7	5.57	2.54	0.86	8.97	9.0	8.11	8.0	3.71	4.0	26641
0.88	0.42		0.40		1.70	1.7	5.94	2.05	0.73	8.72	9.0	7.99	8.0	3.90	4.0	26967
0.16	1.44	0.23	0.30	0.39	2.52	2.5	5.00	1.08	0.60	6.68	7.0	6.08	6.0	8.85	10.0	26666
0.10	1.42	0.27	0.37	0.53	2.69	2.5	6.36	2.10	1.05	9.51	9.0	8.46	8.0	5.36	6.0	26643
0.88	1.57		0.40		2.85	2.5	6.64	1.70	0.51	8.85	9.0	8.34	8.0	5.98	6.0	26965
0.64	0.65	0.17	0.25	0.33	2.04	1.9	5.86	2.57	0.95	9.38	9.0	8.43	8.0	3.11	3.0	26466
0.09	0.39	0.12	0.17	0.18	0.95	0.8	4.56	2.35	0.87	7.78	8.5	6.91	7.5	2.69	3.0	26465
0.15	0.40		0.44		0.99	0.8	5.53	2.23	0.91	8.67	8.5	7.76	7.5	3.19	3.0	26966
1.57	0.74	0.45	1.44	0.79	4.99	5.0	1.44	4.56	0.70	6.70	7.0	6.00	6.0	[2] 10.26	10.0	26646
0.75	1.45	0.45	0.49	0.21	3.35	3.3	2.65	6.92	1.16	10.73	9.0	9.57	8.0	[3] 8.85	9.0	26645
0.88	1.40		1.02		3.30	3.3	2.29	7.13	1.16	10.58	9.0	9.42	8.0	[4] 8.62	9.0	26963
0.90	1.52	0.29	0.33	0.37	3.41	3.3	6.30	2.14	0.78	9.22	9.0	8.44	8.0	6.70	7.0	26642
0.98	1.40		0.84		3.22	3.3	5.52	2.81	0.65	8.98	9.0	8.33	8.0	[5] 6.80	7.0	26964
0.76	0.16	0.36	1.40	0.59	3.27	3.0	3.95	4.15	1.00	9.10	7.0	8.10	6.0	[6] 8.00	8.0	26644
...	1.10	0.21	0.68	0.48	2.47	2.5	8.14	1.88	0.47	10.49	10.0	10.02	9.0	4.21	4.0	26327
...	0.19	0.40	0.71	0.64	1.94	2.1	1.66	3.81	2.41	7.88	6.0	5.47	5.0	4.64	4.0	26263
...	0.12	0.26	0.44	0.32	1.14	1.0	1.53	6.79	2.62	10.94	10.0	8.32	8.0	2.25	2.0	26262
...	1.40	0.80	0.78	0.28	3.26	3.3	4.83	1.50	0.28	6.61	7.0	6.33	6.0	9.96	10.0	26649

[1] 0.60% as muriate, 5.45% as sulphate.
[2] 0.90% as muriate, 9.36% as sulphate.
[3] 0.45% as muriate, 8.40% as sulphate.
[4] 0.62% as muriate, 8.00% as sulplate.
[5] 5.78% as muriate, 1.02% as sulphate.
[6] 0.80% as muriate, 7.20% as sulphate.

NITROGENOUS SUPERPHOSPHATES.

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.
	Sampled by Station Agent:				
	Essex Fertilizer Co., *(Continued).*				
26230	*Complete Manure for Potatoes, Roots and Vegetables	Bristol, Plainville, East Hartford	$39.75	$25.52	55.8
26647	Fertilizer for Grass and Top Dressing	So. Manchester	45.00	28.23	59.4
26229	Market Garden and Potato Manure.	Bristol, Plainville	35.00	18.91	85.1
26648	Special Tobacco Manure	East Hartford, Hazardville	44.00	30.02	46.6
26489	Tobacco Starter and Grower	East Hartford, Poquonock, Ellington	39.00	24.71	57.8
26256	XXX Fish and Potash	Plainville, East Hartford, Suffield	32.00	17.50	82.9
	Fertilizer Materials Supply Co., New York City.				
26962	Tuttle's No. 4 Corn Mixture	Wallingford	....	25.00	....
	The L. T. Frisbie Co., New Haven, Conn.				
26329	Corn and Grain Fertilizer	Hartford, Ansonia, So. Manchester	29.25	19.08	53.3
26328	Potato Manure	Hartford, Ansonia, So. Manchester	33.25	23.70	40.3
26231	*Vegetable Grower	New Haven	39.00	25.68	51.9
26386	* " "	Hartford, New Haven	37.00	26.67	38.7
	Lister's Agricultural Chemical Works, Newark, N. J.				
26667	Ammoniated Dissolved Bone Phosphate	No. Branford	29.00	17.88	62.2
26669	Complete Tobacco Manure	Warehouse Point	37.50	24.28	54.4
26651	Complete Tobacco Manure with Carbonate	Glastonbury, Burnside	39.00	26.50	47.2
26650	Corn and Potato Fertilizer	Hamden, Stafford Springs	32.00	18.48	73.2
26387	Potato Manure	Glastonbury, Burnside, Warehouse Point	38.25	26.46	44.6
26388	Special Grass Mixture	Glastonbury, Warehouse Point	35.75	24.73	44.6
26670	Special 10% Fertilizer	Wallingford	34.00	23.86	42.5
26467	Standard Pure Bone Superphosphate of Lime	Burnside, Warehouse Point, Wallingford	32.00	20.30	57.6
26671	Success Fertilizer	Warehouse Point, Moodus	28.00	16.27	72.1
26668	3-6-10 for Potatoes	Suffield	34.50	25.52	35.2
	E. Manchester & Sons, Winsted, Conn.				
26672	Formula	Winsted, East Haddam	32.00	27.74	15.4
26546	Special	Winsted, Simsbury, Avon.	35.25	34.33	2.7

* See note on page 60.

ANALYSES AND VALUATIONS—*Continued.*

Nitrogen.							Phosphoric Acid.							Potash.		
					Total.					Total.		"Available."				
In Nitrates.	In Ammonia.	Organic, water-soluble.	Organic, active insoluble.	Organic, inactive insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Station No.
...	1.37	0.65	0.81	0.19	3.02	3.3	5.57	1.07	0.28	6.92	7.0	6.64	6.0	10.07	10.0	26230
...	1.62	1.15	0.76	0.49	4.02	4.1	5.37	2.27	0.41	8.05	8.0	7.64	7.0	7.81	8.0	26647
...	0.41	0.58	0.64	0.29	1.92	2.0	6.05	2.35	0.41	8.81	9.0	8.40	8.0	4.79	5.0	26229
2.25	0.05	0.46	0.88	0.39	4.03	4.1	5.32	1.63	0.33	7.28	7.0	6.95	6.0	[1] 9.79	10.0	26648
2.47	0.08	0.24	0.89	0.31	3.99	4.1	3.91	1.06	0.19	5.16	5.0	7.97	4.0	[2] 6.46	6.0	26489
...	0.49	0.66	0.47	0.33	1.95	2.0	5.64	2.71	0.67	9.02	9.0	8.35	8.0	3.02	3.0	26256
1.34	0.08	0.05	0.73	0.65	2.85	3.0	1.64	2.80	1.88	6.32	8.0	4.44	8.0	12.07	6.0	26962
...	0.35	0.70	0.51	0.33	1.89	1.6	2.52	5.27	5.83	13.62	8.0	7.79	8.0	3.50	3.0	26329
...	0.55	1.14	0.57	0.38	2.64	2.5	3.40	5.34	2.33	11.07	8.0	8.74	6.0	6.26	6.0	26328
...	1.37	1.19	0.35	0.26	3.17	3.3	5.12	3.95	3.70	12.77	8.0	9.07	6.0	5.71	8.0	26231
...	1.28	1.47	0.51	0.27	3.53	3.3	3.35	3.84	3.86	11.05	8.0	7.19	6.0	6.99	8.0	26386
...	0.13	0.56	0.90	0.56	2.15	2.1	6.33	2.29	1.24	9.86	9.0	8.62	8.0	1.59	1.5	26667
0.61	1.99	0.57	0.64	0.42	4.23	4.1	2.64	2.19	0.72	5.55	5.0	4.83	4.0	[3] 5.15	5.0	26669
2.36	0.03	0.29	1.12	0.48	4.28	4.1	0.35	3.48	2.60	6.43	5.0	3.83	4.0	[4] 5.13	5.0	26651
...	0.23	0.64	0.66	0.47	2.00	1.7	5.88	2.84	1.36	10.08	9.0	8.72	8.0	3.02	3.0	26650
0.30	1.78	0.50	0.47	0.39	3.44	3.3	7.04	1.76	0.90	9.70	9.0	8.80	8.0	7.35	7.0	26387
1.05	0.02	0.10	0.33	0.23	1.73	1.7	8.93	1.92	0.92	11.77	..	10.85	10.0	10.26	10.0	26388
...	0.51	0.52	0.53	0.34	1.90	1.7	6.56	2.34	0.95	9.85	9.0	8.90	8.0	10.02	10.0	26670
0.56	0.52	0.52	0.59	0.45	2.64	2.5	6.63	2.68	1.55	10.86	10.0	9.31	9.0	2.21	2.0	26467
...	0.15	0.57	0.34	0.28	1.34	1.2	6.75	2.97	1.29	11.01	10.0	9.72	9.0	2.41	2.0	26671
0.97	0.13	0.53	0.79	0.44	2.86	2.5	3.75	2.86	1.10	7.71	7.0	6.61	6.0	10.41	10.0	26668
0.51	0.13	1.28	0.79	0.56	3.27	3.5	3.36	4.61	1.25	9.22	8.0	7.97	....	9.36	8.0	26672
0.94	0.19	2.11	0.93	0.87	5.04	5.0	3.24	4.48	0.69	8.41	8.0	7.72	....	[5] 8.51	7.5	26546

[1] 1.79% potash as muriate, 8.00% as sulphate.
[2] 0.78% potash as muriate, 5.68% as sulphate.
[3] 0.84% potash as muriate, 4.31% as sulphate.
[4] 0.60% potash as muriate, 1.02% as sulphate, 3.51% as carbonate.
[5] 1.45% as muriate, 7.06% as sulphate.

NITROGENOUS SUPERPHOSPHATES.

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.
	Sampled by Station Agent:				
	The Mapes Formula and Peruvian Guano Co., New York City.				
26257	Average Soil Complete Manure	Hartford, Windsor Locks, Meriden	$38.00	$26.80	41.8
26673	Cereal Brand	Hartford	30.00	17.31	73.3
26407	Complete Manure "A" Brand	Hartford, Meriden, Southington	37.25	21.05	77.0
26264	Corn Manure	Hartford, Meriden, Norwich	37.00	23.37	58.3
26479	Dissolved Bone	Hartford	33.00	23.52	40.3
26675	Economical Potato Manure	Hartford, Southington	37.50	26.15	43.4
26285	Fruit and Vine Manure	Hartford, Meriden	42.00	24.54	71.1
26258	Potato Manure	Hartford, Windsor Locks, Meriden	41.00	27.48	49.2
26674	Seeding Down Manure	Forestville	42.00	33.20	26.5
26679	Tobacco Ash Constituents	Hartford, Windsor Locks.	34.50	24.89	38.6
26516	Tobacco Manure, Wrapper Brand	Buckland, Hartford, Hazardville	49.25	40.49	21.6
26676	Tobacco Starter, Improved	Windsor Locks, Glastonbury	37.50	24.16	55.2
26408	Top Dresser, Imp'd, Full Strength	Hartford, Buckland, Forestville	53.25	42.84	24.3
26677	Top Dresser, Imp'd, Half Strength	Hartford, Windsor Locks.	34.50	21.93	57.3
26678	Vegetable Manure for Light Soils	Hartford, Norwich	43.50	31.29	39.0
	The National Fertilizer Co., New York City.				
26490	Ammoniated Bone Phosphate	Wallingford, Torrington, Willimantic	28.00	16.27	72.1
26686	Complete Corn and Grain Fertilizer	Hartland, East Windsor Hill	35.50	25.46	39.4
26680	Complete Grass Fertilizer	So. Manchester	39.00	23.16	68.4
26681	*Complete Root Fertilizer	Silver Lane	38.00	22.27	70.6
27019	* " " "	Silver Lane	38.00	25.08	51.5
26553	Complete Tobacco Fertilizer	Suffield, Hartland, New Milford	38.00	24.71	53.8
26682	Connecticut Valley Tobacco Grower	Broad Brook	45.00	31.83	41.4
26687	Eureka Potato Fertilizer	Willimantic, So. Manchester	35.50	23.66	50.0
26330	Fish and Potash	Silver Lane, West Cheshire, So. Manchester	30.75	18.96	62.2

* See note on page 60.

Analyses and Valuations—*Continued.*

Nitrogen.							Phosphoric Acid.							Potash.		
					Total.					Total.		"Available."				
In Nitrates.	In Ammonia.	Organic, water-soluble.	Organic, active insoluble.	Organic, inactive insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Station No.
2.35	1.70	0.00	0.12	0.26	4.43	4.1	1.30	6.66	0.56	8.52	8.0	7.96	7.0	[1] 5.71	5.0	26257
0.84	0.56	0.05	0.26	0.39	2.10	1.7	0.54	7.48	1.25	9.27	8.0	8.02	6.0	3.60	3.0	26673
1.44	0.69	0.00	0.18	0.30	2.61	2.5	0.87	9.76	2.34	12.97	12.0	10.63	10.0	[2] 3.23	2.5	26407
1.02	0.88	0.08	0.23	0.43	2.64	2.5	0.84	8.62	2.05	11.51	10.0	9.46	8.0	6.88	6.0	26264
....	0.21	1.09	0.78	0.64	2.72	2.1	6.69	8.03	0.93	15.65	....	14.72	12.0	......	.....	26479
1.86	1.14	0.11	0.16	0.31	3.58	3.3	0.55	5.87	0.59	7.01	6.0	6.42	4.0	[3] 8.94	8.0	26675
1.55	0.10	0.03	0.22	0.39	2.29	1.7	0.07	6.17	2.20	8.44	7.0	6.24	5.0	[4] 10.98	10.0	26285
2.08	1.28	0.12	0.13	0.27	3.88	3.7	1.66	7.72	0.65	10.03	8.0	9.38	8.0	[5] 6.84	6.0	26258
2.62	0.05	0.08	0.27	0.10	3.12	2.5	0.05	13.44	4.98	18.47	18.0	13.49	....	11.85	10.0	26674
....	....	....	....	....	0.64	0.5	0.00	3.35	2.53	5.88	5.7	3.35	....	[6] 14.25	15.0	26679
3.74	0.04	0.40	1.31	0.99	6.48	6.2	0.08	4.76	0.92	5.76	4.5	4.84	....	[7] 10.12	10.5	26516
3.60	0.13	0.00	0.37	0.48	4.58	4.1	0.05	7.80	1.11	8.96	8.0	7.85	6.0	[8] 2.19	1.0	26676
6.66	2.91	0.12	0.19	0.13	10.01	9.9	0.35	7.26	0.78	8.39	8.0	7.61	5.0	[9] 4.17	4.0	26408
3.55	1.41	0.01	0.15		5.12	4.9	0.37	3.27	0.75	4.39	4.0	3.64	2.5	[10] 2.24	2.0	26677
2.99	1.40	0.08	0.26	0.34	5.07	4.9	0.84	8.02	0.68	9.54	8.0	8.86	6.0	[11] 7.21	6.0	26678
0.19	0.71	0.33	0.28	0.23	1.74	1.7	5.95	2.59	1.41	9.95	9.0	8.54	8.0	2.40	2.0	26490
....	2.42	0.25	0.51	0.33	3.51	3.3	6.54	2.25	1.06	9.85	9.0	8.79	8.0	6.18	6.0	26686
1.66	0.60	0.24	0.62	0.48	3.60	4.1	3.37	2.81	1.05	7.23	7.0	6.18	6.0	5.73	5.0	26680
0.13	1.80	0.19	0.40	0.33	2.85	3.3	6.67	2.05	1.09	9.81	9.0	8.72	8.0	5.09	6.0	26681
2.22	0.15	1.03			3.40	3.3	6.60	2.19	1.10	9.89	9.0	8.79	8.0	6.17	6.0	27019
....	1.05	0.30	0.88	0.89	3.12	3.3	5.81	3.20	1.24	10.25	9.0	9.01	8.0	[12] 4.94	5.0	26553
0.27	0.08	1.14	1.87	1.58	4.94	4.9	0.39	3.00	1.37	4.76	4.0	3.39	1.0	[13] 6.64	8.0	26682
0.13	1.23	0.13	0.57	0.36	2.42	2.5	4.89	2.19	0.97	8.05	7.0	7.08	6.0	10.05	10.0	26687
0.87	0.76	0.11	0.53	0.47	2.74	2.9	4.35	1.84	0.86	7.05	7.0	6.19	6.0	4.21	4.0	26330

[1] 0.72% as muriate, 4.99% as sulphate.
[2] 2.99% as muriate, 0.24% as sulphate.
[3] 1.01% as muriate, 7.93% as sulphate.
[4] 1.10% as muriate, 9.88% as sulphate.
[5] 0.85% as muriate, 5.99% as sulphate.
[6] 1.50% as muriate, 5.06% as sulphate, 7.69% as carbonate.
[7] 1.40% as muriate, 3.00% as sulphate, 5.72% as carbonate.
[8] 0.65% as muriate, 1.54% as sulphate.
[9] 1.02% as muriate, 3.15% as sulphate.
[10] 0.49% as muriate, 1.75% as sulphate.
[11] 0.96% as muriate, 6.25% as sulphate.
[12] 1.10% as muriate, 3.84% as sulphate.
[13] 0.40% as muriate, 2.12% as sulphate, 4.12% as carbonate.

NITROGENOUS SUPERPHOSPHATES.

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.
	Sampled by Station Agent: **The National Fertilizer Co., (Continued).**				
26683	Formula "A"	Willimantic	$33.00	$23.40	41.0
26685	Market Garden Fertilizer	So. Manchester, East Windsor Hill	34.90	22.10	53.8
26491	Potato Phosphate	Silver Lane, So. Manchester, Wallingford	33.00	21.07	56.6
26552	Tobacco Special	Silver Lane, So. Manchester, Suffield, Hartland	37.25	26.43	40.9
27020	" "	Silver Lane	35.00	28.71	21.9
26684	Tobacco Special with Carbonate	Simsbury	37.00	29.38	25.9
26492	XXX Fish and Potash	So. Manchester, Torrington, Winsted	29.00	17.66	64.2
	New England Fertilizer Co., Boston, Mass.				
26574	Corn and Grain Fertilizer	Plantsville, Rockville	28.50	13.33	113.8
26688	Corn Phosphate	Jewett City	31.00	17.04	81.9
26575	H. G. Potato Fertilizer	Plantsville, Jewett City	35.00	21.70	61.3
26689	Perfect Tobacco Grower	Suffield, Warehouse Point	36.50	24.67	48.0
26358	Potato Fertilizer	Plantsville, Rockville, So. Manchester	31.25	16.41	90.4
26331	Superphosphate	Meriden, Suffield, So. Manchester	32.50	20.30	60.1
	The Niantic Menhaden Oil & Guano Co., South Lyme, Conn.				
26286	Bone, Fish and Potash	New London, Norwich	30.50	19.02	60.4
26708	Corn and Grain Fertilizer	Norwich, Guilford	31.50	22.23	41.7
26707	H. G. Tobacco Fertilizer	Silver Lane, Burnside (2)	35.00	27.78	26.0
26761	Market Garden Manure	Norwich	40.00	32.60	22.7
26409	Potato and Vegetable Manure	New London, New Haven, Guilford	32.75	22.95	42.7
	Nitrate Agencies Co., New York City.				
26710	Peruvian Guano	Waterbury	28.00	19.80	41.4
	Olds & Whipple, Hartford, Conn.				
26233	Complete Corn and Potato Fertilizer	Hartford	34.00	24.80	37.1
26235	Complete Grass Fertilizer	Hartford	34.00	24.63	38.0
26518	Complete Tobacco Fertilizer	Hartford	37.00	29.95	23.5
26439	Fish and Potash	Hartford	30.00	21.07	42.4
26234	H. G. Potato Fertilizer	Hartford	37.00	29.90	23.7
26517	Special Phosphate	Hartford	35.00	25.77	35.8

ANALYSES AND VALUATIONS—*Continued.*

Nitrogen.							Phosphoric Acid.							Potash.		
					Total.					Total.		"Available."				
In Nitrates.	In Ammonia.	Organic, water-soluble.	Organic, active insoluble.	Organic, inactive insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Station No.
0.79	0.85	0.19	0.93	0.34	3.10	3.3	5.04	2.24	0.84	8.12	7.0	7.28	6.0	6.64	6.0	26683
....	1.47	0.29	0.36	0.38	2.50	2.5	6.53	1.99	1.14	9.66	9.0	8.52	8.0	6.29	6.0	26685
....	0.96	0.39	0.37	0.44	2.16	2.1	6.73	1.77	1.56	10.06	9.0	8.50	8.0	6.00	6.0	26491
0.12	0.16	0.43	2.19	1.21	4.11	4.5	2.05	2.76	1.23	6.04	4.0	4.81	3.0	[1] 5.83	5.5	26552
0.23	0.17		4.10		4.50	4.5	2.03	3.01	1.10	6.14	4.0	5.04	3.0	[2] 6.48	5.5	27020
0.13	0.15	0.95	1.83	1.22	4.28	4.5	0.19	4.58	2.97	7.74	4.0	4.77	3.0	[3] 6.15	5.5	26684
0.15	0.74	0.26	0.74	0.61	2.50	2.5	3.99	2.05	0.88	6.92	6.0	6.04	5.0	3.28	3.0	26492
0.06	0.05	0.70	0.30	0.20	1.31	1.2	4.18	2.91	0.70	7.79	8.0	7.09	7.0	2.13	2.0	26574
....	0.10	0.90	0.40	0.25	1.65	1.6	6.76	1.64	1.25	9.65	9.0	8.40	8.0	3.09	3.0	26688
0.37	0.58	0.75	0.53	0.25	2.48	2.5	6.39	1.91	0.41	8.71	9.0	8.30	8.0	6.00	6.0	26575
2.36	0.13	0.88	0.49	0.16	4.02	4.1	3.68	1.26	0.15	5.09	5.0	4.94	4.0	[4] 6.33	6.0	26689
....	0.37	0.67	0.45	0.20	1.69	1.6	5.32	1.94	0.42	7.68	8.0	7.26	7.0	4.05	4.0	26358
....	0.78	0.84	0.56	0.24	2.42	2.5	5.71	2.53	1.25	9.49	9.0	8.24	8.0	4.21	4.0	26331
0.57	0.55	0.15	0.66	0.77	2.70	2.5	2.50	3.86	0.60	6.96	6.0	6.36	5.0	[5] 3.73	3.0	26286
0.75	0.38	0.04	0.79	0.56	2.52	2.1	5.64	3.82	1.18	10.64	8.0	9.46	7.0	[6] 4.54	3.5	26708
1.24	0.25	0.33	0.95	0.77	3.54	3.3	4.30	4.27	2.32	10.89	8.0	8.57	7.0	[7] 6.68	6.0	26707
1.14	0.54	0.54	1.41	1.11	4.74	4.1	4.28	4.15	1.41	9.84	8.0	8.43	7.0	[8] 7.31	6.0	26761
0.89	0.40	0.24	0.65	0.60	2.78	2.5	4.70	3.98	1.13	9.81	8.0	8.68	7.0	[9] 5.11	4.0	26409
0.41	0.78	0.01	0.53	0.37	2.10	2.3	0.89	10.24	3.80	14.93	15.3	11.13	7.8	2.16	2.4	26710
....	0.85	0.65	0.87	0.97	3.34	3.3	0.34	6.98	1.62	8.94	7.0	7.32	6.0	[10] 6.37	6.0	26233
....	0.88	0.62	0.95	0.89	3.34	3.3	0.42	6.91	1.55	8.88	7.0	7.33	6.0	[11] 6.20	6.0	26235
0.56	0.06	2.00	0.91	1.17	4.70	4.5	0.00	3.26	0.14	3.40	3.5	3.26	3.0	[12] 6.15	5.5	26518
....	0.43	0.48	1.10	0.93	2.94	2.5	2.10	5.11	0.82	8.03	6.0	7.21	5.0	3.93	3.0	26439
....	0.66	0.71	1.24	0.80	3.41	3.3	2.03	5.13	1.25	8.41	...	7.16	6.0	[13] 11.48	10.0	26234
0.12	1.06	0.77	1.19	1.27	4.41	4.1	2.84	2.61	0.77	6.22	...	5.45	4.0	[14] 4.22	3.0	26517

[1] 1.10% as muriate, 4.73% as sulphate.
[2] 0.90% as muriate. 5.58% as sulphate.
[3] 0.80% as muriate, 2.86% as sulphate, 2.45% as carbonate.
[4] 0.90% as muriate, 5.43% as sulphate.
[5] 1.30% as muriate, 2.43% as sulphate.
[6] 0.65% as muriate, 3.89% as sulphate.
[7] 0.60% as muriate, 6.08% as sulphate.
[8] 0.40% as muriate, 6.91% as sulphate.
[9] 0.77% as muriate, 4.34% as sulphate
[10] 5.28% as muriate, 1.09% as sulphatė.
[11] 5.06% as muriate, 1.14% as sulphate.
[12] 0.60% as muriate, 0.68% as sulphate, 4.87% as carbonate.
[13] 7.50% as muriate, 3.98% as sulphate.
[14] 0.70% as muriate, 3.52% as sulphate.

NITROGENOUS SUPERPHOSPHATES.

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.
	Sampled by Station Agent:				
	Parmenter & Polsey Fertilizer Co., Boston, Mass.				
26711	Grain Grower	Plantsville	$26.00	$14.05	85.1
26554	Plymouth Rock Brand	Wallingford, So. Woodstock, Plantsville	32.00	20.05	59.6
26576	Potato Fertilizer	Cromwell, Plantsville	30.50	17.31	76.2
26578	Potato Grower	So. Woodstock, Mansfield	38.00	22.95	65.6
26577	Special Tobacco Grower	Wallingford, Warehouse Point	39.25	27.69	41.7
	The Rogers & Hubbard Co., Middletown, Conn.				
26359	Complete Phosphate	Wallingford, Branford, So. Manchester	28.25	18.58	52.0
26713	Grass and Grain Fertilizer	So. Manchester, New Canaan	45.00	29.31	53.5
26714	New Market Garden Phosphate	Wilton, New Canaan	37.00	22.98	61.0
26360	Oats and Top Dressing	Wallingford, East Hampton, So. Manchester	55.00	41.94	31.1
26715	*Potato Phosphate	Moodus, Wilton	33.50	22.31	50.2
26287	* " "	Wallingford, Branford	33.50	21.63	59.4
26519	Soluble Corn and General Crops Manure	Wallingford East Hampton, Andover	36.75	24.41	50.6
26520	Soluble Potato Manure	Branford, East Hampton, Andover	43.00	32.29	33.2
26712	Soluble Tobacco Manure	Somers	49.00	37.08	32.1
	The Rogers Mfg. Co., Rockfall, Conn.				
26716	All Round Fertilizer	Rockfall, Niantic	30.50	17.41	75.2
26580	Complete Potato and Vegetable Fertilizer	East Granby, Suffield, Wapping	33.25	21.84	52.2
26581	Fish and Potash	Rockfall, Wapping, East Winsted	31.50	21.76	44.8
26521	H. G. Complete Corn and Onion Manure	Highwood, Somerville (2).	35.25	26.81	31.5
26717	H. G. Grass and Grain	Somerville	38.50	34.69	11.0
26718	H. G. Oats and Top Dressing	Rockfall	48.00	34.90	37.5
26555	H. G. Soluble Tobacco Manure	Southington, New Milford	46.00	37.76	21.8
26556	H. G. Tobacco and Potato Manure	Somerville, Southington, New Milford	40.00	32.06	24.8
26579	H. G. Tobacco Grower	East Granby (2), Suffield	37.50	30.44	23.2
26719	Tobacco Starter	Wapping (2)	34.00	22.85	48.8
	Sanderson Fertilizer & Chemical Co., New Haven, Conn.				
26363	Atlantic Coast Bone, Fish and Potash	New Haven, Cromwell, East Hampton	25.75	16.83	53.0

* See note on page 60.

ANALYSES AND VALUATIONS—*Continued.*

Nitrogen.							Phosphoric Acid.							Potash.		
					Total.					Total.		"Available."				
In Nitrates.	In Ammonia.	Organic, water-soluble.	Organic, active insoluble.	Organic, inactive insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Station No.
0.06	0.04	0.61	0.40	0.25	1.36	1.2	6.04	1.54	0.38	7.96	8.0	7.58	7.0	2.20	2.0	26711
....	0.83	0.83	0.38	0.41	2.45	2.5	5.74	2.41	0.81	8.96	9.0	8.15	8.0	4.11	4.0	26554
0.07	0.08	0.43	0.54	0.36	1.48	1.6	3.99	3.18	0.56	7.73	7.0	7.17	6.0	6.07	6.0	26576
0.05	1.05	0.29	0.70	0.31	2.40	2.5	5.35	1.05	0.32	6.72	7.0	6.40	6.0	9.93	10.0	26578
2.49	0.06	0.51	0.84	0.33	4.23	4.1	3.49	1.43	0.36	5.28	5.0	4.92	4.0	[1] 8.57	8.0	26577
0.61	0.05	0.27	0.44	0.22	1.59	1.5	4.62	4.35	1.07	10.04	8.0	8.97	7.0	5.50	5.0	26359
0.46	0.13	0.39	0.71	0.63	2.32	2.2	0.06	10.11	5.26	15.43	16.0	10.17	6.5	12.07	12.0	26713
1.13	0.05	0.24	0.35	0.31	2.08	2.0	3.43	4.17	0.81	8.41	7.0	7.60	6.0	10.41	10.0	26714
7.83	0.03	0.09	0.47	0.14	8.56	8.5	0.05	6.82	1.46	8.33	8.0	6.87	4.5	9.28	8.0	26360
1.03	0.05	0.29	0.38	0.35	2.10	2.0	6.12	4.92	1.18	12.22	10.0	11.04	9.0	5.70	5.0	26715
1.06	0.06	0.15	0.33	0.30	1.90	2.0	6.49	4.38	1.23	12.10	10.0	10.87	9.0	6.00	5.0	26287
1.29	0.05	0.43	0.54	0.38	2.69	2.5	2.10	5.91	1.30	9.31	8.0	8.01	6.0	8.92	8.0	26519
2.06	0.21	0.61	1.48	0.73	5.09	5.0	0.90	7.48	3.24	11.62	10.0	8.38	7.0	[2] 5.83	5.0	26520
2.23	0.23	0.61	1.31	0.65	5.03	5.0	0.96	8.20	2.28	11.44	10.0	9.16	7.0	[3] 10.72	10.0	26712
0.90	0.06	0.22	0.35	0.43	1.96	1.6	5.31	3.98	1.06	10.35	10.0	9.29	8.0	2.31	2.0	26716
0.40	0.09	0.45	0.93	0.55	2.42	2.3	4.92	4.25	0.92	10.09	10.0	9.17	8.0	5.12	5.0	26580
1.09	0.14	0.57	0.85	0.80	3.45	3.3	2.65	2.74	1.04	6.43	6.0	5.39	4.0	4.64	3.8	26581
1.73	0.10	0.35	0.94	0.50	3.62	3.6	2.68	5.54	1.13	9.35	8.0	8.22	6.0	7.65	7.0	26521
0.46	0.00	0.03	2.06	0.71	3.26	3.0	0.08	8.95	9.34	18.37	16.0	9.03	....	13.00	12.5	26717
4.58	0.08	0.46	0.82	0.33	6.29	6.3	1.14	6.78	1.42	9.34	9.0	7.92	7.0	7.57	7.5	26718
1.20	0.21	0.96	1.48	1.05	4.90	5.0	0.98	7.29	1.32	9.59	8.0	8.27	6.0	[4] 12.18	11.0	26555
0.67	0.16	0.94	1.17	0.89	3.83	3.5	1.07	7.02	1.62	9.71	9.0	8.09	7.0	[5] 10.30	8.8	26556
2.11	0.15	1.10	1.24	0.66	5.26	5.0	0.72	4.42	1.05	6.19	5.0	5.14	4.0	[6] 6.79	6.0	26579
0.75	0.25	0.64	1.05	1.15	3.84	3.8	1.32	3.90	1.55	6.77	5.0	5.22	4.0	[7] 3.45	3.0	26719
0.12	0.52	0.28	0.72	0.46	2.10	1.7	1.49	3.38	1.62	6.49	6.0	4.87	4.0	5.01	4.0	26363

[1] 1.20% as muriate, 7.37% as sulphate.
[2] 1.13% as muriate, 4.70% as sulphate.
[3] 0.90% as muriate, 9.82% as sulphate.
[4] 0.88% as muriate, 11.30% as sulphate.
[5] 0.80% as muriate, 9.50% as sulphate.
[6] 1.30% as muriate, 5.49% as sulphate.
[7] 0.60% as muriate, 2.85% as sulphate.

Nitrogenous Superphosphates.

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.
	Sampled by Station Agent: **Sanderson Fertilizer & Chemical Co.** *(Continued).*				
26362	Corn Superphosphate	New Haven, Shelton, Portland	$28.25	$18.82	50.1
26361	Formula A	New Haven, Derby, Portland	36.00	24.92	44.5
26237	Formula B	Highwood, New Haven	35.00	25.95	34.9
26557	Kelsey's Bone, Fish and Potash	Branford, Granby	27.50	24.82	10.8
26364	Potato Manure	New Haven, East Hampton, Shelton, Derby	31.50	19.37	62.6
26720	Special with 10% Potash	New Haven, Portland	37.00	23.42	58.0
26522	Top Dressing for Grass and Grain	New Haven, Cromwell, Torrington	37.25	27.90	33.5
	The C. M. Shay Fertilizer Co., Groton, Conn.				
26523	Corn Fertilizer	Leonard's Bridge, Preston, Andover	28.50	21.14	34.8
26365	Potato Manure	New Britain, Meriden, Leonard's Bridge	33.00	26.72	23.5
26721	Grass Fertilizer	Leonard's Bridge, Groton	36.00	28.58	26.0
26486	Special Mixture	Gilead	35.00	33.54	4.4
26487	" "	"	32.00	27.58	16.0
	M. L. Shoemaker & Co., Philadelphia, Pa.				
26259	"Swift-Sure" Superphosphate for General Use	Hartford, Windsor Locks, Milford	35.00	25.19	38.9
26582	"Swift-Sure" Superphosphate for Potatoes	Milford, Guilford	35.00	26.58	31.7
26583	"Swift-Sure" Superphosphate for Truck, Corn and Onions	Milford, Guilford	29.00	19.93	45.5
	Swift's Lowell Fertilizer Co., Boston, Mass.				
26726	Swift's Perfect Tobacco Grower	Warehouse Point, Ellington	38.00	24.48	55.2
26723	" Potato Grower	Southport	35.00	26.16	33.8
26722	" Special Corn and Vegetable Manure	Warehouse Point, New Canaan	38.00	25.33	50.0
26724	Swift's Special Grass Mixture	Rockville	39.00	26.14	49.2
26412	" Special Potato Fertilizer	Southport, Warehouse Point, Guilford	34.75	22.30	55.8
26411	" Superior Fertilizer with 10% Potash	Rockville, Wethersfield, Guilford	38.75	28.69	35.0
26725	Swift's Tobacco Manure	Warehouse Point	42.00	30.97	35.6
26558	" Lowell Animal Brand	Suffield, New Britain, Cheshire	33.75	19.85	70.0

ANALYSES AND VALUATIONS—*Continued.*

Nitrogen.							Phosphoric Acid.							Potash.		
					Total.					Total.		"Available."				
In Nitrates.	In Ammonia.	Organic, water-soluble.	Organic, active insoluble.	Organic, inactive insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Station No.
0.21	0.14	0.68	0.67	0.45	2.15	1.7	5.22	3.11	1.66	9.99	9.0	8.33	7.0	3.12	2.0	26362
0.78	1.24	0.32	0.73	0.34	3.41	3.3	4.93	2.32	1.19	8.44	9.0	7.25	6.0	7.19	6.0	26361
0.72	1.02	0.33	0.76	0.49	3.32	3.3	6.22	1.92	1.11	9.25	10.0	8.14	6.0	[1] 6.63	6.0	26237
....	0.70	0.78	0.95	1.00	3.43	2.5	2.13	4.65	0.88	7.66	5.0	6.78	4.0	[2] 5.77	4.0	26557
0.16	0.60	0.46	0.63	0.33	2.18	1.7	3.71	2.36	1.16	7.23	7.0	6.07	5.0	6.55	6.0	26364
0.48	1.48	0.26	0.38	0.22	2.82	2.5	4.25	1.79	1.18	7.22	7.0	6.04	5.0	9.38	10.0	26720
1.98	0.50	0.00	1.01	0.61	4.10	4.0	5.94	2.12	0.61	8.67	...	8.06	7.0	7.28	7.0	26522
0.20	0.15	0.97	0.68	0.98	2.98	2.5	1.63	4.54	1.71	7.88	...	6.17	7.0	4.38	3.0	26523
1.02	0.12	0.98	0.72	0.81	3.65	3.5	4.14	4.51	0.79	9.44	...	8.65	7.5	6.34	6.0	26365
0.81	0.15	1.66	0.87	0.93	4.42	4.0	1.93	5.16	1.80	8.89	...	7.09	7.5	5.98	6.0	26721
0.50	0.20	2.43	1.01	0.67	4.81	4.1	1.32	5.58	1.93	8.83	8.0	6.90	8.0	[3] 8.76	7.5	26486
....	0.15	1.76	0.86	0.65	3.42	2.9	2.50	4.56	2.20	9.26	...	7.06	8.0	8.52	7.5	26487
1.01	0.02	0.48	0.90	0.50	2.91	2.9	7.36	2.63	0.77	10.76	...	9.99	9.0	[4] 5.47	4.5	26259
1.08	0.03	0.57	0.81	0.54	3.03	2.9	6.92	3.00	0.77	10.69	...	9.92	8.0	7.53	7.0	26582
0.70	0.01	0.28	0.46	0.30	1.75	1.7	5.67	3.53	1.41	10.61	...	9.20	8.0	5.91	5.0	26583
2.29	0.13	0.32	0.84	0.36	3.94	4.1	3.77	1.23	0.18	5.18	5.0	5.00	4.0	[5] 6.35	6.0	26726
....	1.15	0.91	0.84	0.32	3.22	3.3	4.68	2.19	0.38	7.25	7.0	6.87	6.0	9.52	10.0	26723
....	1.55	0.75	0.63	0.27	3.20	3.3	6.98	1.71	0.42	9.11	9.0	8.69	8.0	7.00	7.0	26722
....	2.30	0.89	0.57	0.25	4.01	4.1	6.19	1.55	0.18	7.92	8.0	7.74	7.0	5.95	6.0	26724
0.04	1.10	0.23	0.62	0.25	2.24	2.5	5.40	1.02	0.12	6.54	7.0	6.42	6.0	10.02	10.0	26412
....	1.98	0.64	0.65	0.33	3.60	3.7	6.51	1.41	0.40	8.32	8.0	7.92	7.0	10.26	10.0	26411
2.33	0.06	0.46	0.83	0.31	3.99	4.0	5.54	1.49	0.22	7.25	7.0	7.03	6.0	[6] 10.80	10.0	26725
....	0.94	0.78	0.41	0.27	2.40	2.5	5.83	2.52	0.82	9.17	9.0	8.35	8.0	4.00	4.0	26558

[1] 0.97% as muriate, 5.66% as sulphate.
[2] 0.70% as muriate, 5.07% as sulphate.
[3] 2.10% as muriate, 6.66% as sulphate.
[4] 0.80% as muriate, 4.67% as sulphate.
[5] 0.94% as muriate, 5.41% as sulphate.
[6] 1.00% as muriate, 9.80% as sulphate.

NITROGENOUS SUPERPHOSPHATES.

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.
	Sampled by Station Agent: **Swift's Lowell Fertilizer Co.** *(Continued).*				
26414	Swift's Lowell Bone Fertilizer	Rockville, Warehouse Point, Guilford	$30.25	$17.46	73.3
26410	Swift's Lowell Empress Brand	Southington, Guilford, Moosup	27.00	13.20	104.5
26413	Swift's Lowell Potato Manure	Rockville, Southington, Guilford	31.25	16.09	94.2
26288	Swift's Lowell Potato Phosphate	Suffield, New Britain	35.00	21.58	62.2
	Tanner & Wilcox, Winsted, Conn.				
26459	Reliable Potato and Garden Phosphate	Winsted	34.00	30.73	10.6
	Wells & Downs, Danielson, Conn.				
26415	Special Economical 6-8-5	Danielson, Brooklyn (3)	35.00	29.29	19.5
	The Wilcox Fertilizer Co., Mystic, Conn.				
26727	Complete Bone Superphosphate	Mystic, So. Meriden	36.00	20.26	77.7
26265	Fish and Potash	Suffield, Wallingford, Mystic	27.75	18.69	48.5
26729	4-8-10 Fertilizer	Mystic, Ellington	41.00	30.97	32.4
26493	Grass Fertilizer	Suffield, Mystic	38.25	27.58	38.7
26585	H. G. Fish and Potash	Mystic, Ellington	31.00	25.13	23.4
26728	H. G. Tobacco Special	Mystic, Ellington	38.00	27.64	37.5
26495	Potato Fertilizer	Suffield, So. Meriden, Andover	31.00	19.26	61.0
26494	Potato, Onion and Vegetable Phosphate	Wallingford, Norwich, Andover	35.50	27.42	29.5
26584	Special Superphosphate	Mystic, So. Meriden	30.00	14.81	102.6
	S. D. Woodruff & Sons, Orange, Conn.				
26260	Home Mixture	Orange	31.00	26.64	16.4
	Sampled by Purchasers and others:				
26628	Bowker's Complete Alkaline Tob. Grower with Carbonate	*W. Suffield:* S. Viets	....	29.29	....
26289	*Bowker's Tobacco Ash Elements	*W. Suffield:* S. Viets	32.50	24.19	....
26629	* " " " "	*W. Suffield:* S. Viets	....	22.45	....
26456	Buffalo High Grade Manure	*Branford:* A. E. Plant	....	21.42	....
26319	Coe-Mortimer's Peruvian Tobacco Fertilizer	*Poquonock:* J. A. Dubon	46.00	35.22	....

* See note on page 59.

ANALYSES AND VALUATIONS—*Continued.*

Nitrogen.							Phosphoric Acid.							Potash.		
In Nitrates.	In Ammonia.	Organic, water-soluble	Organic, active in soluble.	Organic, inactive insoluble.	Total. Found.	Total. Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total. Found.	Total. Guaranteed.	"Available." Found.	"Available." Guaranteed.	Found.	Guaranteed.	Station No.
....	0.09	0.95	0.40	0.24	1.68	1.6	6.84	1.76	1.37	9.97	9.0	8.60	8.0	3.16	3.0	26414
....	0.06	0.64	0.32	0.20	1.22	1.3	4.13	3.20	0.69	8.02	8.0	7.33	7.0	2.13	2.0	26410
....	0.31	0.58	0.43	0.28	1.60	1.6	5.05	2.28	0.54	7.87	8.0	7.33	7.0	3.94	4.0	26413
0.15	1.00	0.41	0.55	0.30	2.41	2.5	7.37	1.31	0.40	9.08	9.0	8.68	8.0	5.91	6.0	26288
1.10	0.06	0.68	1.16	0.66	3.66	3.3	3.72	5.17	3.49	12.38	9.3	8.89	8.0	9.56	9.0	26459
2.14	2.59	0.20	0.11		5.04	4.9	6.46	1.61	1.60	9.67	9.0	8.07	8.0	6.08	5.0	26415
1.22	0.13	0.23	0.47	0.37	2.42	2.1	1.56	6.03	4.36	11.95	9.0	7.59	8.0	4.34	3.0	26727
....	0.27	0.53	0.99	0.81	2.60	2.5	0.74	4.27	3.34	8.35	6.0	5.91	5.0	3.62	3.0	26265
1.87	0.10	0.17	0.85	0.58	3.57	3.3	5.35	3.42	1.50	10.27	9.0	8.77	8.0	[1] 11.14	10.0	26729
1.81	0.18	0.22	1.42	0.59	4.22	4.1	3.53	3.33	2.57	9.43	7.0	6.86	6.0	[2] 6.02	5.0	26493
0.09	0.25	0.73	1.54	1.04	3.65	3.3	4.17	2.12	0.95	7.24	7.0	6.29	6.0	5.85	5.0	26585
1.17	0.05	0.32	1.17	0.86	3.57	3.3	0.00	6.30	2.83	9.13	7.0	6.30	5.0	[3] 8.29	7.0	26728
0.97	0.11	0.28	0.61	0.29	2.26	2.1	1.63	4.74	3.02	9.39	7.0	6.37	6.0	5.44	4.5	26495
1.52	0.20	0.17	1.10	0.63	3.62	3.3	5.09	3.24	1.79	10.12	8.0	8.33	7.0	[4] 7.30	6.0	26494
0.20	0.14	0.22	0.47	0.31	1.34	1.0	1.50	6.39	2.87	10.76	9.0	7.89	8.0	2.48	2.0	26584
1.60	0.09	0.41	0.63	0.92	3.65	3.3	3.40	4.46	1.57	9.43	8.0	7.86	...	7.21	8.0	26260
1.00	0.00	0.38	1.53	0.89	3.80	4.1	1.15	5.63	1.66	8.44	5.0	6.78	4.0	[5] 6.50	5.0	26628
....	....	....	....	....	0.14	...	1.05	6.78	3.57	11.40	...	7.83	6.0	[6] 15.97	15.0	26289
....	....	....	....	....	0.12	...	0.96	7.11	1.37	9.44	...	8.07	6.0	[7] 14.98	15.0	26629
1.41	0.21	0.00	0.09	0.14	1.85	...	3.53	3.17	0.69	7.39	...	6.70	...	10.96	....	26456
1.81	0.90	0.34	1.25	0.88	5.18	5.0	1.98	5.17	0.65	7.80	7.0	7.15	6.0	[8] 10.61	10.0	26319

[1] 6.88% as muriate, 4.26% as sulphate.
[2] 3.99% as muriate, 2.03% as sulphate.
[3] 0.80% as muriate, 7.49% as sulphate.
[4] 5.78% as muriate, 1.52% as sulphate.
[5] 0.41% as muriate, 2.34% as sulphate, 3.75% as carbonate.
[6] 0.90% as muriate, 15.07% as sulphate.
[7] 0.74% as muriate, 14.24% as sulphate.
[8] 0.80% as muriate, 9.81% as sulphate.

Nitrogenous Superphosphates.

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.
	Sampled by Purchasers and others:				
26972	Conn. Valley Orchard Co., High Grade Fertilizer................	*Deep River:* C. V. O. Co.	$28.00	....	....
26458	Sanderson's Kelsey's Bone, Fish and Potash	*Branford:* A. E. Plant ...	....	$25.40	....
26457	Sanderson's Kelsey's Bone, Fish and Potash, 10% Potash	*Branford:* A. E. Plant ...	....	24.84	....
26512	Sanderson's Special Mixture, 4-8-8 .	*Milford:* F. H. Woodruff & Sons	....	25.11	....
26244	Manchester's Formula............	*Winsted:* E. Manchester & Sons	....	28.06	....
26245	Manchester's Special Formula	*Winsted:* E. Manchester & Sons	....	33.61	....
26159	Shay's Special	*Manchester:* C. R. Burr & Co.	....	36.85	....
26547	Wilcox's Browning's Formula......	*Storrs:* E. J. Browning ..	30.00	32.58	....
26246	Wilcox's Fielden's Formula No. 1..	*Groton:* H. Fielden	34.04	32.99	....
26247	Wilcox's Fielden's Formula No. 2..	*Groton:* H. Fielden	40.76	39.41	....
26317	Wilcox's Fielden's Formula No. 1.. Grain and Potatoes..............	*Groton:* H. Fielden	....	30.71	....
26318	Wilcox's Fielden's Formula No. 2, Grass.	*Groton:* H. Fielden	....	30.79	....

To obtain the Valuation of a Fertilizer, multiply the pounds per ton of nitrogen, etc., by the trade-value per pound. The several products give the values per ton of the several ingredients and their sum is the total valuation per ton.

Percentage Difference.

Percentage Difference shows the percentage excess of the cost price over the average retail cost, at freight centers, of the nitrogen, phosphoric acid and potash contained in the fertilizer; that is, the percentage amount of the cost of the raw materials which was added to it by charges for manufacture and sale.

ANALYSES AND VALUATIONS—*Continued.*

Nitrogen.							Phosphoric Acid.							Potash.		
					Total.					Total.		"Available."				
In Nitrates.	In Ammonia.	Organic, water-soluble.	Organic, active insoluble.	Organic, inactive insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Station No.
....	...	....	....	....	2.60	2.5	....	....	....	10.21	11.0	....	...	4.16	4.0	26972
0.08	0.69	0.81	1.17	0.88	3.63	...	2.49	4.27	0.93	7.69	....	6.76	...	[1]5.57	.....	26458
0.42	0.71	0.30	0.80	0.72	2.95	...	2.41	2.93	0.83	6.17	....	5.34	...	[2]10.54	.....	26457
0.83	0.97	0.90	0.32	0.21	3.23	3.3	0.00	6.14	3.63	9.77	8.0	6.14	...	8.55	8.0	26512
0.10	0.15	1.70	1.00	0.84	3.79	3.5	2.66	4.07	1.88	8.61	8.0	6.73	...	7.88	8.0	26244
1.04	0.18	1.83	1.07	0.95	5.07	5.0	3.17	4.13	1.05	8.35	8.0	7.30	...	[3]7.92	7.5	26245
1.75	0.18		4.31		6.24	...	0.12	4.97	0.67	5.76	...	5.09	...	10.67	....	26159
3.50	0.00		0.08		3.58	...	7.84	1.25	0.18	9.27	...	9.09	...	15.21	....	26547
2.89	0.08	0.14	1.90	0.85	5.86	...	0.00	2.63	0.43	3.06	...	2.63	...	[4]9.88	....	26246
2.74	0.07	0.33	1.82	1.12	6.08	...	0.21	2.93	0.63	3.77	...	3.14	...	17.13	....	26247
1.77	0.09	0.19	1.55	0.80	4.40	...	0.12	2.84	0.52	3.48	...	2.96	...	[5]12.17	....	26317
2.44	0.08	0.18	1.48	0.88	5.06	...	0.14	2.48	0.45	3.07	...	2.62	...	[6]10.43	....	26318

[1] 0.74% as muriate, 4.83% as sulphate.
[2] 9.57% as muriate, 0.97% as sulphate.
[3] 1.25% as muriate, 6.67% as sulphate.
[4] 1.55% as muriate, 8.33% as sulphate.
[5] 1.10% as muriate, 11.07% as sulphate.
[6] 1.10% as muriate, 9.33% as sulphate.

This information helps the purchaser to determine whether it is better economy to buy the commercial mixed fertilizers, of which so many are now offered for sale, or to purchase and mix for himself the raw materials. In some cases the prices quoted by dealers differ very widely, in extreme cases by $5.00 per ton. As the percentage difference varies with the price, any uncertainty or misstatement as to price makes a corresponding uncertainty and inaccuracy in the percentage difference.

The average cost per ton of two hundred and fifty-five nitrogenous superphosphates, of which the costs and valuations are given in the table, is $34.51, the average valuation $23.10.

The average composition and cost of nitrogenous superphosphates for the last four years have been as follows:

	Nitrogen.	Total Phosphoric Acid.	"Available" Phosphoric Acid.	Potash.	Cost per Ton.	Percentage Difference.
1908........	2.91	9.55	7.97	5.63	$34.13	38.5
1909........	2.93	9.52	8.09	5.78	33.96	52.1
1910........	2.98	9.28	7.83	5.88	34.36	46.9
1911........	2.95	8.86	7.60	6.01	34.51	49.4

A full statement of the average percentages of the different forms of nitrogen in the nitrogenous superphosphates in 1911 is, *Nitrogen*, as nitrates, 0.74; as ammonia, 0.73; water-soluble organic, 0.38; active-insoluble organic, 0.64; inactive organic, 0.46.

The above averages do not at all represent, of course, the average quality of the whole amount of commercial fertilizer used in the state. To get that result would require a knowledge of the tonnage of each brand which was sold. If 30,000 tons of a high-grade fertilizer were bought in this state and 10,000 tons of a low-grade, the average composition of the fertilizer used would be got, not by averaging the analyses of the two brands, but by multiplying the analysis of the high-grade brand by three before averaging.

2. Sampled by Purchasers and Others.

In the table pages 82 to 85 are given the analyses of seventeen samples drawn by others than the station agent. The station assumes the responsibility only for the accuracy of analysis of these samples, not for the accuracy of the sampling. The sender, however, provides a certificate, stating that the sample was drawn properly in substantial accordance with the station's directions.

HOME MIXTURES.

The following table contains analyses of thirteen samples of fertilizer mixtures sent by those who had prepared or used them. The formulas by which they were prepared are also given.

The analyses indicate more care in weighing and mixing than has been usual in previous years. **26485**, however, has more than twice as much potash as the formula should furnish.

Knowing the source of the organic nitrogen in these mixtures, the determination of its solubility shows the value of the conventional method used generally with mixtures. Eleven of the thirteen samples contained organic nitrogen, of which from 76.5 to 90.5 per cent. was soluble and active, satisfactory percentages for the high-grade materials used, tankage, bone or blood. In **26429** and **26428**, however, the solubility is only 45.9 and 46.3, respectively, entirely too low percentages for tankage. The tankage used in these mixtures, however, **26422**, as has already been shown on page 52, is distinctly inferior.

The home mixtures have an average composition of 3.59 nitrogen, 8.15 available phosphoric acid and 9.59 potash, the average cost is $29.15, and represents, in most cases, car lots, unmixed, delivered.

LIME IN VARIOUS FORMS.

1. *Limestone, Quick-lime and Slaked Lime.*

The following thirteen samples of lime were collected by the station agent, most of them in November, 1910, and show various grades of lime on sale at Connecticut and Massachusetts kilns.

25605. Fresh Burned Lime. New England Lime Co., Redding.

25593. Fresh Burned Lime, 1st Grade. The Stearns Lime Co., Danbury.

25594. Burned Lime, 2d Grade. The Stearns Lime Co., Danbury.

25595. Ground Lime Stone. The Stearns Lime Co., Danbury.

25604. Lime Hydrate. Connecticut Lime Co., Canaan.

25599. Air-slaked Lime. New England Lime Co., Canaan.

25602. Air-slaked Lime. New England Lime Co., East Canaan.

25597. Air-slaked Lime. New England Lime Co., New Milford.

25591. Air-slaked Lime. New England Lime Co., Redding.

25598. Air-slaked Lime. Connecticut Lime Co., Canaan.

25600. Air-slaked Lime, Wet. Canfield Lime Co., East Canaan.

26252. Lime. North Adams Lime Co., North Adams, Mass. Stock of John Merrill, Suffield.

26427. R. R. Land Lime. Rockland-Rockport Lime Co., Rockland, Me. Stock of James Price, Warehouse Point.

*Home Mixtures—Formulas.

Station No.	Made by or for	Formula. Nitrate of Soda.	Dried Blood.	Ground Bone.	Tankage.	Acid Phosphate.	Basic Slag.	Muriate of Potash.	Sulphate of Potash.	Double Manure Salt.	Kainit.
26484	W. T. Andrew, Tyler City	250	...	...	700	690	....	360	...	...	...
26366	E. J. Ayres, North Franklin, No. 1	200	...	...	500	1000	....	300	...	...	...
26367	E. J. Ayres, North Franklin, No. 2	200	...	...	667	958	....	175	...	...	...
26190	L. M. Benham, Highwood, Strawberry	...	...	...	600	600	....	600	...	...	...
26191	L. M. Benham, Highwood, Potato	150	...	668	435	400	....	400	...	...	...
26192	L. M. Benham, Highwood, Pea and Bean	132	...	...	768	800	....	300	...	...	...
26485	A. D. Clark, Orange	200	...	...	700	600	....	150	...	...	...
26389	H. E. Clark, Middlebury, Grass	400	300	900	...	....	....	...	400	...	...
26390	H. E. Clark, Middlebury, Corn	400	300	900	...	....	....	400	...	...	...
26391	H. E. Clark, Middlebury, Orchard	170	...	...	...	....	1400	...	430	...	...
26429	Conn. School for Boys, Meriden, Grass	500	...	...	500	400	....	250	...	...	350
26428	Conn. School for Boys, Meriden, Vegetable	100	...	...	750	750	....	200	...	200	...
26193	L. P. Kling, Highwood, Onions and Beets	100	...	...	600	900	....	400	...	...	...

	Fresh Burned Lime.			Ground Limestone.	Fresh Slaked Lime.	Air-Slaked Lime.
	25605	25593	25594	25595	25604	25599
Lime	59.35	93.28	64.58	47.31	47.54	38.92
Magnesia	37.50	1.95	4.89	4.20	31.92	25.95
Iron oxide	1.10	2.14	5.08	1.20	0.50	0.94
Carbonic acid	1.00	0.68	11.79	40.53	0.12	4.12
Insoluble in acid	0.89	1.95	10.46	6.76	4.22	0.84
Water	0.16	.....	3.20	.....	15.70	29.23
Cost per ton f.o.b. bulk car-lots	5.00	5.75†	4.50	3.50*	.....	4.00
Lime-magnesia costs in cents per 100 lbs.	26	30	32	34	.....	31

* Not sold in bulk. Price includes paper bags.

† Fine ground.

Home Mixtures—Analyses.

Station No.	Nitrogen. In Nitrates.	In Ammonia.	In organic, water-soluble.	In organic, active insoluble.	In organic, inactive insoluble.	Total.	Phosphoric Acid. Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.	Potash.	Cost per ton.
26484	1.95	0.05	0.65	0.99	0.34	3.98	3.99	6.32	1.00	11.31	9.41	$28.51¶
26366	1.75	0.08	0.77	0.54	0.27	3.41	6.60	3.50	0.90	11.00	7.92	27.70¶
26367	2.48	0.08	0.89	0.63	0.36	4.44	6.09	3.55	1.07	10.71	5.31	27.30¶
26190	.....	0.09	1.10	0.64	0.33	2.16	3.20	4.07	1.61	8.88	16.73	27.80§
26191	1.04	0.07	0.60	1.49	0.36	3.56	1.95	6.15	5.50	13.60	10.11	32.00§
26192	1.21	0.09	1.19	0.92	0.22	3.63	3.71	4.21	1.98	9.90	8.76	26.00§
26485	1.62	0.05	0.40	1.31	0.54	3.92	3.19	5.41	2.81	11.41	10.71	29.50¶
26389	3.01	0.19	0.72	0.78	0.32	5.02	0.11	8.22	4.78	13.11	10.65*	36.25‖
26390	2.40	0.16	0.80	0.90	0.27	4.53	0.11	8.05	3.11	11.27	13.31	35.70‖
26391	0.96	0.00	0.06	0.03		1.05	0.00	7.76	4.14	11.90	11.60†	26.25‖
26429	3.83	0.02	0.02	0.48	0.59	4.94	2.79	1.32	0.50	4.61	9.61	24.35§
26428	0.94	0.02	0.04	0.72	0.88	2.60	5.14	2.48	1.09	8.71	8.97‡	28.50§
26193	0.83	0.08	0.76	1.41	0.34	3.42	5.15	2.92	0.91	8.98	11.52	....

* 1.32% as muriate, 9.33% as sulphate. † 0.80% as muriate, 10.80% as sulphate.
‡ 7.88% as muriate, 1.09% as sulphate. ‖ Car lot mixed delivered.
§ Unmixed car lots delivered. ¶ Unmixed delivered.

Air-Slaked Lime.

	25602	25597	25591	25598	25600	26252	26427
Lime	49.90	45.11	43.68	45.49	30.03	59.10	61.38
Magnesia	35.52	30.47	29.26	30.52	19.27	0.56	1.54
Iron oxide	0.72	1.56	3.92	1.22	4.14	.....	.....
Carbonic acid	4.94	2.14	5.24	4.34	5.72	.....	.....
Insoluble in acid ..	1.31	1.41	1.97	0.57	1.01	.....	.....
Water	7.61	19.31	5.93	17.86	39.83	.....	.....
Cost per ton	$4.00	4.00	4.00	3.50	.....	5.25‡	9.50‡
Lime-magnesia costs in cents per 100 lbs.	23	26	28	23	.....	44	.....

‡ Retail delivered.

25600 is wet from exposure to the weather and in consequence it has a smaller amount of lime than the others.

A sample of ground limestone, sent by W. H. Plumb, Stevenson, **27235**, made by him from his own quarry, contained 51.90 per cent. of lime and 0.93 per cent. of magnesia, being a quite pure calcitic limestone.

The following nine samples were sent in by the purchasers and, with one exception, were designated simply as "Lime" or "Agricultural Lime":

26152, sold by Olds & Whipple, Hartford; sent by C. B. Sheldon, West Suffield. **26296**, sold by Bellefonte Lime Co.; sent by E. N. Austin, Suffield. **26625**, Farnam Lime Co., sold by Olds & Whipple; sent by J. B. Lewis, Southington. **26696**, sent by Saml. Orr, West Suffield. **26766**, sent by C. F. Curtiss, Plantsville. **25909**, R. R. Land Hydrated Lime, sold by Rockland-Rockport Lime Co., Rockland, Me.; sent by G. W. Thorpe, West Cheshire. **25910**, sold by West Stockbridge Lime Co., West Stockbridge, Mass.; sent by F. M. Peasley, Waterbury. **25911**, sold by Massachusetts Lime Co., Sheffield, Mass.; sent by W. H. Camp, Waterbury. **27010**, sold by Mr. Plumb, Stevenson; sent by N. W. Hendryx, New Haven.

	26152	26296	26625	26696	26766
Lime	72.02	65.76	67.68	63.26	42.52
Magnesia	.....	0.54	1.06	0.93	2.43
Insoluble in acid	.....	.....	.....	.....	.....
Loss on ignition	.....	24.98	.....	.....	.....
Cost per ton	$10.00	10.00	10.00	.....	10.00
Lime-magnesia costs cents per 100 lbs.	69	76	73	.....	1.13

	25909	25910	25911	27010
Lime	62.98	56.46	54.56	50.96
Magnesia	1.80	5.44	3.06	0.40
Insoluble in acid	1.34	3.29	10.99	7.90
Loss on ignition	.....	.....	.....	40.34*
Cost per ton	$9.50	1.50	5.00†	.....
Lime-magnesia costs cents per 100 lbs.	73	.....	43	.....

* Much carbonic acid present.

† In bags.

2. *Lime Kiln Ashes.*

Seven samples were analyzed, four taken by the station agent and three sent in by purchasers.

25592. New England Lime Co., Redding.

25596. New England Lime Co., New Milford.

25601. Canfield Lime Co., East Canaan. Out of doors.

25603. New England Lime Co., East Canaan. Out of doors.

26473. Sold by Buffalo Fertilizer Co.; sent by Somerville Mfg. Co., Somerville.

26531. Massachusetts Lime Co., Sheffield, Mass.; sent by Warner-Miller Co., New Haven.

26975. Sold by W. L. Mitchell, New Haven; sent by W. P. Lockwood, Georgetown.

	25592	25596	25601	25603	26473	26531	26975
Potash	3.39	4.07	3.11	1.56	0.34	1.52	0.12
Phosphoric acid	1.87	1.70	1.85	1.37	0.24	0.64	0.09
Lime	49.09	44.76	41.15	45.09	44.00	51.60	32.10
Magnesia	12.98	10.40	13.77	15.04	0.55	2.36	0.65
Iron oxide	5.60	4.76	5.40	4.50	.....	.....	.....
Carbonic acid	26.15	32.43	29.25	31.88	.....	.....	.....
Insoluble in acid	2.23	4.76	7.30	1.82	.....	6.12	36.13
Water	.....	.....	.....	.....	.....	.....	3.02
Cost per ton car-lots at kilns	$7.50	7.50	.....	4.50	5.00	5.50	5.00*
Lime-magnesia costs cents per 100 lbs.	28	27	.....	19	51	35	74

26975 is inferior in quality, having a relatively low per cent. of lime and a high percentage of insoluble ballast. The cost of lime-magnesia in these ashes is calculated by allowing 4¼ cents per pound for water-soluble potash and 3 cents for phosphoric acid.

These twenty-nine analyses show a rather wide range of composition and of price. It is safer to buy quick-lime or slaked lime from the kilns than to pick up "bargains" in "waste lime," which is likely to have a good deal of foreign matter, sand and silicates in it.

The calculations of cost are based on "lime-magnesia"; that is, both are counted together, assuming that for a first heavy liming of soils, at least, magnesia is not inferior in effect to lime.

* Delivered.

In general, it appears that in bulk, f.o.b., at the kilns, the lime-magnesia of stone lime or "quick-lime" costs about 28 cents per 100 pounds; of air-slaked lime, 29½ cents; of ground limestone, 34 cents; and of lime-kiln ashes, 32 cents.

At retail, delivered, it costs more than twice as much. The freight rates from Connecticut kilns to the center of the state are about $1.40 per ton in twenty-five-ton car-lots, or $1.80 in five-ton lots. That is, in car-lots of lime, with 95 per cent. of lime-magnesia, the freight adds 7.4 cents to the cost of 100 pounds of lime-magnesia; on 75 per cent. goods, it adds 9.3 cents, and on 50 per cent. goods, 14 cents.

MARL.

This is a soft, fine carbonate of lime, well adapted for agricultural use near the place of production. Since only about half of the material is lime, freight charges often make the cost of actual lime delivered too high for economical use.

25642, sent by H. F. Pillsbury & Son, Barton, Vt.

26100, Shell Marl, sold by Vermont Marl Co.; sent by Geo. T. Howland, Norwich.

	25642	26100
Lime	51.27	49.50
Equal to carbonate of lime	91.47	88.31
Insoluble in acid	3.88	7.02

COTTON HULL AND COTTON BOLL ASHES.

This valuable tobacco fertilizer has almost disappeared from our markets. Only six samples were examined this year.

26292, sent by F. B. Hatheway, Suffield; **26508,** sent by H. A. Henshaw, Suffield; **26624,** sent by Olds & Whipple; all sold by Olds & Whipple, Hartford.

26994, "Gin and Memp," and **26995,** "HAN," both sent by Spencer Bros., Suffield.

27021, sent by W. M. Hinson, Hazardville.

	26292	26508	26624	26994	26995	27021
Water-soluble potash	21.94	22.05	22.22	15.98	14.32	20.66
Potash guaranty	23.00	23.00	23.00	18.57	14.41	.....
Cost per ton	$45.00	45.00	46.00	*	*	.....
Potash costs cents per pound	8.79	8.74	8.90	11.2	11.2	.....

* Cost $2.25 per unit of water-soluble potash.

In calculating the cost of the potash per pound an allowance of $6.43 is made for the phosphoric acid contained in the ashes.

None of the samples reached the potash guaranty, the shortage ranging from 0.09 to 2.59 per cent.

WOOD ASHES.

25203. Canada Wood Ashes, sent by Hitchcock Hardware Co., Watertown.

25991. "B." Wood Ashes, sold by J. E. Perkins, Suffield; sent by Bissell Graves Co., Suffield.

26058. Wood Ashes from Stafford Mills, sent by H. M. Gager, Somers. Costs 25 cents per bushel of 60 pounds at mills.

26291. Canada Wood Ashes, sold by John Joynt, Lucknow, Canada, claimed to contain 6 per cent. of potash; sent by F. S. Bidwell & Co., Windsor Locks.

26297. Beaver Brand Unleached Hard Wood Ashes, sold by Chas. Stevens, Napanee, Canada, claimed to contain 4 per cent. of potash; sent by G. N. Skinner, Rockville.

26509. Canada Ashes, sold by Bowker Fertilizer Co., New York, and claimed to contain 3 per cent. of potash; sampled from stock of Lightbourn & Pond Co., New Haven.

26968. Ashes, sold by Magnus, Mebee & Reynard, New York; sent by Connecticut Valley Orchard Co., Deep River.

26990. Unleached Wood Ashes from birch mill; sent by Theo. A. Stanley, New Britain.

27017. Pure Unleached Canada Hardwood Ashes, sent by F. W. Judson, Waterbury.

Two out of the five lots of "pure unleached Canada ashes" contain less than 1 per cent. of water-soluble potash. Two others have less than 3 per cent. and one only, **26291**, has over 4 per cent. of water-soluble potash.

The sample **26058**, from mills in this state, for which no claim is made that it is "pure" or "hard wood" or "Canadian," ranks with the best of the imported articles and is cheaper than any.

The prices quoted range from $12 to $18 a ton: too high, in our opinion, to permit of their economical use. Lime, for which they are chiefly valuable, can be bought more cheaply in other forms.

Analyses of Wood Ashes.

	25203	25991	26058	26291	26297	26509	26968	26990	27017
Total potash	....	....	....	5.10	....	....	....	....	1.51
Water-soluble potash	0.91	3.19	3.88	4.11	2.22	2.93	2.55	3.62	0.81
Phosphoric acid	1.64	2.37	2.05	1.73	0.83	3.06	2.03	5.76	1.74
Lime	32.88	29.39	36.72	21.17	23.65	23.32	28.94	45.34	43.19
Magnesia	2.75	3.04	....	2.29	1.45	1.86	2.58	....	....
Insoluble in acid	9.13	....	....	....	....	....	14.98	....	13.35
Moisture	13.38	21.50	16.65	....	...	....	19.63	....	....
Cost per ton	....	$11.00	8.33†	15.00	12.00	18.00	12.00	....	....

† At the mill.

26990 is ashes from birch twigs. The mineral matter of young twigs is specially rich in phosphates, which explains the high per cent. of phosphoric acid found.

TOBACCO ASHES.

25915. Ashes from broad leaf tobacco, burned while in the bundle ready for delivery to packer; sent by G. A. Cleaveland, Windsor Locks.

26290. Sent by C. A. Prout, Suffield.

	25915	26290
Potash	18.54	20.23
Phosphoric acid	1.60	2.24
Lime	18.12	20.70
Magnesia	.....	6.55

SHEEP MANURE.

26232. Pulverized Sheep Manure, sold by Natural Guano Co., Aurora, Ill.; sampled from stock of D. B. Wilson Co., Waterbury. *Guaranty*, 2.25 nitrogen, 1.50 available phosphoric acid and 1.50 potash.

26236. Wizard Brand Manure, sold by Pulverized Manure Co., Chicago, through Frank S. Platt Co., New Haven; sampled from stock of Lightbourn & Pond Co., New Haven. *Guaranty*, 1.8 nitrogen, 1.0 phosphoric acid and 1.0 potash.

26709. Sheepino Natural Guano, sold by Niantic Menhaden Oil and Guano Co., South Lyme; sampled from stock of J. P. Barstow & Co., Norwich. *Guaranty*, 1.50 nitrogen, 1.0 phosphoric acid and 4.0 potash.

	26232	26236	26709
Nitrogen in nitrates	0.00	0.00	0.43
" in ammonia	0.06	0.42	0.05
" organic, water-soluble	0.34	0.33	0.16
" " active insoluble	0.57	0.48	0.21
" " inactive insoluble	1.45	1.15	0.59
Total nitrogen	2.42	2.38	1.44
Water-soluble phosphoric acid	0.53	0.80	0.23
Citrate-soluble " "	0.43	0.23	0.64
Citrate-insoluble " "	0.28	0.13	0.10
Total phosphoric acid	1.24	1.16	0.97
Potash calculated as muriate	0.80	0.90	2.30
" " " sulphate	1.47	0.78	1.94
Total potash	2.27	1.68	4.24
Cost per ton	$25.00	30.00	38.00

The analyses show that this material contains moderate amounts of nitrogen, phosphoric acid and potash, which could be bought in forms of fertilizer chemicals for about $11 to $12 per ton.

The solubility of the organic nitrogen is very low, ranging from 38.5 to 41.3. The same is true of the nitrogen of other forms of manure. It must be remembered, however, that 60 per cent. of sheep manure consists of fine, easily decomposable animal and vegetable matter, which forms humus in the soil and has great value in feeding the soil bacteria and in regulating the water content of the soil, and that the chief value of all manure, at least on light soils naturally poor in humus, usually rests in this humus-bearing and humus-yielding material. The sheep manure contains, ton for ton, two or three times as much of it as stable manure.

TOBACCO STEMS.

26293. Sold by R. M. Goodrich; sent by W. H. Olcott, South Manchester.

26996. Cut Stems, sent by H. K. Brainard, Thompsonville. **26997,** long stems, sent also by Mr. Brainard.

	26293	26996	26997
Nitrogen in nitrates	0.30	.....	.....
" " ammonia	0.27	.....	.....
" organic	1.63	.....	.....
Total nitrogen	2.20	2.37	2.48
Phosphoric acid	0.41	0.42	0.41
Potash	3.29	6.00	5.32
Cost per ton	$12.00	12.00	12.00

MUCK.

25640, taken from surface of a swamp formerly covered by a pond; **25641,** taken from eighteen inches below surface of swamp; both sent by Olaf Swanson, Naugatuck.

25958, sent by W. Harrington, Greenwich.

26138, from a New Jersey bog, sent by B. T. Fairchild, Greenwich.

26983, sent by G. A. Drew, Greenwich.

27000, sent by C. M. Jarvis, Berlin.

27011, surface samples; **27012,** taken from three feet below surface; both sent by F. DeWitt Wells, Greenwich.

	25640	25641	25958	26138	26983	27000	27011	27012
Water	65.33	80.06	62.04	57.21	74.40	79.81	11.40	62.96
Organic matter	25.24	12.82	29.41	33.02	6.17	16.03	26.94	29.39
Mineral matter	9.43	7.12	8.55	9.77	19.43	4.16	61.66	7.65
Nitrogen	0.90	0.38	0.82	1.36	0.22	0.45	1.09	0.81

Calculated Water-free.

Organic matter	72.82	64.36	77.34	77.17	24.09	79.38	30.41	79.35
Mineral matter	27.18	35.64	22.66	22.83	75.91	20.62	69.59	20.65
Nitrogen	2.60	1.89	2.16	3.18	0.87	2.22	1.23	2.19

The four samples tested showed organic nitrogen solubilities of 23.2, 26.9, 30.6 and 50.0 per cent.

Inquiry was usually made by those who sent the samples as to the fertilizer value of muck or peat. The percentages of potash and phosphoric acid are very small. The nitrogen in muck,—which is essentially vegetable matter, which has slowly decayed in the absence of much air,—is that which has resisted the general decay or has changed into forms which are resistant. Naturally it will become only slowly available to crops. The chief value of muck lies in its vegetable matter or humus. This is a very effective absorbent when fairly dry, and can be used in stables to absorb urine and dung liquor and as a deodorizer.

Connecticut experience has also shown that when peat is composted with its own bulk of stable manure, the mixture is as valuable as the same bulk of manure.

The nature of these mucks is best learned from the water-free analyses. The mineral matter is chiefly sand and soil. Samples **26983** and **27011** contain more of this than of peat, and in so far are less valuable. On the other hand, peats which in water-free condition consist chiefly of vegetable matter, hold water very tenaciously, and dry out very slowly after digging, so that they are expensive to handle. It is quite possible that the peats which contain a good deal of soil may dry out so much more rapidly than the others as to make it more profitable to handle them.

SHODDY AND HAIR WASTES.

26077. Shoddy Waste, sent by G. W. Hughes, Rockville.

26586, Park's Fertilizer; **26587**, Pouncing or Shaving Dust; **26588**, Hare's Hair; **26589**, Coney Hair; and **26590**, Sweepings. These are all hat factory wastes from Danbury.

These samples were only analyzed with respect to their nitrogen content.

	26077	26586	26587	26588	26589	26590
Nitrogen in ammonia	0.01	0.00	0.00	0.11	0.17	0.10
" organic, water-soluble	0.11	0.77	0.50	0.42	0.00	0.19
" " active insoluble	5.83	8.83	10.11	10.00	8.43	8.45
" " inactive insoluble	2.75	2.48	3.59	3.55	2.63	2.86
Total nitrogen	8.70	12.08	14.20	14.08	11.23	11.60
Percentage solubility of organic nitrogen	68.3	79.5	74.7	74.6	76.2	75.1

MISCELLANEOUS FERTILIZERS.

26024. *Totty's Carnation Fertilizer,* sent by A. A. Young, Jewett City. Price, $3.00 per ten pounds. It contained 8.73 per cent. nitrogen, 6.52 per cent. phosphoric acid and 21.24 per cent. potash.

27002. *Liquid Manure,* sent by William Bunker, Ridgefield. It had a specific gravity of 1.002 and contained 0.03 per cent. nitrogen and 0.18 per cent. ash; its fertilizing value is extremely slight.

27254. *Liquid Manure,* being the drainage from barnyard manure. Collected from a vault beneath the manure pile. Sent by A. A. Young, Jewett City. It has a specific gravity of 1.0073 and contains: nitrogen as ammonia 0.057 per cent., nitrogen organic 0.23 per cent., phosphoric acid 0.019, and potash 0.39 per cent.

26764. *Gluten Meal,* made by Corn Products Refining Co., New York, sent by H. C. Humphrey. It contained 7.05 per cent. nitrogen.

26186 and **26187.** *Phosphatic Material,* sent by R. S. Woodruff, New Haven. The former contained 0.23 per cent. citrate-soluble, 3.25 per cent. citrate-insoluble and 3.48 per cent. total phosphoric acid; the latter contained 1.20 per cent. citrate-soluble, 8.55 per cent. citrate-insoluble and 9.75 per cent. total phosphoric acid.

25630. *Elm Tree Food,* made by Frost, Boston; sent by H. L. Wells, New Haven. It contained 2.62 per cent. nitrogen, 11.42 per cent. phosphoric acid, 5.40 per cent. potash and 23.67 per cent. lime.

25212. *Shay's Chrysanthemum Fertilizer,* sold by C. M. Shay, Groton; sent by T. W. Head, Groton. Only the nitrogenous constituents were determined; it contained 0.42 per cent. as nitrates, 0.08 per cent. as ammonia, 2.87 per cent. as organic, and 3.37 per cent. total nitrogen. Its reaction was strongly alkaline.

25955. *Ash Base,* made by burning unleached manure from stock yards and livery stables; sent by American Reduction and Fertilizer Company, Kansas City. It contained 3.07 per cent. phosphoric acid and 3.74 per cent. potash.

THE COST OF NITROGEN, PHOSPHORIC ACID AND POTASH IN RAW MATERIALS.

Nitrogen. The analyses show that in 1911 the average retail cash cost of nitrogen and also the observed range of cost was:

	Average.	Range.
In nitrate of soda about	16.4	15.5–17.4
" cotton seed meal	20.4	17.3–24.6
" castor pomace	22.4	21.5–24.3
" tankage, approximately	19.4	....
" bone meal, approximately	22.7	....
" fish, approximately	22.5	....

The calculation of the cost of nitrogen is less certain in tankage, bone meal and fish, because tankage and fish may contain as much phosphoric acid as nitrogen, and bone seven or eight times as much. Therefore, to calculate cost of nitrogen we have to assume a somewhat arbitrary figure, four cents, for the cost of a pound of phosphoric acid.

It appears that the nitrogen of nitrate of soda has been much cheaper than that of any other quickly available form in our market. Such being the case, it should find wider use for potatoes and for top dressing winter grain or meadows, in short, whereever it can be immediately taken up by a growing crop and where the ground is too cold to permit rapid decay and nitrification of organic matter. On lands which are not at all acid its abundant use on potatoes may increase the prevalence of scab because the removal of the nitrogen by the crop leaves an alkaline base in the soil. Nitrogen in sulphate of ammonia, when its price is nearly the same as that of nitrate-nitrogen, may be found a desirable substitute on potato land.

The writers doubt whether, in spite of the lower cost, it is wise to largely substitute nitrate for organic forms of nitrogen on summer crops. The success of the venture will depend a great deal on weather conditions. With normal rainfall, sunshine and temperature, we should expect the nitrogen of nitrate to be as effective and probably more effective pound for pound than organic nitrogen. On our light soils, heavy or continued rainfalls cause a very much greater loss of nitrate-nitrogen by leaching than of organic nitrogen or sink the nitrate for a time out of reach of the crop roots.

Phosphoric Acid. "Available" phosphoric acid at retail has cost:

	Average.	Range.
In basic slag meal (15.5 per cent. available)	5.8	5.1–6.3
" precipitated bone phosphate	5.0	....
" acid phosphate	5.3	4.6–6.6

Basic slag meal is alkaline, containing 35 to 50 per cent. of lime, and the most expensive source of available phosphoric acid. The phosphoric acid of basic slag is probably not quite as quick in its action but more lasting in its effects than that of acid phosphate. There are several grades of this meal on the market. The highest grade, 16-18 per cent., is the only one which our farmers can afford to use.

Potash. Water-soluble potash, at retail, has cost as follows:

	Average.	Range.
In carbonate	7.0	....
" "vegetable potash"	8.4	....
" high-grade sulphate	5.2	4.9–5.5
" double manure salt	5.6	....
" muriate	4.37	4.1–4.7
" kainit	5.63	4.6–6.2

The carbonate, "vegetable potash" and sulphates are chiefly used as tobacco fertilizers. The cheaper muriate answers well for most other crops. We have never noticed any ill-effects when it is made part of a potato formula.

The above prices are retail in small lots and not in all cases strictly cash. When bought in mixed car-lots for cash great saving can be effected. Thus acid phosphate, which sold at retail from $13.00 to $18.00 per ton, was bought by farmers in mixed car-lots as low as $16.75. Muriate of potash cost on the average about $44.40, but in mixed car-lots was bought as low as $37.50 per ton. The same holds true for mixed fertilizers, and like reductions on their price are made to buyers of car-lots or mixed car-lots for cash in thirty days.

PART II.

SIXTEENTH REPORT ON FOOD PRODUCTS AND FOURTH REPORT ON DRUG PRODUCTS, 1911.

By JOHN PHILLIPS STREET.*

This station is required by law to make examinations of food and drug products, to publish its findings, and to report to the dairy commissioner all cases of adulteration or misbranding which are discovered. Under this law a large number of samples have been bought in various parts of the state and carefully examined, and all cases of adulteration or misbranding reported to the dairy commissioner. The station has no power of prosecution, its duty being to determine the facts and supply expert testimony in case of prosecution.

Seven hundred and twenty-two samples, collected by the station agent, have been analyzed. Of these, 362 were not found adulterated, 232 were adulterated, below standard or misbranded, and fifty-seven were legally labeled compounds. One hundred and sixty-two samples in all were reported to the dairy commissioner, and in forty instances second samples of these brands were bought by him of the same dealers and sent to the station for analysis. Of these, ten were not found adulterated and thirty were adulterated or misbranded. The dairy commissioner and his deputy have also sent a number of samples, chiefly milk, vinegar, butter and soda water syrups, which were taken by them. These will be briefly discussed, leaving the full details and the results of prosecution to be given in the commissioner's report. Of these 514 samples, 182 were not found adulterated, and 311 adulterated, misbranded, or below standard. To summarize: Of 554 samples taken by the commissioner under the law, 341 were found to be either adulterated, misbranded or below standard. The station has been called on for court testimony in nine instances.

In addition to the above, a number of samples of food and dry products have been examined for individuals; these will likewise receive brief mention.

* The analytical work herein reported was done jointly with Messrs. Bailey, Morrison, Roe and Shepard.

I. FOOD PRODUCTS.

CHOCOLATE.

The standards for chocolate are as follows:

"*Chocolate, plain chocolate, bitter chocolate, chocolate liquor, bitter chocolate coatings,* is the solid or plastic mass obtained by grinding cocoa nibs without the removal of fat or other constituents except the germ, and contains not more than three (3) per cent. of ash insoluble in water, three and fifty-hundredths (3.50) per cent. of crude fibre, and nine (9) per cent. of starch, and not less than forty-five (45) per cent. of cocoa fat."

"*Sweet chocolate, sweet chocolate coatings,* is chocolate mixed with sugar (sucrose), with or without the addition of cocoa butter, spices, or other flavoring materials, and contains in the sugar- and fat-free residue no higher percentage of either ash, fibre, or starch than is found in the sugar- and fat-free residue of chocolate."

Crude fibre and starch were not determined because the other chemical data established the substantial purity of these samples. Both the solubility and alkalinity of the ash, however, were

TABLE I.—PLAIN CHOCOLATE NOT FOUND ADULTERATED.

Station No.	Brand.	Serial No.	Price per package, cents.	Weight claimed, grams.	Weight found, grams.
25769	Crimson Brand, Premium Plain Chocolate. Packed for S. S. Adams, New Haven	2811	15	...	224
25674	Chocolate Premium No. 1. W. H. Baker, Winchester, Va.	....	22	227	227
25662	Premium Plain Chocolate. Brewster Cocoa Mfg. Co., Jersey City, N. J.	....	15	...	225
25458	"East India" Brand Chocolate, Premium No. 1. Prep. expressly for East India Tea Co.	....	20	...	227
25460	Howco Plain Chocolate. Mfd. for Howland's, Bridgeport	2811	20	...	220
25842	Baking and Cooking Chocolate. Huyler's, New York	2598	20	...	232
25661	Lowney's Premium Chocolate.	1761	20	227	226
25647	Premium Chocolate (without Sugar). Henry Maillard, New York	....	18	...	240
25459	Mohican Plain Chocolate Premium. Mfd. for The Mohican Co., New York	2811	15	...	227
25701	Premium Baking Chocolate. Runkel Bros., New York	5	5	113	117

TABLE II.—ANALYSES OF PLAIN CHOCOLATE.

Station No.	Brand.	In Air-dry Material. Ash. Total.	Ash. Soluble in water.	Ash. Insoluble in acid (sand).	Alkalinity of Ash. 1 gram of Chocolate.	Alkalinity of Ash. 1 gram of Ash.	Fat.	Nitrogen.	Soluble in Water. Cold.	Soluble in Water. At 65° C.	Soluble in Water. At 100° C.	Organic Matter Soluble in Cold Water.	Relative Sedimentation.	In Fat-free Material. Total Ash.	Nitrogen.	Soluble in Cold Water.	Per Cent. of Total Ash Soluble in Water.	Constants of Fat. Iodide No. (Hanus).	Refractive Index at 40° C.
25769	Crimson.........	3.64	1.48	0.09	3.95	109	47.05	2.29	13.52	14.86	17.64	12.04	57	6.87	4.34	25.53	41	35.44	1.4567
25674	W. H. Baker's....	2.91	1.11	0.03	3.29	113	51.20	2.09	12.68	14.70	16.18	11.57	48	5.96	4.28	25.98	38	36.66	1.4569
25662	Brewster	3.76	1.66	0.10	4.19	111	47.90	2.29	14.00	15.68	17.56	12.34	48	7.22	4.40	26.87	44	34.95	1.4572
25458	East India.......	3.65	1.60	0.12	4.38	120	49.66	2.46	11.76	12.48	15.22	10.16	60	7.25	4.89	23.36	44	34.19	1.4569
25460	Howco	3.58	1.60	0.05	4.27	119	47.03	2.28	13.36	15.02	16.98	11.76	58	6.76	4.30	25.22	45	36.99	1.4567
25842	Huyler's.........	3.39	1.41	0.18	4.10	120	49.74	2.35	13.12	14.20	15.92	11.71	50	6.74	4.68	26.10	42	35.64	1.4567
25661	Lowney's........	3.21	1.24	0.21	3.63	113	51.04	2.31	11.02	12.74	14.80	9.78	46	6.56	4.72	22.51	39	34.15	1.4571
25647	Maillard's	2.94	1.18	0.05	3.58	122	52.35	2.24	11.04	13.26	14.38	9.86	45	6.17	4.70	23.17	40	35.22	1.4563
25459	Mohican.........	3.69	1.61	0.08	4.42	120	49.13	2.34	12.90	13.98	16.70	11.29	58	7.25	4.60	25.36	44	34.25	1.4572
25701	Runkel's.........	3.26	1.34	0.07	3.78	116	50.46	2.29	11.94	13.46	15.70	10.60	51	6.58	4.62	24.10	41	35.72	1.4569
	Average ...	*3.40*	*1.42*	*0.10*	*3.96*	*116*	*49.56*	*2.29*	*12.53*	*14.04*	*16.11*	*11.11*	*52*	*6.74*	*4.55*	*24.82*	*42*	*35.32*	*1.4569*

determined and certain constants of the fat; the solubility of the chocolate in water at different temperatures was studied, as well as its rate of sedimentation.

Thirty-four samples were analyzed, ten of plain chocolate, fourteen of sweet chocolate, and ten of milk chocolate.

Plain Chocolate.

The ten samples were remarkably uniform in composition. The highest percentage of ash insoluble in water was 2.16, well below the maximum permitted by the standard. The amount of sand found was small in all cases, ranging from 0.03 to 0.21 per cent. The alkalinity of the ash likewise showed no striking variations. The fat ranged from 47.03 to 52.35, with an average of 49.56 per cent. The iodine number and refractive index of the fat in every case fell well within the established limits for cocoa fat. The nitrogen also showed but slight variations.

The solubility tests showed the relative insolubility of chocolate, even in boiling water. The average solubility in water, at room temperature, was 12.53 per cent., at 65° C., 14.04 per cent., and at 100° C., 16.11 per cent. The relative sedimentation (see methods below) ranged from 48 to 60.

In the fat-free material the variation in ash, nitrogen and water-solubility were within quite narrow limits. The weight of the package was given on the label in only three cases, and was in each case correct.

Sweet Chocolate.

Fourteen samples were analyzed, and wider variations in composition were found, chiefly due to the varying quantities of sugar added. The ash ranged from 0.94 to 2.18 per cent., and the ash insoluble in water from 0.33 to 1.30 per cent., from 40 to 72 per cent. of the ash being soluble in water. The alkalinity of the ash ranged from 1.10 to 2.22 per gram of chocolate, or from 102 to 123 per gram of ash.

The greatest variations were found in the fat and the sugar. The fat ranged from 11.22 to 41.19 per cent., although in twelve samples it lay between 20 and 32 per cent. The sugar, as would be expected, varied almost inversely with the fat. The extremes were 34.45 and 63.05 per cent.

TABLE III.—COMPOUND CHOCOLATE.

Station No.	Brand.	Serial No.	Price per package, cts.	Weight claimed, grams.	Weight found, grams.
	Sweet Chocolate.				
25722	Anco Sweet Chocolate. Austin, Nichols & Co., New York, Distributors	188	5	...	85
25754	Sweet Chocolate Cinquième. Walter Baker & Co., Ltd., Dorchester, Mass	90	5	91	91
25835	German's Sweet Chocolate. Walter Baker & Co., Ltd., Dorchester, Mass	90	5	57	55
25691	"Dot" Sweet Chocolate. Walter Baker & Co., Ltd., Dorchester, Mass	90	25	227	243
25768	Grand Union Sweet Vanilla Chocolate. Dist. by Grand Union Tea Co., Brooklyn, N. Y	....	5	...	49
25461	Howco Sweet Chocolate. Howland's, Bridgeport	....	5	91	97
25840	Vanilla Sweet Chocolate. Huyler's, New York	2598	15	113	108
25681	Barker's Hasty Lunch Chocolate, Sweetened. Knickerbocker Chocolate Co., N. Y	2121	17	...	234
25710	Lowney's Vanilla Sweet Chocolate	1761	5	...	51
25843	Chocolat-Menier Santé Fine Vanilla Quality. Menier	2676	15	113	115
25697	Sweet Chocolate. The Mohican Co	....	6	113	116
25663	Vienna Sweet Chocolate. Runkel Bros., New York	5	5	113	113
25762	Instantaneous Chocolate. Stephen F. Whitman & Son, Philadelphia	2293	40	...	239
25709	Super Extra XXX Vanilla Chocolate. Stephen F. Whitman & Son, Philadelphia	2293	10	...	110
	Milk Chocolate.				
25741	F. L. Cailler's Genuine Swiss Milk Chocolate*	....	15	...	95
25688	Milk Chocolate. Hershey Chocolate Co., Hershey, Pa	5262	10	...	82
25654	Jersey Milk Chocolate. Hooton Cocoa and Chocolate Co., Newark, N. J. †	151	5	...	42
25841	New Process Milk Chocolate. Huyler's, New York	2598	10	...	52
25844	Nestlé's Swiss Milk Chocolate	....	10	...	84
25703	Gala Peter Peter's Milk Chocolatè. Peter & Kohler's Swiss Chocolate Co., Fulton, N. Y.	....	10	...	69
25721	Pulver Milk Chocolate‡	....	5	...	60
25702	Stollwerck Gold Brand Milk Chocolate. Stollwerck, Cologne, New York, etc	3447	15	...	106
25695	Suchard Milka Chocolate au Lait Concentré. Neuchatel, Switz	....	10	...	65
25847	American Milk Chocolate. H. O. Wilbur & Sons, Philadelphia	2208	10	...	...

*Consists solely of the best unskimmed and sterilized Swiss milk, cocoa and sugar.

†Made from genuine Jersey milk, cane sugar, pure cocoa of superior quality.

‡ Consists solely of best cocoa nibs, sugar and sterilized milk.

Owing to the presence of from 34 to 63 per cent. of sugar, which of course is soluble in water even at room temperature, the solubility of the sweet chocolates at the different temperatures is nearly the same. The average solubility at room temperature was 62.10, at 65° C., 62.32, and at 100° C., 63.45 per cent. The solubility of the organic matter other than sugar at room temperature ranged from 3.59 to 8.17, with an average of 4.56 per cent., indicating that on the average about forty per cent. of the sweet chocolate consisted of cocoa mass.

On the sugar-free basis the fat ranged from 53.72 to 66.63, excepting **25681**, which contained only 25.23 per cent. With this exception, there was no evidence that any fat had been

TABLE IV.

Station No.	Brand.	In Air-dry Material.								
		Ash.			Alkalinity of Ash.					
		Total.	Soluble in water.	Insoluble in acid (sand).	1 gm. of Chocolate.	1 gm. of Ash.	Fat.	Nitrogen.	Sucrose.	Lactose.
	Sweet.									
25722	Anco	1.22	0.60	0.03	1.53	125	24.37	0.88	58.31	0
25754	Baker's	1.34	0.69	0.02	1.55	116	27.90	0.90	55.09	0
25835	German's	1.12	0.60	0.04	1.32	118	28.05	0.81	55.67	0
25691	Dot	1.68	0.78	0.04	2.06	123	41.19	1.21	34.55	0
25768	Grand Union	0.96	0.54	0.04	1.10	115	25.10	0.64	62.33	0
25461	Howco	1.17	0.75	0.05	1.38	118	25.13	0.70	59.55	0
25840	Huyler's	1.13	0.56	0.05	1.38	122	23.35	0.73	63.05	0
25681	Barker's	2.18	0.88	0.03	2.22	102	11.22	1.61	55.53	0
25710	Lowney's	0.99	0.71	0.05	1.15	116	26.60	0.67	59.28	0
25843	Menier	1.58	0.79	0.05	1.75	111	21.90	0.98	59.39	0
25697	Mohican	0.94	0.61	0.04	1.11	118	27.50	0.63	57.88	0
25663	Runkel's	1.06	0.61	0.02	1.29	122	20.14	0.74	62.86	0
25762	Whitman's Instantaneous	1.61	0.77	0.05	1.84	114	24.60	1.11	54.21	0
25709	Whitman's Vanilla	1.26	0.92	0.05	1.51	120	31.78	0.63	53.01	0
	Milk.									
25741	Cailler's	1.56	0.54	0.02	1.19	76	29.95	1.17	48.31	7.28
25688	Hershey's	1.85	0.63	0.02	1.82	98	28.69	1.36	45.81	7.75
25654	Hooton's	1.71	0.66	0.03	2.09	122	32.13	1.19	43.09	3.57
25841	Huyler's	1.67	0.85	0.01	1.93	116	28.77	1.11	49.45	2.25
25844	Nestlé's	1.56	0.61	0.01	1.58	101	28.85	1.17	49.65	6.87
25703	Peter's	1.79	0.82	0.02	2.10	117	33.23	1.42	39.45	6.24
25721	Pulver	2.12	0.83	0.04	2.49	117	26.84	1.44	44.26	8.46
25702	Stollwerck	1.66	0.67	0.04	1.89	114	33.31	1.20	42.45	7.39
25695	Suchard's	1.60	0.53	0.04	1.92	120	32.67	1.29	42.64	7.81
25847	Wilbur's	2.25	0.92	0.00	1.75	78	30.63	1.55	39.49	8.17

removed, although in certain cases it appeared that fat had been added to make it possible to incorporate more sugar with the chocolate. This fat in every case appeared to be cocoa fat. **25681** is not entitled to be called chocolate at all, as about half of the cocoa fat has been removed; it is rather a sweetened cocoa.

On the fat-sugar-free basis the sweet chocolates contained on the average 7.30 per cent. ash, 4.91 per cent. nitrogen and 31.60 per cent. soluble in cold water; on the same basis, the plain chocolates contained 6.74, 4.55 and 24.82 per cent., respectively. The increased solubility of the sweet chocolates was probably due to the fact that in these a smaller amount of chocolate

Compound Chocolate.

Station No.	In Air-dry Material.							In Fat-Sugar-free material.			Per Cent. of Total Ash Soluble in Water.	Constants of Fat.		
	Polarization at 20° C.		Soluble in water.			Organic matter, not Sugar, Soluble in Cold Water.	Relative Sedimentation, corrected for Sugar Content.							
	Direct.	After Inversion.	Cold.	At 65° C.	At 100° C.			Total Ash.	Nitrogen.	Soluble in Cold Water.		Iodine No. (Hanus).	Refractive Index at 40° C.	Reichert-Meissl No.
25722	49.2	−15.95	63.38	63.34	64.52	4.47	70	7.05	5.08	29.27	49	37.04	1.4569	—
25754	46.4	−15.40	59.42	60.20	61.26	3.64	47	7.87	5.28	25.45	51	35.73	1.4566	—
25835	47.0	−15.40	60.16	60.38	61.34	3.89	45	6.89	4.98	27.59	54	35.38	1.4566	—
25691	30.4	− 9.35	41.12	41.96	42.90	5.79	41	6.93	5.00	27.08	46	34.74	1.4563	—
25768	52.5	−16.83	66.46	67.24	68.10	3.59	40	7.64	5.09	32.84	56	35.03	1.4568	—
25461	50.5	−15.95	65.40	65.40	66.50	5.10	40	7.63	4.30	38.19	64	33.62	1.4567	—
25840	52.9	−17.16	67.50	66.78	67.82	3.89	51	8.31	5.38	32.72	50	34.42	1.4563	—
25681	48.8	−15.40	64.58	65.56	66.98	8.17	79	6.86	4.84	27.22	40	34.50	1.4576	—
25710	50.0	−16.17	63.84	64.26	65.66	3.85	47	7.01	4.76	32.30	72	38.50	1.4574	—
25843	50.0	−16.28	65.05	64.86	65.52	4.96	91	8.44	5.23	30.26	50	36.01	1.4569	—
25697	49.2	−15.51	64.08	64.16	65.56	5.59	47	6.42	4.32	42.41	65	34.63	1.4569	—
25663	52.6	−17.27	69.40	69.44	70.68	5.93	67	6.23	4.37	38.48	58	34.35	1.4567	—
25762	47.2	−15.62	59.94	60.06	61.54	4.96	85	7.61	5.23	27.03	48	33.76	1.4566	—
25709	46.1	−14.42	59.06	59.46	60.02	5.13	38	8.28	4.14	39.78	73	34.14	1.4567	—
25741	45.7	− 8.47	61.64	61.46	62.34	5.51	47	10.78	8.08	41.83	35	35.60	1.4566	6.2
25688	44.0	− 7.48	60.38	60.66	61.66	6.19	24	10.41	7.67	38.44	34	31.41	1.4567	5.9
25654	40.4	− 9.90	54.04	54.28	55.02	6.72	41	8.06	5.61	34.80	39	33.86	1.4567	5.0
25841	43.5	−12.21	59.26	58.94	59.58	6.71	62	8.56	5.69	38.71	51	33.35	1.4569	3.2
25844	46.5	− 9.20	65.78	64.43	63.52	8.65	28	10.67	8.07	63.30	39	34.42	1.4562	5.6
25703	38.0	− 6.82	52.52	53.66	53.62	6.01	39	8.50	6.73	32.41	46	35.36	1.4566	4.1
25721	43.2	− 6.60	62.09	61.24	61.44	8.54	44	10.36	7.06	45.85	39	35.16	1.4576	3.7
25702	42.4	− 7.04	56.24	56.24	56.64	5.73	36	9.86	7.12	37.99	40	34.08	1.4569	3.7
25695	:1.5	− 6.60	57.98	58.14	58.46	7.00	38	9.48	7.63	44.61	33	33.80	1.4562	5.1
25847	39.2	− 5.50	57.12	57.04	56.34	8.54	32	10.37	7.14	43.56	41	35.30	1.4563	5.8

material was subjected to the solvent action of the water than in the plain chocolates.

The relative sedimentation of the sweet chocolates ranged from 40 to 91, the higher figures generally being associated with the lower percentages of fat.

From the standpoint of legality, exception is taken to the following: **25681**, *Barker's Hasty Lunch Chocolate, Sweetened,* which contained 55.53 per cent. sucrose, not indicated in the brand name. It contained only 11.22 per cent. fat, indicating that about one-half of the cocoa fat had been removed. On a slip inside this claim was found: "One ounce of Hasty Lunch Chocolate equals one ounce of Baking Chocolate," a statement which is untrue. It should properly be labeled as a sweetened cocoa.

25843, *Chocolat-Menier, Santé Fine Vanilla Quality,* is misbranded, in that it contained 59.39 per cent. sucrose, the presence of sugar not being indicated in the brand name.

For the same reason, **25762**, *Whitman's Instantaneous Chocolate,* and **25709**, *Whitman's Super-Extra XXX Vanilla Chocolate,* are both misbranded.

The labels of eight of the samples stated the weight of the contents. With the exception of a slight shortage in one sample, these statements were correct.

Milk Chocolate.

Ten samples were analyzed. The fat ranged from 26.84 to 33.31 per cent.; sucrose, from 39.45 to 49.65 per cent., and lactose, from 2.25 to 8.46 per cent. The solubility in water was somewhat lower than that of sweet chocolate, because smaller amounts of sugar were present; in three cases the solubility in boiling water was less than in cold. The relative sedimentation ranged from 24 to 62, the latter value being much higher than any other obtained.

Milk chocolate is a mixture of cocoa mass, milk powder, sugar and cocoa butter. If dried skim milk or casein is substituted for a whole milk powder, the word "milk" should not be used without some qualification. The lactose determinations and the Reichert-Meissl numbers furnish data as to the nature and amount of milk product used. It will be noted that the percentages of lactose are fairly uniform, except in two instances, where only 2.25 and 3.57 per cent. were found. The sample containing 2.25 per cent. lactose also showed the lowest Reichert-Meissl number, 3.2. These numbers ranged from 3.2 to 6.2. Dubois* has pointed out that by determining the Reichert-Meissl number of the extracted fat, the approximate amount of butter fat in the milk chocolate may be calculated. From these numbers it appears that the samples contained 25.8, 24.6, 20.8, 13.3, 23.3, 17.1, 15.4, 15.4, 21.3, and 24.2 per cent. of butter fat, respectively, in the order followed in the table.

Methods of Analysis.

Ash, Soluble Ash, and *Insoluble Ash.* Conn. Expt. Stat., Report, 1902, p. 273.

Alkalinity of Ash. Ash two gms. of material, add 20 cc. of $\frac{N}{10}$ hydrochloric acid and 100 cc. of water, boil gently over asbestos, cool, and titrate excess of acid with $\frac{N}{10}$ sodium hydroxid, using methyl orange as indicator. The alkalinity is expressed as the number of cubic centimeters of tenth-normal acid used on the ash of one gram of material.

Sucrose and Lactose. Dubois method. U. S. Dept. Agr., Bur. of Chem., Bull. 137, p. 101.

Fat. U. S. Dept. Agr., Bur. of Chem., Bull. 107 (revised), p. 39, using one gram of material, mixed with asbestos to prevent clogging.

†*Cold Water Extract.* Shake 4 gms. of material in a 200 cc. flask, filled to the mark with cold water, once an hour for eight hours, and allow to stand undisturbed for sixteen hours; filter. Determine soluble matter in 25 cc. of filtrate.

†*Extract at 65° C.* Mix 4 gms. of material with a little water at 65° in a 200 cc. flask; fill flask slightly above mark with water at 65° and maintain at this temperature for thirty minutes, shaking every five minutes. Cool quickly, adjust to mark, mix and filter. Determine soluble matter in 25 cc. of filtrate.

†*Extract at 100°C.* Mix well 4 gms. with 10 to 15 cc. of boiling water in a 200 cc. flask, then add actively boiling water slowly and with constant mixing to a point one to two inches above mark, stopper, invert once and immerse in a bath of vigorously boiling water for three minutes; cool immediately in ice water, adjust to mark, invert once and filter. Determine soluble matter in 25 cc. of filtrate. (This is supposed to give a result comparable with that effected by the three-minute boiling usually prescribed for cocoa.)

Relative Sedimentation. Mix 0.35 gm. of chocolate with a few drops of boiling water in a small beaker, adding a little more water gradually until the chocolate makes a thin paste without lumps, wash into a Hortvet

* Jour. Amer. Chem. Soc., 1907, *29*, 560.

† Communicated by letter by C. D. Howard, of the New Hampshire State Board of Health.

tube with boiling water, the total volume being 35 cc. Invert the tube once and centrifuge for one and one-half minutes, allowing ten seconds to come to full speed and ten seconds for stopping. The volume of the sediment is then noted and recorded. The principle of this method was also suggested by Mr. Howard, but we have modified it slightly to meet our conditions. The results, of course, are only relative, and it is essential that the method used be conducted uniformly for a series of tests. This test is a measure of the miscibility of the chocolate or cocoa, and, to a certain extent, also indicates its food value.

CHILI SAUCE.

Of the eight samples examined, four were stated to be free from preservatives, a claim sustained by the analysis; three were guaranteed to contain one-tenth of one per cent. of benzoate of soda; while the fourth bore the following indefinite statement: "the correct amount of Benzoate of Sodium to keep wholesome."

The labels of the samples read as follows:—

25748. *Campbell's Chili Sauce.* Joseph Campbell Co., Camden, N. J.

TABLE V.—CHILI SAUCE

Station No.	Brand.	Price per bottle, cents.	Net weight of contents, oz.	Solids.	Insoluble Solids.	Ash.	Sodium Chloride.	Ash less Sodium Chloride.	Polarization. Direct at 21° C.	Polarization. After Inversion at 21° C.
25748	Campbell's......	10	9.3	23.18	2.70	3.07	2.48	0.59	14.40	12.32
25845	Shrewsbury.....	15	8.0	25.75	2.79	5.06	4.56	0.50	−4.80	−5.72
25440	Heinz's.........	25	12.0	33.41	4.39	4.30	3.37	0.93	−0.60	−8.80
25441	Snider's.........	13	9.3	22.42	3.54	4.75	3.70	1.05	−3.00	−4.64
	Average.....	*15.8*	...	*26.20*	*3.36*	*4.30*	*3.53*	*0.77*	.....	.....

TABLE VI.—CHILI SAUCE

25779	Royal	15	8.4	25.53	2.79	3.70	3.00	0.70	−0.20	−5.72
25780	Libby's.........	10	12.1	26.86	3.94	5.40	4.26	1.14	−2.60	−6.60
25667	Pride of the Farm	15	9.1	19.16	2.46	3.36	2.60	0.76	−2.60	−4.40
25694	Acme............	10	10.1	36.56	3.78	5.30	4.22	1.08	0.80	−7.48
	Average.....	*12.5*	...	*27.03*	*3.24*	*4.44*	*3.52*	*0.92*	.....	.....

25845. *Shrewsbury Chili Sauce.* E. C. Hazard & Co., Shrewsbury, N. J.

25440. *Heinz Chili Sauce.* H. J. Heinz Co., Pittsburgh. "Contains no benzoate of soda, other drugs, or artificial preservatives."

25441. *Snider's Chili Sauce.* The T. A. Snider Preserve Co., Cincinnati, O. "Contains tomatoes, granulated sugar, vinegar, salt, onions, garlic and spices. Not artificially colored. Does not contain a chemical preservative."

25779. *Royal Chili Sauce.* The Horton-Cato Mfg. Co., Detroit, Mich. "Made from fresh tomatoes, pure spices, etc. Contains $\frac{1}{10}$ of 1 per cent. Benz. of Soda."

25780. *Libby's Chili Sauce.* Libby, McNeill & Libby, Chicago. "Contains $\frac{1}{10}$ of 1 per cent. Benz. of Soda."

25667. *The Celebrated Pride of the Farm Chili Sauce.* E. Pritchard, New York. "Made from Chili Peppers, Tomatoes, Spices, granulated Sugar and Salt, and with the correct amount of Benzoate of Sodium to keep wholesome; guaranteed free from artificial coloring."

CONTAINING NO SODIUM BENZOATE.

Polarization after Inversion at 86° C.	Sucrose.	Invert Sugar.	Non-Sugar Solids.	Acetic Acid.	Sodium Benzoate.	Water-free Basis. Insoluble Solids.	Water-free Basis. Ash.	Water-free Basis. Sodium Chloride.	Water-free Basis. Ash less Sodium Chloride.	Water-free Basis. Total Sugars.	Color.
11.66	1.57	*7.15	14.46	0.48	0.00	11.65	13.24	10.69	2.55	†38.40	Natural
....	0.70	18.00	7.05	1.44	0.00	10.83	19.69	17.75	1.94	72.62	"
....	6.20	22.26	4.95	1.92	0.00	13.14	12.87	10.09	2.78	85.18	"
....	1.24	13.88	7.30	1.86	0.00	15.79	21.19	16.49	4.68	67.44	"
....	...	....	*8.44*	*1.43*	*0.00*	*12.85*	*16.75*	*13.76*	*2.99*	*65.91*	....

* Glucose. † Excluding invert sugar, not determined.

CONTAINING SODIUM BENZOATE.

....	4.18	14.34	7.01	0.84	0.09	10.93	14.49	11.75	2.74	72.54	Natural
....	3.03	18.43	5.40	1.32	0.10	14.67	20.10	15.86	4.24	79.90	"
....	1.36	12.96	4.84	0.99	0.17	12.84	17.54	13.57	3.97	74.74	"
...	6.27	17.90	12.39	1.44	0.16	10.34	14.50	11.55	2.95	66.11	"
....	*3.71*	*15.91*	*7.41*	*1.15*	*0.13*	*12.20*	*16.66*	*13.18*	*3.48*	*73.39*	....

25694. *Acme Chili Sauce.* The J. Weller Co., Cincinnati, O. "Prepared with $\frac{1}{1000}$ part of Benzoate of Soda."

The analyses show that chili sauce is a rather more uniform product than ketchup. However, the variations in solids were quite wide, ranging from 19.16 to 36.56 per cent. There were no very striking differences in the content of insoluble solids, ash or sodium chloride. The acidity varied from 0.48 to 1.92, averaging somewhat higher in the samples containing no benzoate of soda. The solids appeared to be measured chiefly by the amount of sugars present; in one sample the sugars made up over 85 per cent. of the dry matter. The average analyses of the non-benzoated and benzoated samples showed none of the striking differences noted last year in ketchups.

Of the benzoated samples, two were illegally sold, **25667** because the label bore no statement of the *quantity* of preservative present, and **25694** because it contained 0.16 per cent. of benzoate while only 0.10 per cent. was claimed.

No foreign color was found in any of the samples. **25748** contained glucose.

CIDER.

The standards for cider are as follows:

"*Apple juice, apple must, sweet cider,* is the fresh fruit juice obtained from apples, the fruit of *Pyrus malus,* has a specific gravity (20° C.) not less than 1.0415 nor greater than 1.0690; and contains in one hundred (100) cubic centimeters (20° C.) not less than six (6) grams, and not more than twenty (20) grams of total sugars, in terms of reducing sugars, not less than twenty-four (24) centigrams nor more than sixty (60) centigrams of apple ash, which contains not less than fifty (50) per cent. of potassium carbonate."

"*Cider, hard cider,* is the product made by the normal alcoholic fermentation of apple juice, and the usual cellar treatment, and contains not more than seven (7) per cent. by volume of alcohol, and, in one hundred (100) cubic centimeters of the cider, not less than two (2) grams nor more than twelve (12) grams of solids, not more than eight (8) grams of sugars, in terms of reducing sugars, and not less than twenty (20) centigrams nor more than forty (40) centigrams of cider ash."

TABLE VII.—ANALYSES OF CIDER AND APPLE JUICE.

Station No.	Brand.	Specific gravity at 15.6° C.	Per cent. of alcohol. By weight.	Per cent. of alcohol. By volume.	Polarization of Original Liquid at 20° C. Direct.	Polarization of Original Liquid at 20° C. After inversion.	Grams per 100 cc. of Cider. Solids.	Reducing Sugars. Direct.	Reducing Sugars. After Inversion.	Ash.	Alakalinity of Ash, as K_2CO_3.	Acidity, as Malic.	Potash (K_2O).	Phosphoric Acid (P_2O_5).	Tannin.	Original Solids of Juice (calculated).	Pentosans.	Benzoic and Salicylic Acids.
25736	Boiled Cider. Vermont Farmer's Co., Springfield, Mass.	1.2387	1.09	1.69	—135.1	—137.1	62.14	50.08	50.46	1.378	1.130	3.082	0.774	0.045	....	....	0.80	none
25737	Boiled Cider. J. Eames & Sons, Sherborn, Mass.	1.2665	none	none	—137.7	—156.1	69.50	53.34	58.08	1.308	1.148	2.774	0.752	0.087	....	....	0.95	"
25749	Duffy's Apple Juice. American Fruit Product Co., Rochester, N. Y.	1.0558	1.79	1.90	— 33.1	— 33.6	14.25	11.47	11.66	0.298	0.234	0.643	0.153	0.016	0.070	17.83	....	"
25750	Centennial Prize Medal Cider. H. Paulding, Huntington, L. I.	1.0249	2.90	3.74	— 21.0	— 20.2	7.74	5.49	5.49	0.234	0.191	0.332	0.113	0.008	0.035	13.54	....	"
25778	Thompson's Apple Juice. J. A. Thompson & Son, Melrose.	1.0324	2.78	3.62	— 26.3	— 25.5	9.77	7.12	7.07	0.311	0.235	0.389	0.140	0.018	0.262	15.33	....	"
25850	Newhall's Sweet Apple Cider. Newhall Cider Co., Holyoke, Mass.	1.0206	4.16	5.35	— 20.5	— 20.2	7.24	4.90	4.90	0.254	0.175	0.616	0.125	0.013	0.122	15.46	....	"

Six samples were analyzed, two labeled "boiled cider," two "apple juice," one "sweet cider," and one simply "cider." With the exception of one sample of "apple juice," all the samples were sold as "cider."

The two samples of boiled cider appeared to be true to name, representing a concentration of about five times. **25736** contained 1.69 per cent. alcohol by volume, with correspondingly less reducing sugars than **25737**; the latter also contained sucrose. Neither of these samples contained benzoic or salicylic acid.

25750 must be judged by the standard for cider (hard cider), to which it corresponds in all respects. All the analytical data, however, indicate a rather weak preparation.

The other three samples were labeled as apple juice or sweet cider. **25749** was of normal composition except for the presence of 1.90 per cent. alcohol by volume, which indicates that it is not strictly "non-alcoholic," as its label claims. It is, therefore, misbranded. **25778** had a specific gravity below the minimum of the standard, and its sugars closely approached the minimum. This is probably due to the fact that it is not an unfermented juice, as it contained 3.62 per cent. of alcohol by volume. **25850** likewise was of low gravity, was below standard in sugars and contained 5.35 per cent. of alcohol by volume.

None of the four samples can be considered as sweet cider, for they all contained alcohol, ranging from 1.90 to 5.35 per cent. by volume. No benzoic or salicylic acid was found in any of the samples.

COCOA.

The standards for cocoa are as follows:

"*Cocoa, powdered cocoa,* is cocoa nibs, with or without the germ, deprived of a portion of its fat and finely pulverized, and contains percentages of ash, crude fiber, and starch corresponding to those in chocolate after correction for fat removed."

"*Sweet cocoa, sweetened cocoa,* is cocoa mixed with sugar (sucrose), and contains not more than sixty (60) per cent. of sugar (sucrose), and in the sugar- and fat-free residue no higher percentage of either ash, crude fiber, or starch than is found in the sugar- and fat-free residue of chocolate."

Sixty-two samples were analyzed. The methods of analysis used were the same as those given under chocolate in this report (see page 109) except for fat the Gottlieb-Roese method was used.* Fifty-two samples proved to be straight cocoa, while ten were compound cocoa, containing starch, sugar, or milk.

In judging the purity of a cocoa its analysis must be compared with that of chocolate, the only differences being that a part of the fat has been removed, and that in some cases the cocoa has been treated with alkali to increase its so-called "solubility." Booth† and Winton‡ have made extended analyses of pure cocoa nibs and pure chocolates and cocoa. The averages secured by them are given below.

	Cocoa Nibs. Original Material.		Cocoa Nibs. Fat-free.		Chocolate. Winton.		Cocoa. Winton.	
	Booth.	Winton.	Booth.	Winton.	Orig. Mat.	Fat-free.	Orig. Mat.	Fat-free.
Ash	3.11	3.32	6.28	6.66	3.15	6.59	5.49	7.49
Soluble ash	1.28	1.16	2.58	2.33	1.41	2.95	2.82	3.85
Sand	0.06	0.02	0.12	0.04	0.06	0.13	0.24	0.32
Nitrogen	2.24	2.38	4.53	4.77	2.26	4.73	3.33	4.54
Fat	50.50	50.12	....	....	52.19	....	26.69	....
Fiber	2.73	2.64	5.52	5.29	2.86	5.98	4.48	6.11
Starch	....	8.07	....	16.18	8.11	16.75	11.14	15.20
Per cent. ash, sol. in water	41	35	....	....	45	....	51	....
Cold water extract	11.40	....	23.00	....	....	....	....	....

It will be noted that on the fat-free basis, which is the only fair basis for comparison, cocoa differs but little in composition from cocoa nibs and chocolate, except for the higher ash and the greater solubility of the ash in water. The above figures are averages and the extremes of Winton's analyses showed a considerable range. For instance, in the fat-free material ash ranged from 5.46 to 8.31, soluble ash from 1.51 to 3.73, nitrogen from 4.47 to 5.12, and percentage of soluble ash from 26 to 45; again the ash showed the greatest variations.

From the above figures a pure cocoa on the fat-free basis should contain from 6 to 7 per cent. ash, of which from 35 to 45 per cent. is soluble in water, from 4.50 to 5 per cent. nitrogen, and from 23 to 26 per cent. cold water extract. Cocoas treated with alkali would naturally show higher ash and higher water-soluble ash.

* Conn. Expt. Stat. Report, 1909, p. 192.

† Analyst, *34*, 134.

‡ Conn. Expt. Stat., Report, 1902, p. 282.

TABLE VIII.—COCOA.

Station No.	Brand.
25755	Crimson Brand Breakfast Cocoa. Manufactured for S. S. Adams, New Haven....
25813	Carmelo Breakfast Pure Cocoa. Austin, Nichols & Co., New York..............
25826	Sunbeam Pure Food Breakfast Cocoa. Austin, Nichols & Co, N. Y., Distributors
25679	Breakfast Cocoa. Walter Baker & Co., Ltd., Dorchester, Mass..................
25766	Webb's Pure Cocoa Powder. Walter Baker & Co., Ltd., Dorchester, Mass.......
25810	Justice Brand Cocoa. Wm. H. Baker, Inc., Syracuse, New York................
25652	W. H. Baker's Best Cocoa. Winchester, Va..................................
25653	Best Breakfast Cocoa. A. F. Beckmann & Co., New York......................
25756	Royal Dutch Cocoa. Bensdorp & Co., Amsterdam, Holland.....................
25738	Gold Star Brand Breakfast Cocoa. The Wm. Boardman & Sons Co., Hartford ....
25427	L. B. C. Cocoa. Brewster Cocoa Mfg. Co., Jersey City, N. J..................
25425	Royal Breakfast Cocoa. Brewster Cocoa Mfg. Co., Jersey City, N. J.............
25714	Savoy Breakfast Pure Cocoa. Brewster Cocoa Mfg. Co., Jersey City, N. J........
25803	Autocrat Breakfast Cocoa, Packed for Brownell & Field Co.....................
25711	Victoria Brand. Packed expressly for H. E. Bushnell, Meriden.................
25765	Health Cocoa. J. and W. Cahill & Co., New Haven, Distributors................
25666	Swan Brand Breakfast Cocoa. Clark, Chapin & Bushnell, New York............
25665	Oxford Brand Supreme Quality Breakfast Cocoa. The Danbury Groc'y Co., Danbury
25609	Welcome Dainty Brand Cocoa. Packed for Edward D. Depew & Co., New York.
25764	Economy Brand Cocoa. Packed for M. C. Dingwall's Dairy Store, New Haven...
25429	Premium Brand Cocoa. Packed for East India Tea Co., Bridgeport..............
25767	Grand Union Cocoa. Grand Union Tea Co., Brooklyn, N. Y., Distributors ......
25713	Grant's Special Cocoa. H. M. Grant, Meriden..................................
25740	Hall's Pure Soluble Cocoa. Prepared expressly for Edw. E. Hall & Son, New Haven
25675	Amazon Breakfast Cocoa. Hooton Cocoa & Chocolate Co., Newark, N. J........
25430	Howco Breakfast Cocoa. Packed for Howland's, Bridgeport ....
25788	Huyler's Cocoa..
25783	Old Dutch Pure Soluble Breakfast Cocoa. Ideal Cocoa and Chocolate Co., Lititz, Pa.
25426	White Lily Pure Cocoa. H. Isenburg & Co., Bridgeport ....
25608	Nabob Breakfast Cocoa. Francis H. Leggett & Co., New York, Distributors .....
25428	Breakfast Cocoa. The Walter M. Lowney Co., Boston ....
25646	Breakfast Cocoa. Henry Maillard, New York ....
25690	Melbourne Australian Brand Pure Breakfast Cocoa. Melbourne Trading Co., Boston
25718	Capitol House Brand Cocoa. Packed for Middletown Cash Grocery, Middletown
25696	Mohican Brand Cocoa. Packed for The Mohican Co., New York.................
25685	Palmer's Brand Breakfast Cocoa. Packed for R. C. Palmer, Waterbury..........
25719	Breakfast Cocoa. Alex. M. Powell, New York...................................
25686	Premium Brand Breakfast Cocoa. Prepared expressly for Premium Trade.........
25720	Breakfast Cocoa. Pulver's Chocolate and Chicle Mfg. Co., Rochester, N. Y......
25811	Rallion's Special Breakfast Cocoa. Put up expressly for Rallion the Grocer, Norwich
25712	Semper Idem Breakfast Cocoa. Rockwood & Co., New York ....

TABLE VIII.—COCOA.

Serial No.	Price per package, cts.	Weight claimed, grams.	Weight found, grams.	Claims of Label.
3289	10	91	98	"Excess of oil has been extracted by the latest improved process."
....	10	...	96	
188	20	...	235	
90	25	227	224	"Of greater strength than cocoa mixed with starch, arrowroot or sugar, and is therefore more economical." "No chemicals." "The albuminoids are preserved."
90	9	113	115	
6165	20	227	226	
5257	10	...	91	"Owing to the removal of oil, it is certainly the most nutritious and wholesome cocoa now manufactured in the world."
....	20	227	231	"Triple the strength of cocoa as usually prepared." "Preserving in their entirety . . . the nutritive properties of the natural bean."
....	22	...	141	"Acknowledged by the leading authorities to be absolutely the purest cocoa made."
....	20	227	240	"Double the strength of ordinary grades of cocoa."
2811	15	...	194	"Full strength and flavor."
....	18	227	233	"Double the strength of ordinary grades of cocoa."
....	10	...	139	"No chemicals used."
....	25	...	210	
1878	10	...	...	"Is extra strong."
....	20	...	215	"Being made by the special process it preserves . . . the nutritive properties and is rendered treble the strength of cocoas as usually prepared."
....	25	227	239	
1878	10	91	89	"Is extra strong."
....	10	...	99	
....	15	227	232	"Double the strength of ordinary grades of cocoa."
....	25	227	254	"Excess of oil extracted by mechanical means only."
....	25	227	237	"Excess of oil removed by hydraulic pressure."
....	8	...	97	"Double the strength of ordinary grades of cocoa."
....	27	...	236	"A nutritious and perfectly soluble food." "The cocoa having the oil removed, becomes at once a healthful aliment to the most delicate stomach."
....	25	227	243	"Excess of oil extracted by mechanical means only."
2811	10	...	105	
2598	10	...	71	"Soluble and digestible."
3751	28	...	243	"Soluble."
....	20	...	230	"Double the strength of ordinary grades of cocoa.'
....	10	91	90	"Made in Holland."
1761	10	91	92	"Is unlike any other."
2506	23	...	245	"Excess of oil entirely removed."
1878	25	227	215	"Solubility unequalled." "Pure soluble cocoa."
....	22	227	227	"Double the strength of ordinary grades of cocoa."
....	10	...	127	"Full strength and flavor."
....	25	227	267	"Excess of oil extracted by mechanical means only."
....	20	227	232	
....	25	227	242	"Excess of oil extracted by mechanical means only."
....	20	227	209	"Cocoa is stronger and more economical than chocolate."
1878	23	227	207	"Double the strength of ordinary grades of cocoa."
3289	5	...	55	

TABLE VIII.—COCOA—*Continued.*

Station No.	Brand.
25700	Pure Breakfast Cocoa. Runkel Bros., New York ....
25833	Sadd's Cocoa. Packed for The T. R. Sadd Co., Willimantic ....
25804	White Rose Brand Cocoa. Seeman Bros., New York, Distributors ....
25739	Alliance Brand Pure Breakfast Cocoa. Packed expressly for Shartenberg & Robinson Co., New Haven ....
25457	Pure Breakfast Cocoa. Prepared expressly for George W. Smith, Bridgeport .....
25793	Standard Cocoa. Standard Tea House, Hartford ....
25733	Stollwerck Cocoa. Stollwerck Bros., New York-Chicago ....
25775	Soluble Cocoa. Ph. Suchard, Neuchatel, Switz ....
25456	Ambassador Brand Breakfast Cocoa. James Van Dyk Co., New York ....
25715	Pure Soluble Cocoa. C. J. Van Houten & Zoon, Weesp, Holland ....
25610	Sold in bulk. Columbia Tea Co., Stamford ....

The following tabulation shows the average composition of all the straight cocoas, of the eight showing high ash and high alkalinity of ash, and of the remaining forty-four not possessing these characteristics.

	Average. All Cocoas.	Average. 44 Cocoas.	Average. 8 Cocoas (high ash and alkalinity).
Ash, total	5.59	5.25	7.49
Ash, sol. in water	2.85	2.32	5.79
Ash, insol. in acid	0.13	0.15	0.03
Alkalinity of ash, 1 gm. of cocoa ...	6.55	6.04	9.36
Alkalinity of ash, 1 gm. of ash	117.0	115.0	125.0
Fat	24.85	24.83	24.99
Nitrogen	3.52	3.52	3.51
Soluble in cold water	19.40	19.34	19.75
Soluble in water, 65° C.	21.52	21.55	21.33
Soluble in water, 100° C.	23.55	23.29	24.99
Organic matter sol. in cold water ..	16.55	17.02	13.96
Relative sedimentation	95.0	96.0	87.0
Per cent. ash sol. in water	49.0	44.0	76.0
Fat-free basis			
Total ash	7.44	6.98	9.99
Nitrogen	4.68	4.68	4.68
Soluble in cold water	25.82	25.73	26.33

TABLE VIII.—COCOA—*Continued.*

Serial No.	Price per package, cts.	Weight claimed, grams.	Weight found, grams.	Claims of Label.
5	10	91	103	"Superfluous oil removed by most modern process, and which thereby renders the powder more soluble in hot water or milk, and increases the strength threefold compared with chocolate or similar preparations containing sugar, starch or arrowroot." "Physicians recommend Runkel's cocoa."
....	25	227	231	"Double the strength of ordinary grades of cocoa."
722	23	...	257	
1878	16	227	219	"Extra strong."
....	10	113	115	"Excess of oil extracted by mechanical means only."
....	10	113	122	"Double the strength of ordinary grades of cocoa."
....	25	227	223	
....	45	...	232	"Most of the cocoa butter has been eliminated." "Free from alkali." Stamped on side, "Prepared with alkali."
....	10	...	94	
9045	15	...	74	"Manufactured by a special process which increases the mineral ingredients about 3½ per cent."
....	18	227	223	

These averages show that the so-called "soluble" cocoas contain a higher total ash, higher water-soluble ash, and higher alkalinity of ash, as would be expected. They contain about the same amounts of fat and nitrogen as the untreated cocoas. The most striking fact brought out by these averages is that while 1.7 per cent. more of the total cocoa is soluble in boiling water, over 3 per cent. less of organic matter is soluble in cold water. In other words, the apparent slightly increased solubility is due to the added alkali and not to any change in the cocoa mass itself. On the average, the "soluble" cocoas show a lower water-solubility of the cocoa mass than those brands making no claim to superior solubility. In the relative sedimentation tests the untreated cocoas show an average of 96, while the treated show 87, only a little less.

The samples were examined for starch, under the microscope. While cereal starches were detected in a number of samples, the amount present, excepting **25827**, where its presence was declared, did not seem sufficient to class the samples as adulterated. In no sample sold as pure cocoa was there sufficient starch to reduce the fat content below the normal.

TABLE IX.—ANALYSES OF COCOA.

Station No.	Brand.	In Air-dry Material. Ash. Total.	Ash. Soluble in Water.	Ash. Insoluble in acid (sand).	Alkalinity of Ash. 1 gm. of Cocoa.	Alkalinity of Ash. 1 gm. of Ash.	Fat.	Nitrogen.	Soluble in Water. Cold.	Soluble in Water. At 65° C.	Soluble in Water. At 100° C.	Organic Matter Soluble in Cold Water.	Relative Sedimentation.	In Fat-free Material. Total Ash.	Nitrogen.	Soluble in Cold Water.	Per cent. of Total Ash Soluble in Water.	Constants of Fat. Iodine No. (Hanus).	Refractive Index at 40° C.
25755	Crimson..........	5.06	1.93	0.21	5.88	115	27.53	3.38	18.80	21.32	23.12	16.87	91	6.98	4.66	25.94	38	34.53	1.4577
25813	Carmelo...	5.01	2.04	0.24	5.61	112	26.45	3.40	17.88	19.92	21.78	15.84	101	6.81	4.62	24.31	40	36.59	1.4574
25826	Sunbeam	5.49	2.05	0.01	5.98	109	20.20	3.93	19.88	21.94	24.66	17.83	101	6.88	4.92	24.91	37	36.26	1.4580
25679	Walter Baker's....	5.25	2.00	0.13	5.85	111	27.92	3.53	17.36	19.88	21.36	15.36	104	7.28	4.90	24.08	38	33.78	1.4583
25766	Webb's..........	4.82	2.01	0.12	5.90	122	26.20	3.55	19.14	20.66	25.10	17.13	103	6.53	4.81	25.94	42	35.89	1.4573
25810	Justice	5.24	1.96	0.27	5.91	113	26.02	3.47	18.86	20.40	22.72	16.90	102	7.08	4.69	25.49	37	33.55	1.4577
25652	W. H. Baker's....	4.59	1.72	0.17	5.47	119	29.67	3.19	18.02	20.28	21.86	16.30	90	6.53	4.54	25.62	37	36.19	1.4585
25653	Beckmann's	5.54	2.46	0.29	6.35	115	24.50	3.43	19.66	21.68	23.76	17.20	90	7.34	4.54	26.04	44	38.28	1.4590
25756	Bensdorp's	6.65	5.24	0.00	8.49	128	31.37	3.45	18.28	20.24	24.66	13.04	82	9.69	5.03	26.64	79	35.91	1.4574
25738	Gold Star..... ...	8.27	6.97	0.03	9.84	119	20.40	3.44	21.28	22.68	26.82	14.31	89	10.39	4.32	26.73	84	36.78	1.4580
25427	L. B. C..........	5.25	3.11	0.14	6.20	118	24.45	3.48	20.58	22.54	24.38	17.47	91	6.95	4.61	27.24	59	39.05	1.4583
25425	Royal	4.58	2.61	0.03	4.90	107	28.95	3.21	19.02	21.70	23.38	16.41	85	6.45	4.52	26.77	57	38.57	1.4590
25714	Savoy	5.29	2.08	0.19	6.10	115	23.32	3.43	19.32	22.28	23.74	17.24	98	6.90	4.47	25.20	39	37.26	1.4574
25803	Autocrat..........	4.83	1.72	0.06	5.45	113	26.79	3.52	19.34	21.64	23.52	17.62	103	6.60	4.81	26.42	36	33.06	1.4582
25711	Victoria	5.68	2.71	0.13	6.85	121	24.14	3.62	19.66	21.82	23.50	16.95	100	7.48	4.77	25.92	46	36.88	1.4585
25765	Cahill's Health....	4.78	1.91	0.03	5.65	118	21.82	3.38	21.37	24.54	26.10	19.46	94	6.12	4.33	27.33	40	34.43	1.4573
25666	Swan	4.82	1.77	0.17	5.75	119	26.67	3.45	18.96	21.26	22.74	17.19	93	6.71	4.70	25.86	37	39.14	1.4586
25665	Oxford............	5.15	2.34	0.18	6.23	121	24.54	3.53	19.90	22.32	23.90	17.56	104	6.82	4.68	26.37	45	36.91	1.4585
25609	Welcome Dainty..	5.49	2.88	0.09	6.57	120	24.85	3.67	19.36	21.54	23.04	16.48	102	7.31	4.88	25.76	52	36.75	1.4576
25764	Economy	5.52	2.44	0.05	6.43	116	23.90	3.65	19.32	21.58	23.28	16.88	84	7.25	4.80	25.39	44	33.53	1.4578
25429	Premium (East India)	5.37	3.05	0.20	6.27	117	23.45	3.57	19.48	21.54	23.18	16.43	93	7.02	4.66	25.45	57	38.37	1.4590
25767	Grand Union.....	6.08	2.26	0.32	6.35	104	23.40	3.63	18.60	20.72	22.32	16.34	101	7.94	4.74	24.28	37	34.01	1.4580
25713	Grant's...........	5.51	2.62	0.14	6.68	121	22.95	3.57	20.10	22.44	24.24	17.48	100	7.15	4.63	26.09	48	39.91	1.4583
25740	Hall's Soluble....	4.33	1.88	0.04	5.38	124	29.71	3.04	18.16	21.22	23.58	16.28	97	6.16	4.33	25.84	43	37.05	1.4580
25675	Hooton's Amazon.	5.23	2.23	0.10	6.10	117	24.60	3.66	19.26	21.28	22.86	17.03	102	6.94	4.85	25.54	43	38.07	1.4590
25430	Howco...........	5.14	3.15	0.05	6.20	118	23.17	3.64	20.30	22.58	24.18	17.15	83	6.67	4.74	26.42	61	36.96	1.4580
25788	Huyler's..........	4.99	2.10	0.18	5.84	117	27.21	3.39	18.02	19.64	21.50	15.92	94	6.84	4.66	24.76	42	36.11	1.4577
25783	Old Dutch Soluble	9.03	7.18	0.02	10.92	121	21.65	3.45	21.36	22.95	26.58	14.18	90	11.53	4.40	27.26	80	38.85	1.4578

TABLE IX.—ANALYSES OF COCOA—*Continued.*

Station No.	Brand.	In Air-dry Material. Ash. Total.	Ash. Soluble in Water.	Ash. Insoluble in acid (sand).	Alkalinity of Ash. 1 gm. of Cocoa.	Alkalinity of Ash. 1 gm. of Ash.	Fat.	Nitrogen.	Soluble in Water. Cold.	Soluble in Water. At 65° C.	Soluble in Water. At 100° C.	Organic Matter Soluble in Cold Water.	Relative Sedimentation.	In Fat-free Material. Total Ash.	Nitrogen.	Soluble in Cold Water.	Per cent. of Total Ash Soluble in Water.	Constants of Fat. Iodine No. (Hanus).	Refractive Index at 40° C.
25426	White Lily	5.07	2.83	0.07	6.00	118	24.92	3.60	19.74	21.80	22.30	16.91	96	6.75	4.80	26.29	56	38.86	1.4585
25608	Nabob	6.21	4.60	0.06	7.29	117	19.56	4.07	20.28	22.60	26.24	15.68	96	7.72	5.06	25.21	74	37.51	1.4583
25428	Lowney's	5.49	3.02	0.20	6.18	113	21.41	3.79	19.38	21.32	22.64	16.36	101	6.99	4.82	24.66	55	38.34	1.4590
25646	Maillard's	5.04	1.97	0.06	6.07	120	25.65	3.64	18.86	20.56	22.08	16.89	100	6.78	4.90	25.37	39	36.41	1.4589
25690	Melbourne	5.69	2.10	0.32	6.10	107	24.46	3.47	20.12	22.34	24.00	18.02	100	7.53	4.57	26.63	37	37.97	1.4586
25718	Capitol House	5.42	2.45	0.13	5.95	110	23.65	3.48	19.56	21.96	23.70	17.11	101	7.10	4.56	25.62	45	35.23	1.4582
25696	Mohican	5.53	2.47	0.15	6.14	111	23.12	3.43	22.64	24.85	26.66	20.17	99	7.19	4.46	29.45	45	35.08	1.4587
25685	Palmer's	5.57	2.35	0.21	6.20	111	23.00	3.54	20.22	22.08	23.80	17.87	102	7.23	4.60	26.26	42	39.62	1.4587
25719	Powell's	5.09	2.17	0.07	6.30	122	22.00	3.68	18.78	21.32	22.86	16.61	102	6.53	4.72	24.08	43	39.67	1.4585
25686	Premium	5.41	2.34	0.16	6.40	118	24.52	3.58	18.68	20.46	21.96	16.34	93	7.17	4.74	24.75	43	35.95	1.4588
25720	Pulver	5.95	2.86	0.37	7.04	118	20.90	3.58	20.12	22.22	24.62	17.26	101	7.52	4.53	25.44	48	35.82	1.4585
25811	Rallion's	9.25	7.62	0.00	12.29	133	21.07	3.37	21.56	22.66	26.52	13.94	94	11.72	4.27	27.32	82	34.56	1.4577
25712	Semper Idem	4.93	2.08	0.17	6.04	122	26.27	3.46	19.76	22.20	24.36	17.68	95	6.69	4.69	26.80	42	38.64	1.4585
25700	Runkel's	5.38	2.30	0.15	6.46	120	25.89	3.62	18.64	20.68	22.06	16.34	100	7.26	4.89	25.15	43	37.79	1.4587
25833	Sadd's	5.39	2.43	0.08	5.88	109	24.68	3.46	19.88	21.90	23.70	17.45	97	7.16	4.60	26.39	45	34.45	1.4578
25804	White Rose	5.97	2.22	0.34	5.83	98	23.76	3.61	18.34	20.30	22.20	16.12	105	7.83	4.73	24.06	37	35.63	14.580
25739	Alliance	5.11	2.43	0.02	6.15	120	23.31	3.64	19.52	21.94	23.72	17.09	84	6.67	4.75	25.45	48	39.08	1.4582
25457	Smith's	6.02	2.62	0.36	6.43	107	23.70	3.61	18.60	21.20	22.56	15.98	95	7.89	4.73	24.38	44	38.27	1.4587
25793	Standard	4.63	2.28	0.03	5.50	119	27.67	3.21	19.06	21.34	21.96	16.78	98	6.40	4.44	26.35	49	37.63	1.4577
25733	Stollwerck	5.96	3.65	0.08	7.40	124	26.07	3.63	18.64	20.32	23.72	14.99	90	8.06	4.91	25.21	61	35.13	1.4580
25775	Suchard's Soluble	6.44	4.53	0.01	8.12	126	31.28	3.29	17.46	18.74	23.10	12.93	82	9.37	4.79	25.41	70	34.57	1.4572
25456	Ambassador	4.86	1.80	0.05	5.45	112	25.40	3.53	20.20	22.76	23.62	18.40	90	6.51	4.73	27.08	37	36.83	1.4590
25715	Van Houten's Soluble	8.07	6.55	0.01	10.55	131	28.49	3.38	19.12	20.46	22.30	12.57	74	11.29	4.73	26.74	81	35.79	1.4573
25610	Columbia Tea Co.	5.20	2.34	0.09	5.75	111	26.05	3.53	18.58	20.64	22.00	16.24	97	7.03	4.77	25.13	45	38.83	1.4580
	Maximum	*9.25*	*7.62*	*0.37*	*12.29*	*133*	*31.37*	*4.07*	*22.64*	*24.85*	*26.82*	*20.17*	*105*	*11.72*	*5.03*	*27.33*	*84*	*39.91*	*1.4590*
	Minimum	*4.33*	*1.72*	*0.00*	*4.90*	*98*	*19.56*	*3.04*	*17.36*	*18.74*	*21.36*	*12.93*	*74*	*6.12*	*4.25*	*24.06*	*36*	*32.55*	*1.4572*
	Average	*5.59*	*2.85*	*0.13*	*6.55*	*117*	*24.85*	*3.52*	*19.40*	*21.52*	*23.55*	*16.55*	*95*	*7.44*	*4.68*	*25.82*	*49*	*36.55*	*1.4582*

TABLE X.—

Station No.	Brand.	Serial No.	Price per package, cents.
25812	Admiral Sweet Cocoa. Stephen L. Bartlett Co., Boston	....	15
25757	Ralston Health Club Cocoa. Stephen L. Bartlett, Boston	....	25
25839	Croft's Swiss Milk Cocoa. Croft and Allen Co., Philadelphia	3373	25
25706	A. and P. Lunch Cocoa. Packed for The Great Atl. and Pac. Tea Co., New York	9244	15
25763	Empire Brand Compound Lunch Cocoa. Melbourne Trading Co., Boston	1878	13
25827	Gold Medal Breakfast Cocoa. Packed for Edward Mullan, Putnam	2811	17
25664	Best Lunch Cocoa. New Jersey Chocolate Works, Jersey City, N. J.	2811	17
25777	Phillips Digestible Cocoa. The Chas. H. Phillips Chem. Co., New York.	632	35
25731	Milk Cocoa. Stollwerck Bros., New York-Chicago	....	10
25611	Sold in bulk. Columbia Tea Co., Stamford	....	8

TABLE XI.—ANALYSES

Station No.	Brand.	In Air-dry Material.								
		Ash.			Alkalinity of Ash.					
		Total.	Soluble in water.	Insoluble in acid (sand).	1 gram of Cocoa.	1 gram of Ash.	Fat.	Nitrogen.	Sucrose.	Lactose.
25812	Admiral Sweet	2.94	2.18	0.02	3.77	128	7.73	1.42	61.80	0
25757	Ralston Health Club	3.11	2.27	0.01	3.98	128	12.60	1.60	55.07	0
25839	Croft's Swiss Milk	4.71	1.84	0.26	5.44	115	22.06	2.86	15.25	1.25
25706	A. and P. Lunch	2.01	0.90	0.03	2.32	115	18.37	1.35	51.48	0
25763	Empire Compound	2.62	1.88	0.03	3.35	128	7.60	1.30	63.25	0
25827	Gold Medal	5.19	2.40	0.03	5.93	114	23.80	3.54	0	0
25664	N. J. Best Lunch	2.06	1.14	0.08	2.60	126	12.33	1.45	54.95	0
25777	Phillips Digestible	3.68	2.38	0.04	3.82	104	30.85	2.45	21.98	0
25731	Stollwerck's Milk	5.44	2.01	0.05	6.30	116	20.92	3.89	....	..
25611	Columbia Tea Co.	2.50	2.00	0.04	3.28	131	9.00	1.14	67.00	0

Compound Cocoa.

Station No.	Weight claimed, grams.	Weight found, grams.	Claims of Label.
25812	227	235	"Pure sweetened cocoa, free from all such adulterations as starch, rice, flour, etc." "It is readily soluble."
25757	227	227	
25839	...	235	"Manufactured from the finest cocoa bean, pasteurized milk, sugar and flavor."
25706	...	256	"Made of pure cocoa and refined sugar only." "Is perfectly soluble."
25763	...	206	"Composed of our pure cocoa and sugar and nothing else."
25827	227	238	On side in small print, "blended with 10 per cent. of prepared cereal."
25664	227	231	"A superior preparation of cocoa and sugar." "It is perfectly soluble."
25777	227	232	"Compounded of cocoa, sugar, phosphates, with vanilla flavor."
25731	...	...	
25611	113	107	Sold as sweet cocoa.

of Compound Cocoa.

Station No.	In Air-dry Material.							In Fat-Sugar-free Material.				Constants of Fat.		
	Polarization at 21° C.		Soluble in Water.			Organic Matter, not Sugar, Soluble in Cold Water.	Relative Sedimentation, corrected for Sugar Content.	Total Ash.	Nitrogen.	Soluble in Cold Water.	Per cent. of Total Ash Soluble in Water.	Iodine No. (Hanus).	Refractive Index at 40° C.	Reichert-Meissl No.
	Direct.	After Inversion.	Cold.	At 65° C.	At 100° C.									
25812	54.0	−17.16	70.28	70.78	72.08	6.30	110	9.65	4.66	27.83	74	34.01	1.4583	..
25757	48.6	−15.18	65.26	65.76	67.54	7.92	100	9.62	4.95	31.52	73	35.57	1.4583	..
25839	14.6	− 3.52	31.30	32.48	34.28	12.96	103	7.65	4.65	24.09	39	34.78	1.4562	0.0
25706	45.6	−14.08	60.96	61.80	63.90	8.58	93	6.67	4.48	31.44	44	42.13	1.4578	..
25763	55.6	−17.16	72.24	73.40	75.24	7.11	109	8.99	4.46	30.84	72	37.29	1.4590	..
25827	0.0	0.00	19.78	21.96	23.86	17.38	100	6.82	4.65	25.96	46	34.34	1.4576	0.0
25664	*48.0	*−16.28	64.64	65.80	67.06	8.55	100	6.30	4.43	29.61	55	35.60	1.4590	..
25777	19.4	− 6.60	32.84	33.88	35.46	8.48	115	7.80	5.19	23.02	65	34.83	1.4573	0.0
25731	6.0	6.16	31.02	32.64	32.88	....	85	....	....	.....	37	37.92	1.4576	3.7
25611	*58.4	*−17.60	74.08	74.52	75.28	5.08	100	10.42	4.75	29.50	80	38.43	1.4586	..

* Polarized at 18° C.

No adulteration is reported, therefore, in the fifty-two samples sold as cocoa; of these, however, twenty-four were misbranded, and will be discussed in more detail later. Of the ten compound cocoas, three were legally labeled, five were misbranded and two were adulterated.

The adulterated samples were **25757**, *Ralston Health Club Cocoa,* which contained 55 per cent. of sugar, which was not declared, and was also high in ash and alkalinity; and **25731**, *Stollwerck's Milk Cocoa,* which contained glucose.

The chief difficulty with cocoa at the present time seems not to be adulteration but a very marked tendency among the manufacturers to exaggerate the food value, assimilabilty and digestibility of their products.

Nine samples were claimed on the label to be "double the strength" and three "triple the strength" of ordinary grades of cocoa. The strength of a cocoa depends primarily on the amount of cocoa fat it contains. The fifty-two straight cocoas averaged 24.85 per cent. fat; the nine samples claiming "double" strength ranged from 20.40 to 28.95 per cent. fat, average, 24.24; the three samples claiming "triple" strength ranged from 21.82 to 25.89; average, 24.07. These claims are therefore entirely unjustified.

Claims as to superior "solubility" likewise are exaggerated if not entirely false. Strictly speaking, there is no such thing as a "soluble" cocoa. It has been claimed that the use of alkali increases the solubility. In certain cases cocoas made by this process show a greater miscibility with water, but the fineness of the cocoa powder would seem to exert almost as much influence as the alkali treatment. In the eight samples, whose high ash and ash alkalinity clearly indicate that the Dutch process was used in their manufacture, the water-soluble matter at 100° C. ranged from 22.30 to 26.82; average, 24.99; the water-soluble organic matter ranged from 12.57 to 15.68; average, 13.96, and the relative sedimentation from 74 to 96; average, 87. These figures do not indicate any startling increase of solubility as compared with cocoa made by the usual process.

Misbranded Cocoas.

Below will be found our criticisms of the claims of the samples we have classed as misbranded.

25425, *Brewster's Royal Breakfast;* **25764**, *Dingwall's Economy Brand;* **25713**, *Grant's Special;* **25428**, *Isenburg's White Lily;* **25718**, *Capitol House Brand;* **25833**, *Sadd's Cocoa,* and **25793**, *Standard Cocoa,* all claimed to be "double the strength of ordinary grades of cocoa," which statement is untrue.

25652. *W. H. Baker's Best Cocoa.* "Owing to the removal of oil, it is certainly the most nutritious and wholesome cocoa now manufactured in the world." Less oil has been removed than in most cocoas, and it is not the "most nutritious."

25653. *Beckmann's Best Breakfast Cocoa.* "Triple the strength of cocoa as usually prepared. Preserving in their entirety . . . the nutritive properties of the natural bean." It is not "triple" strength, and the nutritive properties of the bean have not been entirely preserved, as over half of the fat has been removed.

25756. *Bensdorp's Royal Dutch Cocoa.* "Acknowledged by the leading authorities to be absolutely the purest cocoa made." It is not "the purest cocoa made," as it contains an excess of added alkali.

25738. *Boardman's Gold Star Brand Breakfast Cocoa.* "Double the strength of ordinary grades of cocoa." It is not "double" strength, and contains excessive ash and alkalinity.

25711. *Bushnell's Victoria Brand Pure Breakfast Cocoa.* "Is extra strong." It is not "extra strong."

25765. *Cahill's Health Cocoa.* "Being made by the special process it preserves . . . the nutritive properties and is rendered treble the strength of cocoas as usually prepared." It is not "treble" strength, and the nutritive properties are not preserved, as over half of the fat has been removed.

25665. *Oxford Brand Supreme Quality Breakfast Cocoa.* "Is extra strong." It is not extra strong.

25740. *Hall's Pure Soluble Cocoa.* "A nutritive and perfectly soluble food." "The cocoa having the oil removed, becomes at once a healthful aliment to the most delicate stomach." It is not "perfectly soluble," as 81 per cent. is insoluble; only a little over half of the oil has been removed.

25788. *Huyler's Cocoa.* "Soluble and digestible." It is not "soluble," as nearly 87 per cent. is insoluble.

25783. *Old Dutch Pure Soluble Breakfast Cocoa.* It is not "soluble," as over 78 per cent. is insoluble. It contains excessive ash and alkalinity.

25690. *Melbourne Australian Brand Pure Breakfast Cocoa.* "Solubility unequalled." "Pure soluble cocoa." Its "solubility" is not unequaled and it is not soluble, as nearly 80 per cent. is insoluble.

25720. *Pulver's Breakfast Cocoa.* "Cocoa is stronger and more economical than chocolate." The statement is untrue.

25811. *Rallion's Special Breakfast Cocoa.* "Double the strength of ordinary grades of cocoa." It is not "double" strength, and contains excessive ash and alkalinity.

25700. *Runkel's Pure Breakfast Cocoa.* "Superfluous oil removed . . . which thereby renders the powder more soluble in hot water or milk, and increases the strength three-fold compared with chocolate or similar preparations containing sugar, starch or arrowroot." This label is misleading as it implies that chocolate is commonly adulterated with sugar or starch, which is not the case. Its solubility in hot water is considerably less than that of the average cocoa examined.

25739. *Shartenberg and Robinson's Alliance Brand Pure Breakfast Cocoa.* "Extra strong." It is not "extra strong."

25775. *Suchard's Soluble Cocoa.* "Most of the cocoa butter has been eliminated." "Free from alkali." Stamped on side, "Prepared with alkali." It is not "soluble," as over 82 per cent. is insoluble. Most of the cocoa butter has not been "eliminated," as with one exception it contains more fat than any other sample examined. One portion of the label gives the impression that no alkali was used, while an obscure stamping indicates its use. It contains excessive ash and alkalinity.

25715. *Van Houten's Pure Soluble Cocoa.* "Manufactured by a special process which increases the mineral ingredients about 3½ per cent." This statement is correct. The sample, however, is not "pure" cocoa, as it contains excessive ash and alkalinity. It is not "soluble," as nearly 81 per cent. is insoluble.

25812. *Bartlett's Admiral Sweet Cocoa.* "It is readily soluble." It is not "readily soluble," as 30 per cent. is insoluble. It contains excessive ash and alkalinity.

25706. *A. and P. Lunch Cocoa.* "Is perfectly soluble." It is not "perfectly soluble," as nearly 40 per cent. is insoluble.

25839. *Croft's Swiss Milk Cocoa.* The Reichert-Meissl number indicates the presence of no milk fat.

25827. *Mullan's Gold Medal Breakfast Cocoa.* On side in small print "blended with 10 per cent. of prepared cereal." The compound nature of this preparation is not indicated with sufficient prominence.

25664. *Best Lunch Cocoa.* "It is perfectly soluble." It is not "perfectly soluble," as nearly 36 per cent. is insoluble. Its compound nature is not indicated in the brand name as required by law.

Accuracy as to Claimed Weight.

Thirty-five samples claimed a definite weight on the label. In general these claims were satisfied, there being a slight tendency to over-weight. In three samples, however, there were deficiencies of 12, 18 and 20 grams in half-pound packages, equal to from 5 to 9 per cent. Two of these deficiencies occurred in samples bearing the same serial number.

CREAM.

Forty samples were bought at stores in ten cities. There being no cream standard in this state almost any percentage of butter fat may be expected to be found in cream.* The samples ranged from 18.02 to 56.47 per cent. fat, the price for these two extreme samples being the same, 15 cents per half pint. The average content of fat was 37.33 per cent.

Two samples contained sucrate of lime according to Baier and Neumann's test.†

Two samples, both stated to come from Patty's Dairy, and sold by G. H. Moorey and Bull's Head Market, Bridgeport, contained formaldehyde.

In a few samples determinations of ash, alkalinity of ash and lime were made. The results follow:

No.	Ash.	Alkalinity of 100 gms. Ash, cc. $\frac{N}{10}$ H_2SO_4.	Lime.
25870	0.474	8.37	0.105
25871	0.524	10.97	0.120
25872	0.495	13.47	0.130
25873	0.408	7.64	0.089

* At the last session of the Connecticut legislature 16 per cent. was adopted as the minimum standard in this state.

† Zeit. Nahr. Genussm., *16*, 51.

Table XII.—Cream Sampled at Stores.

Station No.	Producer.	Dealer.	Fat.
		Bridgeport.	
26781	*Mitchell Dairy	Public Market, 731 E. Main St.	55.69
26782	Dewhirst Dairy	R. W. Parrott	35.28
26783	" "	L. Isenberg	35.97
26784	†Patty's Dairy	G. H. Moorey	47.33
25887	Mitchell Dairy	Butter Store, 1360 Main St.	54.45
25888	Dewhirst Dairy	Public Market, State and Bank Sts.	34.91
25889	Roger Farm Dairy	Roger Farm Dairy	42.89
25890	Borden's Condensed Milk Co.	Borden's Milk Depot	36.57
26913	Mitchell Dairy	R. T. Whiting	55.75
26921	†Patty's Dairy	Bull's Head Market	45.78
		Hartford.	
26829	Bryant & Chapman	C. N. Dodge	48.34
26830	" "	C. H. Strong	48.27
26831	" "	Boston Grocery	48.81
26832	" "	Tracy's Grocery	48.65
		Meriden.	
26874		David Higgins	42.59
26875		L. C. Brown	27.55
26876	Meriden Dairy	City Market	36.00
26877	Oriental Dairy (Booth)	Creamery, 175 Pratt St.	35.67
		Middletown.	
26895	Millbrook Farm Dairy Co.	Millbrook Dairy	38.10
26896	" " " "	W. J. Trevithick	20.00
		New Britain.	
26819	Hall's Dairy	Miller & Olsen	56.47
26820	Avery's Dairy	Sovereign Trading Co.	26.82
		New Haven.	
25870	C. E. Smith	S. S. Adams	36.22
25871	Whitneyville Creamery	M. C. Dingwall	31.55
25872	*M. B. & F. S. Hubbell	F. J. Markle Co., Chapel St.	37.22
25873	Valley Farm Creamery Co.	Paul Jente & Bros.	44.91
25884	Elm Tree Dairy	F. J. Markle Co., Congress Ave.	20.50
25885	Valley Farm Creamery Co.	W. G. Graves & Son	33.07
25886	Oakhurst Farm	E. J. Cullom	41.25
		New London.	
26888	Thompson's Dairy	Schwaner's Market	22.59
26889	Brigham Dairy	Delicatessen, 460 Bank St.	24.73
26890	Williams' Dairy	F. H. Davis & Co.	18.02
		Norwich.	
26868	Palmer's Dairy	C. W. Hills	25.20
26869	" "	H. D. Rallion	21.94
		Stamford.	
26805		Samuel Price Co.	35.73
26806	J. H. Bedell Dairy	Stamford Grocery Co.	48.21
		Waterbury.	
26845	Dennison's Dairy	Duesler Bros. Co.	31.39
26846	" "	Woodruff's Grocery	31.53
26847	Smith's Dairy	Hewitt's Grocery	25.97
26848	Worden's Dairy	Model Market Co.	41.20

* Contained sucrate of lime. † Contained formaldehyde.

FRUIT JUICES AND BOTTLED SYRUPS.

Grape Juice. Seven samples were examined, all of which purported to be pure grape juice, except **25109**, which admitted the addition of a small amount of cane sugar. The samples were of normal and quite uniform composition, except **25107**, which contained almost no sugar. Five of the samples contained no alcohol, one a trace, and **25111** 0.62 per cent. by weight, although it was labeled "strictly non-alcoholic." None of the samples contained sodium benzoate, salicylic acid or saccharin, nor any foreign color.

Lime Juice. Seven samples were examined. In all but one the presence and amount of a chemical preservative was declared on the label and was found on analysis in substantially the amount stated. **24956**, **24991** and **25079** contained 0.10 per cent. of sodium benzoate, as was stated on the label, and **25078**, **25083** and **24957** contained sulphur dioxide not exceeding the amount stated on the label. **24958** contained no chemical preservative.

24956 and **24991** indicated on the label, though not in the brand name, that they were diluted juices, the former claiming only 33 per cent. and the latter 60 per cent. of lime juice. Analysis showed these statements to be correct, although the proper label of such preparations should be "Diluted Lime Juice." Both the solids and acidity indicated their inferior quality. The other five samples were quite uniform in composition, the specific gravity ranging from 1.0337 to 1.0384, the solids from 7.32 to 8.49 and the acidity from 10.50 to 11.25. No added sugar, saccharin, or artificial color was found in any case. **24991** alone showed a trace of alcohol.

Orange Preparations. The labels showed that three of the four samples were compounds, all containing artificial color, and one, sodium benzoate. **25088** contained neither a preservative nor artificial color. None of the samples contained glucose, saccharin, or alcohol.

Raspberry Syrup. Three of the samples were correctly labeled as containing artificial color and sodium benzoate. **25104** was adulterated, as it contained salicylic acid and artificial color, neither of which was declared on the label. None of the samples contained glucose or saccharin. **25091** contained 0.82 per cent. alcohol, the other samples only traces.

TABLE XIII.—FRUIT JUICES AND SYRUPS.

Station No.	Brand.	Price per bottle, cents.	Specific gravity at 15.6° C.	Alcohol by weight.	Solids.	Polarization. Direct.	Polarization. After Inversion.	Polarization. Temperature, ° C.	Acidity. (1 gm. = cc. $\frac{N}{10}$ Ba (OH)$_2$.)	Preservatives. Sodium Benzoate.	Preservatives. Salicylic Acid.	Preservatives. Sulphur dioxide. (Mgms. per 100 gms. of juice.)	Color.
	Grape Juice.												
25110	Duffy's Grape Juice Sterilized Unfermented. American Fruit Prod. Co., Rochester, N. Y.	25	1.0754	0	17.02	−5.0	−5.1	20	1.35	0	0	....	Natural.
25121	Armour's Grape Juice, "Top-Notch" Brand, Unfermented. Armour & Co., Chicago	25	1.0752	0	17.14	−4.6	−5.1	20	1.40	0	0	....	Natural.
25108	Fenner's Chautauqua Grape Juice, Unfermented. The Fenner Grape Juice Co., Westfield, N. Y.	10	1.0740	Tr.	16.63	−5.7	−6.6	20	1.05	0	0	....	Natural.
25107	Walker's Grape Juice. The Grape Products Co., North East, Pa.	10	1.0701	0	15.92	±0.0	−0.7	20	1.50	0	0	....	Natural.
25109	[1] Howland's Grape Juice. The Howland Dry Goods Co., Bridgeport	20	1.0782	0	17.53	−5.0	−5.9	20	1.30	0	0	....	Natural.
25111	Strictly Non-Alcoholic Grape Juice Catawba, Unfermented. Lake Erie Grape Juice Co., Sandusky, O.	30	1.0819	0.62	18.94	−7.0	−7.5	20	1.35	0	0	....	Natural.
25106	Millen's Unfermented Grape Juice. Millen Grape Juice Co., Watkins, N. Y.	10	1.0762	0	17.31	−5.4	−5.5	20	1.50	0	0	....	Natural.
	Lime Juice.												
25078	[2] Stone's Lime Fruit Juice. Finsbury Distillery Co., London	35	1.0384	0	8.49	±0.0	±0.0	22	10.50	0	0	*21.8	Natural.
25083	[3] Imperial West Indian Lime Juice. T. A. Hedley, New York	25	1.0340	0	7.32	+0.2	±0.0	22	11.25	0	0	*9.0	Natural.
24956	[4] West India Lime Juice. J. P. & D. Plummer, Boston	10	1.0118	0	2.78	±0.0	±0.0	22	3.34	*0.10	0	....	Natural.

Notes from labels. [1] "Small amount of cane sugar added." [2] "Preserved with 0.04% sulphurous acid." [3] "Preserved with 0.03% sulphurous acid." [4] "Prepared from lime juice, 33%, water, 66%, 0.10% benzoate of soda." * Declared on the label.

TABLE XIII.—FRUIT JUICES AND SYRUPS—*Continued.*

Station No.	Brand.	Price per bottle, cents.	Specific gravity at 15.6° C.	Alcohol by weight.	Solids.	Polarization. Direct.	Polarization. After Inversion.	Polarization. Temperature, °C.	Acidity. (1 gm. = cc. $\frac{N}{10}$ Ba $(OH)_2$.)	Preservatives. Sodium Benzoate.	Preservatives. Salicylic Acid.	Preservatives. Sulphur dioxide. (Mgms per 100 gms. of juice.)	Color.
	Lime Juice (continued).												
24957	[5] Rose's Prepared West India Lime Juice, Unsweetened. L. Rose & Co., London..........	35	1.0337	0	8.01	−0.1	± 0.0	22	10.92	0	0	*3.1	Natural.
24958	Rowat's Thistle Brand Unsweetened Lime Juice. Rowat & Co., Glasgow......................	30	1.0371	0	8.31	+0.2	± 0.0	22	11.04	0	0	0	Natural.
24991	[6] Banner Brand Jamaica Lime Juice. Simpson Spring Co., South Easton, Mass...............	14	1.0221	Tr.	5.04	+0.1	+ 0.11	22	7.00	*0.06	0	....	Natural.
25079	[7] Victor Jamaica Lime Juice. Simpson Spring Co., South Easton, Mass.	25	1.0350	0	7.76	+0.2	+ 0.22	22	10.50	*0.11	0	....	Natural.
	Orange Preparations.												
25092	[8] Celebrated Clicquot Club Blood Orange. The Clicquot Club Co., Millis, Mass...............	13	1.0498	0	11.08	−0.5	− 3.85	20	....	0	0	....	*Artificial.
25080	[9] C. & M. Orangeade. National Fruit Products Co., Boston	25	1.3287	0	65.88	+0.9	−17.60	27	....	*0.07	0	....	*Artificial.
25101	[10] Simpson Spring Gold Label Orange. Simpson Spring Co., South Easton, Mass	10	1.0378	0	9.44	+0.8	− 2.75	20	....	0	0	....	*Artificial.
25088	Blood Orange Nectar. Steele Bros., New Britain..	15	1.2182	0	44.73	−10.0	−14.10	27	....	0	0	....	Natural.
	Raspberry Syrup.												
25081	[11] C. & M. Fruit Syrups, Raspberry. Curtis & Moore, Boston............................	25	1.2871	Tr.	57.33	−16.0	− 16.1	27	....	*0.04	0	....	*Artificial.

Notes from labels. [5] "Preserved with 1.5 grains sulphur dioxide." [6] "A mixture of natural lime juice, 60%, Simpson spring water, 40%, 0.10% sodium benzoate." [7] "0.10% sodium benzoate." [8] "Artificial color." [9] "Preserved with $\frac{1}{10}$ of 1% Benzoate of Soda. Artificially colored." [10] "Artificially colored." [11] "Preserved with 0.10% benzoate of soda; harmless color." * Declared on the label.

TABLE XIII.—FRUIT JUICES AND SYRUPS—*Continued.*

Station No.	Brand.	Price per bottle, cents.	Specific gravity at 15.6° C.	Alcohol by weight.	Solids.	Polarization. Direct.	Polarization. After Inversion.	Polarization. Temperature, ° C.	Acidity. (1 gm. — cc. $\frac{N}{10}$ Ba (OH)$_2$.)	Preservatives. Sodium Benzoate.	Preservatives. Salicylic Acid.	Preservatives. Sulphur dioxide. (Mgms. per 100 gms. of juice.)	Color.
	Raspberry Syrup (continued).												
25091	[12] True Fruit Syrup Raspberry. John Matthews, New York	35	1.3157	0.82	60.24	−17.1	−17.6	27	....	*0.02	0	....	*Artificial.
25094	[13] Raspberry Syrup. Strohmeyer & Arpe Co., New York	25	1.3416	Tr.	66.96	4.4	−18.7	27	....	*0.03	0	....	*Artificial.
25104	Magnolia "Hallonsaft" Raspberry Syrup. The Swedish Importing Co., Worcester, Mass.	25	1.3383	Tr.	66.17	− 8.0	−18.9	27	....	0	Yes	....	Artificial.
	Strawberry Syrup.												
25102	[14] Strawberry Syrup Helvetia. Imported by Deforth Bros., New York	45	1.3358	Tr.	64.34	−19.0	−20.79	20	....	0	Yes	....	*Artificial.
25053	Superior Flavored Strawberry Syrup. Eagle Manufacturing Co., New York	10	1.3193	0	60.92	+51.2	+44.99	22	....	0	0	....	Artificial.
25090	[12] True Fruit Syrup Strawberry. John Matthews, New York	35	1.2170	0	56.75	−16.6	−18.81	22	....	*0.06	0	....	*Artificial.
24975	[15] C. & M. Fruit Syrups, Strawberry. National Fruit Products Co., Boston	24	1.3288	0	56.10	− 8.6	−19.69	20	....	*0.04	0	....	Artificial.
25086	Standard Strawberry Syrup. I. Calvin Shafer Co., New York	60	1.2704	3.64	54.99	−15.8	−16.50	22	....	0	0	....	Natural.
25068	[16] "True Fruit" Strawberry Syrup. J. Hungerford Smith Co., Rochester, N. Y.	25	1.3381	0	60.56	−17.4	−19.25	22	....	*0.05	0	....	*Artificial.

Notes from labels. [12] "Contains harmless color and less than ⅛ of 1% benzoate of soda." [13] "Addition of less than 0.10% benzoate of soda and trifle coloring and citric acid." [14] "Only prepared with sugar, artificially colored." [15] "Preserved with 0.10% benzoate of soda." [16] "Contains vegetable color and less than $\frac{1}{10}$ of 1% benzoate of soda." * Declared on the label.

TABLE XIII.—FRUIT JUICES AND SYRUPS—*Concluded.*

Station No.	Brand.	Price per bottle, cents.	Specific gravity at 15.6° C.	Alcohol by weight.	Solids.	Polarization. Direct.	Polarization. After Inversion.	Polarization. Temperature, ° C.	Acidity. (1 gm. = cc. $\frac{N}{10}$ Ba $(OH)_2$.)	Preservatives. Sodium Benzoate.	Preservatives. Salicylic Acid.	Preservatives. Sulphur dioxide. (Mgms. per 100 gms. of juice.)	Color.
	Miscellaneous Preparations.												
25085	[17] C. & M. Fruit Syrups, Ambrosia Punch. National Fruit Products Co., Boston	24	1.3106	0.64		−17.5	−18.90	20	....	*0.04	0	....	Artificial.
25105	Duffy's Apple Juice, Sterilized, Non-Alcoholic. American Fruit Prod. Co., Rochester, N. Y.	20	1.0599	Tr.	11.55	− 8.0	− 8.69	20	....	0	0	....	Natural.
25112	[18] Bittermead. Jacob House & Son, Buffalo, N. Y.	15	1.0402	0	8.26	− 0.3	− 2.53	20	....	0	0	....	*Caramel.
24999	Jamaica Ginger Fruit Cordial, Non-Alcoholic. G. C. Hines & Co., Boston	25	1.2342	4.24		−13.6	−14.30	20	....	0	0	....	Natural.
25103	[19] Brooke's Finest Lemos, Sweetened Lemon Juice. C. M. Brooke & Sons, New York	45	1.1108	0.54	22.71	− 6.0	− 6.05	22	5.00	*0.08	0	....	Artificial.
25093	[20] Celebrated Clicquot Club Lemon Soda. The Clicquot Club Co., Millis, Mass.	13	1.0538	0	11.70	− 0.3	− 2.75	20	....	0	0	....	*Artificial.
25113	[21] Marrowfood. Marrowfood Co. of New York, N. Y.	25	1.0429	0	9.13	+ 1.8	− 2.86	20	....	0	0	....	
25084	[22] C. & M. Fruit Syrups, Pineapple. National Fruit Products Co., Boston	24	1.3269	0	64.90	+ 3.6	−18.30	27	....	*0.04	0	...	Natural.

Notes from labels. [17] "Preserved with 0.10% benzoate of soda." [18] "Formula: Fluid extract calamus, comp. tinct. gentian, tinct. angostura bark, ext. vanilla bean, prune juice, sol. essence coriander, sol. essence anise, burnt sugar, syrup, fruit acid, carbonated water. Each ½ pint contains 10 minims of the medicinal and flavoring elements.' [19] Preserved with 0.10% benzoate of soda. (Above analysis represents only the liquid-portion of the sample, 986 gms., 11 gms. of pulp being filtered off." [20] "Artificial color." [21] "Contains with other vegetable tonics Iron in the most assimilable form and the right proportion." [22] "Preserved with 0.10% benzoate of soda," *Declared on the label.

Strawberry Syrup. The labels of four of the samples stated the presence of either artificial color or sodium benzoate, or both. **25102** contained salicylic acid, which was not declared, also a trace of alcohol. **25053** contained glucose and artificial color, not declared; **24975**, artificial color, not declared, and **25086**, 3.64 per cent. of alcohol.

Miscellaneous Preparations. **25085** contained sodium benzoate, declared, and artificial color, not declared. **24990** was misbranded "non-alcoholic," as it contained 4.24 per cent. of alcohol.' **25103** contained sodium benzoate, declared, and artificial color, not declared. It contained only 3.20 per cent. of acid, calculated as citric, less than half the standard's requirement.

ORANGE SUGAR.

25087. *Orange Sugar,* for making orangeade. Boyd Fruit Sugar Co., New York. "A compound of pure refined sugar, colored, acidulated and flavored with the best orange product." The sample polarized at 20° C. direct + 96.0, after inversion — 34.1, equivalent to 98.1 per cent. cane sugar. No preservatives were found, but it was artificially colored and, therefore, was adulterated.

GLUTEN PREPARATIONS.

The U. S. standard for gluten flour requires it to be "the clean, sound product made from flour by the removal of starch, and contains not less than five and six-tenths (5.6) per cent. of nitrogen and not more than ten (10) per cent. of moisture."

With the exception of *Granola* and *"C B X,"* all the samples examined were sold as gluten preparations and should conform to this standard. *40% Gluten Biscuit* contained more protein than guaranteed. *No. 2 Proto Puffs* was very rich in protein and was relatively low in starch. *Dr. Johnson's Educator Standard Gluten Flour, Hoyt's Gum Gluten Granules, Hoyt's Gum Gluten Breakfast Food, Hoyt's Gum Gluten Flour* and *Hoyt's Gum Gluten Noodles,* all exceeded the requirements of the standard. *Educator Gluten Cookies* was 1.37 per cent. low in nitrogen, and had a very high fat content. The label claimed "a minimum of starch and a high protein content. Delight to diabetics." Neither of the first claims is true, and a material con-

TABLE XIV.—GLUTEN PREPARATIONS.

Station No.	Brand.	Water.	Ether Extract.	Crude Fiber.	Ash.	Protein (N x 6.25).	Nitrogen-free Extract.	Starch.	Nitrogen.
25122	40% Gluten Biscuit. Battle Creek Sanitarium Food Co., Battle Creek, Mich. .	8.04	1.20	0.17	1.63	43.25	45.71	35.28	6.92
25129	Granola. Battle Creek Sanitarium Co., Battle Creek, Mich.	6.14	0.80	0.64	2.34	13.88	76.20	45.23	2.22
25132	No. 2 Proto Puffs. The Health Food Co., N. Y.	8.15	1.48	0.22	1.79	52.38	35.98	27.18	8.38
25133	C B X (Cold Blast Extra Flour), 25% Proteine. The Health Food Co., New York	8.71	0.87	0.15	0.51	10.13	79.63	68.85	1.62
25123	Dr. Johnson's Educator Standard Gluten Flour. Johnson Educator Food Co., Boston	7.32	1.40	0.23	0.82	40.13	50.10	40.91	6.42
25130	Educator Gluten Cookies. Dr. Wm. L. Johnson	4.75	15.98	0.31	2.73	26.44	49.79	37.80	4.23
25124	Hoyt's Gum Gluten Granules. The Pure Gluten Food Co., New York	7.48	1.55	0.31	1.46	45.50	43.70	32.27	7.28
25125	Hoyt's Gum Gluten Breakfast Food. The Pure Gluten Food Co., New York.	7.48	1.33	0.38	1.23	37.81	51.77	37.89	6.05
25126	Hoyt's Gum Gluten Flour. The Pure Gluten Food Co., New York	8.12	1.62	0.19	1.04	38.25	50.78	42.35	6.12
25127	Hoyt's Gum Gluten Noodles. The Pure Gluten Food Co., New York	8.26	2.36	0.21	1.13	36.56	51.48	42.03	5.85
25128	Gluten Flour (in bulk). D. M. Welch & Son, New Haven	8.73	1.00	0.17	0.70	18.00	71.40	61.61	2.88

taining 50 per cent. of nitrogen-free extract, of which nearly 38 per cent. is starch, may be a very dangerous "delight to diabetics."

The label of *Granola* claimed that "one pound more than equals one pound of best beef in nutrient value." This statement would be equally true of almost any food rich in carbohydrates, and is not a virtue peculiar to this particular preparation. In roast beef about 73 per cent. of the nutriment is due to protein, and 27 per cent. to fat. In *Granola,* only 15 per cent. is due to protein, less than 1 per cent. to fat, and about 84 per cent. to carbohydrates. The comparison of foods as to value, without considering the nature of the nourishment in them, is absolutely futile and misleading.

"C B X" Cold Blast Extra Flour was clearly misbranded, as it claimed 25 per cent. of protein, and contained only 10.13. It differed very little in composition from ordinary flour, and yet was sold at the rate of 15 cents per pound.

Gluten Flour **25128**, sold by D. M. Welch & Son, contained only 2.88 per cent. of nitrogen, about one-half of the amount required by the standard.

The following tabulation shows the cost per package of the different samples, together with the calculated cost per pound.

No.	Net Weight. gms.	Cost per Package. cts.	Cost per Pound. cts.
25122	244	40	74
25129	370	10	12
25132	161	25	71
25133	2350	75	15
25123	1358	38	13
25130	259	25	24
25124	457	20	20
25125	465	20	20
25126	464	15	15
25127	118	15	58
25128	907	16	8

ICE CREAM.

The U. S. standard for ice cream requires a minimum of 14 per cent. of milk fat. Thus far this State has adopted no standard for this product.

This present investigation was undertaken because of sensational reports as to the quality of ice cream sold in New Haven. It was stated that some ice cream contained no fat whatever. Twenty-one samples were analyzed, which contained from 2.0 to 19.0 per cent. of fat; average, 8.56. Only two samples satisfied the U. S. standard. Even based on a standard of 8 per cent. fat, adopted by several of the states, much of the ice cream sold in New Haven is distinctly inferior in fat content. While it is true that some of the lower grade ice cream sold for a considerably lower price, from twenty to thirty cents per quart, this reduction in price, for poorer cream, was far from universal, forty cents being charged for ice cream containing such divergent amounts of fat as 2.0 and 19.0 per cent.

There is some doubt as to the proper minimum standard for fat in ice cream. It would seem, however, that some distinction in name should be used for products of such diverse composition as those here reported.

No boric acid or formaldehyde was found in any sample. All but five of the samples reacted for gelatin.

TABLE XV.—ICE CREAM.

Station No.	Manufacturer.	Flavor.	Cost per qt. cts.	Fat. Per cent.
26879	Boston Confectionery Co...	Vanilla	40	19.0
26859	F. A. Atwood Co.	"	40	18.5
26795	D. Boschen................	"	40	11.5
26791	New Haven Dairy..........	"	40	11.0
26860	Chocolate Shop............	"	40	11.0
26880	Greek-Amer. Ice Cream Co..	"	30	11.0
26792	The Semon Ice Cream Co....	"	40	10.5
26790	D. Cummings...............	"	40	10.0
26789	Hillman..............	"	40	10.0
26788	Olympia Candy Co..........	"	30	9.75
26794	Hasselbach	"	50	9.5
26897	*B. Frankel.................	Vanilla and Chocolate....	40	9.0
26793	Hauff......................	Chocolate and Water Ice..	40	7.5
26878	Fred Ross..................	Vanilla..................	40	6.5
26858	The Harris-Hart Co.........	Vanilla and Chocolate....	40	6.0
26907	J. H. Keyes...............	Vanilla..................	30	5.5
26908	Rubins....................	"	20	4.0
26910	†New York Ice Cream Co....	Vanilla and Strawberry...	40	3.0
26909	New Haven Candy Kitchen.	Vanilla..................	40	2.5
26898	Peter Muti............. ...	"	40	2.0
26911	Deviveo	"	25	2.0

*Statement of dealer, Alfonso Elposito. †Statement of dealer, Andrew Esposito.

ICE CREAM POWDERS.

Four samples, all made by the same manufacturer, were analyzed. They were as follows:

25070. *Jell-O Ice Cream Powder, Chocolate, a Mixture.* The Genesee Pure Food Co., LeRoy, N. Y.

25071. *Jell-O Ice Cream Powder, Strawberry, a Mixture, Color and Flavor artificial.*

25072. *Jell-O Ice Cream Powder, Vanilla, Flavor Compounded, a Mixture.*

25073. *Jell-O Ice Cream Powder, Lemon, a Mixture, Color artificial.*

As the labels indicated, with the exception of **25070,** these materials were all more or less artificial in either flavor or color, or both. The chocolate powder contained less sugar and more ash and nitrogen than the others. The low percentages of nitrogen in **25071, 25072** and **25073,** proved the absence of any appreciable amount of gelatine.

The analyses are given below.

	25070	25071	25072	25073
Water	0.82	0.52	0.52	0.52
Ash	0.53	0.25	0.26	0.26
Sucrose	91.80	97.60	96.20	96.60
Nitrogen	0.25	0.02	0.02	0.02

MILK.

No general examination of milk has been made at this station during the past five years, although within that time about 650 samples have been examined for the dairy commissioner, milk inspectors and others. This year, 124 samples were bought from stores in twelve of the cities of the state, between July 15 and August 20. While this number is not large, and a few of the larger towns had to be omitted because of their distance from New Haven, it is believed that the analyses fairly represent the quality of the milk sold at stores during the time named. In most cases the samples were bought in the bottles delivered from the various dairies, but in twenty-seven cases the samples were dipped from the can by the dealer. This introduces the possible error of improper sampling, but with a very few exceptions these dipped samples compare very favorably with the bottled milk in quality. In certain stores, where dipped samples were bought, extremely dirty conditions prevailed, and it would seem that the ordinances against this practice, now in effect in certain cities, should become universal throughout the state.

The examination has been entirely chemical, chiefly to learn how far store milk conformed with the legal standard, and to determine whether or not chemical preservatives and artificial coloring were used. The legal standard for milk in this state requires a minimum of 11.75 total solids, 8.50 solids not fat, and 3.25 fat. The use of preservatives or coloring is, of course, illegal.

A summary of the results is given in Table XVI, and the detailed analyses in Table XVII. From the summary it appears that of the one hundred and twenty-four samples examined, only forty-two fully met the legal standard, while thirty-three were below standard in solids, seventy-nine in solids not fat, and fifteen in fat. On the average, the samples contained 12.27 per cent. solids and 3.92 per cent. fat.

TABLE XVI.—SUMMARY OF ANALYSES OF MILK BY CITIES.

City.	Number of Samples.	Average percentage total solids.	Average percentage fat.	Below 11.75 per cent. total solids.	Below 8.50 per cent. solids not fat.	Below 3.25 per cent. fat.	Contain boric acid (borax).	Contain formaldehyde.
Bridgeport	16	11.41	3.56	8	15	6	0	0
Danbury	8	11.54	3.40	6	8	3	0	0
Hartford	20	13.04	4.29	0	3	0	0	0
Meriden	4	12.56	4.07	0	2	0	0	0
Middletown	4	11.79	3.65	3	4	0	0	0
New Britain	5	13.16	4.36	0	0	1	0	0
New Haven	28	11.98	3.71	11	25	2	0	0
New London	7	13.09	4.57	0	4	0	0	0
Norwalk	9	12.80	4.31	1	2	2	0	0
South Norwalk	7	11.95	3.76	1	6	0	0	0
Stamford	7	12.31	3.90	1	4	0	0	0
Waterbury	9	12.32	3.94	2	6	1	0	1
Total	*124*	.....	....	*33*	*79*	*15*	*0*	*1*

One sample was found to be skimmed milk and twelve samples had been watered. A number of other samples, which showed a relatively high fat content for the amount of solids present, gave indications of watering, but the methods used could not determine this with certainty. One sample contained formaldehyde; no artificial color was found in any case.

The sample of skimmed milk was sold by a bakery (name unknown) at 1054 East Main Street, Bridgeport.

The following dealers sold watered milk:

G. H. Campana, Bridgeport.
W. B. Meyer, Bridgeport.
Delicatessen, 491 Water Street, Bridgeport.
C. M. Bassett, Bridgeport.
J. Schiene, Bridgeport.
David Schneider, Bridgeport.
Angelo Risi, Bridgeport.
Mrs. B. Schultz, New Haven.
J. Beschel, New Haven.
Justin Holden, Norwalk.
L. Joseloff, South Norwalk.
A. Sirica, Waterbury.

TABLE XVII.—MILK SAMPLED AT STORES.

Station No.	Producer.	Dealer.	Specific gravity at 60° F.	Total solids.	Solids not fat.	Fat.	Refraction of Copper Serum at 20° C
		Bridgeport.					
26773		S. Sumelovitz	31.1	12.53	8.63	3.9	....
26774	*†	Bakery, 1054 E. Main St.	30.1	10.90	8.10	2.8	37.0
26775	‡Wilson Dairy	G. H. Campana	26.9	10.37	7.37	3.0	35.0
26776	*	D. E. McNamara	29.9	12.76	8.26	4.5	....
26777	‡Burr's Dairy	W. B. Meyer	28.0	10.87	7.67	3.2	35.9
26778	‡Hoyt's Farm Dairy	Delicatessen, 491 Water St.	27.8	11.50	7.80	3.7	35.4
26779	*‡	C. M. Bassett	27.1	11.97	7.57	4.4	35.5
26780	‡Bernstein Dairy	J. Schiene	24.4	9.61	6.61	3.0	33.1
26912	Dewhirst Dairy	Geo. Cleveland	29.7	11.81	8.41	3.4	....
26914	" "	Peoples Dairy	30.3	12.37	8.47	3.9	....
26915	‡H. Polokoff, North Main Dairy	David Schneider	25.9	10.13	7.13	3.0	35.0
26916	‡Randall's Dairy	Angelo Risi	27.2	10.45	7.35	3.1	35.8
26917	Roger Farm Dairy	Roger Farm Dairy	28.2	11.60	7.80	3.8	36.5
26918	Mitchell's Dairy	G. C. Stewart	30.0	11.80	8.20	3.6	....
26919	E. R. Burr	Thos. Sullivan	28.5	11.77	7.87	3.9	36.4
26920	Borden's Condensed Milk Co.	Borden's Milk Depot	29.6	12.20	8.40	3.8	....
		Danbury.					
26899	Haviland's Dairy	P. McGrath	30.9	12.34	8.34	4.0	....
26900	City Creamery	Michael De Palmi	29.4	11.46	7.96	3.5	36.5
26901	Hatch Dairy	Gigliotti Bros.	28.9	10.98	7.98	3.0	36.0
26902	Danbury Creamery & Milk Ster. Co.	Fruit Store, 141 Main St.	29.5	11.19	7.99	3.2	36.5
26903	Rogers Dairy	Peterson's Market	30.3	11.98	8.38	3.6	....
26904	City Creamery	Joe Solomon	30.1	11.05	8.05	3.0	36.6
26905	" "	Liberty St. Market	30.2	11.68	8.18	3.5	37.5
26906		F. Gigliotti	30.7	11.62	8.22	3.4	37.3

* Dipped from can. † Skimmed. ‡ Watered.

TABLE XVII.—MILK SAMPLED AT STORES—*Continued.*

Station No.	Producer.	Dealer.	Specific gravity at 60° F.	Total solids.	Solids not fat.	Fat.	Refraction of Copper Serum at 20° C.
		Hartford.					
26821	Cooley's Dairy	Tracy's Grocery	32.3	13.38	8.98	4.4	....
26822	Burnham's Dairy	I. Gellis	31.2	13.05	8.65	4.4	....
26823	Bryant & Chapman Milk Co.	J. Carosino & Co.	30.1	12.45	8.45	4.0	....
26824	....	Tom Rates	30.5	13.11	8.51	4.6	....
26825	Botticello Bros. Dairy	Geo. Bemanto	30.9	12.95	8.45	4.5	....
26826	Anderson W. Hart Dairy	Public Market, 1143 Main St.	32.3	13.41	9.21	4.2	....
26827	J. Rosenbaum	Allyn Bros.	33.2	14.35	9.45	4.9	....
26828	Bryant & Chapman Co.	C. N. Dodge	30.0	12.43	8.43	4.0	....
26833	Christensen Dairy	H. Hershman	30.5	13.46	8.56	4.9	....
26834	Cloverdale Farm	M. Friedman	32.5	12.95	8.85	4.1	....
26835	Gober's Dairy	N. Barrillo	31.0	12.72	8.62	4.1	....
26836	Bryant & Chapman	P. George	30.9	12.52	8.52	4.0	....
26837	Epstein's Dairy	Windsor St. Grocery	31.1	12.98	8.88	4.1	....
26838	Botticello Bros. Dairy	Frank Denaldo	31.1	13.13	8.63	4.5	....
26839	Hartford Dairy	S. Lipman	30.7	12.82	8.62	4.2	....
26840	J. J. Felth	Scandia Market Co.	32.6	12.78	8.88	3.9	....
26841	Goldstein's Dairy	F. Kabinovitz	31.2	12.66	8.56	4.1	....
26842	Clover Farm Dairy	Max Ziky	31.4	12.79	8.69	4.1	....
26843	J. J. Felth	F. Rates & Co.	32.6	13.91	9.21	4.7	....
26844	Otto Jensen	D. F. Burns Co.	31.9	13.00	8.90	4.1	....
		Meriden.					
26870	*	R. W. Mueller	34.7	12.54	8.94	3.6	....
26871	Hourigan & Son	Julius Augur	28.5	12.12	8.12	4.0	....
26872	....	Meriden Dairy	30.8	12.45	8.55	3.9	....
26873	David Higgins	David Higgins	30.0	13.14	8.34	4.8	....

* Dipped from can.

TABLE XVII.—MILK SAMPLED AT STORES—*Continued.*

Station No.	Producer.	Dealer.	Specific gravity at 60° F.	Total solids.	Solids not fat.	Fat.	Refraction of Copper Serum at 20° C.
		Middletown.					
26891	Gilbert's Dairy	J. H. Cone	29.6	11.73	7.93	3.8	36.3
26892	Tucker's Dairy	Kellery's Grocery	29.8	12.47	8.47	4.0	....
26893	Millbrook Farm Dairy Co.	W. J. Trevithick	29.8	11.56	8.16	3.4	36.5
26894	Millbrook Farm Dairy Co.	Millbrook Dairy	29.7	11.41	8.01	3.4	36.6
		New Britain.					
26814	....	Gaffney Bros.	32.5	11.86	8.76	3.1	....
26815	North End Dairy	L. Protass	31.5	13.02	8.72	4.3	....
26816	Wm. Caudran	G. L. Geer	31.0	12.92	8.62	4.3	....
26817	....	Holcombe & Fricke	29.3	14.41	8.91	5.5	....
26818	....	Wray & Co.	32.0	13.58	8.98	4.6	....
		New Haven.					
25857	Guss Pierson	F. A. White	30.5	11.30	8.40	2.9	37.6
25858	‡§Wm. Neubig	Mrs. B. Schultz	27.0	11.75	7.85	3.9	35.8
25859	Cherry Hill Dairy	J. J. Sullivan	31.5	12.86	8.96	3.9	38.0
25860	J. F. Dunn	The Waite Grocery	30.0	11.78	8.28	3.5	37.3
25861	*	Charles Geider	29.8	11.70	8.40	3.3	37.4
25862	*	A. Duhan	30.0	11.58	8.28	3.3	37.5
25863	Whitneyville Creamery	F. A. Voelker	29.6	11.89	8.39	3.5	37.0
25864	W. H. Davis	H. Ginzberg	30.9	12.31	8.41	3.9	38.0
25865	G. B. Hall	C. F. Clark	29.3	11.94	8.14	3.8	37.0
25866	Elm Tree Dairy	Kohn Bros.	28.9	12.49	8.19	4.3	37.1

* Dipped from can. ‡ Watered. § Contained a shrimp and a grasshopper's thigh.

TABLE XVII.—MILK SAMPLED AT STORES—*Continued.*

Station No.	Producer.	Dealer.	Specific gravity at 60° F.	Total solids.	Solids not fat.	Fat.	Refraction of Copper Serum at 20° C.
		New Haven (continued).					
25867	Louis Waas	F. J. Markle Co.	30.1	11.65	8.25	3.4	37.0
25868	C. E. Smith	S. S. Adams, 380 State St.	29.5	11.29	8.19	3.1	37.4
25869	Whitneyville Creamery	M. C. Dingwall	29.9	11.77	8.27	3.5	36.8
25874	*	Wm. Hellar	27.3	13.25	7.85	5.4	36.2
25875	*C. E. Minor	Milk Dairy, 119 Oak St.	30.3	12.37	8.47	3.9	....
25876	" " (H. Weinstein, on cap)	Wm. McLeman	30.9	12.66	8.66	4.0	....
25877	Geo. A. Vogt	S. S. Adams, Grand Ave.	28.0	11.25	7.85	3.4	36.6
25878	New Haven Dairy Co.	John P. Hugo	28.9	11.89	8.09	3.8	37.1
25879	Jacob Cohen	D. Nestel	29.9	11.92	8.42	3.5	37.5
25880	J. R. Cummings	A. F. Waterbury	29.4	12.39	8.19	4.2	....
25881	Clover Dairy	Maher Bros.	30.6	12.24	8.64	3.6	....
25882	C. E. Minor	W. R. Bailey	30.1	12.04	8.44	3.6	....
25883	Whitneyville Creamery	Arthur Tennant	30.1	11.63	8.33	3.3	37.1
26768	R. H. Nesbit Co.	R. H. Nesbit Co.	29.4	11.68	8.08	3.6	37.5
26769	New Haven Dairy Co.	J. W. Scobie	30.0	12.13	8.33	3.8	....
26770	‡Buckholtz Dairy	J. Beschel	27.0	11.49	7.69	3.8	36.0
26771	C. E. Smith	W. D. Hall	27.8	11.68	7.88	3.8	36.4
26772	New Haven Dairy Co.	S. S. Adams, 399 Howard Ave.	29.8	12.39	8.49	3.9	....
		New London.					
26881	*	Schwaner's Market	32.4	12.51	8.91	3.6	....
26882	*	Hartford Delicatessen	28.0	13.82	8.22	5.6	....
26883	*	G. M. Chapin, Jr.	29.0	13.53	8.73	5.3	....

* Dipped from can. ‡ Watered.

TABLE XVII.—MILK SAMPLED AT STORES—*Continued.*

Station No.	Producer.	Dealer.	Specific gravity at 60° F.	Total solids.	Solids not fat.	Fat.	Refraction of Copper Serum at 20° C.
		New London (continued).					
26884	*	W. H. Slocum	28.6	14.16	8.36	5.8	....
26885	*	P. Parquette	31.2	12.18	8.48	3.7	....
26886	Lanphere Dairy	Peabody Bros.	31.2	13.33	8.93	4.4	....
26887	*	Burr Bros.	31.2	12.14	8.54	3.6	....
		Norwalk.					
26803	Middlebrook Dairy	Felix Cipette	30.7	13 62	8.62	5.0	....
26804	N. W. Benedict	N. W. Benedict	31.5	11.76	8.76	3.0	37.0
		Norwich.					
26861	*	W. H. Cardwell	29.0	14.87	8.87	6.0	....
26862	*‡	Justin Holden	26.3	10.20	7.10	3.1	34.3
26863	*	194 West Main St.	30.7	12.51	8.51	4.0	....
26864	*	R. F. Smith	33.3	12.60	9.20	3.4	....
26865	*	Henry Norman	28.5	13.70	8.20	5.5	....
26866	*	Panos & Demetri	32.3	13.42	9.02	4.4	....
26867	*	T. McMahon	28.3	12.53	8.13	4.4	....
		So. Norwalk.					
26796	‡Crosby's Dairy	L. Joseloff	28.6	10.99	7.69	3.3	30.6
26797	Bean's Dairy	B. Hershield	29.8	11.88	8.18	3.7	....
26798	Woodruff's Dairy	F. H. Fitch	29.4	12.05	8.35	3.7	....
26799	" "	Nelson Hoyt	29.3	12.18	8.28	3.9	....

* Dipped from can. ‡ Watered.

TABLE XVII.—MILK SAMPLED AT STORES—*Concluded.*

Station No.	Producer.	Dealer.	Specific gravity at 60° F.	Total solids.	Solids not fat.	Fat.	Refraction of Copper Serum at 20° C.
		So. Norwalk (continued).					
26800	Bean's Dairy	Royal Grocery Co	29.3	12.08	7.98	4.1	....
26801	Webb & Jackson	Morris Vogel	30.5	11.78	8.38	3.4	....
26802	Borden's Condensed Milk Co.	Borden's Milk Depot	29.9	12.72	8.52	4.2	....
		Stamford.					
26807	C. R. Waterbury	Benevelli Bros.	30.4	12.30	8.50	3.8	....
26808	" "	Philip Kosminer	30.4	12.04	8.24	3.8	....
26809	" "	Brown Bros.	29.6	12.44	8.34	4.1	....
26810	" "	Antonio Finio	30.3	12.59	8.79	3.8	....
26811	" "	Morris Gordon	29.4	12.40	8.20	4.2	....
26812	S. Tompkins	H. Harris	30.0	12.63	8.63	4.0	....
26813	Long Ridge Dairy	J. M. Wassing	28.6	11.74	8.14	3.6	....
		Waterbury.					
26849	*	A. Gagnon	31.5	12.79	8.59	4.2	....
26850	*	Penner & Bohn	29.9	11.76	8.36	3.4	37.0
26851	*‡¶	A. Sirica	26.3	10.73	7.33	3.4	34.7
26852	*	C. E. Peck	29.7	12.48	8.28	4.2	....
26853	*	Fruit Store, 538 E. Main St.	31.5	11.71	8.61	3.1	37.6
26854	*	Spencer, Pierpont Co.	29.5	13.78	8.48	5.3	....
26855	Worden Dairy	Santoro Bros.	30.5	12.47	8.37	4.1	....
26856	" "	Blanchette's Grocery	30.5	12.49	8.49	4.0	....
26857	George Dreher	Palace Fruit Store	31.6	12.71	8.91	3.8	....

* Dipped from can. ‡ Watered. ¶ Contained formaldehyde.

The sample from A. Sirica, Waterbury, besides being watered, contained formaldehyde. The watered sample from Mrs. B. Schultz, New Haven, was dirty and contained a whole shrimp and the thigh of a grasshopper.

Eight of the watered milks bore either on the bottle or the cap the name of the dairy from which they were bought. Just who is responsible for the added water cannot be determined. If the dairyman is innocent his protection lies in refusing to sell to a dealer who "doctors" his milk. On the other hand, if the dealer is innocent, the facts published herewith should lead him to patronize another dairyman for his own protection.

The quality of milk varied greatly in the different cities. In Hartford, Meriden, New Britain, and New London the milk was exceptionally good, all the thirty-six samples exceeding the standard for solids, and only one being deficient in fat. On the other hand, the milk sold in Bridgeport, Danbury, Middletown and New Haven was distinctly inferior. Of these fifty-six samples, twenty-eight were below standard in solids and eleven in fat. Of the sixteen Bridgeport samples, seven were watered and one was skimmed. If the Hartford stores can sell good milk there is no reason why Bridgeport and New Haven stores cannot do the same.

In the table, all full face figures indicate failure to reach the standard required. It is not intended, of course, to classify the samples so marked as being adulterated. Where actual adulteration was found it is indicated by proper references to the foot notes following the table.

PAPRIKA.

The definition of paprika in the standards is as follows: "Paprika is the dried ripe fruit of *Capsicum annuum* L., or some other large-fruited species of *Capsicum*, excluding seeds and stems." In spite of this definition, which prescribes that only the pod shells shall be used, commercial samples, as a rule, contain the seeds as well, only the stems and placentæ being rejected.

Ground paprika has a deep, red color and a sweetish, mildly pungent flavor. The inferior grades are sometimes artificially colored to give them the appearance of high-grade paprika,

TABLE XVIII.—ANALYSES OF PAPRIKA.

Station No.	Brand.	Cost per package.	Net Weight. Claimed.	Net Weight. Found.	Alcohol Extract.	Ether Extract. Official Method. Total.	Ether Extract. Official Method. Volatile.	Ether Extract. Official Method. Non-Volatile.	Ether Extract. Provisional Method. Total.	Ether Extract. Provisional Method. Iodine No.	Crude Fiber.	Color.
		cts.	oz.	oz.								
25454	National Brand Pure Paprika. Archibald and Lewis Co., New York	10	..	2.2	28.71	21.35	0.40	20.95	18.24	114.9	20.17	*Natural.
25824	Pure Hungarian Paprica Sweet Pepper. Austin, Nichols and Co., New York	15	..	2.5	28.35	14.39	0.39	14.00	11.77	131.2	21.18	"
25809	Allerfeinster Rosen-Paprika legsinomabb. S. J. Benisch, Szegedin, Hungary	15	..	1.2	27.42	14.40	0.01	14.39	12.93	129.3	19.90	"
25590	Paprika Hungarian Sweet Pepper. Bennett, Simpson and Co., New York	15	2	2.1	25.71	15.55	0.48	15.07	13.13	133.3	21.42	"
25583	Paprika Sweet Red Pepper. The A. Colburn Co., Philadelphia.	15	..	1.5	27.99	15.40	0.57	14.83	12.87	122.3	19.24	"
25588	Gauntlet Paprika. E. R. Durkee and Co., New York	10	1	1.0	30.84	15.43	0.38	15.05	12.59	127.0	20.98	"
25613	" " " " " "	8	⅝	0.9	28.97	14.67	0.39	14.28	11.69	131.4	24.64	"
25585	A. and P. Paprika. The Great Atlantic and Pacific Tea Co., New York	10	..	1.9	27.04	15.47	0.47	15.00	13.42	129.1	20.48	"
25586	Premier Hungarian Rosen Paprika. Francis H. Leggett and Co., New York	10	..	1.7	27.92	16.00	0.70	15.30	13.63	123.3	19.39	"
25655	Rosen Paprika with Olive Oil. National Spice Co., New York.	10	..	1.0	25.84	16.09	0.24	15.85	13.63	123.8	20.58	"
25584	Sovereign Spices Paprika. The Union Pacific Tea Co., New York	15	..	2.8	25.69	16.66	0.24	16.42	14.48	123.2	20.90	"
25455	Ambassador Brand Absolutely Pure Paprika. James Van Dyk Co., New York	15	..	2.3	24.98	15.10	0.55	14.55	12.05	131.5	21.30	"
25587	Ambassador Brand Absolutely Pure Paprika. James Van Dyk Co., New York	15	..	2.1	26.16	15.36	0.53	14.83	11.89	130.1	19.52	"
25589	Arrow Mills Pure Paprika. Van Loan, Maguire and Gaffney, New York	10	..	2.2	30.91	19.28	0.70	18.58	15.73	110.3	18.47	"
25612	Winowitz Brand Hungarian Sweet Pepper	8	..	1.0	25.97	16.88	0.50	16.38	14.19	129.9	26.71	"

* In the sense that no added color, as such, was present.

and sometimes the color of the poorer grades is intensified by grinding the pods with olive oil. The seeds and the placentæ contain certain sharp, pungent properties, which are not desirable in a high-grade article. The finer grades, therefore, consist only of ground selected, well-ripened and highly-colored pods from which the stems and more or less of the seeds have been removed. In the poorer grades, inferior pods are used, from which the seeds or even the stems are not removed; sometimes the seeds and stems of the finer grades are also added. One grade, known as the "Mercantile," is composed entirely of ground stems and other refuse.

Fifteen samples, representing thirteen brands, were analyzed. The chief purpose of the inspection was to ascertain whether or not added oil or artificial color had been employed.

Methods of Analysis.

Alcohol extract. (See U. S. Dept. Agr., Bur. of Chem., Bull. *107* (revised), p. 163.)

Ether extract, official method. Ibid., p. 163.

Ether extract, Provisional method; and Iodine number. (See U. S. Dept. Agr., Bur. of Chem., Bull. *137*, p. 81.) The method there given was used with a few modifications as follows: Five grams of material (later two grams, which is better) were desiccated over sulphuric acid for at least twelve hours; Gottlieb tubes were filled to the 75 cc. mark with absolute ether. The desiccated paprika was brushed into the tube and the exact reading on the tube noted. This was allowed to stand for one hour, shaking three times meanwhile for two to three minutes each time. An aliquot of the clear supernatant liquor, equivalent to nearly two grams, was drawn off and the ether distilled off, at low temperature, over an electric plate. The last traces of ether vapor were removed in air by gentle heat, and the flask then heated in a steam oven for thirty minutes, cooled and weighed. The ether extract was then transferred to wide-mouthed bottles with 10 cc. of chloroform, the flasks being dried in a steam oven, cooled, and weighed, obtaining the weight of extract by difference. The iodine number was then obtained by using the Hanus solution.

By reference to Table XVIII, it will be noted that the ether extract obtained by this method was always from 1.50 to 3 per cent. lower than that secured by the official method. It has been shown by Seeker* and others that the long-continued extraction of the official method appears to remove some substance having a small iodine absorption, thus lowering the iodine value of the ether extract of the paprika. It would seem that

* U. S. Dept. Agr., Bur. of Chem., Bull. *132*, p. 116.

the official method gives the truer value for ether extract, but when the iodine number is to be determined, the extract obtained by the provisional method is to be preferred. In our samples the iodine numbers of the official ether extract ranged from 92.1 to 122.2; average, 105.6; those of the provisional ether extract from 110.3 to 133.3; average, 126.0.

Crude fiber. Usual method.

All the samples, except **25655**, which was declared to contain olive oil, were sold as straight paprikas, and the weights claimed on the label were found correct in all cases. The price ranged from 8 to 15 cents for from one to nearly three ounces.

The alcohol extract ranged from 24.98 to 30.91, variations which have no particular significance.

The total ether extract (official) ranged from 14.39 to 21.35, two samples, **25454** and **25589**, having abnormally high percentages, 21.35 and 19.28 respectively. These samples, as will be noted below, had the lowest iodine numbers of any of the samples.

The volatile ether extract (official) ranged from 0.01 to 0.70.

Our chief basis for judging as to the presence of added oil rests on the provisional ether extract and its iodine value. Doolittle and Ogden,* using a somewhat similar method with samples of known origin, found that "paprika produced from the shells alone contains not to exceed 7.50 per cent. of ash, and not to exceed 8.00 per cent. total ether extract, having an iodine number of not less than 127, while paprika made from the whole pods contains not to exceed 7.50 per cent. ash, and not to exceed 13.00 per cent. of total ether extract, having an iodine number of not less than 130."

Using these figures as a basis, it would appear that none of our samples consisted of shells alone. The total ether extract (provisional) ranged from 11.69 to 18.24, while the iodine numbers ranged from 110.3 to 133.3. Without trying to judge these samples too strictly, the high ether extract and the low iodine number of **25454** and **25589** indicate that these samples contained an added oil. **25655** also contained added oil, but its presence was declared on the label.

Crude fiber in the samples ranged from 18.47 to 26.71, the latter figure, obtained in **25612**, appearing to be excessive.

---

* Jour. Amer. Chem. Soc., *30*, p. 1486.

ROOT BEER EXTRACT.

Twelve samples were examined. In the absence of a standard for this preparation, no legal objection can be made to any of these samples except **25095**, which contained 0.78 per cent. of sodium benzoate, nearly eight times as much as claimed on the label. The high alcohol content of **25025** and **25069** would certainly not yield a temperance beverage. Glucose appeared to be the sweetening agent commonly employed, as the eight samples polarized all showed its presence. The solid matter in the extracts varied greatly, ranging from 24.76 to 62.14 per cent.; the ash and sugars likewise were very variable.

TABLE XIX.—ROOT BEER EXTRACT.

Station No.	Brand.	Price per bottle, cts.	Specific gravity at 15.5° C.	Alcohol by weight.	Solids.	Ash.	Sodium Benzoate.	Polarization at 19° C. Direct.	Polarization at 19° C. After Inversion.
25052	Monarch Brand. A. F. Beckmann & Co., New York	10	1.1582	1.77	36.26	1.46	0	15.6	14.0
25025	A. & P. The Great Atl. and Pac. Tea Co., New York	10	1.2259	7.68	51.02	1.94	0	*	*
25019	Hires' Household Extract. The Charles E. Hires Co., Philadelphia	15	1.1253	0	29.82	0.42	0	15.2	14.0
25069	Knapp's. The Knapp Extract Co., New York	12	1.1142	9.33	29.94	1.06	0	*	*
25096	Kronan's Pure Extract För Svagdricka. Kronan's Extract Co., Worcester, Mass.	20	1.2702	1.28	62.04	1.55	0	28.0	24.8
25097	Lundin's Condensed Juniper-Ade. Lundin & Co., Chicago	20	1.2987	0	62.14	0.46	0	21.8	0.0
25020	Mammoth Brand. Made at Hartford	10	1.1090	0.92	25.91	0.30	0	13.6	13.0
25051	Premium Brand. Made at Hartford	15	1.1057	0.76	24.76	0.25	0	10.8	9.6
25095	Extract for Svensk Öl. Strohmeyer & Arpe Co., New York	15	1.1985	0	43.48	1.24	†0.78	30.7	26.9
25582	Svensk-Öl Extract. The Swedish Importing Co., Worcester, Mass.	15	1.1934	0.36	42.92	0.31	0	*	*
25018	Williams' Concentrated. The Williams & Carleton Co., Hartford	13	1.1374	1.12	32.53	0.36	0	20.0	18.0
25089	UN-X-LD. Packed for Wise, Smith & Co., Hartford	12	1.1545	0.32	34.70	1.14	0	*	*

*Insufficient sample left to polarize. †One-tenth of one per cent. claimed on the label.

RELISHES.

Twelve samples were analyzed. With three exceptions, these were labeled as compounds. In two of the three no benzoic or salicylic acid or saccharin was found, and not more than a trace of alum. **25796** contained no benzoic or salicylic acid, but did contain saccharin; its sale, therefore, is illegal. Another sample contained no preservatives, but .02 per cent. of alum was present. The remaining eight samples contained benzoic acid, as declared on the label. Alum was found in traces or up to .048 per cent. in all but two samples. **25795** must be considered as misbranded, for it is "Guaranteed absolutely pure," although it contains sodium benzoate and alum.

SALAD DRESSING.

In the absence of a standard for salad dressing, objection can only be based on the presence of chemical preservatives and coloring matter. It is interesting, however, to note the very wide range in composition of materials of this character.

Four of the twelve samples claimed on the label to be "mayonnaise dressing." The Century Dictionary defines this dressing as "a sauce composed of yolks of eggs and salad oil beaten together with vinegar or lemon juice to the consistency of thick cream, and seasoned with salt, pepper, garlic, etc." A true mayonnaise dressing, then, should at least contain oil, eggs and vinegar. The absence of phosphoric acid in the product would prove that eggs had not been used, although its presence would not necessarily mean that egg solids were present. These four samples contained from 0.32 to 0.61 per cent. phosphoric acid, from 46.05 to 59.40 per cent. of oil, and acetic acid from 1.68 to 1.80 per cent. The use of oil, eggs and vinegar, therefore, seems fairly well established, and these preparations may be properly labeled as mayonnaise dressings. In three of the four, turmeric, a yellow coloring matter, was present. In **25657**, **25692** and **25439** the oil used was cotton seed oil, as indicated by the positive Halphen test and the iodine numbers and refractive indices. In **25656**, while a positive Halphen test was obtained, the lower iodine number and refractive index suggest the possible presence of olive oil as well.

TABLE XX.—

Station No.	Brand.	Price per bottle, cts.	Polarization. Direct.	Polarization. After Inversion.	Polarization. Temperature.
25836	Diamond Brand India Relish. A. C. Blenner & Co., New Haven	10	0.0	0.0	23
25606	Columbia Sweet Piccalette. Columbia Conserve Co., Indianapolis, Ind.	15	−6.5	−6.93	23
25796	Pepper Relish 20th Century Brand. F. W. Dixon, East Hartford	10	−1.0	−0.33	23
25807	Doyle's Country Club India Relish. The John T. Doyle Co., New Haven	10	0.8	−5.28	23
25660	Doyle's Country Club India Relish. The John T. Doyle Co., New Haven	10	−3.2	−3.3	23
25683	Heinz India Relish. H. J. Heinz Co., Pittsburgh, Pa.	15	−6.7	−7.26	23
25814	Diamond Relish. Lutz & Schramm Co., Pittsburg, Pa.	10	−8.0	−8.80	23
25798	Pepper Relish. The Silver Lane Pickle Co., Silver Lane	10	0.0	0.0	23
25795	Waldorf Brand Relish. Williams Bros. Co., Detroit, Mich.	10	−5.3	−5.72	23
25672	Williams' Sour Relish. The Williams Bros. Co., Detroit, Mich.	10	0.0	0.0	23
25443	Wilco Sweet Relish. The Williams Bros. Co., Detroit, Mich.	10	−2.8	−2.75	23
25837	Relish. Richard Zastrow, New Haven	10	0.0	0.0	23

25848, although making no claim to be a mayonnaise dressing, had the characteristics of such a preparation, and was far richer in oil than any of the other samples examined. While the Halphen test indicated the absence of cotton seed oil, the iodine number and refractive index were both too high for olive oil. This sample contained only natural color.

RELISHES.

Aluminum Oxide.	Sodium Benzoate.	Salicylic Acid.	Saccharin.	Claims of Label.
.048	Yes	No	No	"Made of chopped pickles, spices, vinegar, etc. Contains no coloring, and is preserved with $\frac{1}{10}$ of 1 per cent. Benzoate of Soda."
.000	"	"	"	"Composed of Green Tomatoes, Onions, Cabbage, Celery, Mustard, Celery Seed, Pepper, Cloves, Allspice, Cinnamon, White Wine Vinegar, Sugar, Salt, Tumeric, $\frac{1}{10}$ of 1 per cent. sod. benzoate."
.009	No	"	Yes	
.016	Yes	"	No	"Benzoate of Soda $\frac{1}{10}$ of 1 per cent."
.010	"	"	?	"$\frac{1}{10}$ of 1 per cent. of benzoate of soda and $\frac{1}{100}$ of 1 per cent. of saccharine."
.000	No	"	No	"Contains no artificial preservative or coloring matter."
.008	"	"	"	
.002	Yes	"	"	"Preserved with $\frac{1}{100}$ of 1 per cent. Benzoate of Soda."
.010	"	"	"	"Composed of cucumbers, onions, cauliflower, string beans, spices, turmeric, sugar and distilled vinegar, with $\frac{1}{15}$ of 1 per cent. Benz. of Soda and $\frac{1}{3}$ of 1 per cent. alum." Around neck "Guaranteed absolutely pure."
.020	No	"	"	"Contains $\frac{1}{4}$ of 1 per cent. aluminum sulphate."
.028	Yes	"	"	"Contains $\frac{1}{15}$ of 1 per cent. Benzoate of Soda, and $\frac{1}{3}$ of 1 per cent. alum. Composed of cucumbers, onions, cauliflower, string beans, spices, turmeric, sugar and vinegar."
.014	"	"	"	"Put up in Pure Malt Vinegar." Around top of bottle: "Preserved with Spice Vinegar, $\frac{1}{10}$ of 1 per cent. Benz. of Soda and Vegetable Coloring."

25723 likewise had the characteristics of a mayonnaise dressing, cotton seed oil being used, and turmeric being present.

The other six samples were preparations of a very different character. The loss at 100° C., chiefly water, in these ranged from 61.12 to 77.08, oil from 2.37 to 11.43, phosphoric acid from

TABLE XXI.—SALAD DRESSING.

Station No.	Brand.	Price per bottle, cts.	Capacity of bottle, oz.	Loss at 100° C.	Solids.	Oil.	Phosphoric Acid.	Acidity as Acetic.	Extracted Oil. Iodine No. Hanus.	Extracted Oil. Refractive Index at 15.5° C.	Extracted Oil. Halphen Test.	Boric Acid.	Color.
25723	Sunbeam Pure Food Salad Dressing. Austin, Nichols & Co., New York	10	5.0	54.01	45.99	21.88	0.36	1.68	109.6	1.4751	Yes	No	Turmeric.
25659	Campbell's Salad Dressing. Joseph Campbell Co., Camden, N. J.	10	8.6	73.19	26.81	6.88	0.24	0.78	95.1	1.4749	No	No	Natural.
25656	‡Durkee's Salad Dressing. E. R. Durkee Co., New York	10	3.4	38.21	61.79	34.99	0.61	1.80	99.6	1.4726	Yes	No	Turmeric.
25657	‡Premium Brand Salad Dressing. East India Tea Co.	15	4.1	53.73	46.27	23.09	0.32	1.68	110.0	1.4744	Yes	No	"
25692	‡Green Seal Brand Salad Dressing. Farrington & Whitney, New York	10	4.8	53.95	46.05	22.55	0.36	1.68	111.7	1.4751	Yes	No	"
25438	My Wife's Salad Dressing. Fred Fear, Chicago	20	8.1	77.08	22.92	8.10	0.35	1.50	105.3	1.4744	Yes	No	*Naphthol Yellow S.
25732	Haaker's Delicious Salad Dressing. Wm. Haaker & Co., New York	10	6.5	68.57	31.43	7.82	0.58	1.86	100.0	1.4739	No	No	Turmeric.
25670	Royal Salad Dressing. The Horton-Cato Mfg. Co., Detroit, Mich.	10	5.3	61.12	38.88	11.43	0.58	1.50	96.7	1.4740	No	Yes	"
25848	Howard's Salad Dressing. J. F. Howard, Haverhill, Mass.	25	7.6	38.47	61.53	53.97	0.61	1.56	107.4	1.4735	No	No	Natural.
25669	†Dandy Salad Dressing. Kittredge & Co., Boston.	10	6.1	74.75	25.25	2.37	0.32	1.08	91.9	1.4741	....	No	"
25668	Snider's Salad Dressing. The T. A. Snider Preserve Co., Cincinnati, O.	10	4.2	76.99	23.01	3.42	0.28	1.26	94.4	1.4736	No	No	"
25439	‡Sovereign Salad Dressing. The Union Pacific Tea Co., New York	15	6.4	40.60	59.40	34.12	0.50	1.80	110.6	1.4766	Yes	No	"

*A permitted coal-tar color; color declared on label. †Labeled "Contains $\frac{1}{10}$ of 1% Benzoate of Soda." ‡Sold as a "mayonnaise" dressing.

0.24 to 0.58, and acetic acid from 0.78 to 1.86 per cent. One was colored with napthol yellow S, a permitted color, two with turmeric, and in three the color was natural. Eggs appeared to be a component of all the samples. In **25438**, cotton seed oil was present. **25670** contained boric acid.

VINEGAR.

Thirteen samples of vinegar, sold in bottles, were examined. A much more extensive inspection was made later on samples collected by the dairy commissioner (see page 206 et seq.).

The labeling of the samples is shown below:

25684. Genuine Cider Vinegar, with a rich, mellow flavor. Haynes-Piper Co., Boston.

25572. Pure Cider Vinegar. H. J. Heinz Co., Pittsburgh.

25838. Pure Cider Vinegar. A. C. Blenner & Co., New Haven.

25853. A. and P. Brand Pure Cider Vinegar, Clarified. The Great Atlantic and Pacific Tea Co., Jersey City, N. J. (Distributor).

25774. Pure Malt Vinegar. H. J. Heinz Co., Pittsburgh.

25784. Newport Pure Malt Vinegar. The Lathrop Co., Hartford.

25808. Malt Vinegar flavored with Tarragon. Crosse and Blackwell, London, Eng.

25852. Pure Malt Vinegar. Crosse and Blackwell, London, Eng.

25771. Doyle's Distilled Vinegar with Malt Added. The John T. Doyle Co., New Haven.

25854. A. and P. Brand Distilled Spirit Vinegar. The Great Atlantic and Pacific Tea Co., Jersey City, N. J. (Distributor).

25855. Distilled Spirit Vinegar. A. C. Blenner & Co., New Haven.

25717. Spiced Salad Vinegar Distilled. H. J. Heinz Co., Pittsburgh.

25773. White Pickling and Table Vinegar. H. J. Heinz Co., Pittsburgh.

The four samples sold as cider vinegar all satisfied the legal requirements of 4 per cent. acidity and 2 per cent. solids, and if judged by that standard alone, would be passed as cider vinegars. The insufficiency of this standard, however, is well known.

TABLE XXII.—VINEGAR.

(Grams per 100 cc.)

Station No.	Brand.	Specific gravity at 15.6° C.	Alcohol.	Total Acids, as acetic.	Volatile Acids, as acetic.	Solids.	Polarization at 20° C. (°V.).	Reducing Sugars. Direct.	Reducing Sugars. After Inversion.	Non-Sugar Solids.	Ash. Total.	Ash. Insoluble.	Alkalinity of Water-Soluble Ash, (cc. $\frac{N}{10}$ acid).	Phosphoric Acid (mgms. per 100 cc.).	Malic Acid.	Lead No.	Glycerine.	Pentosans.	Per cent. Ash in Total Solids.	Per cent. Ash in Non-Sugar Solids.	Per cent. Reducing Sugars in Total Solids.	Glycerine Ratio.
25684	Haynes-Piper Cider	1.0161	..	5.00	4.88	2.55	− 1.21	0.71	0.72	1.83	0.33	0.06	30.4	23.4	0.214	.150	0.29	0.20	12.9	18.0	28.2	8.8
25772	Heinz Cider	1.0180	0.19	5.36	5.30	2.45	− 3.19	1.17	1.18	1.27	0.32	0.08	29.6	21.2	0.154	.110	0.24	0.16	13.1	25.2	48.2	12.0
25838	Blenner Cider	1.0163	0.19	4.08	4.02	2.57	− 0.44	0.48	0.51	2.06	0.44	0.09	41.6	30.3	0.174	.152	0.28	0.20	17.1	21.4	19.8	7.9
25853	A. and P. Cider	1.0148	0.02	4.56	4.32	2.37	− 1.76	0.85	0.89	1.48	0.40	0.06	38.4	23.7	0.161	.148	0.06	0.19	16.9	27.0	37.6	39.1
25774	Heinz Malt	1.0143	..	4.78	4.24	2.37	− 2.20	0.45	0.54	1.83	0.27	0.17	2.6	88.3	.....	.524	...	...	11.4	14.8	22.8	..
25784	Newport Malt	1.0127	..	5.88	5.40	2.14	too dark	0.66	0.75	1.39	0.25	0.15	1.6	68.9	.....	.424	...	...	11.7	18.0	35.0	..
25808	C. and B. Malt with Tarragon.	1.0136	..	5.56	5.40	2.41	− 2.64	0.78	0.87	1.54	0.54	0.21	17.2	104.1	0.342	.667	...	...	22.4	35.1	36.1	..
25852	C. and B. Malt	1.0179	..	6.12	5.92	2.58	too dark	0.51	0.61	1.97	0.36	0.16	7.2	86.2	.....	.380	...	...	14.0	18.3	23.6	..
25771	Doyle Distilled	1.0076	..	4.44	4.36	0.24	± 0.00	0.13	0.13	0.11	0.06	0.03	1.0	2.6	0.074	.002	...	...	...	...	...	..
25854	A. and P. Distilled	1.0060	..	4.30	4.30	0.14	± 0.00	0.03	0.06	0.08	0.03	0.02	1.0	4.8	0.020	.000	...	...	...	...	...	..
25855	Blenner Distilled	1.0030	..	3.70	3.70	0.14	± 0.00	0.01	0.03	0.11	0.02	0.01	1.4	0.0	0.067	.000	...	...	...	...	...	..
25717	Heinz Spiced Salad Distilled.	1.0747	..	5.40	5.40	14.57	−13.42	10.19	10.24	4.33	3.28	0.08	1.6	17.1	0.121	.180	...	...	...	...	...	..
25773	Heinz White Pickling	1.0070	..	5.22	5.20	0.11	± 0.00	0.03	0.03	0.08	0.03	0.02	0.6	1.0	0.054	.000	...	...	...	...	...	..

25684, by its high reducing sugars and pentosans, indicates the addition of a material high in sugars, such as apple waste. **25772**, by its high reducing sugars, high polarization and low non-sugar solids, shows the addition of boiled cider. **25838**, while containing a rather high ash and high percentage of pentosans, is passed as cider vinegar. **25853** is high in reducing sugars, high in ash and very low in glycerine. Its analysis indicates the addition of distilled vinegar, or acetic acid, mineral matter and a material high in sugars, such as apple waste. It also contained an unusually high percentage of non-volatile acid.

The standard for malt vinegar requires that it shall be dextro-rotatory, and shall contain not less than 4 gms. of acetic acid, not less than 2 gms. of solids, not less than 0.2 gm. of ash, and an alkalinity of soluble ash equivalent to not less than 4 cc. of decinormal acid per 100 cc. The four samples examined satisfied the standard in acidity, solids and ash. **25774**, however, was lævo-rotatory and low in alkalinity, and is not a pure malt vinegar. **25784** was too dark to polarize: its alkalinity was extremely low. **25808** was lævo-rotatory, but it was not sold as pure malt vinegar. **25852** appeared to be genuine.

The only requirement for distilled vinegar in the standard is 4 per cent. acetic acid. The five samples all satisfied this requirement, except **25855**, which was slightly below standard. The labeling of **25771** is open to serious objection, as the amount of "malt added" is extremely small, only enough to color the distilled vinegar so as to resemble cider or malt vinegar. There is no legal objection to the sale of distilled vinegar, if sold as such, but Section 2564 of the Connecticut Statutes explicitly forbids the sale of any vinegar to which any coloring matter has been added.

25717 is a most unusual vinegar. It contained 14.57 per cent. of solids, of which 10.24 per cent. was reducing sugars and 3.28 per cent. of ash.

Methods of Analysis.

The usual methods were used for all determinations, except for glycerine and pentosans. For glycerine, the modified method for wines, as given in Bull. 137, U. S. Dept. of Agr., Bur. of Chem., p. 61, was used. For pentosans the official method was used, Bull. 107, U. S. Dept. of Agr., Bur. of Chem., p. 54, 100 cc. of vinegar being taken and 43 cc. of hydrochloric acid (sp. gr. 1.19) added, the distillation then being conducted exactly as directed in the Bulletin.

WORCESTERSHIRE AND OTHER TABLE SAUCES.

Six samples of Worcestershire and fourteen samples of miscellaneous table sauces were examined. In no case was benzoic or salicylic acid found. One sample, **25432**, contained saccharin, which was declared on the label. The acidity ranged from 1.14 to 3.72 per cent. acetic acid, and the total sugars from none to 28.8 per cent.

TABLE XXIII.—WORCESTERSHIRE AND OTHER TABLE

Station No.	Brand.
25607	The 20th Century Brand Worcestershire Sauce. Lewis De Groff & Son, New York
25794	Lea & Perrins' Worcestershire Sauce. John Duncan's Sons, New York..........
25436	Worcestershire Sauce. Holbrook & Co., Stourport, Eng......................
25431	John Bull Genuine Worcestershire Sauce. The John Bull Co., Ltd., Hull, Eng. ..
25770	Westminster Brand Genuine Worcestershire Sauce. Miner, Read & Tullock, N. H.
25432	Worcestershire Sauce. Ralph, Pembroke & Sons, Worcester, Eng...............
25437	[1]Brand's International Sauce, The A1. G. F. Heublein & Bro., Importers.........
25785	[2]The Original Bengal Club Chutney. Crosse & Blackwell, London, Eng..........
25435	Celebrated Challenge Sauce. E. R. Durkee & Co., New York..................
25815	Longfield's Sauce, North of England Brand. The Garret Bergen Co., Brooklyn, N. Y.
25687	Heinz Gold Medal Sauce. H. J. Heinz Co., Pittsburgh.......................
25781	Excelsior Table Sauce. The E. S. Kibbe Co., Hartford.......................
25797	Indian Brand Table Sauce. New England Supply Co., Providence, R. I..........
25806	Andrews Brand Sauce. E. Pritchard, New York..............................
25693	Eddy's Brand Old English Style Sauce. E. Pritchard, New York ....
25442	[3]English Royal Relish. J. P. Smith & Co., London and New York ....
25825	[4]Snider's Oyster Cocktail Sauce. The T. A. Snider Preserve Co., Cincinnati, O. ..
25434	Sovereign Sauce. The Union Pacific Tea Co., New York......................
25433	Deer Brand Table Sauce. H. F. Voss, Brooklyn, N. Y.........................
25671	The Finest Indian Sauce Waw-Waw. The Waw-Waw Sauce Co., London and N. Y.

[1] Contains 19.67 solids, 3.77 insoluble solids, 4.58 ash and 3.87 sodium chloride.
[2] Contains 50.39 solids, 4.69 insoluble solids, 3.12 ash and 2.26 sodium chloride.
[3] A mustard preparation.
[4] Contains 20.12 solids, 2.58 insoluble solids, 3.86 ash and 3.10 sodium chloride.

The legality of the claims on the labels is in some cases open to serious doubt. Such claims as "The Only Good Sauce," "Superior to others Best," "Superior to all others," "A fine tonic and digestive," "A wonderful Digestive and Tonic," the manufacturers might have difficulty in substantiating. To label a sauce containing saccharin as "The best sauce extant" is clearly a misstatement of fact.

SAUCES (CONTAINING NO BENZOIC OR SALICYLIC ACID).

Price per bottle, cents.	Acetic acid.	Polarization. Direct.	After Inversion.	Temperature.	Saccharin.	Claims of Label.
10	3.72	3.2	−4.84	22	No	
25	2.82	4.0	−3.74	22	"	"Pronounced by Connoisseurs to be 'The Only Good Sauce.'"
18	3.48	−2.6	−2.20	22	"	
20	2.94	−5.0	−4.84	22	"	"Superior to others Best."
10	3.30	1.8	−5.04	22	"	
10	1.38	0.4	0.00	22	Yes	"The best sauce extant," on back, "Compound-Vinegar, Spices, Saccharine, Salt, Sugar coloring and Vegetables."
45	2.88	0.0	−1.54	21	No	"A fine tonic and digestive."
25	2.46	−8.0	−8.80	21	"	
10	2.70	−4.0	−4.64	22	"	"Superior to all others." "Unequalled by any in the world."
10	3.42	0.2	−2.82	22	"	
15	3.18	−3.4	−2.86	22	"	
10	3.60	−3.0	−2.64	22	"	
10	3.72	−3.4	−2.64	22	"	
10	3.12	−3.0	−3.30	22	"	
10	3.06	2.0	−2.86	22	"	
13	...	....	.....	..	"	
10	1.14	0.0	−4.18	21	"	"Contains tomatoes, granulated sugar, salt, vinegar, onions, garlic, horseradish and spices."
15	2.40	0.6	−4.18	22	"	"The 20th Century Condiment."
8	2.52	2.6	−0.44	22	"	"Prepared from vinegar, tamarinds, spices, vegetables, salt, lemons, sugar and Chinese soy."
20	2.82	−3.4	−3.08	22	"	"A Wonderful Digestive and Tonic." "The Only Digestive Sauce."

MISCELLANEOUS FOODS

CREAM OF TARTAR. Three samples were analyzed, **25651** and **25823** bought in bulk without the name of the manufacturer, and **25776** made by James P. Smith & Co., New York and Chicago. All the samples were of a high degree of purity.

PREPARED COFFEE. **25849.** *G. Washington Prepared Coffee.* G. Washington Coffee Refining Co. of New York. Sold by John Gilbert & Son, New Haven. Price, 35 cents per can, containing 50 gms. of the preparation. The following chemical data were obtained:

Soluble in cold water	94.84
Ether extract (not fat; probably largely caffeine)	1.16
Total ash	16.25
Water-soluble ash	12.84
Water-insoluble ash	3.41
Nitrogen	3.32
Potash, water-soluble	8.78
Chlorine	Trace.
Carbonic acid in insoluble ash	Present.
Alkalinity of 1 gm. soluble ash	17.13 cc. $\frac{N}{10}$ acid.
Lime in insoluble ash	Present.

The analysis indicates that this material is a finely ground, dried coffee extract.

CEREAL COFFEE. **25134.** *Dr. Johnson's Educator Substitute for Coffee.* Johnson Educator Food Co., Boston, Mass. Sold by R. T. Whiting, Bridgeport. Price, 25 cts. per 379 grams. It contained 5.58 water, 1.88 fat, 8.70 fiber, 2.54 ash, 16.25 protein, 42.57 starch, and 22.48 other carbohydrates. No coffee was detected in the sample.

JAM. **25782.** *Seal Brand Apricot and Apple Jam.* P. J. Ritter Conserve Co., Philadelphia. Sold by Brown, Thomson, & Co., Hartford. "Contains no preservative and no artificial color." Solids, 58.51; polarization at 21° C., direct, +6.80, after inversion, —12.10; benzoic and salicylic acid, none; color, natural. Not found adulterated.

25832. *Strawberry.* Logan, Johnson & Co., Boston. Sold by James M. Young & Son, Willimantic. "Prepared from fresh fruit, granulated sugar, enough corn syrup to prevent crystallization and $\frac{1}{10}$ of 1 per cent. sodium benzoate. Solids, 77.47; polarization at 21° C., direct, +35.60, after inversion, +6.82; benzoic acid, present; color, natural. A legally labeled compound.

25805. *Le Roy Extra Quality Strawberry.* Le Roy Packing Co., Boston. Sold by City Market, New London. Solids, 69.66; polarization at 21° C., direct, +23.20, after inversion, +5.06; benzoic acid, present; color, natural. Adulterated, as it contained glucose and benzoic acid, not declared on the label; misbranded as it is not of "extra quality."

MELTOSE. **25846.** *Sanitas Meltose.* The Kellogg Food Company, Battle Creek, Mich. "A pure carbohydrate and contains 86 calories to the ounce." "Should be substituted for cane sugar, honey, syrup, and all artificially prepared sweets, which produce diabetes," etc. It analyzed as follows: Water, 26.81; ash, 0.46; nitrogen × 6.25, 0.63; reducing sugars as maltose, 47.09; sucrose by Clerget, 2.08; dextrin, 18.80; other carbohydrates by difference, 4.13. A 5 per cent. solution in a 200 mm. tube polarized at 20° C., direct, + 32.1, and after inversion, + 31.57. Its specific rotation A_D was 111.3°. Our analysis substantially confirms that given on the label. From the label, however, it appears that this preparation is especially recommended as a diabetic food, a recommendation which is not justified by our analysis. That the articles named, sugar, honey, syrup, etc., "produce diabetes" would be startling if true.

CONDENSED SOUPS. Two samples of condensed soup were analyzed, both made by C. H. Knorr, Heilbronn, Germany. **25734,** *Knorr's Readymade Pea Soup (Erbswurst), Knorr's Pea Soup with Bacon.* Price, 10 cts. for 113 gms., about 4 oz. **25735.** *Knorr's Readymade Bean Soup.* Price, 10 cts. for 124 gms., or 4.4 oz.

The analyses were as follows:

	25734	25735	25851
Water	9.58	11.01	6.56
Fat	8.99	6.19	1.67
Ash	14.96	16.01	65.21
Protein (N × 6.25)	21.38	19.31	
Carbohydrates, including fiber, by difference	45.09	47.48	
Nitrogen	3.42	3.09	3.89
Sodium chloride, calculated from chlorine	12.52	12.79	59.48

The samples are condensed foods, apparently true to name. Both samples show the addition of considerable fatty material and common salt to the vegetables specified.

25851. *Steero Bouillon Cubes,* made by American Kitchen Products Co., New York. "A cube makes a cup." "A highly concentrated extract made of Beef and Vegetables." Price 35 cts. per 12 cubes, weighing 52 gms. For analysis see above.

These cubes contain considerable nitrogenous matter and fat. They also contain over half their weight of common salt. At the price charged for twelve cubes one pound of the cubes would cost $3.05. The six-tenths of a pound of salt contained in this quantity could be purchased separately for about one cent. It is apparent, therefore, that while the bouillon cubes may offer many conveniences in their use, they are a very expensive form of food.

II. DRUG PRODUCTS.

LINIMENTUM CAMPHORÆ.

(*Camphor Liniment.*)

Twenty-three samples of camphor liniment were bought from druggists who in the past had sold this preparation of less than standard quality. Eighteen contained from 18.0 to 25.6 per cent. of camphor, in no case less than 90 per cent. U. S. P. strength, and in only three cases less than 95 per cent. U. S. P. The refractive index at 25° C. ranged from 1.4690 to 1.4716, indicating that cottonseed oil had been used in all cases.

In four of the other samples, the camphor ranged from 12.0 to 17.6 per cent., or from 60 to 88 per cent. U. S. P. strength. These samples were as follows:

No.	*Place of Sale.*	*Camphor %*
25447	Bridgeport	17.6
25817	Norwich	16.1
25648	Stamford	15.2
25790	Hartford	12.0

Another sample contained 15.7 per cent. camphor and no oil. It was apparently "spirit of camphor."

OLEUM THEOBROMATIS.

(*Oil of Theobroma—Cacao Butter.*)

This oil is commonly known as Cacao or Cocoa Butter. It is much used as an ingredient of cosmetic ointments, as a coating of pills and for preparing suppositories.

The sixteen samples examined satisfied the U. S. P. requirements as to iodine and saponification values. The iodine values ranged from 34.0 to 37.1; average, 35.8; the saponification values from 191.5 to 194.5; average, 193.1.

The cost ranged from ten to twenty cents for two ounces.

TABLE XXIV.—CACAO BUTTER.

Station No.	Brand.	Place of Sampling.	Cost, cents.	Weight. Claimed.	Weight. Found.	Iodine Value.	Saponification Value.
				oz.	oz.		
24943	Blooker	Bridgeport	10	2	1.9	36.1	193.5
24908	Bensdorf	Hartford	10	2	1.9	35.4	193.5
24909		"	20	2	2.0	35.9	193.5
24926		"	20	2	2.1	35.3	193.5
24141		Meriden	20	2	2.0	34.0	193.5
24149		New Britain	20	2	2.0	36.4	192.9
24150	Huyler	"	20	2	1.7	36.8	194.5
24974	Blooker	New Haven	15	2	2.1	35.1	193.5
24992		New London	20	2	2.0	36.2	192.9
24995		Norwich	20	2	2.2	36.1	192.5
25021		Stamford	10	2	1.8	36.3	192.5
24129	Bensdorf	Waterbury	10*	..	1.0	34.2	192.5
24130	Huyler	"	10*	..	0.6	34.8	193.5
24131	Blooker	"	20	2	2.2	37.1	191.5
24132		"	20	2	1.9	37.1	192.5
25008		Willimantic	15	2	1.9	35.7	192.5

*Cost per stick.

COD LIVER OIL AND OTHER EMULSIONS.

Twenty-eight samples were examined. Twenty-two of these were sold as Cod Liver Oil Emulsion with Hypophosphites, one as a plain Cod Liver Oil Emulsion, and five under special proprietary names. Both Cod Liver Oil Emulsion and Cod Liver Oil Emulsion with Hypophosphites are U. S. P. prepara-

TABLE XXV.—COD LIVER OIL AND OTHER EMULSIONS.

Station No.	Brand.	Claims of Label. Oil.	Alcohol.	Hypophosphites.	Miscellaneous.	Cost per bottle.	Volume of bottle.
		%	%			cts.	fl. oz.
.....	Laboratory Sample. (U. S. P. except addition of 0.25 cc. H_3PO_4)	....	......	....	....	......	......
25137	American Druggist Syndicate, New York. Premium Emuls. of Pure Norwegian C. L. O. with Hypophosphites..........	40	0	Ca, Na.	....	75	10.2
25488	Carleton & Hovey Co., Lowell, Mass. Father John's Medicine	....	0	....	No morphine or poisonous drugs	50	4.3
25138	Cosmopolitan Pharmacy, Bridgeport. Emuls. of C. L. O. with Hypophosphites..........	50	4	Ca, Na.	5% glycerine.	50	12.2
25478	Dike Drug Co., New York. Dike's C. L. O. Emuls. with Hypophosphites..........	40	0	Ca, Na.	....	85	12.5
25544	T. P. Gillespie & Co., New Haven. Gillespie's C. L. O. Emuls. with Hypophosphites..........	40	0	Ca, Na.	....	50	12.0
25475	Graeber Pharmacies, Meriden. Emuls. C. L. O. with Hypophosphites..........	33⅓	7	....	Not U. S. P., 1900.	50	11.7
25477	Halloran's Drug Store, New Britain. Emuls. C. L. O. with Hypophosphites..........	33⅓	7	Ca, Na, K.	Not U. S. P., 1900.	49	11.7
25541	William H. Hull, New Haven. Hull's Emuls. of C. L. O. with Hypophosphites..........	25	0	....	....	50	15.3
25476	F. M. Kibbe & Co., Meriden. Emuls. C. L. O. with Hypophosphites..........	33⅓	7	Ca, Na, K.	Not U. S. P., 1900.	50	12.2
25513	King Medicine Co., Philadelphia. C. L. O. Emuls. with Hypophosphites..........	40	0	Ca, Na.	....	50	8.3
25486	E. G. Lathrop & Co., Hartford. Emuls. Norwegian C. L. O. with Hypophosphites..........	....	0	Ca, Na.	....	50	11.3
25820	The Lee & Osgood Co., Norwich. Emuls. of Pure C. L. O. with Hypophosphites..........	....	0	Ca, Na.	....	75	16.2
25140	John A. Leverty & Bro., Bridgeport. Emuls. C. L. O. with Hypophosphites..........	40	0	Ca, Na.	....	65	12.5
25557	Magee's Emuls. of Pure C. L. O. with Extract of Malt and Hypophosphites..........	....	0	Ca, Na.	Malt extract.	100	14.8
25540	New York & London Drug Co., New York. Nyal's Emuls. C. L. O. with Hypophosphites..........	40	0	Ca, Na.	....	75	11.2

TABLE XXV.—COD LIVER OIL AND OTHER EMULSIONS.—*Concluded.*

Station No.	Brand.	Claims of Label. Oil.	Alcohol.	Hypophosphites.	Miscellaneous.	Cost per bottle.	Volume of bottle.
		%	%			cts.	fl. oz.
25136	Will I. Nichols, Bridgeport. Emul. of C. L. O. with Hypophosphites	33⅓	7	....	Not U. S. P., 1900.	50	10.8
25489	The Ozomulsion Co., New York. Ozomulsion	....	1⅓	Ca, Na.	Guaiacol and glycerine.	90	16.3
25537	The Chas. H. Phillips Chem. Co., New York. Phillips' Palatable C. L. O. Emuls. with the Soluble Phosphates	50	0	....	Sol. of Phillips' Wheat Phosphates-acid (representing Phosphates similar to those in Wheat), Salicylic acid, Glycerine, Sugar, Gum, Flavoring.	45	5.3
25535	Scott & Bowne, New York. Scott's Emuls. of Pure C. L. O. with Hypophosphites	....	0	Ca, Na.	....	45	6.7
25554	Sharpe & Dohme, Baltimore. Emuls. of C. L. O. with Hypophosphites	....	0	Ca, Na.	....	100	16.2
25536	C. G. Spalding, New Haven. Emuls. C. L. O.	50	0	Ca, Na.	Phosphoric acid 0.4%.	50	15.8
25555	Standard Emulsion Co., New York. Russell Emuls. Mixed Fats, a modified Pancreatic Emulsion	42	0	....	Beef suet, cocoanut, peanut and cotton seed oils, oil of cloves, and 0.5% sodium borate.	100	12.0
25492	D. G. Stoughton & Co., Hartford. Emuls. of C. L. O.	50	0	....	....	40	6.5
25542	Henry Thayer & Co., Cambridge, Mass. Thayer's Emuls. C. L. O. with Hypophosphites	33	0	Ca, Na, K.	....	50	11.7
25139	United Drug Co., Boston. Rexall C. L. O. Emuls. with Hypophosphites	40	0	Ca, Na, K.	....	50	13.3
25538	E. Wadewitz, New Haven. Emuls. of Pure Norwegian C. L. O. with Hypophosphites	....	0	Ca, Na.	....	50	11.5
25543	Whitman Chemical Co., Boston. Whitman Emuls. C. L. O. with Hypophosphites	33⅓	7	....	Not U. S. P., 1900.	50	12.3
25576	The Wilson Drug Co., Willimantic. Emuls. of C. L. O. with Hypophosphites	50	0	Ca, Na.	....	50	13.2

tions, and should contain about 50 per cent. of cod liver oil by volume.

A sample of the emulsion with hypophosphites was prepared in the laboratory according to the U. S. P. formula, with the single exception of the addition of 0.5 cc. of 85 per cent. syrupy phosphoric acid to facilitate the solution of the hypophosphites. The procedure was as follows: 500 cc. of cod liver oil (sp. grav. 0.9270) were added to 125 gms. of powdered acacia and thoroughly triturated in a mortar to a uniform mixture. 250 cc. of water were added and the mixture further triturated to a complete emulsion, and 4 cc. of oil of gaultheria

TABLE XXVI.—COD LIVER OIL

Station No.	Brand.	Spec. gr. at 15.6° C.	Alcohol by weight.	Oil by weight	Refractive Index of Oil at 25° C.	Iodine No.	Ash.	Total Phosphoric Acid (P_2O_5)	Phosphoric Acid.
			%	%			%	%	
.....	Laboratory Sample	1.0486	0	43.92	1.4771	137.7	2.25	1.48	Yes
25137	A. D. S.	0.9824	0	39.85	1.4789	137.6	1.98	1.39	No
25488	Father John's Medicine	1.0546	0	36.98	1.4783	149.0	0.76	0.05	..
25138	Cosmopolitan Pharm..	0.9901	4.64*	46.04	1.4795	136.7	0.95	0.55	No
25478	Dike's	1.0181	0	36.82	1.4792	136.2	0.47	0.36	"
25544	Gillespie's	1.0137	0	36.50	1.4763	138.2	0.65	0.37	"
25475	Graeber's	1.0192	5.28*	28.37	1.4798	140.7	1.19	0.74	"
25477	Halloran's............	1.0182	5.92*	28.10	1.4798	133.8	1.13	0.71	"
25541	Hull's................	1.0118	3.36	23.24	1.4787	135.3	1.96	1.46	Tr.
25476	Kibbe's	1.0207	5.56*	27.84	1.4795	156.1	1.29	0.71	No
25513	King's	1.0152	0	36.50	1.4786	138.7	0.49	0.37	"
25486	Lathrop's............	1.0062	2.76	46.71	1.4812	134.4	2.62	2.03	"
25820	Lee & Osgood's.......	1.0444	0	40.30	1.4787	141.0	2.06	1.17	"
25140	Leverty's	1.0156	0	35.54	1.4789	138.4	0.58	0.40	Tr.(?)
25557	Magee's	semi-solid	0	24.27	1.4792	133.0	1.63	0.97	?
25540	Nyal's................	1.0172	0	38.28	1.4777	149.8	0.51	0.34	No
25136	Nichols'	1.0160	5.28*	28.47	1.4792	131.2	1.19	0.67	"
25489	Ozomulsion	1.0283	0.64*	37.65	1.4786	158.0	0.66	0.49	"
25537	Phillips'..............	1.0605	0	44.40	1.4766	137.5	0.65	0.35	Yes*
25535	Scott's................	1.0090	0	46.86	1.4795	146.8	2.55	1.85	No
25554	Sharpe & Dohme's	1.0003	2.64	46.44	1.4777	142.4	1.89	1.35	"
25536	Spalding's............	1.0175	0	50.39	1.4787	136.9	2.07	1.48	Yes*
25555	Russell's	0.9995	0	34.96	1.4637	66.1	1.58	0.40	?
25492	Stoughton's...........	0.9965	0	48.15	1.4789	138.2	0.03	Tr.	No
25542	Thayer's..............	1.0127	0	25.97	1.4786	130.1	3.08	2.29	"
25139	Rexall	1.0242	0	38.86	1.4803	135.2	1.14	0.74	"
25538	Wadewitz'............	1.1009	0	30.75	1.4783	140.2	1.88	1.25	"
25543	Whitman's............	1.0180	5.56*	27.38	1.4786	132.4	1.30	0.73	"
25576	Wilson's..............	1.0006	3.28	44.25	1.4757	152.5	1.24	0.76	"

* Claimed on the label.

added. 20 gms. of calcium hypophosphite, and 10 gms. each of potassium and sodium hypophosphites were dissolved in cold distilled water, and 0.5 cc. of 85 per cent. phosphoric acid added to clear the resulting opalescent solution. The volume was then made up to 300 cc., the solution well shaken and filtered. 150 cc. of the filtrate were mixed with 100 cc. of syrup, prepared as directed on p. 435 of the U. S. P., and added to the emulsion, and the whole mass thoroughly mixed in a large evaporating dish.

The analysis of our mixture as thus prepared is shown in Table XXVI.

AND OTHER EMULSIONS.

Hypophosphorous Acid.	Sodium Borate.	Acidity per 100 gms. (cc.—$\frac{N}{10}$ NaOH)	Completeness of Emulsion.	Remarks.
	%			
Yes	No	46	Separation	U. S. P. except addition of 0.25 cc. H_3PO_4.
"	"	49	"	
...	"	41	......	
Yes	"	12	Sl. separation	Low in hypophosphites.
"	"	45	" "	" " "
"	"	8	Separation	" " "
"	"	20	Sl. separation	Not claimed to be U. S. P.
"	"	8	No separation	" " " "
"	"	15	Sl. separation	Contains alcohol, not stated on label.
"	"	7	" "	Not claimed to be U. S. P.
"	"	9	No separation	Low in hypophosphites.
"	"	48	" "	Contains alcohol, not stated on the label.
"	"	39	" "	
"	"	12	Separation	Low in hypophosphites.
?	"	?	......	Reducing sugars as dextrose before inversion, 14.85%, after inversion, 29.70%.
Yes	"	17	No separation	Low in hypophosphites.
"	"	11	" "	Not claimed to be U. S. P.
"	"	15	" "	Low in hypophosphites.
No	"	126	Separation	No hypophosphites and only small amount of phosphates; contains salicylic acid.
Yes	"	14	No separation	
"	"	38	Separation	Contains alcohol, not stated on the label.
"	"	88	"	
?	0.36*	sl. alk.	No separation	Cod liver oil not claimed, none present; sodium borate present as claimed.
No	No	10	Separation	No phosphates or hypophosphites, none claimed.
Yes	"	14	"	
"	"	10	"	
"	"	35	No separation	Low in oil.
"	"	4	" "	Not claimed to be U. S. P.
"	"	52	Separation	Low in hypophosphites; contains alcohol, not stated on label.

The following summary shows the average analyses of the fifteen samples sold as U. S. P., of the seven not claimed to be U. S. P., and of the plain emulsion, compared with the laboratory sample.

	Laboratory Sample.	Emulsions sold as U. S. P.	Emulsions not sold as U. S. P.	Plain Emulsion.
Specific gravity	1.0486	1.0170	1.0167	0.9965
Oil	43.92	40.94	27.05	48.15
Refractive index of oil	1.4771	1.4786	1.4791	1.4789
Iodine No. of oil	137.7	140.3	137.1	138.2
Ash	2.25	1.41	1.59	0.03
Total phosphoric acid	1.48	0.96	1.04	Tr.
Acidity per 100 gms.	46	32	11	10

The fifteen samples sold as U. S. P., judged by the index of refraction and the iodine number of the separated oil, appear to be made from cod liver oil as claimed. However, they showed wide differences in composition. The specific gravities ranged from 0.9824 to 1.0444, with one exception much lower than that of the laboratory sample. In four cases the low specific gravities were in part due to the presence of alcohol; the use of no syrup or syrup of a low density, or an excessive use of water, would give similarly low gravities. The oil ranged from 30.75 to 50.39, eight of the samples showing a decided deficiency in this essential ingredient. The ash ranged from 0.47 to 2.62, eight samples showing clearly that the required amount of hypophosphites had not been used. The total phosphoric acid ranged from 0.34 to 2.03, eight samples again showing a deficiency in hypophosphites. Phosphoric acid, as such, was found in only one sample, and in this the fact was declared on the label. The acidity of this sample is much higher than any of the other U. S. P. preparations, and is probably due to the phosphoric acid used. Three samples contained alcohol, ranging from 2.64 to 3.28 per cent., which in no case was declared on the label.

The seven samples not sold as U. S. P. preparations can only be judged by comparing their analyses with the claims made for them. With one exception, these samples claim 33⅓ per cent. of oil. We found from 25.97 to 28.47 per cent. by weight. In five of them, 7 per cent. of alcohol was claimed on the label. We found from 5.28 to 5.92 per cent. by weight. One sample claimed 25 per cent. of oil, and 23.24 per cent. was found. It contained 3.36 per cent. of alcohol by weight, which was not declared on the label. These seven samples contained from 1.13 to 3.08 per cent. of ash, and from 0.67 to 2.29 per cent. of total phosphoric acid, indicating that in all but two cases the amount of hypophosphites added was far below the U. S. P. requirements.

The sample sold as a straight emulsion contained 48.15 per cent. of oil. Its low specific gravity, 0.9965, indicated the absence of the full amount of syrup required by the formula.

Father John's Medicine, although not claimed to be a cod liver oil emulsion, is essentially one, and contained 36.98 per cent. of oil by weight with practically no hypophosphites present.

Magee's Emulsion was a semi-solid preparation, claiming to contain malt extract as well as hypophosphites. It contained 24.27 per cent. of oil by weight, 1.63 per cent. of ash and 0.97 per cent. of total phosphoric acid. It contained reducing sugars as dextrose, before inversion, 14.85 per cent.; after inversion, 29.70 per cent.

Ozomulsion claimed to be an emulsion of cod liver oil, combined with guiacol, glycerine and hypophosphites. It contained 0.64 per cent. of alcohol by weight, 37.65 per cent. of oil by weight, 0.66 per cent. ash, and 0.49 per cent. of phosphoric acid, indicating about one-third the amount of hypophosphites of the U. S. P. preparations.

Phillips' Palatable Cod Liver Oil Emulsion combined with the Soluble Phosphates claimed 50 per cent. of oil; 44.40 per cent. by weight was found. Its total ash was 0.65 per cent., so that the "soluble phosphates" are present in extremely small amount. The acidity of this material was relatively very high.

Russell's Emulsion Mixed Fats claims no cod liver oil and contains none. It contained 34.96 per cent. of oil by weight whose refractive index was 1.4637 and whose iodine number was 66.1. It contained 0.36 per cent. of sodium borate, somewhat less than claimed on the label. The material had a slightly alkaline reaction.

Comments on the Samples.

Although the U. S. P. preparation requires the use of calcium, sodium and potassium hypophosphites, in only four cases was the potassium salt claimed on the label. In our analyses no attempt was made to determine the nature of the hypophosphite present, as this was deemed of minor importance.

We make the following criticisms of the samples specified:

25138, **25478**, **25544**, **25513**, **25140** and **25540**, were low in hypophosphites.

25541, **25486** and **25554** contained alcohol not declared on the label.

25576 contained undeclared alcohol and was low in hypophosphites.

25538 was low in oil.

Methods of Analysis.

Fat. Gottlieb-Roese method. (See Conn. Expt. Stat., Rept., 1909, p. 192.)

Ash. The cod liver oil used in preparing the laboratory emulsion contained 0.025 per cent., a negligible amount. The acacia contained 3.01 per cent., so that the 125 gms. used contained 3.76 gms. acacia ash, or 0.36 per cent. by weight of the total emulsion. No attempt was made at first to calculate the theoretical amount of ash due to the hypophosphites, because of their well-known tendency to decompose on ignition, and because on igniting them with organic compounds reductions might occur with loss of phosphorus. The ash in the emulsion was determined as follows: Five gms. were weighed into a porcelain capsule, and gently heated over asbestos until the mass began to discolor and decompose. The capsule was then heated in a muffle at low redness until a hard carbonaceous mass remained. This was extracted with hot water, and the filter and contents ignited in the original capsule. Strong ignition did not oxidize the carbon and a black residue persisted. Treatment three times with nitric acid gave a perfectly white ash. The filtrate was added to the capsule, evaporated to dryness, heated to constant weight at dull redness and weighed. A percentage of 2.30 ash was obtained.

Assuming that the hypophosphites used were pure salts, and allowing for the acacia ash, the finished emulsion should contain theoretically 2.27 per cent. ash, which agrees excellently with the determined value, and which somewhat minimizes the theoretical objections referred to above. In view of the above data it was believed that the determination of ash as indicated was a fair measure of the inorganic constituents of the emulsion.

Total Phosphoric Acid. The organic matter of 5 gms. of emulsion is destroyed by digesting with sulphuric acid and potassium sulphate, as in the Gunning method for nitrogen. The residue is boiled with 100 cc. of water, the solution neutralized with ammonium hydroxide and acidified with nitric acid, transferred to a 500 cc. flask, cooled and made up to the mark. From this filtered solution an aliquot of 100 cc., equivalent to 1 gm. of emulsion, is taken, in which phosphoric acid is determined in the usual way with ammonium molybdate.

Test for Phosphoric and Hypophosphorous Acids. Five gms. of emulsion were made up to 200 cc., with water, and filtered. A yellow precipitate, on acidifying with nitric acid and adding ammonium molybdate, indicated the presence of phosphoric acid. The presence of phosphorous or hypophosphorous acid was indicated by the appearance of a white precipitate of mercurous chloride, on acidifying with hydrochloric acid and adding mercuric chloride.

WINE OF THE EXTRACT OF COD LIVER OIL.

The following extracts from a paper in the *Journal of the American Medical Association,* October 13, 1906, p. 1207, describes very clearly the nature and claims of this class of preparations:

"The introduction of cod liver oil as a supposedly easily assimilable nutrient and reconstructive was followed by its extensive use in wasting diseases, especially in phthisis, in the treatment of which it came to be considered almost essential, as it was supposed to possess some mysterious power different from that of other oils. Its unpalatable character led to various devices to render it tasteless and to make it more acceptable to the stomach. Emulsions containing the oil in mixture with other substances were put on the market and served a useful purpose. But the oily nature, imperfectly concealed, was disagreeable to many, and gradually other preparations appeared which attempted to retain the supposed therapeutic virtues of cod liver oil while dispensing with its disagreeable character. This attempt has been carried to the extreme that in many of the cod liver oil preparations now on the market the oil has been entirely eliminated and all that is left of the oil is the name. This is a species of fraud which has been tolerated too long, but which will be kept up so long as physicians are willing to be duped. Some of these articles are said to 'represent' the oil and to possess all its virtues. Others are said to contain oil, while still others are stated to contain 'all the valuable constituents' . . . . .

"Is cod liver oil to be considered a food or a medicine? A food, certainly. As a food its value will consist in the fats it contains. These fats are more easily oxidizable and are considered more digestible than other fats because of the presence of compounds derived from the liver which favor its emulsification and enable it to penetrate the mucous membrane more easily than other fats. Aside from their nutrient properties we have no evidence that the fats of cod liver oil possess any therapeutic value; if the oil possesses therapeutic qualities they must reside in its non-fatty constituents, and the activity of these non-fatty constituents is not acknowledged by those who have investigated them scientifically. Most pharmacologists believe that whatever virtue there is in cod liver oil depends on its qualities as an easily assimilable fat. On the whole, we must conclude with Cushny that 'cod liver oil has not been shown to have any action apart

TABLE XXVII.—WINE OF THE EXTRACT OF COD LIVER OIL.

Station No.	Brand.	Claims of Label.			Cost per bottle, cts.	Volume of bottle, fl. oz.
		Alcohol.	Hypophosphites.	Miscellaneous.		
		%				
25575	Prep. for G. O. Cartier, Willimantic. Wine of the Extract of Cod Liver Oil and Iron with Malt and Hypophos....	16	Ca, Fe, Na, K, Mn.	Malt, Wild Cherry, Hypophos. of Quinine and Strychnine.	50	12.3
25490	Prep. for Goodwin's Drug Store, Hartford. Wine of the Extract of Cod Liver Oil and Iron with Malt and Hypophos.	16	Ca, Fe, Na, K, Mn.	Malt, Wild Cherry, Hypophos. of Quinine and Strychnine.	65	11.8
25539	Katharmon Chem. Co., St. Louis. Hagee's Cordial of the Extract of Cod Liver Oil, Compound............	8	Ca, Na.	Saccharin, salicylic acid, glycerine.	79	15.8
25558	North American Remedy Co., Philadelphia. Narco Wine of Cod Liver Oil..................................	16	Ca, K, Fe, Na, Mn.	Malt, Wild Cherry, Hypophos. of Quinine and Strychnine.	75	15.3
25581	Prep. for Mark N. Sullivan, New Haven. Tasteless Wine of Cod Liver Extract with Beef, Malt and Hypophosphites	12	Ca, Na, K, Fe, Mn.	Beef, Malt, Wild Cherry, Hypophos. of Quinine and Strychnine.	75	16.3
25556	Henry K. Wampole & Co., Philadelphia. Perfected Tasteless Prep. of the Extract of Cod Liver...............	17	Ca, Na, K, Fe, Mn.	Malt, Wild Cherry, Hypophos. of Quinine and Strychnine.	100	14.8
25487	Made for Wise, Smith & Co., Hartford. Dr. Heckler Brand Palatable Prep. of the Alcoholic Extr. of C. L. Oil, etc.	16	Ca, K, Fe, Na, Mn.	Malt, Wild Cherry, Hypophos. of Quinine and Strychnine.	65	12.0

from that of an easily digested food, and its superiority to some other fats and oils has not been satisfactorily established.'

"If, then, the value of cod liver oil depends on the presence of fat as its nutritive constituent, the amount of fat a preparation contains will determine the worth or worthlessness of such a preparation; at all events, a preparation claiming to represent cod liver oil which does not contain fat in some form is fraudulent. . . . . .

"Some of the so-called cod liver oil preparations are termed extracts of cod liver oil, but are not in fact made from the oil, but from the cod livers instead. They are preparations which, if honestly made, might be worthy of trial, but they are improperly called 'extracts' of cod liver oil, since they do not contain the fat, which is the active constituent of the oil, but the extractives from the liver which may or may not possess therapeutic virtues. So far as we know, however, no satisfactory evidence is forthcoming to indicate that such extractives have any therapeutic value."

The above pronouncement of the official journal of the leading American medical association is unmistakable in its tone. In addition to the above it is interesting to note the definition of "extract" as given in the Century Dictionary:

"A pharmaceutical extract consists of the active principles of a drug, obtained by maceration, percolation or decoction with a suitable menstruum, or by using the expressed juice of the fresh plant and reducing the solution thus obtained to a proper consistency and strength by evaporation. The menstrua used are water, alcohol and ether, or two of these combined, and in some cases aqua ammoniæ, glycerine or hydrochloric or acetic acid is added. . . . . Hence 3. A concentration of the principles or elements of anything; a condensed embodiment or representation."

Seven samples of this material were examined. All were labeled to contain alcohol, ranging from 8 to 17 per cent. The alcohol found ranged from 7.50 to 16.59 per cent. by volume, in four cases considerably below the amounts claimed.

No oil was found in any sample.

The extract in six samples ranged from 31.45 to 42.97 gms. per 100 cc. In Hagee's cordial, only 13.18 gms. of extract were found, 10.81 gms. of this consisting of glycerine. The ash ranged from 0.27 to 0.68, Hagee's differing again with a much higher percentage, 1.89. The phosphoric acid ranged from 0.14 to 1.31 per cent., varying quite uniformly with the amount of ash present. All the samples showed a minus polarization, both before and after inversion, except Sullivan's, which polarized plus before and after inversion and at 87° C. This sample contained 8.62 per cent. sucrose and 12.82 per cent. glucose.

None of the other samples contained more than traces of sucrose, except **25556**, where 1.11 per cent. was present. Hagee's contained only 1.30 per cent. reducing sugars, calculated as dextrose, while the others contained quite uniform amounts, ranging from 10.84 to 15.02 per cent.

The matter soluble in ether-chloroform, acid solution, ranged from 44.0 to 142.0 mgms. per 100 cc., while that extracted by the same solvents, in alkaline solution, ranged from 2.8 to 17.2 mgms. These extractives are in part alkaloids, probably largely so, especially in the alkaline solution. The large yield of Hagee's in acid solution, 142 mgms., however, was not of an alkaloidal nature, but saccharin and salicylic acid.

Acidity ranged from 17.4 to 39.4 cc. tenth-normal alkali per 100 gms.

Hagee's alone contained salicylic acid and saccharin.

The ash was not tested for potassium or sodium, either one or both of which being probably present as hypophosphites. Iron, calcium and manganese were found in all the samples, except in Hagee's, which contained no manganese.

Quinine and strychnine were detected in all of the samples, except Hagee's and the Narco sample. The latter contained quinine, but strychnine could not be detected in 50 cc. of the sample, although its presence was declared on the label.

TABLE XXVIII.—ANALYSES OF WINE

Station No.	Brand.	Specific gravity at 15.6° C.	Alcohol by weight.	Alcohol by volume.	Oil.	Extract, gms. per 100 cc.	Ash.	Total Phosphoric Acid as P_2O_5.	Polarization. Direct.	Polarization. After Inversion.	Polarization. Temperature °C.
							%	%.			
25575	Cartier.........	1.1106	7.73	10.83	None	32.61	0.58	0.37	−3.0	−2.86	19
25490	Goodwin.......	1.1045	8.85	12.31	"	31.45	0.68	0.42	−2.8	−2.86	19
25539	Hagee	1.0405	5.73	7.50	"	*13.18	1.89	1.31	−0.6	−0.22	19
25558	Narco	1.1506	6.84	9.93	"	42.97	0.65	0.40	−1.8	−2.20	19
25581	Sullivan	1.1465	8.09	11.69	"	42.42	0.49	0.23	30.2	†18.7	19
25556	Wampole	1.1305	11.64	16.59	"	39.53	0.27	0.14	−1.6	−3.08	19
25487	Heckler	1.1047	8.71	12.13	"	31.45	0.67	0.43	−3.0	−3.08	19

*10.81 gms. glycerine per 100 cc.

†Polarized +20.9 at 87° C.=12.82% glucose (+175° V.).

The following statement is made in the *Journal of the American Medical Association,* October 13, 1906, p. 1207:

"The preparations claiming to 'represent' cod liver oil are in liquid form, and if they contain oil it must be one of the following forms:

1. An emulsion of the oil which may be miscible with water, but from which the fat tends to separate and rise to the top. In this form the fat can be seen as globules under the microscope.

2. A solution, resulting from the saponification of the oil, containing a soap which usually will be alkaline in reaction, especially when mixed with water, and from which fatty acids are separated as a precipitate when the solution is acidified.

3. A solution of fatty acids. This will be acid in reaction and will be precipitated by the addition of water, in which the fatty acids are not soluble."

The following tabulation shows the data secured when applying these tests to the samples:

No.	Oil.	Reaction to litmus.	Precipitate on addition of water.	Precipitate on addition of HCl.	Precipitate on addition of HCl, and standing over night.	Pettenkoffer Test for Bile Products.
25575	None.	Acid.	None.	Very Slight.	Flocculent	Negative.
25490	"	"	"	" "	"	"
25539	"	"	"	None.	None.	"
25558	"	"	"	Slight.	Flocculent.	"
25581	"	"	"	None.	"	"
25556	"	"	"	Slight.	"	"
25487	"	"	"	Very slight.	"	"

OF THE EXTRACT OF COD LIVER OIL.

Sucrose.	Reducing Sugars as Dextrose.	Mgms. per 100 cc. Sol. in ether-chloroform, acid solution.	Mgms. per 100 cc. Sol. in ether-chloroform, alkaline solution.	Acidity per 100 gms. (cc. $\frac{N}{10}$ NaOH).	Salicylic Acid.	Saccharin.	Metals found in Ash (not tested for Na or K).	Alkaloids found.
Tr.	15.02	66.0	17.2	23.4	None	None	Fe, Ca, Mn.	Quinine, Strychnine.
Tr.	14.28	60.0	11.2	26.2	"	"	Fe, Ca, Mn.	Quinine, Strychnine.
Tr.	1.30	‡142.0	3.6	39.4	Yes	Yes	Fe, Ca.	None.
Tr.	10.84	58.0	8.8	20.9	None	None	Fe, Ca, Mn.	§Quinine.
8.62	†12.90	44.0	11.6	17.4	"	"	Fe, Ca, Mn.	Quinine, Strychnine.
1.11	14.02	54.4	2.8	23.0	"	"	Fe, Ca, Mn.	Quinine, Strychnine.
Tr.	12.62	71.6	12.0	25.4	"	"	Fe, Ca, Mn.	Quinine, Strychnine.

‡Probably saccharine and salicylic acid.

§No reaction for strychnin in 500 cc. of material.

From these data we conclude, first, that the samples are not emulsions of cod liver oil, for they contain no oil as such. They mix with water without precipitation and therefore cannot contain more than traces of fatty acids. They are all of acid reaction when mixed with water and, on addition of hydrochloric acid, two show none, three very slight and two slight precipitation. On standing over night, strongly acidified, all but Hagee's show a flocculent precipitate. In Table XXVI the amount of this precipitate determined quantitatively is shown to range from 44.0 to 71.6 mgms. per 100 cc. or from .04 to .06 per cent. These figures do not include the Hagee sample with its 142 mgms., or .15 per cent., as this was shown by other tests to consist chiefly of salicylic acid and saccharine. Remembering that these acid extracts obtained with ether-chloroform are in all cases impure products, it is obvious that the maximum amount of saponified fat in these samples cannot exceed .04 or .06 per cent.

These data indicate that none of the samples is entitled to be called a cod liver oil preparation, as none contains either oil or fatty acids and only the merest traces of saponified fat. Hagee's does not even contain this trace.

Furthermore (the Pettenkoffer test giving negative results for bile products in every case), none of the samples is entitled to be called a cod liver product, for no appreciable amount of cod liver extractive is present in any sample.

We are thus obliged to condemn the use of the names under which most of these preparations are sold; it is also important to consider them individually in connection with the specific claims made for each.

25575. *Wine of the Extract of Cod Liver Oil and Iron with Malt and Hypophosphites.* (Prep. for G. O. Cartier, Willimantic.) "A Reconstructive Tonic, Tissue Maker and Nutrient indicated in General Debility, Emaciation, Winter Cough, Bronchitis, Loss of Appetite and as a General Tonic." "This preparation represents the remedial and stimulating principles of the best Norwegian Cod's Liver, freed entirely from the fatty nauseating oil and enhanced medicinally by combination with Extract of Malt, Wild Cherry Bark and the Hypophosphites of Iron, Lime, Soda, Potash, Manganese, Quinine and Strychnine. This preparation agrees with all stomachs and is more palatable and efficient than plain Cod Liver Oil or any emulsion of Cod Liver Oil." As we have previously stated, leading pharmacologists do not acknowledge that cod liver oil possesses "remedial and stimulating principles" aside from the oil itself. The propriety of claiming that this preparation represents these principles, whose existence is more than doubtful, is certainly questionable. The statement that this wine is more "efficient than Cod Liver Oil or any emulsion of Cod Liver Oil" is glaringly false. The other statements as to its ingredients appear to be true.

25490. *Wine of the Extract of Cod Liver Oil and Iron with Malt and Hypophosphites.* (Prep. for Goodwin's Drug Store, Hartford.) Aside from the name of the druggist the label on this sample is exactly the same in size, type and text as that on **25575**, and the criticisms made apply equally to this preparation.

25539. *Hagee's Cordial of the Extract of Cod Liver Oil Compound.* "Tonic, Stimulant, Alterative, Reconstructive, Nutritive and Digestive." "Each fluidounce represents the extract obtainable from 1-3 fluidounce of Cod Liver Oil (the fatty portion being eliminated), 6 grs. calcium hypophosphite, 3 grs. sodium hypophosphite, 1-16 gr. saccharin, 1-2 gr. salicylic acid (made from oil Wintergreen), with Glycerine and Aromatics." The statement as to hypophosphites appears to be correct. Saccharin and salicylic acid are present as claimed. The qualifying words applied to salicylic acid, "made from oil Wintergreen," are without significance, for salicylic acid is salicylic acid, no matter what its source. Whatever nutritive value this preparation possesses depends upon the alcohol, glycerine and small amount of sugar it contains, and nothing else. The words "Cod Liver Oil" have no proper use in connection with a product like this. It is the weakest preparation of the kind examined and contains saccharin and salicylic acid; it does not even possess the tonic virtues due to the quinine and strychnine contained in the other samples. Its claims are grossly exaggerated.

25558. *Narco Wine of Cod Liver Oil, Alcoholic Extract of the Oil with Malt and Hypophosphites.* "The remedial principles and fat-producing constituents of the best Norwegian Cod Liver Oil, freed entirely from the fatty portion and unpleasant taste of Cod Liver Oil, and enhanced medicinally by combination with Extract of Malt, Wild Cherry Bark and Compound Syrup of the Hypophosphites, containing Lime, Potash, Iron, Soda, Manganese, Quinine and Strychnine." "This preparation agrees with all stomachs and is more palatable and efficient than pure Cod Liver Oil, or any emulsions of Cod Liver Oil." Inasmuch as cod liver oil is only very slightly soluble in alcohol, an alcoholic extract might be prepared containing practically no oil. The descriptive name used on this preparation, therefore, is a nearer approach to the truth than generally found. However, to state that it contains the "remedial principles and fat-producing constituents" of the oil "freed entirely from the fatty portion" is like saying it contains all the oil except the oil. This claim is false and misleading. The statement that this wine is more "efficient than cod liver oil or any emulsion of cod liver oil" is likewise glaringly false. No strychnine was detected in this sample, although claimed on the label.

25581. *Tasteless Wine of Cod Liver Extract with Beef, Malt and Hypophosphites.* (Prep. for Mark N. Sullivan, New Haven.) "This preparation combines the virtues of cod liver extract (without any disagreeable oily properties) with Beef, Malt, and Hypophosphites. It forms a valuable tonic and nutritive and is useful in coughs, consumption and wasting diseases." No serious objection can be made to this label, aside from the general criticism of the use of the words "cod liver." However, as already pointed out, there appears to be no satisfactory evidence that cod liver extractives, other than the oil, possess any therapeutic value. The sample contains nutriment and possesses tonic properties entirely independent of cod liver. It contains nearly twenty-two per cent. of sugars, over half of which is glucose, but can hardly be recommended as an economical means of obtaining these foods.

25556. *Wampole's Perfected Tasteless Preparation of the Extract of Cod Liver.* "Contains a solution of the extractive obtainable from fresh cod liver, the oily or fatty portion being afterward eliminated. This extractive is combined with Liquid Extract of Malt, Fluidextract of Wild Cherry Bark and Compound Syrup of Hypophosphites (containing Calcium, Sodium, Potassium, Iron, Manganese, Quinine and Strychnine)." In spite of the presence of the different hypophosphites as claimed, the total phosphoric acid in this sample amounts to only 0.14 per cent., so that the amount of hypophosphites present cannot be great. In other respects the label is a reasonably accurate description of the product.

25487. *Dr. Heckler Brand Palatable Preparation of the Alcoholic Extract of Cod Liver Oil with Malt and Hypophosphites.* In essentials this label is the same as those on **25490** and **25575,** although in some respects it is more moderate in its claims. In composition, it closely resembles those samples. Its brand name is scarcely open to criticism, as it only claims to be the "alcoholic extract" of cod liver oil. The statement that it "may be employed in all cases where Cod Liver Oil is indicated" seems like very dangerous advice to a user ignorant of its true character.

HEADACHE PREPARATIONS.

In six of the eight samples examined, acetanilid was claimed on the label, and in two acetphenetidin. **25452** was illegally labeled a

TABLE XXIX.—HEADACHE PREPARATIONS.

Station No.	Brand.	Contents of package.	Price per package.	Guaranty.	Weight of powder in grains.	Acetanilid in powder. Grains.	Acetanilid in powder. Per cent.
			cts.				
25650	[1] Dr. Hobson's Headache Wafers. Pfeiffer Chem. Co., Philadelphia.	12 wafers.	25	139 grs. acetanilid per oz. (=29%).	19.64 17.95 18.62	6.80 6.27 6.41	
				Average	*18.74*	*6.49*	*34.6*
25452	[2] Ingram's Celero-Caffeine Headache Wafers. F. F. Ingram and Co., Detroit, Mich.	12 wafers.	25	218 grs. acetanilid per oz. (=45.4%).	4.68 5.14 4.27	2.15 2.32 1.92	
				Average	*4.70*	*2.13*	*45.3*
25453	[3] Jamieson's Headache Konceals. Prep. for G. A. Jamieson, Bridgeport.	12 wafers.	25	164 grs. acetanilid per oz., or 4½ grs. per powder (=34.2%).	9.61 9.44 9.54	3.85 3.95 3.93	
				Average	*9.53*	*3.91*	*41.0*
25699	Mohegan Headache Wafers. Mfd. for The McCarthy Pharmacy, Waterbury.	3 wafers. (one broken).	10	3½ grs. acetanilid per powder.	10.54 9.98	3.74 3.58	
				Average	*10.26*	*3.66*	*35.7*
25680	Reliable Headache Wafers. Mfd. for E. S. Schoonmaker, Ansonia.	2 wafers. (one broken).	10	5 grs. acetanilid per wafer.	9.02	4.71	52.2
25698	Headache Powders (Dr. Tanner's). Joseph A. Urba, Waterbury.	3 wafers.	10	4 grs. acetanilid per powder.	9.98 9.34	4.09 3.93	
				Average	*9.66*	*4.01*	*41.5*

[1] Contains a large dosage of acetanilid, over 5% in excess of amount claimed.
[2] Illegally labeled a "cure." Acetanilid guaranty not prominent on label.
[3] Acetanilid considerably below guaranty.

"cure," and **25453** was deficient in acetanilid. **25650** and **25730** each contained considerably more than the amount of drug claimed, the dosage in the former seeming to be dangerously high.

When previously examined, in 1908, **25680** bore no guaranty of acetanilid on the label, and **25761** contained acetanilid instead of acetphenetidin. Acetphenetidin is a derivative of acetanilid and only slightly less objectionable for indiscriminate and undirected use. Its dangerous character is less known by the public, hence its frequent substitution for acetanilid in these preparations.

TABLE XXX.—HEADACHE PREPARATIONS.

Station No.	Brand.	Contents of package.	Price per package.	Guaranty.	Weight of powder or tablet in grains.	Acetphenetidin per powder or tablet. Grains.	Per cent.
25761	[1]Antikamnia Tablets. The Antikamnia Chem. Co., St. Louis.	12 tablets.	25	305 grs. acetphenetidin per oz. (=63.5%).	5.41 5.02 5.29	3.41 3.20 3.56	....
				Average	*5.24*	*3.39*	*64.7*
25730	[2]Halloran's Headache Wafers. Prep. for Halloran's Drug Store, New Britain.	12 wafers.	25	194 grs. acetphenetidin per oz. (=40.4%).	9.06 9.20	4.08 4.67	....
				Average	*9.13*	*4.38*	*48.0*

[1] Contains 0.29 gr. caffein per tablet, equal to 5.5%. In 1908 the samples examined contained acetanilid, not acetphenetidin.
[2] Contains 0.70 gr. caffein per wafer, equal to 7.5%. The acetphenetidin is 7.6% in excess of the amount claimed.

TINCTURA IODI.

(*Tincture of Iodine.*)

Twenty samples were examined, all but two from druggists whose iodine tincture had in a previous year been found below standard. The samples contained from 6.29 to 7.63 grams of iodine per 100 cc., no sample showing less than 90 per cent. of U. S. P. strength. The tabulation below shows the great improvement in the quality of the tincture sold by druggists, whose tincture in 1908 and 1909 was far below standard.

No.	Grams of Iodine per 100 cc. 1911.	1908 or 1909.	No.	Grams of Iodine per 100 cc. 1911.	1908 or 1909.
25786	7.63	2.51	25787	7.00	....
25816	7.55	5.36	25705	6.87	5.13
25746	7.53	2.26	25752	6.84	....
25751	7.46	4.05	25673	6.72	4.14
25658	7.41	5.07	25677	6.72	4.84
25829	7.28	4.28	25760	6.70	5.13
25747	7.25	5.40	25726	6.67	2.46
25676	7.18	3.61	25725	6.59	2.68
25727	7.15	4.91	25821	6.54	5.60
25728	7.02	4.05	25649	6.29	4.39
			Average (18)	7.03	4.22

From the above figures the usefulness of drug inspection in this state is apparent.

LIME WATER.

(*Liquor Calcis.*)

Four samples were bought from druggists whose lime water had been found below standard in a previous year. Three of these samples were of full standard strength. The fourth, taken in Naugatuck, contained only a trace of calcium hydroxide, 0.002 per cent., or 1.4 per cent. U. S. P. strength.

SPIRITUS ÆTHERIS NITROSI.

(*Spirit of Nitrous Ether.*)

The U. S. P. preparation is a 4 per cent. alcoholic solution of ethyl nitrite.

It deteriorates gradually, unless great care is used in keeping and dispensing it. The U. S. P. directs to "transfer the product to small, well-stoppered, dark amber-colored vials, and keep these in a cool place, remote from lights or fire." The pharmacists' responsibility does not end, therefore, with the correct preparation of this drug; care must also be exercised in maintaining its strength and quality. Druggists quite commonly dispense this preparation from ordinary clear-glass shelf bottles, and in many cases no precautions are taken to keep the bottle full and away from the light. It is not believed that this preparation is often intentionally adulterated, but that it is carelessly kept is demonstrated by the analyses in Table XXXII.

TABLE XXXI.—SPIRIT OF NITROUS ETHER.—(PASSED.)

Station No.	Place of Sale.	Price per 4 oz., cts.	Specific gravity at 15.6° C.	Alcohol by weight.*	Nitrous Acid.	Acetic Acid.	Ethyl Nitrite.	Per cent. U. S. P. strength.
25000	Norwich	25	.8252	89.08	0.06	0.07	3.96	99
24145	Meriden	30	.8203	90.93	0.06	0.07	3.80	95
24161	New Haven	20	.8207	90.75	0.06	0.07	3.70	93
24990	New London	32	.8213	90.54	0.06	0.07	3.62	91
	Made in Laboratory	..	.8192	91.17	0.01	0.02	3.80	95

TABLE XXXII.—SPIRIT OF NITROUS ETHER BELOW STANDARD.

Station No.	Place of Sale.	Price per 4 oz., cts.	Specific gravity at 15.6° C.	Alcohol by weight.	Free Nitrous Acid.	Free Acetic Acid.	Ethyl nitrite.	Per cent. U. S. P. strength.
24159	New Britain	25	.8252	89.08	0.11	0.07	3.52	88
25039	South Norwalk	35	.8239	89.58	0.23	0.07	3.43	86
24989	New London	25	.8204	90.86	0.20	0.07	3.40	85
24953	Bridgeport	35	.8210	90.64	0.20	0.04	3.34	84
24901	New Haven	30	.8256	88.92	0.06	0.07	3.34	84
24126	Waterbury	35	.8283	87.85	0.20	0.04	3.34	84
24146	Meriden	35	.8234	89.77	0.11	0.07	3.28	82
24971	New Haven	20	.8209	90.68	0.14	0.07	2.92	73
25016	Willimantic	20	.8214	90.50	0.11	0.97	2.92	73
25064	Danbury	35	.8249	89.19	0.29	0.07	2.89	72
24918	Hartford	20	.8272	88.28	0.28	0.07	2.72	68
24952	Bridgeport	20	.8193	91.25	0.14	0.07	2.70	68
24158	New Britain	25	.8219	90.32	0.11	0.07	2.67	67
24127	Waterbury	25	.8261	88.72	0.29	0.07	2.65	66
24128	"	35	.8233	89.81	0.29	0.07	2.55	64
25040	Norwalk	30	.8204	90.86	0.12	0.07	2.52	63
25038	South Norwalk	25	.8297	87.31	0.40	0.07	2.30	58
25001	Norwich	25	.8263	88.64	0.42	0.07	2.26	57
24919	Hartford	25	.8214	90.50	0.29	0.07	2.20	55
24125	Waterbury	35	.8215	90.46	0.32	0.04	2.20	55
24156	New Britain	20	.8234	89.77	0.29	0.07	2.20	55
24930	Middletown	25	.8229	89.96	0.34	0.07	1.97	49
24920	Hartford	25	,8216	90.43	0.11	0.04	1.81	45
24124	Waterbury	25	.8253	89.04	0.14	0.04	1.81	45
24954	Bridgeport	35	.8221	90.25	0.31	0.07	1.65	41
24123	Waterbury	25	.8231	89.88	0.29	0.07	1.50	38
24921	Hartford	35	.8214	90.50	0.14	0.07	1.42	36
25061	Bethel	35	.8238	89.62	0.42	0.07	1.19	30
25029	Stamford	25	.8424	82.38	0.67	0.07	1.03	26
24157	New Britain	20	.8224	90.14	0.11	0.07	0.85	21

It is not an easy matter to make spirit of nitrous ether of full standard strength by the U. S. P. method. A sample made in this laboratory, with the greatest care, contained only 3.80 instead of the required 4 per cent. of ethyl nitrite, but when a sample shows only 60, 50, 30 or 20 per cent. of standard strength, the excuse of difficulties in preparation loses its validity.

Allen has pointed out* that the presence of excess of water greatly favors the destruction of nitrous ether. In only one of our samples, **25029**, was there such an excess, and here the content of ethyl nitrite was only 1.03 per cent. This sample, likewise, had the largest amount of free nitrous acid, 0.67 per cent., still further evidence of the destruction of the ethyl nitrite.

Thirty-four samples were examined, none of which fully met the U. S. P. standard, although four samples were deficient by less than ten per cent. The remaining thirty samples contained from 3.52 to 0.85 per cent. of ethyl nitrite, or from 88 to 21 per cent. U. S. P. strength. Excluding **25029**, already referred to as containing an excess of water, the other thirty-three samples had the following range of composition:

Specific gravity	.8193— .8297,	ave......	.8232
Alcohol by weight	87.31 —91.25,	ave......	90.12
Nitrous acid	0.06 — 0.42,	ave......	0.21
Acetic acid	0.04 — 0.07,	ave......	0.07
Ethyl nitrite..............	0.85 — 3.96,	ave......	2.62

The cost of four ounces ranged from 20 to 35 cents, with an average of 27.6 cents.

PEPSIN.

The U. S. P. defines pepsin as follows: "A proteolytic ferment or enzyme, obtained from the glandular layer of the fresh stomach of the hog (*Sus scrofa,* var. *domesticus* Gray), and proved to be capable, when assayed by the process given below (U. S. P. p. 335), of digesting not less than 3000 times its own weight of freshly coagulated and disintegrated egg albumin."

Pepsin can convert natural protein substances into soluble products known, as proteoses and peptones. The assay of commercial pepsin is, therefore, based on a determination of this

* Allen's Commercial Organic Analysis, *1*, 143.

power of conversion, which varies with the period of digestion, temperature, nature of the protein material subjected to its action, the reaction of its solution, and on other conditions difficult to control.

The U. S. P. assay method is open to strong objections. The prolonged period of digestion is inconvenient, the use of fresh egg albumin introduces a reagent of uncertain and variable water content, and the final deposit of undissolved albumin cannot be measured very accurately. In recent years, several methods have been suggested for the determination of the pepsin content of gastric juice, which appear to possess advantages over the U. S. P. method. Among the best of these are the methods suggested by Jacoby and Solms,* Fuld and Levison† and Rose.‡ The Jacoby method is based on the fact that a solution of the protein of the castor bean in salt solution gives a precipitate when a very little acid is added to the solution. When all the protein is converted into soluble products no precipitate forms on adding acid. The Fuld and Levison method depends upon the fact that under the action of acid alone edestin is rapidly changed into edestan,§ which is soluble in very dilute acids containing no dissolved salts. On adding very dilute salt solutions to acid solutions containing edestan a precipitate forms which is not soluble in an excess of salt solution. When pepsin acts on edestan it converts it into products soluble in pure water, hence when all the edestan has been thus converted no precipitate forms on adding salt to its acid solution. In the Rose method pea globulin is substituted for the ricin used by Jacoby.

The method used by us was a combination of the Fuld and Levison and Rose methods, with a few minor modifications. Our thanks are due to Dr. T. B. Osborne of this station, who kindly placed at our disposal some edestin of a high degree of purity, prepared by him from hemp seed.

After much experimental work, the following procedure was adopted:

---

* Zeit. f. klin. Med., 1907, *64*, 159.
† Biochem. Zeit., 1907, *6*, 473.
‡ Arch. Intern. Med., 1910, *5*, 459.
§ Osborne, Zeit. f. physiol. Chem., 1901, *33*, 225.

Prepare accurately a 0.1 per cent. solution of edestin in 0.1 per cent. hydrochloric acid. Weigh 0.25 gm. of the sample of pepsin and triturate in a glass mortar with a small quantity of water. Transfer to a 500 cc. flask and dilute to mark. Mix well and filter, thus obtaining a 1 to 2000 solution of the pepsin. Next, ascertain if suitable dilution of the pepsin has been secured, as follows: Measure from a burette 2 cc. of edestin solution into a small glass vial, add 0.9 cc. of water and 0.1 cc. of pepsin solution (measured from a 2 cc. capillary pipette). Shake and digest at 20° C.* for exactly thirty minutes. Remove from digestion bath, add 0.5 cc. saturated sodium chloride solution and shake. If a slight turbidity is produced the dilution of 1 to 2000 is a suitable one. If the solution is more than slightly turbid another solution should be prepared, containing more pepsin. If the solution is clear less pepsin should be taken. After the proper dilution has been ascertained proceed as follows: To each of a series of four or five small glass vials add 2 cc. of 0.1 per cent. edestin solution from a 25 cc. Schellbach burette. Then add to each from a 5 cc. pipette, graduated in tenths, sufficient water, depending upon amount of pepsin solution added later, to make final volume exactly 3 cc. Then add, as rapidly as possible, measured amounts of the dilute pepsin solution from a small burette, graduated to tenths. Shake and digest for exactly thirty minutes in a water bath at 20° C. Remove and add 0.5 cc. saturated salt solution, shake, and note degree of turbidity. The end point requires some care in judging results, remembering that the end point is *not* a perfectly clear solution, but extremely slight turbidity. The pepsin activity is calculated by the following formula:—

$$\text{peptic activity} = \frac{\text{quantity of pepsin solution used}}{\text{2 cc. edestin solution} \times \text{pepsin dilution}}$$

Thus, if the proper end point was shown in the vial to which 0.5 cc. of pepsin of 1 to 5000 dilution had been added,

$$\text{peptic activity} = \frac{.5}{2 \times 5000} = \frac{1}{20000}.$$

To obtain a comparison of peptic activity as determined by this and the U. S. P. methods, two samples of pepsin, **23094** and **23147**, were tested by the latter method. They showed a peptic activity of 1 to 3000 and 1 to 1500 respectively. In other words, **23094** was twice as strong as **23147**, confirming the relative values 20,000 and 10,000 obtained by the edestin method. From these tests it appears that a commercial pepsin showing a peptic activity of 20,000 by the edestin test is of the strength required by the U. S. P., namely, 3000.

* Experiments at 35° C. showed no appreciable difference over 20°, and the latter temperature was therefore adopted as being more convenient.

TABLE XXXIII.—POWDERED PEPSIN.

Station No.	Label.	Place of sale.	Price of sample, cents.	Net weight of sample, grms.	Strength of Pepsin.		Per cent. of U.S.P. strength
					Edestin Test.	U. S. P. Test.	
23202	Extra Strong Po. Pepsin, 1-6000 ...	Norwich....	40	8	40,000	*6,000	200
23094	Pepsin in Powder, U. S. P., 1-3000	Bridgeport	75	25	20,000	3,000	100
23671	Pepsin	New Haven.	30	15	17,400	*2,610	87
23104	Pepsin in Powder, U. S. P., 1-3000	Ridgefield ..	40	25	16,000	*2,400	80
23200	Pure Powd. Pepsin	New London	40	15	16,000	*2,400	80
23112	Po. Pepsin	Danbury ...	35	18	14,280	*2,142	71
23668	Powd. Pepsin	New Haven	25	15	13,332	*2,000	67
23024	Pure Pepsine, 1-3000...........	Bridgeport	25	12	13,332	*2,000	67
23022	Pure Pepsin Powd.	"	25	16	13,332	*2,000	67
22305	Po. Pepsin	Hartford ...	15	15	13,332	*2,000	67
23667	Powdered Pepsin	New Haven	35	23	12,000	*1,800	60
23063	Pow. Pepsin....................	" "	25	15	11,200	*1,680	56
23670	Pure Po. Pepsin, 1-3000.........	" "	30	14	11,200	*1,680	56
22306	Pure Pepsin, U. S. P............	Hartford ...	25	16	10,000	*1,500	50
23147	Powd. Pepsin...................	Waterbury..	25	16	10,000	1,500	50
23139	Pepsin Powder	" ..	40	20	8,320	*1,248	42
23240	Pepsin, U. S. P.	Willimantic	35	15	8,000	*1,200	40
23034	Po. Pepsin	Stamford ...	25	28	1,810	* 272	9
23176	Pepsin	Winsted....	25	1	1,430	* 215	7
23669	Pepsin, U. S. P.	New Haven	30	12	1,250	* 188	6

* Calculated from edestin test (20,000 edestin test = 3,000 U. S. P. test).

Twenty samples of commercial powdered pepsin were tested by this method. All of them were bought in bulk or in broken packages, except **23094**, which was sold in the unbroken original package of its manufacturer, Fairchild Bros. & Foster, New York.

One sample was sold as "extra strong, 1-6000." This showed by the edestin test a peptic strength of 40,000, corresponding to 6000 by the U. S. P. test. Four samples were labeled, "1-3000," while three others were simply labeled "U. S. P." All the other samples, however, were bought as U. S. P. preparations and should conform to the minimum U. S. P. strength of 1-3000.

Of the nineteen samples bought as U. S. P. pepsin, only one was of U. S. P. strength, **23094**, while three were reasonably close, showing strengths of 16,000 to 17,400 by the edestin test, corresponding to 2400 to 2610 by the U. S. P. test, or 80 to 87 per cent. U. S. P. strength. The other fifteen samples ranged from 14,280 to 1250 by the edestin test, corresponding to 2142 to 188 U. S. P. test, or from 71 to 6 per cent. U. S. P. strength.

Great inaccuracy was noted in the weight of certain of the samples as purchased. Although one-half ounce (14 grams) was asked for, with **23202** only 8 gms. was obtained, and with **23176** only 7 gms., while with **23034** a full ounce was obtained, although only half that quantity was asked for. Wide variations in price were also noted. In the nineteen samples sold as U. S. P. the price ranged from 25 to 80 cents per ounce, prices which the table shows were entirely independent of the quality of the pepsin sold, except in **23034.**

TABLE XXXIV.—QUININE PILLS (2 GRAINS).

Station No.	Place of Sale.	No. of Pills in Sample.	Price of Sample, cents.	Average weight of Pill, grains.	Quinine Sulphate, per Pill.	
					Gravimetric.	Volumetric.
					grains.	grains.
24942	Bridgeport	26	20	2.92	1.68	1.54
25448	"	12	10	2.57	1.99	1.96
25449	"	12	10	3.06	1.91	1.91
25450	"	12	10	2.66	1.96	1.94
25451	"	12	10	2.71	1.94	1.90
25067	Danbury	24	10	2.56	1.92	1.84
24910	Hartford	25	20	2.90	1.89	1.88
24911	"	26	20	2.69	2.01	2.01
24925	"	12	10	2.59	1.85	1.80
25800	"	12	10	2.57	1.86	1.83
25801	"	12	10	2.53	1.95	1.95
25802	"	12	10	4.41	2.10	1.96
24139	Meriden	50	25	2.61	1.87	1.83
24140	"	24	15	2.81	1.88	1.80
24934	Middletown	25	10	2.84	1.88	1.94
24147	New Britain	23	10	2.62	1.91	1.84
24148	" "	24	20	2.60	2.04	1.98
24902	New Haven	24	10	3.41	1.88	1.83
24972	" "	34	15	2.92	2.05	2.05
24973	" "	24	20	3.41	1.96	1.98
25742	" " (Upjohn's Friable)	12	5	2.62	1.85	1.83
25743	" "	12	5	3.48	1.75	1.74
25744	" "	12	5	2.66	1.76	1.69
25758	" "	12	10	2.60	1.92	1.88
24993	New London	24	15	2.64	1.97	1.95
24994	Norwich	25	15	3.40	1.91	1.88
25022	Stamford	24	20	2.63	1.87	1.88
24133	Waterbury	25	20	2.68	2.00	1.98
24134	"	25	15	3.42	1.95	1.93
24135	"	25	15	3.06	2.00	1.93
24136	"	37	25	2.60	1.92	1.90
24137	"	25	20	4.25	1.99	2.07
25009	Willimantic	36	25	4.79	1.87	1.87
	Average	..	..	*2.98*	*1.92*	*1.89*

QUININE PILLS.

All of the thirty-three samples examined were sold as 2 grain pills. With a tendency towards a slight deficiency in quinine sulphate, as a rule the samples are very satisfactory. The quinine sulphate found ranged from 1.68 to 2.10 grains per pill by the gravimetric method, and from 1.54 to 2.07 grains by the volumetric method. Only three samples showed a deficiency greater than 10 per cent., **24942** from Bridgeport and **25743** and **25744** from New Haven containing only 1.68, 1.75 and 1.76 grains respectively.

The price ranged from 5 to 10 cents per dozen pills.

COMPOUND EXTRACT OF SARSAPARILLA.

Nine samples of this proprietary preparation were analyzed. According to the labels they are of most complex composition and we have not attempted the almost impossible task of identifying all the ingredients claimed to be present. The following drugs are claimed on the labels of the various preparations: Sarsaparilla, yellow dock, stillingia, burdock, licorice, sassafras, mandrake, buckthorn, senna, black cohosh, pokeroot, wintergreen, cascara sagrada, cinchona bark, prickly ash, alcohol, glycerine and iodides of potassium and iron. Whatever value the vegetable drugs named above possess is due to their power as emetics, purgatives or alteratives.

The dominant vegetable ingredient is, or should be, extract of sarsaparilla; the important active mineral ingredient present is potassium iodide.

Both extract of sarsaparilla and potassium iodide possess remedial powers, especially in syphilitic and scrofulous diseases. Potassium iodide is a powerful drug, which should be used with care. In fact, there has been considerable discussion whether preparations containing it should not be so labeled as to inform the public. Dr. Abbott, referring to sarsaparillas, in the Report of the Massachusetts State Board of Health for 1892, says: "With but few exceptions, they contain a considerable percentage of a very active and powerful remedy—iodide of potassium. . . . The sale of such an article in unlimited quantities by druggists, grocers and others is censurable. More than this, the method of its sale is dishonest, since the unwary purchaser is led to believe that he is purchasing a harmless vegetable remedy, namely, sarsaparilla. . . . It may be seriously questioned whether the blood of persons who take iodide of potassium continuously is not decidedly impoverished instead of being purified, as is claimed by the manufacturers. It is not uncommon to find persons who have used continuously six, eight or ten pint bottles of these preparations. Unlike sarsaparillas, the iodide of potassium is classed among poisons by nearly every writer upon toxicology."

The following illuminating report of a conversation with the representative of a patent medicine house producing sarsaparilla is thus recorded by Prof. E. F. Ladd in his Report for 1906:

"He stated in my office that a sarsaparilla without potassium iodide, or some similar product, would have very little demand. There must be present, he said, something like potassium iodide, which shall cause the people taking the same to believe that they are being benefited as shown by the crop of pimples when they have continued the use of sarsaparilla for some time; when, as a matter of fact, such treatment is undermining the health. In other words, the manufacturers of this class of patent medicines treat their patients to produce the disease that they may treat the patient further and take from him the money to pay for a remedy which in reality is undermining the health."

Our analyses show these preparations to be of very variable composition.

The labels of five samples claimed from 7 to 27 per cent. of alcohol. **25545** contained 22.52 per cent., although none was claimed; its sale was therefore illegal.

Three samples contained so much glycerine as to interfere seriously with the determination of solids. The others ranged from 3.80 to 52.63 per cent. solids, more than half in the latter consisting of cane sugar in the form of molasses. Such percentages of solids as 3.80 and 4.74 certainly do not indicate a very concentrated preparation; both of these were very high in alcohol.

The percentage of ash ranged from 0.48 to 2.73, except in **25491**, where 9.40 was present. In this sample the ash consisted chiefly of magnesium sulphate, with considerable chlorides and phosphates.

Table XXXV.—Extract of Sarsaparilla.

Station No.	Brand.	Price per bottle, cents.	Net volume of sample, fl. oz.	Specific gravity at 15.6° C.	Alcohol. By weight.	Alcohol. By volume.	Total Solids.	Ash.	†Potassium Iodide. Per cent.	†Potassium Iodide. Grains per fl. oz.	Polarization at 20° C. Direct.	Polarization at 20° C. After Inversion.	Sucrose.	Glycerine.
							%	%	%				%	%
25548	A. D. S. Sarsaparilla Compound. American Druggists Syndicate, New York	75	10.8	1.0946	0	0	*	2.20	1.48	7.5	1.2	1.2	....	25.71
25142	Ayer's Compound Conc. Extr. of Sarsaparilla. J. C. Ayer Co., Lowell, Mass.	85	10.0	1.1523	0	0	*	0.88	0.64	3.4	0.0	0.0	....	53.63
25512	Our Sarsaparilla. Prep. for E. Callahan, Jr., New London	75	10.0	0.9942	19.04	23.86[1]	4.74	1.58	1.21	5.6	1.2	0.8	....	....
25547	Hood's Comp. Extr. of Sarsaparilla. C. I. Hood Co., Lowell, Mass.	79	10.5	1.0419	11.89	15.60[2]	12.87	1.59	0.91	4.4	−2.2	−2.2	....	....
25141	Jamieson's Comp. Extr. of Sarsaparilla. Prep. for Geo. A. Jamieson, Bridgeport	75	12.0	1.0490	6.59	8.71[3]	11.58	0.49	0.29	1.4	−1.4	−1.4	....	....
25546	Nyal's Spring Sarsaparilla, etc., Comp. New York and London Drug Co., New York.	89	12.0	1.1237	0	0	*	1.39	0.71	3.7	3.0	2.8	....	27.78
25511	Sayle's Comp. Extr. of Sarsaparilla. Sayle's Pharmacy, New London	50	10.8	1.0587	20.73	27.68[4]	20.04	2.73	0.70	3.4	0.0	−4.4	3.32	....
25545	Rexall Sarsaparilla Tonic. United Drug Co., Boston	50	16.2	1.0053	17.77	22.52[5]	3.80	0.48	0	0	−1.4	−1.2	....	....
25491	Wilson's Compound Sarsaparilla. B. O. & G. C. Wilson, Boston	100	16.3	1.3160	3.13	5.19[6]	52.63	9.40	0	0	26.4	−9.2	26.84	....

Alcohol guaranty, 20%. [1] Guaranty, 18%. [2] Guaranty, 10%. [4] Guaranty, 27%. [5] No alcohol guaranteed. [6] Guaranty, about 7%. * Not determined because of presence of large amount of glycerine. † All iodide present calculated as potassium iodide.

All but two samples contained potassium iodide in quantities ranging from 0.29 to 1.48 per cent., or from 1.4 to 7.5 grains per fluidounce.

Five samples had plus or zero polarizations, both before and after inversion, indicating the probable presence of glucose. **25511** contained 3.32 per cent. and **25491** 26.84 per cent. of sucrose.

Three samples contained glycerine, ranging from 25.71 to 53.63 per cent.

The labels of these medicines are too prolix to permit of their reproduction here. We will take up the samples in order and point out the truthfulness or falsity of their claims as indicated by our analyses.

25548. *A. D. S. Sarsaparilla Compound.* "A preparation of vegetable substances that eliminates poison from blood and tissues. This is not a patent medicine but a Premium Remedy selected and warranted by an association of 12,000 qualified druggists." This "vegetable" preparation contained 7.5 grains of potassium iodide per fluidounce; it is therefore misbranded. In this material, glycerine has been substituted for alcohol, a change of doubtful efficacy.

25142. *Ayer's Compound Concentrated Extract of Sarsaparilla.* This preparation no longer contains alcohol, as formerly, but does contain 53.63 per cent. of glycerine. The active principle of sarsaparilla is parillin, which is readily soluble in alcohol. A serious doubt arises as to whether the elimination of alcohol from an extract of sarsaparilla does not at the same time wholly or in part prevent the presence of the parillin, its most valuable ingredient. The label claims 4 grs. of potassium iodide per fluidounce; 3.4 grains were found.

25512. *Callahan's Our Sarsaparilla.* Claims to be the "King of all Purifiers." It is an extremely dilute preparation containing only 4.74 per cent. of solids, of which 1.21 per cent. is potassium iodide, or 5.6 grains per fluidounce. It is a highly alcoholic preparation, containing nearly 4 per cent. more than claimed, and its virtues would seem to depend upon alcohol and potassium iodide, rather than on the small amounts of vegetable drugs present.

25547. *Hood's Compound Extract of Sarsaparilla.* "Contains 18 per cent. alcohol, the smallest quantity that will extract and preserve all the remedial properties of the ingredients." This statement is substantially correct, as regards the amount of alcohol, and the preparation appears to be a genuine extract, as claimed. It contains 4.4 grains of potassium iodide per fluidounce.

25141. *Jamieson's Compound Extract of Sarsaparilla.* This, likewise, appears to be a genuine extract, characterized by a rather low content of potassium iodide, 1.4 grains per fluidounce.

25546. *Nyal's Spring Sarsaparilla Compound.* "The cultivation of cheerfulness of mind, purity of life, and habits of cleanliness, greatly conduce to aid the medicine in the cure of disease." This delightful truism cannot be contradicted, but can hardly be considered as a specific recommendation for this particular preparation. As in the A. D. S. and Ayer's compounds, glycerine has been substituted for alcohol, a change of doubtful value. It claims 4.5 grains of iodides of potassium and iron per fluidounce; 3.4 grains, calculated as potassium iodide, were found. Glucose appeared to be the sweetener used.

25511. *Sayle's Compound Extract of Sarsaparilla.* This appears to be a genuine extract of very high alcohol content, with 3.4 grains of potassium iodide per fluidounce. It contains about 3 per cent. of sucrose.

25545. *Rexall Sarsaparilla Tonic.* This is the most dilute preparation we examined, as it contained only 3.80 per cent. of solids. It contained 22.52 per cent. of alcohol by volume, which was not declared on the label; it is therefore misbranded. It contained no iodides.

25491. *Wilson's Compound Sarsaparilla.* "Patients should cautiously avoid the use of Beer and Alcoholic Stimulants even in small quantities, which is distinctly calculated to produce the very diseases which they wish to cure." Such advice is most refreshing when connected with a preparation containing 5.19 per cent. of alcohol, more than usually found in beer itself. The compound contains no iodides, but over half of its very high solids consist of cane sugar in the form of molasses.

Determination of Potassium Iodide.

All the samples were first tested qualitatively for iodides by the following method: 10 cc. of the material were treated in a test tube with 2 gms. ammonio-ferric alum, 10 cc. water, 10 cc. sulphuric acid (1–10) and 10 cc. of chloroform; a violet coloration of the chloroform layer indicated iodides.

The distillation method, following out the same reactions as given above,* was tried for the quantitative estimation of iodides with poor success, high results being generally obtained. Shaking out with chloroform from an acid solution and titrating the extract with sodium thiosulphate gave satisfactory results in some samples, but not in others. The method finally used was a modification of that suggested by Hunter.† The following experimental data shows the accuracy of the method. To portions of samples **25545** and **25491**, which were shown to contain no iodides, .050 gm. potassium iodide was added. The recovery was .0498, .0506, .0488 and .0495 gm. with the former, and .0484 and .0484 with the latter. Sample **25491** was an especially severe test of the method, as it contained over 50 per cent. of solids, half of which was sugar. The method as finally used was as follows:

Reagents. Fusion mixture, 138 grams (1 mol.) anhydrous potassium carbonate, 106 grams (1 mol.) anhydrous sodium carbonate, 75 grams potassium nitrate (¾ mol.).

Decinormal solution of sodium thiosulphate.

Starch solution, 0.5 per cent.

Phosphoric acid solution, 1 part 85 per cent. acid to 1 part water.

Solution of chlorinated soda, U. S. P., fresh.

Starch potassium iodide paper.

Procedure. Weigh 2 gms. of material on a watch glass, and transfer to a nickel crucible, using a small piece of filter paper to clean the glass, and adding same to crucible. Add gradually 10 to 15 gms. of the fusion mixture and stir thoroughly with a platinum rod. The mass should be in the form of small lumps. Cover the crucible and place over a full flame. In about 10 minutes the contents will have become white and in a pasty condition. Remove crucible and dissolve melt in a beaker with water, heating if necessary. Transfer to an Erlenmeyer flask, the volume of the solution being 150–200 cc., and cool to room temperature. Add 30–40 cc. of fresh chlorinated soda solution and then carefully acidity with phosphoric acid (1–1), keeping flask cool and inclined. Place flask, with funnel in neck, over a flame and boil vigorously for some time after starch potassium iodide paper shows no test for chlorine when moistened and held in the escaping steam. (A little emery previously added prevents bumping.) Remove flask, cool contents, and add about 10 cc. of 10 per cent. potassium iodide solution. Run in immediately from a burette decinormal sodium thiosulphate solution, adding starch solution towards the end of the titration. The reading of the burette divided by six shows

* Schimpf, Manual of Volumetric Analysis, 1909, p. 220.

† Jour. Biol. Chem., 7, 321.

the amount of thiosulphate required by the iodine originally present, according to the following reaction:

$$5\ KI + HIO_3 + 5\ HCl = 5\ KCl + 3\ H_2O + 3\ I_2$$

Note. It was found necessary to have a distinct excess of phosphoric acid present. Unless such is the case the addition of potassium iodide to the solution, even if acid to litmus, will show no iodine liberated. The addition of more phosphoric acid to such a solution immediately brings out the free iodine.

In case the melt after solution shows much color, due to iron, etc., filtration is advisable.

AQUA HAMAMELIDIS.

(*Hamamelis Water—Extract of Witch Hazel.*)

Extract of witch hazel, according to the U. S. P., contains the volatile products of hamamelis bark, as obtained by distillation, and should contain in the finished product 14.25 per cent. of ethyl alcohol by volume.

The following extract from the U. S. Dispensatory is of interest as indicating the exaggerated idea as to the value of this preparation.

"This water was probably introduced into the British Pharmacopœia and U. S. Pharmacopœia (8th Rev.) on account of the large demand for it, which has grown out of the wide advertisements of a certain proprietary medicine, and the universally recognized need in American families for an embrocation which appeals to the psychic influence of faith. As the tannic acid of hamamelis bark does not come over into the distillate the water is therapeutically a mixture of water and alcohol."

The seventy-six samples examined were tested only for alcohol, wood alcohol and formaldehyde. Neither wood alcohol nor formaldehyde was found in any sample; the ethyl alcohol ranged from 12.23 to 15.76 per cent. by volume, with an average of 14.06 per cent.

Forty-five samples contained over 14 per cent. of alcohol, twenty-six from 13 to 14 per cent., and five less than 13 per cent.

Seven samples only were sold under brand names, representing three manufacturers. The alcohol content of these brands, with the amount guaranteed, was as follows:

No.	Manufacturer.	Alcohol. Claimed.	Alcohol. Found.
25482	Parke, Davis & Co.	15	14.05
25510	Pond's Extract	16	14.70
25495	E. E. Dickinson & Co................	15	14.09
25517	E. E. Dickinson & Co................	15	13.84
25565	E. E. Dickinson & Co................	15	14.21
25568	E. E. Dickinson & Co................	15	13.86
25572	E. E. Dickinson & Co................	15	14.72

The cost of four ounces of the samples sold as extract of witch hazel ranged from 5 to 15 cents. The cost of the sample of Pond's Extract was 50 cents for 5.3 ounces.

FOOD AND DRUG PRODUCTS EXAMINED FOR THE DAIRY COMMISSIONER.

Five hundred and fifty-four samples were referred to this station by the dairy commissioner for examination. Since the details regarding them will be found in his report, only a brief summary of the results is here given, excepting in cases where quite complete analytical data were secured, notably, soda waters and vinegars.

Of the whole number of samples examined, 192 were not found to be adulterated, while 341 were adulterated, misbranded, or below standard.

Butter and Butter Substitutes. Of the fifty samples examined, fourteen were butter, twenty-nine were oleomargarine and seven were renovated butter. In many cases the illegality of the sale consisted in the failure to display the required sign when selling oleomargarine, or failure to stamp renovated butter at the time of sale.

Cocoa. Of the nine samples examined, eight were misbranded, and one was an illegally labeled compound.

Cream. The fifteen samples analyzed contained from 20.00 to 50.70 per cent. fat. Formaldehyde was found in samples sold by Isaac Moorey and E. C. Paddock, both of Bridgeport. Eleven samples were examined for sucrate of lime and gelatine, with negative results.

Ice Cream. The sixteen samples analyzed contained from 2.0 to 11.0 per cent. of fat, average, 6.7 per cent. Six samples contained less than 4 per cent. Boric acid was found in no case. One sample of strawberry contained an unpermitted coal-tar color, phloxine or an eosine.

Cream of Tartar. No adulteration was found in the sample examined.

Gluten Flour. A sample sold by D. M. Welch & Son, New Haven, contained only 16.25 protein (2.60 per cent. nitrogen). It was misbranded, as standard gluten flour contains not less than 5.6 per cent. of nitrogen.

Fruit Syrups. "C and M. Fruit Syrup Strawberry," made by National Fruit Products Co., Boston, and sold by Shartenberg & Robinson, New Haven, contained a coal-tar dye, which was not declared on the label.

"Magnolia Hallonsaft, or Raspberry Syrup," made by The Swedish Importing Co., Worcester, Mass., and sold by R. T. Whiting, Bridgeport, also contained an undeclared coal-tar color.

Ketchup. "Star Brand Tomato Catsup," made by The Warwick Pickling Co., Arctic, R. I., and sold by Karl Bielstzky, New London, was adulterated in that it contained 0.244 per cent. of sodium benzoate, which was not stated on the label.

Lemon Extract. Four samples were found to be of standard strength, containing from 5.20 to 9.50 per cent. of lemon oil. A sample of terpeneless extract contained only 0.40 per cent. of oil, and was artificially colored. Another sample, high in lemon oil, contained an unpermitted coal-tar color.

Mace. The sample analyzed proved to be Bombay mace. It contained 55.05 total ether extract, 53.70 non-volatile ether extract, 2.05 ash, and 0.38 per cent. acid-insoluble ash.

Milk. Two hundred and ninety samples were examined. Of these, eighty-eight conformed to the legal standards, one hundred and thirty-seven were below standard in solids, one hundred and ninety-five in solids not fat and eighty-nine in fat, two hundred and two samples failing to meet the legal requirements in one or more particulars. Seven samples were skimmed, eighty-seven were watered and three were both skimmed and watered.

The skimmed samples were taken in Colchester, Columbia, Franklin and Hartford; the watered samples in Colchester, Bozrahville, Montville, Columbia, Turnerville, Lisbon, Killingly, Stafford Station, Durham, South Manchester, Manchester, Woodbridge, Bridgeport, South Norwalk, West Hartford, East Wea-

TABLE XXXVI.—SODA WATER AND SODA WATER SYRUPS.

Station No.	Flavor.	Solids.	Polarization.			Preservative.	Saccharin.	Color.	Flavor.
			Direct.	Invert.	Temperature °C.				
	Birch Beer.								
6030	Frankel Bottling Works	3.11	2.2	− 0.33	27	None	Yes	Natural	Natural.
6042	Crystal Springs Bottling Co.	7.03	6.0	− 0.77	27	"	None	"	"
	Cherry Soda.								
6033	Rosie Alderman	10.85	10.7	− 2.75	27	"	"	Coal tar	Artificial.
	Ginger Ale.								
6016	Star Bottling Works	2.29	2.3	− 0.55	28	"	"	Natural	Natural.
6025	Frank Mosca	0.18	0.3	± 0.0	28	"	Yes	"	Capsicum.
6029	Frankel Bottling Works	4.63	4.7	− 0.99	27	"	"	Coal tar	Natural.
6043	Crystal Springs Bottling Co.	6.98	6.7	− 1.87	27	"	None	Natural (?)	Natural (?)
6048	Gilhuly's Bottling Works	3.40	3.1	− 0.66	23	"	Yes	Natural	Natural.
	Lemon Soda.								
6052	Isaac Koplowits	10.72	7.1	− 2.75	28	Benz. acid (Tr.)	None	Natural	Natural.
	Orangeade Syrup.								
6059	Sidney Negbaur	76.68	52.2	−17.38	23	Benz. acid	"	* Tropeolin O.	Natural.
6055	G. R. Volpe	68.73	59.2	−20.02	23	" "	"	* " "	"
	Orangeade.								
4901	J. S. Coburn	.....	9.2	− 3.50	20	" "	"	Coal tar	"
6054	G. R. Volpe	13.01	11.2	− 3.41	23	None	"	* Tropeolin O.	"
6058	Sidney Negbaur	12.25	8.7	− 2.42	23	"	"	* " "	"

* Unpermitted coal-tar color.

TABLE XXXVI.—SODA WATER AND SODA WATER SYRUPS.—*Continued.*

Station No.	Flavor.	Solids.	Polarization. Direct.	Polarization. Invert.	Polarization. Temperature °C.	Preservative.	Saccharin.	Color.	Flavor.
	Pineapple Soda.								
6051	Carl Goldhammer	13.11	11.0	− 3.63	28	Benz. acid	"	Natural	Natural.
	Raspberry Stock.								
6039	Clark Extract Co.	58.03	− 15.0	−16.06	26.5	" "	"	"	"
	Raspberry Soda.								
4895	John Clancey	.....	1.5	− 1.10	20	....	Yes	Coal tar	......
4898	Star Bottling Works	.....	1.6	− 1.00	20	....	"	" "	......
	Root Beer.								
6017	Star Bottling Works	3.86	4.0	− 0.70	28	None	None	Natural	Natural.
	Sarsaparilla.								
6044	Crystal Springs Bottling Co.	7.05	5.6	− 0.11	27	"	"	"	"
	Strawberry Syrup.								
6037a	Dina Yonker	40.52	40.2	−11.55	27	"	Yes	*Acid magenta	Artificial.
6040	Clark Extract Co.	61.50	− 1.8	−17.27	27	Benz. acid	None	Natural	Natural.
6060a	Hine Morris	66.67	− 11.16	−16.06	23	" "	"	"	"
	Strawberry Soda.								
4851	Crystal Springs Bottling Co.	.....	0.5	− 1.10	20	....	Yes	Coal tar	......
4899	Frank Limauro	.....	0.5	± 0.0	20	....	"	" "	......
6015	Star Bottling Works	2.85	2.7	− 0.55	28	None	"	Amaranth	Artificial.

* Unpermitted coal-tar color.

TABLE XXXVI.—SODA WATER AND SODA WATER SYRUPS.—*Concluded.*

Station No.	Flavor.	Solids.	Polarization. Direct.	Polarization. Invert.	Polarization. Temperature °C.	Preservative.	Saccharin.	Color.	Flavor.
	Strawberry Soda (continued).								
6018	Star Bottling Works	26.59	22.4	− 7.04	28	None	Yes	Amaranth	Artificial.
6019	Louis Lapides	9.63	7.5	− 2.53	28	"	None	Coal tar	"
6021	Samuel Goolst	12.04	12 3	− 3.30	28	"	"	*Acid magenta	"
6022	John Clancey	7.50	7.0	− 1.87	28	"	Yes	Amaranth (?)	"
6023	Frank Mosca	0.03	0.2	± 0.0	28	"	"	* Coal tar	Artific'l (?)
6026	John Cannan	8.35	5.7	− 2.09	28	"	None	* " "	"
6027	Louis Elberg	14.05	14.2	− 2.53	28	(?)	"	Natural	Natural.
4894	Frankel Bottling Works	.....	3.6	− 1.10	20	....	Yes	Coal tar	......
6028	" " "	4.16	4.3	− 0.55	27	None	"	Amaranth	Artificial.
6034	Colman Gorenberg	6.02	6.4	− 1.54	27	"	None	*Acid magenta	"
6036	A. Grossman	2.91	2.7	− 0.66	27	"	Yes	Amaranth	"
6037	Dina Yonker	10.64	10.6	− 2.75	27	"	"	*Acid magenta	"
6038	Charles Duschnitsky	4.40	4.6	− 1.10	27	"	None	* " "	"
6045	J. W. Sears	12.05	9.3	− 2.86	27	Benz. acid	"	Coal tar	"
4897	Gilhuly's Bottling Works	.....	3.1	− 1.00	20	....	Yes	" "	......
6047	" " "	3.36	3.2	− 1.10	28	None	"	Amaranth	Artificial.
6049	J. M. Botvinik	9.75	7.3	− 2.20	23	"	None	Coal tar	Artific'l (?)
6050	Carl Goldhammer	9.99	8.4	− 2.53	28	"	"	Amaranth (?)	Artificial.
6057	Yale Bottling Works Co.	3.07	2.9	− 0.55	23	"	Yes	Amaranth	"
6060	Hine Morris	20.02	18.0	− 5.50	23	Benz. acid	None	Natural	Natural (?)

* Unpermitted coal-tar color.

togue, Wethersfield, Naugatuck, Norwalk, Branford and Glastonbury. The watered samples averaged 9.79 per cent. solids, two samples containing only 6.57 and 7.26 per cent.

Condensed Milk. A sample of Van Camp's Evaporated Milk contained 28.77 per cent. solids and 9.35 per cent. fat.

Molasses. The two samples examined showed no adulteration.

Olive Oil. The six samples examined contained neither cottonseed, sesame or peanut oil.

Soda Water and Soda Water Syrups. Forty-six samples were examined, all collected in New Haven. They included two orangeade syrups, one raspberry stock, three strawberry syrups, two birch beers, five ginger ales, three orangeades, two raspberry sodas, twenty-three strawberry sodas, and one each of cherry, lemon and pineapple soda, and one root beer and one sarsaparilla.

The samples were examined chiefly for the presence of chemical preservatives, saccharin and artificial color and flavor. The detailed analyses are given in Table XXXVI.

Ten samples contained henzoic acid, twenty saccharin, thirty-one artificial color and twenty artificial flavor. Of the forty-six samples, only six contained no benzoic acid, saccharin or artificial color or flavor. These included one birch beer, two ginger ales, one root beer, one sarsaparilla and one strawberry soda.

Of the thirty-one artificially colored samples, four contained Tropeolin O, and five acid magenta, both unpermitted coal-tar colors. Eight contained amaranth, a permitted color, and thirteen contained coal-tar colors, probably mixed colors, which we did not identify with certainty. Two of these, however, failed to give the reactions of the three permitted red shades.

One sample of ginger ale contained capsicum.

While seven permitted colors are allowed by government regulation to be used in food products, it must not be forgotten that a declaration of the presence of these colors is necessary to make the sale of the product legal. The use of an unpermitted color is illegal, whether declared or not, and in the future the same will be true for saccharin. The proof of the presence or absence of a permitted color is relatively simple, and it does not seem that it should be obligatory for the chemist to identify the unpermitted color used. The mere fact that a permitted color has not been employed furnishes sufficient grounds for food official or prosecuting officers to bring action against the seller of the product, provided, of course, he has a sincere intent to enforce the law. Aside from the question whether or not the coal-tar dye used is injurious to health, its presence conceals inferiority or permits imitation of a natural product, which, under the law, constitutes adulteration or misbranding or both.

There is not one of the samples containing a permitted coal-tar color which is not illegal in some other respect.

To summarize: Of the forty-six samples examined, forty were adulterated as follows:

7	contained	benzoic acid.			
2	"	" "	and unpermitted color.		
1	"	" "	and artificial flavor.		
8	"	saccharin.			
1	"	"	and unpermitted color.		
8	"	"	and artificial flavor.		
3	"	"	and	" "	and unpermitted color.
2	"	unpermitted color.			
4	"	" "	and artificial flavor.		
4	"	artificial flavor.			

It is an indisputable fact that the soda waters and soda water syrups sold in this state are grossly adulterated with chemical preservatives, saccharin and artificial colors and flavors. While the samples herewith reported were taken only in New Haven, our experience in our two general inspections of the past shows that these inferior preparations are not confined to that one city. In 1899 and 1902 the station made a very complete examination of these products and laid before the prosecuting authorities and the public the facts just as it found them. It is interesting, and at the same time a matter for regret, to note that certain manufacturers whom we find in the present inspection to be selling adulterated soda waters, were reported by us in 1899 and 1902 as selling products similarly adulterated. By publishing its findings the station has done its duty, in fact all that it is permitted to do under the law, and it would seem that public sentiment should demand a proper enforcement of the law against the sale of these adulterated drinks.

Lemonade Sugar. **5117.** *The Original Lemonade Sugar, colored.* The F. A. Atwood Co., New Haven. "Take one teaspoonful of Lemonade Sugar and three of granulated to each glass of ice water, stir until dissolved." Oil of lemon was present, citric acid, 13.73 per cent., no sulphuric, hydrochloric or phosphoric acid present; polarization at 25°, direct 77.2, after inversion —24.2, equivalent to sucrose 77.9 per cent. Color, probably napthol yellow.

Candied Apples. **6056.** Sold by Dominick Rosso, New Haven. It consisted of natural apples, somewhat mouldy on the inside, coated over with sugar and colored red. The sugar coating polarized at 28°, direct 94.1, after inversion —28.05, equivalent to 94 per cent. sucrose. No benzoic, salicylic or boric acids, or saccharin was present. The color used was probably amaranth.

Colors and Flavors for Soda Waters.

6032. *Strawberry Red.* Frankel Bottling Works, New Haven. Consisted of a permitted coal-tar color, amaranth.

6024. *Strawberry Color.* Frank Mosca, New Haven. Consisted of an unpermitted coal-tar color, either fast scarlet or amaranth B.

6041. *Red Color.* Clark Extract Co., West Haven. Consisted of a permitted coal-tar color, Ponceau 3 R.

6020, 6047a, 6053. *Red Color.* Louis Lapides, Gilhuly's Bottling Works, and J. M. Botvinik, respectively. Consisted of a permitted coal-tar color, amaranth.

6031. *Imitation Strawberry Essence.* Frankel Bottling Works, New Haven. Solids, 2.52 per cent., polarization at 27°, direct 1.3, after inversion —0.33, no preservative or saccharin present, colored with coal-tar color, artificial flavor.

6038a. *Imitation Flavor Strawberry.* H. Baron & Co., New York. Sold by Charles Duschnitsky, New Haven. Colored with an unpermitted coal-tar color, acid magenta, and artificially flavored.

6048a. *Caramel Coloring.* Gilhuly's Bottling Works, New Haven. Consisted of caramel as stated.

5142. *Fruit Red No. 1.* National Extract Co., New York. Taken at Torrington Creamery. Consisted of a permitted color, amaranth.

Vanilla Extract. One sample of vanilla extract was found not to be adulterated. Another sample, labeled Providence Brand, Vanilla Flavor, Providence Extract Co., Providence, R. I., and sold by A. W. Smith, Danielson, contained 0.272 per cent. vanillin and 0.07 per cent. coumarin. It was adulterated with coumarin and caramel and probably contained synthetic vanillin.

Vinegar. Seventy-three samples were analyzed. It has long been recognized that the simple determination of acidity and solids gives but little useful information as to the genuineness of a cider vinegar. It requires but little skill on the part of the vinegar chemist to manipulate a vinegar so that it shall contain 4 per cent. acidity and 2 per cent. solids. The determination of reducing sugars, ash, alkalinity of soluble ash and phosphoric acid are of some value in judging the purity of a vinegar, but here, again, the manipulation of the vinegar chemist comes into play, and, a purely factitious vinegar may give analytical data in close agreement with that obtained with genuine vinegars. Recent work by the Bureau of Chemistry, of the United States Department of Agriculture, has shown that the determination of glycerine and pentosans gives very useful information as to the purity of a cider vinegar. A large number of analyses of cider vinegars made by the generator process show that in no case was less than 0.24 per cent. of glycerine present. A cider vinegar, therefore, showing appreciably less than this amount of glycerine must be judged with suspicion. It has also been shown that the pentosans in a genuine cider vinegar rarely exceed 0.15 to 0.17 per cent. A higher figure than that indicates the addition of apple waste (skins and cores) or the use of second pressings.

The amount of non-sugar solids present is also of value. A genuine cider vinegar rarely shows less than 1.50 per cent. A value much lower than this indicates the addition of water, distilled vinegar (or acetic acid), or boiled cider. The presence of the last-named material would be further shown by a high percentage of reducing sugars in the solids.

It is not possible in this report to discuss in detail the results secured. Table XXXVII (pages 206 et seq.), however, gives the full analytical data, and below will be found a summary of our findings. The methods of analysis used were furnished the writer in private correspondence by Dr. R. E. Doolittle of the New York laboratory, and have been adopted as provisional methods by the Association of Official Agricultural Chemists. They are too lengthy for publication here.

Summary of Results.

Cider Vinegar. Twenty-seven samples were analyzed in detail, while in nine, duplicate brands, only acidity and solids were determined. Of these only four, **6203**, **6236**, **6248** and **6254**, fully satisfied the standard and proved to be genuine cider vinegars. **6262** was a genuine vinegar, slightly below standard in solids; **6222** likewise was genuine, but was incompletely acetified and therefore was low in acidity; it contained over 3 per cent. of alcohol.

The analyses of **6208**, **6235** and **6264** showed that second pressings had been added to otherwise genuine cider vinegars.

In **6216**, **6220**, **6228**, **6231** and **6234** the high reducing sugars and pentosans indicated the use of apple waste, or dried apples.

6202, **6227** and **6237** showed excessive dilution with water.

6212 was low in glycerine and probably contained some boiled cider.

6214 and **6240** were mixtures of cider and distilled vinegars, boiled cider and added mineral matter.

6224 was low in acidity and high in alcohol, indicating incomplete acetification. Second pressings or material high in sugars, partly fermented, had been added.

6244 was low in solids and indicated that distilled vinegar, second pressings and mineral matter had been added.

6230 was a mixture of cider and distilled vinegar and second pressings partially fermented.

6232 showed addition of distilled vinegar and material high in sugars.

6218 showed the addition of boiled cider.

6247 showed the addition of distilled vinegar.

6270 was low in acidity and solids; distilled vinegar added.

Of the nine duplicate brands of cider vinegar, eight satisfied the standard for acidity and solids, while one was low in solids. The complete analysis of duplicate samples of these nine brands showed only one of them to be genuine cider vinegar.

Other Vinegars. Twenty-three samples of distilled or spirit vinegar, twelve of compound vinegar, and one each of syrup and wood acid vinegar were analyzed. The analyses are shown in Table XXXVIII. Twenty of the distilled vinegars satisfied the legal standard of 4 per cent. acidity; the other three showed slight deficiencies. 6211 and 6221 were sold by the dealers as "white wine" vinegar.

The twelve samples sold as compound vinegars were essentially colored distilled vinegars. The percentage of solids found shows that no considerable amount of molasses or syrup vinegar was present in any case. The labeling is clearly deceptive. Three of these samples were deficient in acidity, 6250 notably so.

The sample of wood-acid vinegar was deficient in acidity. It was nothing more than dilute acetic acid.

Camphor Liniment. Samples bought of D. W. Tracy, Hartford, and The City Pharmacy, Stamford, contained only 4.3 and 16.5 per cent. of camphor, respectively, or only 21.5 and 82.5 per cent. of the required U. S. P. strength.

Cod Liver Oil Emulsions. A sample sold by Daskum & Gyde, Waterbury, contained 3.32 per cent. alcohol by weight, and was therefore adulterated. Another sample sold by J. A. Leverty & Bro., Bridgeport, was below standard in hypophosphites, containing only 0.37 per cent. of phosphoric acid, about one-fourth the proper amount.

Headache Wafers. A sample of "Ingram's Celero Caffeine Headache Wafers," made by F. F. Ingram & Co., Detroit, and sold by Edward Toucey, Bridgeport, was analyzed. On a separate label on the side of the package was the guaranty. "Contains 218 grains acetanilid to the ounce," or an equivalent of 45.4 per cent. acetanilid. The weights of the wafers and the actual amounts of acetanilid present in each were very variable, although the percentage content of acetanilid was fairly constant. No acetphenetidin was present. The details are given below.

Wafer.	Wgt. of wafer contents. grams.	Acetanilid per wafer. grams.	Acetanilid per wafer. grains.	Per cent.
1	.0478	.0228	0.35	47.7
2	.2622	.1233	1.90	47.0
3	.0598	.0295	0.45	49.3
4	.3508	.1608	2.47	45.8

Opium. A suspected sample sold by Hong Heong Lou & Co., Bridgeport, proved to be opium.

Spirit of Nitrous Ether. Nine samples were examined, all of which were below U. S. P. standard, ranging from 0.25 to

TABLE XXXVII.—
(*Grams per*

Station No.	Brand.	Manufacturer.	Specific gravity at 15.6° C.	Alcohol.
6230	Pure Cider Vinegar, Conn. Standard	Ford Allen, Chittenango Station, N.Y.	1.0163	0.05
6222	" "	F. S. Armstrong, Franklin, Conn. ...	1.0099	3.05
6224	Cider Vinegar..................	Said to be George E. Bates, Scotland.	1.0132	2.28
6235	Beech-Nut Brand Cider Vinegar..	Beech-Nut Packing Co., Canajoharie, N. Y........................	1.0167	0.16
6264	Cary's Pure Cider Vinegar........	W. W. Cary & Sons, Lyonsville, Mass.	1.0158	0.17
6208	Pure Cider Vinegar..............	S. R. Deyo Co., Kingston, N. Y......	1.0159	0.12
6248	Pure Cider Vinegar, 40 grains....	Egypt Vinegar Product Co., Egypt, N. Y........................	1.0160	0.18
6270	Pure Cider Vinegar..............	Empire Bottling Works, Newark, N.J.	1.0125	0.18
6244	Cider Vinegar..................	H. Erdman's Sons, Philadelphia.....	1.0128	0.31
6247	The Old Mill Brand Cider Vinegar	Fairchilds & Hegany, Danbury, Conn.	1.0096	1.41
6237	Pure Cider Vinegar..............	Mfd. for Fleischmann Vinegar Works, N. Y........................	1.0123	0.67
6216	Bon-Ton Brand Pure Cider Vinegar, 45 grains................	Haynes, Piper Co., Boston..........	1.0189	0.14
6220	Guaranteed Pure Cider Vinegar, 4%	" " "	1.0175	0.13
6228	" " " 45 grains....................	" " "	1.0175	0.01
6231	Guaranteed Pure Cider Vinegar, Standard Test................	" " "	1.0163	0.20
6218	Pure Apple Cider Vinegar Fermented......................	H. J. Heinz Co., Pittsburgh, Pa......	1.0165	0.07
6236	Crescent Brand Pure Cider Vinegar, 45 grains..................	Charles Hirsh & Co., New York.....	1.0139	0.71
6232	Pure Cider Vinegar..............	Mfd. for Humphrey-Cornell Co., New London, Conn.................	1.0156	0.26
6212	Pure Apple Cider Vinegar........	F. E. Jewett & Co., Lowell, Mass....	1.0152	0.40
6234	Best Apple Vinegar, 40 grains.....	S. R. & J. C. Mott, Bouckville, N. Y.	1.0158	0.08
6202	Cider Vinegar..................	New England Vinegar Works, Boston	1.0144	0.35
6214	Extra Old Farm Orchard Brand Cider Vinegar................	Place Bros., Oswego, N. Y..........	1.0166	0.20
6240	Cider Vinegar..................	M. H. & M. S. Place, Oswego, N.Y..	1.0165	0.16
6254	Pure Cider Vinegar..............	Put up for Morris Spirt, Waterbury, Conn........................	1.0125	1.27
6203	Pure Cider Vinegar, XXX........	J. A. Thompson & Son, Melrose, Conn.	1.0124	1.25
6262	" " "	" " "	1.0106	1.67
6227	Pure Apple Cider Vinegar, 4%.....	York State Fruit Co., Fairport, N.Y..	1.0140	0.30

CIDER VINEGAR.

100 cc.)

Total Acids as acetic.	Solids.	Polarization at 20° C. (°V.).	Reducing Sugars. Direct.	Reducing Sugars. After Inversion.	Non-Sugar Solids.	Total Ash.	Alkalinity of Water-Soluble Ash (cc. $\frac{N}{10}$ acid).	Phosphoric Acid (mgms. per 100 cc.).	Glycerine.	Pentosans.	Per cent. Ash in Total Solids.	Per cent. Ash in Non-Sugar Solids.	Per cent. Reducing Sugars in Total Solids.	Glycerine Ratio.
4.10	2.29	+0.8	0.93	0.92	1.36	0.356	40.4	22.1	0.10	0.24	15.6	26.2	40.6	21.3
3.48	2.47	−1.0	0.53	0.51	1.94	0.353	42.2	19.8	0.31	0.12	14.3	18.2	21.5	12.2
3.12	3.14	±0.0	0.62	0.61	2.52	0.339	40.6	23.3	0.36	0.22	10.8	13.5	19.7	8.5
4.76	2.34	−1.0	0.85	0.84	1.49	0.312	30.4	26.0	0.27	0.17	13.3	20.9	36.3	9.4
4.24	2.49	−2.0	0.97	0.96	1.52	0.260	30.0	15.0	0.22	0.11	10.4	17.1	39.0	10.4
4.06	2.37	−0.2	0.72	0.74	1.63	0.302	31.0	21.2	0.25	0.28	12.7	18.5	31.2	8.6
4.02	2.43	−0.4	0.73	0.72	1.70	0.367	35.0	25.9	0.23	0.18	15.1	21.6	30.0	9.5
3.92	1.64	−1.2	0.56	0.56	1.08	0.250	26.6	18.4	0.16	0.13	15.2	23.1	34.1	8.2
4.12	1.69	−0.8	0.64	0.64	1.05	0.270	28.2	24.2	0.09	0.09	16.0	25.7	37.9	7.7
4.32	1.24	−0.6	0.27	0.27	0.97	0.273	29.8	19.5	0.16	0.05	22.0	28.1	21.8	19.7
4.00	1.82	−0.4	0.58	0.57	1.24	0.247	23.6	19.3	0.20	0.14	13.6	20.0	31.9	12.4
4.52	2.93	−2.0	1.00	1.00	1.93	0.350	36.8	26.8	0.24	0.22	11.9	18.1	34.1	10.0
4.22	2.69	−0.6	0.98	0.95	1.71	0.301	32.2	25.9	0.29	0.29	11.2	17.6	36.4	7.7
4.64	2.59	−0.2	0.74	0.73	1.85	0.313	34.4	23.9	0.31	0.23	12.1	16.9	28.6	7.7
4.16	2.44	−0.2	0.74	0.74	1.70	0.300	32.8	22.1	0.29	0.22	12.3	17.6	30.3	7.8
4.72	2.21	−1.4	1.05	1.05	1.16	0.292	32.0	21.0	0.20	0.11	13.2	25.2	47.5	12.3
4.36	2.20	−1.0	0.52	0.53	1.67	0.354	36.2	27.4	0.29	0.17	16.1	21.2	24.1	9.3
4.24	2.24	−1.0	0.89	0.89	1.35	0.355	42.4	19.9	0.14	0.09	15.8	26.3	39.7	16.7
4.28	2.32	−0.6	0.80	0.83	1.49	0.331	38.2	16.4	0.19	0.13	14.7	22.2	35.8	12.9
4.12	2.27	−0.8	0.87	0.87	1.40	0.279	30.6	22.1	0.24	0.26	12.3	20.0	38.3	9.0
4.00	1.73	−0.8	0.58	0.59	1.14	0.252	27.2	13.8	0.21	0.10	14.6	22.1	34.1	10.7
4.54	2.28	−1.4	1.13	1.22	1.06	0.323	29.6	33.0	0.09	0.10	14.2	30.5	53.5	27.3
4.00	2.63	−2.2	1.50	1.52	1.11	0.369	33.6	24.5	0.08	0.09	14.0	33.2	57.8	26.5
4.24	2.18	−1.0	0.53	0.52	1.65	0.290	32.8	22.7	0.25	0.11	13.3	17.6	24.3	11.5
4.20	2.10	−0.8	0.47	0.47	1.63	0.293	30.8	20.6	0.29	0.12	14.0	18.0	22.4	9.8
4.08	1.82	−0.4	0.40	0.39	1.42	0.291	29.2	20.2	0.30	0.08	16.0	20.5	22.0	10.3
4.26	1.84	−1.0	0.65	0.63	1.19	0.257	26.8	17.2	0.30	0.15	14.0	21.6	35.3	7.9

TABLE XXXVIII.—MISCELLANEOUS VINEGARS.

(Grams per 100 cc.)

Station No.	Manufacturer and Brand.	Specific gravity at 15.6° C.	Alcohol.	Total Acids, as acetic.	Solids.	Reducing Sugars. Direct.	Reducing Sugars. After Inversion.	Non-Sugar Solids.	Total Ash.	Alkalinity of Water-Soluble Ash (cc. $\frac{N}{10}$ acid).	Phosphoric Acid (mgms. per 100 cc.).
	Alart and McGuire, New York.										
6266	Pure Spirit, 4%	1.0063	0.24	4.00	0.10	0.02	0.02	0.08	0.03	0.8	2.3
	Fleischmann's Vinegar Works, N. Y.										
6204	Superior Distilled Spirit	1.0064	0.36	4.24	0.25	0.10	0.10	0.15	0.03	1.6	8.6
6209	" " "	....	....	4.16	0.22	....	....	....	....	....	....
6211	[1] " " "	....	....	4.80	0.44	....	....	....	....	....	....
6241	" " "	....	....	3.96	0.16	....	....	....	....	....	....
6239	" " " 40 grs.	....	....	4.20	0.25	....	....	....	....	....	....
6268	" " " 40 grs.	....	....	4.04	0.24	....	....	....	....	....	....
6233	" " " 45 grs.	....	....	4.60	0.25	....	....	....	....	....	....
6206	White Distilled Grain	1.0093	0.01	5.36	0.28	0.05	0.05	0.23	0.10	2.8	7.7
6207	" " "	1.0067	0.45	4.04	0.25	0.09	0.09	0.16	0.03	1.4	3.1
6210	" " "	....	....	4.16	0.23	....	....	....	....	....	....
6221	[1] " " "	....	....	4.64	0.26	....	....	....	....	....	....
6223	" " "	....	....	4.08	0.20	....	....	....	....	....	....
6226	" " "	....	....	4.12	0.18	....	....	....	....	....	....
6238	" " "	....	....	3.92	0.22	....	....	....	....	....	....
6243	" " "	....	....	4.04	0.23	....	....	....	....	....	....
6246	" " "	....	....	3.92	0.19	....	....	....	....	....	....
6249	" " "	....	....	4.04	0.24	....	....	....	....	....	....
6259	" " "	....	....	4.04	0.60	....	....	....	....	....	....
6260	" " "	....	....	4.00	0.19	....	....	....	....	....	....
6263	" " "	....	....	4.00	0.22	....	....	....	....	....	....
6269	" " "	....	....	4.32	0.23	....	....	....	....	....	....

[1] Sold by dealer as white wine vinegar.

TABLE XXXVIII.—MISCELLANEOUS VINEGARS—*Concluded.*

(Grams per 100 cc.)

Station No.	Manufacturer and Brand.	Specific gravity at 15.6° C.	Alcohol.	Total Acids as acetic.	Solids.	Reducing Sugars. Direct.	Reducing Sugars. After Inversion.	Non-Sugar Solids.	Total Ash.	Alkalinity of Water-Soluble Ash (cc. N/10 acid).	Phosphoric Acid (mgms. per 100 cc.).
	H. J. Heinz Co., Pittsburgh.										
6217	Pure Pickling and Table Distilled	1.0077	0.25	5.06	0.13	0.02	0.01	0.11	0.02	1.4	6.1
	The John T. Doyle Co., New Haven.										
6272	[2]Royal Brand Comp. Spirit and Syrup	1.0075	0.35	4.26	0.38	0.10	0.10	0.28	0.08	2.4	5.9
	Fleischmann's Vinegar Works, N. Y.										
6213	[3]Superior Comp., 80% Molasses, 20% Dist.	1.0074	0.71	4.00	0.61	0.09	0.09	0.52	0.14	6.0	7.6
6215	" " " "	....	....	4.20	0.57	....	....	....	....	....	....
6219	" " " "	....	....	4.08	0.49	....	....	....	....	....	....
6225	" " " "	....	....	4.52	0.62	....	....	....	....	....	....
6245	" " " "	....	....	3.80	0.43	....	....	....	....	....	....
6250	" " " "	....	....	2.64	0.76	....	....	....	....	....	....
6252	" " " "	....	....	3.80	0.51	....	....	....	....	....	....
6253	" " " "	....	....	4.16	0.47	....	....	....	....	....	....
6255	" " " "	....	....	4.16	0.74	....	....	....	....	....	....
6258	" " " "	....	....	4.00	0.47	....	....	....	....	....	....
6261	" " " "	....	....	4.04	0.70	....	....	....	....	....	....
	Alart & McGuire, New York.										
6267	[4]Syrup, 40 grains	1.0070	0.95	4.00	0.54	0.09	0.09	0.45	0.14	3.6	7.0
	Rogoff & Mintz, New Haven.										
6271	Wood Acid	1.0049	0.02	3.28	0.01	0.01	0.01	0.00	0.004	0.6	2.4

[2] Contained .03 glycerine and .03 pentosans. [3] Contained .04 glycerine and .04 pentosans. [4] Contained .03 glycerine and .04 pentosans.

3.51 per cent. of ethyl nitrite, or from 6 to 88 per cent. U. S. P. The details follow:

Dealer.	Spec. grav. at 15.6° C.	Ethyl Nitrite.	Per cent. U. S. P.
C. E. Pickard & Co., Bridgeport	.8224	2.57	64
J. J. Hickey & Co., Willimantic	.8256	3.16	79
C. E. Miller, Hartford	.8156	3.36	84
J. R. Halloran, New Britain	.8227	3.43	86
City Drug Store, New Britain	.8225	2.67	67
The Miller-Hanson Drug Co., New Britain	.8171	3.51	88
Arcade Drug Store, New Britain	.8178	0.25	6
Edward P. Weed, Norwalk	.8144	3.09	77
Frank H. Baxter, South Norwalk	.8157	2.65	66

Quinine Pills. Sample of "Gelatine Coated Pills Quinine Sulphate, 2 grains, Beekman Brand" made by Schiefflin & Co., New York, and sold by Charles Fleischner, New Haven, was found to be of standard quality. The average content of two lots of five pills was 1.99 and 2.05 grains quinine sulphate per pill.

"Snuff." Three samples suspected of containing cocaine contained none of that drug or of eucaine. They contained a mixture of alkaloids, which gave characteristic reactions for morphine or its salts, and some of the reactions for heroin, the acetyl derivative of morphine.

MISCELLANEOUS MATERIALS SENT BY PRIVATE INDIVIDUALS.

Milk. Twenty-one samples were tested, of which sixteen satisfied the legal standard, two were below standard and three were watered. The latter contained 9.66, 9.45 and 9.33 per cent. solids. Two samples tested for formaldehyde showed none of that preservative. In addition to these the milk of the individual cows of a herd of twenty-eight were tested for fat. This ranged from 2.1 to 6.3 per cent., only four cows showing less than the legal standard.

Cream. Nineteen samples were tested. These contained from 17.0 to 61.6 per cent. fat. One sample contained sucrate of lime. Its analysis was fat 21.0 per cent., ash 0.56, lime .151 and alkalinity of ash (100 gms.) 18.0 cc. $\frac{N}{10}$ sulphuric acid. No chemical preservatives were found.

Buttermilk. The sample examined contained no chemical preservative.

Butter. Five samples were examined, four of which were undoubtedly genuine butter. A fifth sample showed peculiar white areas in the print, which had a somewhat tallowy or lardy flavor. The white and normal portions were analyzed separately as follows:

	Reichert-Meissl No.	Refraction at 25° C.
White portion	31.0	51.0
Normal portion	30.2	51.0

These figures indicated no adulteration. Seerkowitsch suggests (Vol. *2*, p. 832) that "on exposure to light, butter loses its yellow color and acquires a tallowy ("lardy") smell and taste."

Coffee. Two samples were examined. One contained a trace of coffee, but was largely leguminous; the other contained no coffee, and consisted chiefly of a legume, differing from that found in the first sample.

Fish. A sample of fresh fish was tested for preservatives with negative results.

Flour. A sample of graham flour contained 10.56 per cent. of protein; no other starch than wheat was present; the small amount of the seed coats of corn cockle (*Agrostemma githago*) present did not indicate intentional adulteration. Two samples of "Wholesome Brownish Flour" were examined. It was claimed to be useful in preventing constipation. No agar-agar or mineral drug was present. It contained 11.75 per cent. protein, 1.86 per cent. ash and 0.45 per cent. phosphoric acid.

Ice Cream. Four samples contained 10.0, 11.0, 11.5 and 13.25 per cent. fat; a fifth sample contained no chemical preservatives.

Jam. A sample of quince jam contained no chemical preservative.

Maple Sugar. The sample examined analyzed as follows: Polarization at 25° C. direct, 84.2; after inversion, —27.28, equivalent to sucrose 85.65; total ash, 1.13; ash soluble in water, 0.66; ash insoluble in water, 0.47; alkalinity of 100 gms. soluble and insoluble ash 59 cc. and 84 cc. $\frac{N}{10}$ hydrochloric acid, respectively; Winton lead No. 1.90; ratio insoluble to soluble ash, 1 to 1.4. The sample was passed as probably pure.

Molasses. The sample examined polarized at 21° C. direct, 25.8; after inversion, —12.32, equivalent to sucrose 28.84 per cent.; water, 26.96 per cent. It was a very dark colored molasses, low in sugar and high in water.

Olive Oil. The two samples contained no cottonseed, sesame or peanut oil.

Soda Water. This sample was sent by a New Haven newspaper. It analyzed as follows: Solids, 5.17; polarization at 25° C. direct, 4.7; after inversion, —1.4, equivalent to sucrose 4.69 per cent.; flavor, artificial; colored with acid magenta (an unpermitted color); no saccharin, benzoic acid or salicylic acid present.

Vinegar. Thirteen samples were examined for solids and acidity; seven satisfied the legal standards, two were low in solids, two in acidity and two in both solids and acidity.

Alfalfa Bread. The sample contained 20.48 per cent. water, 2.65 ash, 10.62 protein, 0.95 fiber, 63.98 nitrogen-free extract and 1.32 fat.

Dried Egg. Made by the National Bakers Egg Co., Sioux City. It contained 8.81 per cent. water, 35.05 fat, 44.13 protein, 3.42 ash, 2.42 phosphoric acid, no boric acid, and natural color. The analysis indicates it to be a genuine egg product.

Brandy. The sample showed a specific gravity of .9440 at 15.6° C. and 46.86 per cent. alcohol by volume, just about the minimum strength allowed by the U. S. P.

Rum. The sample was too small for a complete examination. It showed a specific gravity of .9485 at 15.6° C. and 39.42 per cent. alcohol by volume. No methyl alcohol was present.

Whisky. A sample of Glengarry Scotch whisky analyzed as follows: Specific gravity at 15.6° C. 0.93978; extract, 156.7 gms. per 100 liters; acidity, 29.4 gms. acetic per 100 liters; esters, 54.56 gms. ethyl acetate per 100 liters; no methyl alcohol.

Abortion Medicine. This medicine was claimed to prevent abortion in cows. Qualitative tests showed lead, sodium, iron, acetic acid, carbonates, and borates. There was found the equivalent of 19.36 lead acetate, 57.49 per cent. sodium biborate, and 73.32 per cent. insoluble in alcohol. The following assumed composition was calculated:

19.36 lead acetate.
57.49 sodium biborate.
15.83 sodium carbonate and iron oxide.
7.32 soluble in alcohol (other than lead acetate).

Elixir Glycerophosphates Comp. A New Haven man had a prescription, our number 25560, calling for a proprietary preparation of this medicine, filled at a local drug store. On taking the medicine he showed many of the symptoms of strychnine poisoning and for a day was in a very serious condition. Suspecting that the druggist had either made a mistake or had substituted another preparation, he had his physician write another prescription, which he had filled at the same drug store, our number **25561**. The two preparations were very unlike in appearance and were brought to us for examination. **25560** showed .0338 gm. total alkaloids per 20 cc., **25561**, .0138 gm. Qualitative tests on the residues showed the presence of strychnine and quinine in both samples. Our attempt to separate these alkaloids by the oxalate method was unsuccessful, but the action of the residues with absolute alcohol and ether and the characteristic crystalline residue in the first sample indicated that there was much more strychnine in **25560** than in **25561**. In the latter the quinine seemed to predominate. Chemical methods failing to separate the alkaloids, physiological tests with frogs were used. Our thanks are due to Prof. L. B. Mendel, of Yale University, who kindly permitted us to use his frogs and his laboratory for this purpose.

It is well known that frogs are susceptible to strychnine. It was believed that if comparable amounts of our two preparations, based on their total alkaloidal content, were administered to frogs under similar conditions, and unequal toxic effects were produced, the relative toxicity of the two preparations might be established.

The original preparation, **25560**, was diluted with distilled water, the dilutions corresponding to $\frac{1}{5}$, $\frac{1}{10}$, $\frac{1}{15}$, $\frac{1}{25}$ and $\frac{1}{75}$ of the original strength. The following table shows the volume of original solution contained in the respective dilutions and the amounts of total alkaloids in solution per cc. of the dilute solutions:

	Original Solution. cc.	Total Alkaloids. gm.
1 cc. of dilution, $\frac{1}{5}$..........	0.200	.000338
1 cc. of dilution, $\frac{1}{10}$..........	0.100	.000169
1 cc. of dilution, $\frac{1}{15}$..........	0.067	.000113
1 cc. of dilution, $\frac{1}{25}$..........	0.040	.000068
1 cc. of dilution, $\frac{1}{75}$..........	0.013	.000022

From the dilute solutions, 0.5 cc. was administered to the frog, injecting into the dorsal lymph sac. The frog was then immediately placed under a bell-jar, allowing the entrance of sufficient air for respiration, the time taken and the effects of the injection noted, comparing deportment with a normal frog. The following results were noted:

Frog.	Weight of Frog. gms.	Dilution of Orig. Material.	Total Alkaloids. gms.	Result of Injection.
1......	33	$\frac{1}{5}$	.000169	Tetanized in 14 min.
2......	36	$\frac{1}{25}$	.000034	Tetanic spasm in 83 min.; recovered in 125 min.
3......	30	$\frac{1}{75}$	.000011	No symptoms.
4......	24	$\frac{1}{15}$	.000057	Tetanized in 54 min.
5......	33	$\frac{1}{10}$	.000085	Tetanized in 36 min.

The rate of tetanization varied directly with the strength of the injection. The characteristic symptoms of strychnine poisoning were observed, and the presence of this alkaloid was thus definitely established.

A series of tests were then conducted, using similar amounts of total alkaloids from the two prescriptions. **25561** was diluted with water so that 1 cc. of the diluted solution corresponded very closely with the total alkaloid content of the $\frac{1}{5}$ dilution of **25560**, so that 0.5 cc. of **25560** diluted contained .000169 gm. and the same amount of **25561** diluted .000149 gm. of total alkaloids. The results of these tests follow:

Frog.	Weight of Frog. gms.	Sample No.	Dilution.	Total Alkaloids. gms.	Result of Injection.
6.....	34	25561	$\frac{1}{5}$	.000149	Slightly tetanized in 56 min.; completely tetanized in 68 min.
7.....	39	25560	$\frac{1}{5}$	.000169	Tetanized in 21 min.

Frog 6, twenty-four hours after the injection, recovered, was able to maintain itself on its hind legs, jumped well and on removal to the tank swam easily. Frog 7, after twenty-four hours, was still tetanized. Similar results were secured with two other frogs where .000198 gm. total alkaloids from **25560** and .000166 gm. from **25561** were administered.

These experiments seemed to demonstrate that **25560** was more toxic to frogs than **25561**, and that the two preparations differed considerably in their alkaloidal content.

TABLE XXXIX.—SUMMARY OF RESULTS OF EXAMINATION OF FOOD AND DRUG PRODUCTS IN 1911.

	Not found *Adulterated.	*Adulterated or below standard.	Compound.	Total number examined.
Sampled by Station.				
Chocolate	10	4	20	34
Chili Sauce	4	2	2	8
Cider	2	4	0	6
Cocoa	28	31	3	62
Coffee	1	..	..	1
Coffee Substitute	1	..	..	1
Cream	36	4	..	40
Cream of Tartar	3	..	..	3
Fruit Juices	13	8	15	36
Gluten Preparations	8	3	..	11
Ice Cream	..	..	..	21
Ice Cream Powders	1	..	3	4
Jam	1	1	1	3
Meltose	..	..	..	1
Milk	42	82	..	124
Orange Sugar	..	1	..	1
Paprika	12	2	1	15
Root Beer Extracts	..	1	..	12
Relishes	2	2	8	12
Salad Dressings	..	1	2	12
Sauces	..	..	..	20
Soups, Condensed	..	..	..	3
Vinegar	5	6	2	13
Camphor Liniment	18	5	..	23
Cocoa Butter	16	..	..	16
Cod Liver Oil Emulsions	17	11	..	28
Cod Liver Oil Wines	0	8	..	8
Headache Preparations	4	4	..	8
Tincture Iodine	20	..	..	20
Lime Water	3	1	..	4
Spirit Nitrous Ether	4	30	..	34
Pepsin	5	15	..	20
Quinine Pills	30	3	..	33
Sarsaparilla Extract	..	3	..	9
Extract Witch Hazel	76	..	..	76
Total	362	232	57	722
Sampled by Dairy Commissioner.				
Candied Apples	..	..	..	1
Butter and Butter Substitutes	14	36	..	50
Cocoa	0	9	..	9
Colors and Flavors	8	2	..	10
Condensed Milk	1	..	..	1
Cream	13	2	..	15
Cream of Tartar	1	..	..	1
Fruit Syrups	..	2	..	2
Gluten Flour	..	1	..	1
Ice Cream	..	1	..	16
Ice Cream Cones	..	1	..	1
Ketchup	..	1	..	1
Lemonade Sugar	..	..	..	1

* Also includes misbranding.

TABLE XXXIX.—SUMMARY OF RESULTS OF EXAMINATION OF FOOD AND DRUG PRODUCTS IN 1911—*Continued.*

	Not found *Adulterated.	*Adulterated or below standard.	Compound.	Total number examined.
Sampled by Dairy Commissioner (continued).				
Lemon Extract	4	2	..	6
Mace	..	1	..	1
Milk	88	†202	..	290
Molasses	2	..	..	2
Olive Oil	6	..	..	6
Soda Water and Soda Water Syrups	6	40	..	46
Vanilla Extract	1	1	..	2
Vinegar	35	26	12	73
Camphor Liniment	..	2	..	2
Cod Liver Oil Emulsions	..	2	..	2
Headache Wafers	..	1	..	1
Spirit Nitrous Ether	..	9	..	9
Opium	..	..	..	1
Quinine Pills	1	..	..	1
"Snuff"	..	..	..	3
Total	180	†341	12	554
Sampled by Private Individuals.				
Abortion Medicine	..	..	..	1
Alfalfa Bread	..	..	..	1
Brandy	1	..	..	1
Butter	5	..	..	5
Buttermilk	1	..	..	1
Chicken Crop	..	..	..	1
"Cobalt"	..	..	..	1
Coffee	..	2	..	2
Cream	18	1	..	19
Dried Egg	1	..	..	1
Elixir Glycerophosphates Comp	..	..	..	2
Fish	1	..	..	1
Flour	3	..	..	3
Ice Cream	5	..	..	5
Insecticides	..	..	..	8
Jam	1	..	..	1
Maple Sugar	1	..	..	1
Milk	40	9	..	49
Molasses	..	1	..	1
Olive Oil	2	..	..	2
Rat Poison	..	..	..	1
Rum	..	..	..	1
Soda Water	..	1	..	1
Stomach Contents	..	..	..	4
Vinegar	7	6	.	13
Whisky	..	..	..	1
Miscellaneous	..	..	..	3
Total	86	20	..	130
Total from all sources	628	593	69	1406

* Also includes misbranding. † Includes 60 samples below standard in solids—not fat.

Miscellaneous Examinations.

The following examinations have been made from time to time and are printed now as a matter of record.

A sample of what was supposed to be 4 per cent. acetic acid solution was sent to be tested; it contained 3.58 per cent.

The contents of the stomach of a man, who had died under suspicious circumstances, were examined for wood alcohol with negative results.

The contents of three cows' stomachs were examined for arsenic with negative results.

A sample of green weed leaves, suspected of being covered with a poison, were examined and paris green was found.

A bottle, found in the room of a man who had died suddenly, was sent by a coroner, the contents to be tested for methyl alcohol; none was found.

A sample of "rat poison" contained 0.22 per cent. total phosphorus, 0.13 per cent. phosphorus soluble in carbon bisulphide, reducing sugar and glucose present, no arsenic found.

The crop of a chicken, suspected of having been poisoned, was found to contain much arsenic. A sample of soil, taken from the place where the chicken had been feeding, contained .009 per cent. metallic arsenic, equivalent to .012 per cent. arsenious oxide.

A sample of so-called "Cobalt," intended for use as an insecticide, contained 94.61 per cent. total arsenic, water-soluble arsenic (1 day) 11.28, (10 days) 16.46. It contained no chlorides, sulphates, reducing sugars or saccharin.

Ortho-Arsenite of Zinc. This material, made by the California Spray Chemical Co., was tested for water-solubility. After twenty-four hours 1.60 per cent. solids was dissolved and 0.495 per cent. arsenious oxide.

Cut Worm Food. This material, made by Geo. L. Warncke & Co., Cannon Station, was found to consist chiefly of brown middlings and arsenate of lead.

Arsenate of Lead. These analyses were made in 1908 and 1909, and are published now as supplementing those given in our Bulletin 157. They do not necessarily represent the quality of the products offered by the different manufacturers at the present time. Sample 20920 was much drier than is usual with this material.

No.	Manufacturer.	In Material as Analyzed. Water.	Arsenic Oxide.	Lead Oxide.	Undetermined.	In Water-free Material. Arsenic Oxide.	Lead Oxide.
20564	Grasselli Chem. Co. ...	40.70	15.24	.....	.....	25.70	.....
22163	Grasselli Chem. Co. ...	45.57	15.38	37.25	1.80	28.26	68.43
22382	Thomsen Chem. Co. ..	51.73	13.81	32.04	2.42	28.61	66.38
22701	Thomsen Chem. Co. ..	45.76	16.10	35.71	.....	29.68	65.84
20920	Disparene	36.61	18.80	42.05	.....	29.66	66.34
20913	Unknown	.....	12.44	.....	.....	.....	.....

PART III.

COMMERCIAL FEEDING STUFFS

BY E. H. JENKINS AND J. P. STREET.*

THE LAW REGULATING THEIR SALE.

Under the Connecticut statutes the term "concentrated commercial feeding stuff" covers practically all feeds *excepting*:—hay and straw, whole seeds, unmixed meal made directly from any one of the cereals or from buckwheat, and feed ground from whole grain and sold directly from manufacturer to consumer.

Section 4592 requires that every package of concentrated commercial feeding stuff shall bear a statement giving the name and address of manufacturer or importer, the number of net pounds in the package, the name of the article and the percentage of protein and fat contained in it.

The penalty prescribed for violation of the statute is not more than $100 for the first offense and not more than $200 for each subsequent offense.

The law authorizes this station to take samples from any manufacturer, or dealer, in a prescribed fashion, and requires the station to analyze, annually, at least one sample of each brand which it has collected and to publish these analyses "together with such additional information in relation to the character, composition and use thereof as may be of importance."

The dairy commissioner is charged with the enforcement of the statute.

In compliance with these requirements the following report has been prepared. The utmost brevity of discussion of work is made necessary by the limit imposed by law on the size of the report.

---

* The analytical work here described has been done by Messrs. Street, Bailey, Morrison, Roe and Shepard. The report has been prepared mainly by Mr. Street.

During the fall of 1911 the station sampling agent visited fifty-six towns and villages of this State and collected 212 samples of feeds as prescribed by law. The results of the chemical and miscroscopical examination of these samples are here given and discussed and the chemical analyses are given in Table III.

There are also sixty-one analyses of samples sent by individuals.

OIL SEED PRODUCTS.

Cotton Seed Meal, Sampled by the Station.

Of the ten samples analyzed all substantially satisfied their guaranties except **27217**, which was 1.88 per cent. low in protein. The average composition was practically the same as last year, but the selling price was $1.65 less per ton.

Cotton Seed Meal, Sampled by Purchasers.

Twelve samples of *Dixie Brand,* Humphreys, Godwin & Co., Memphis, were uniformly guaranteed 38.62 per cent. protein. These were **25929**, sent by E. A. Root, East Granby; **25997** and **27263**, sent by C. G. Lawton, Brooklyn; **26093**, sent by Theo. Wachter, Winsted; **26129**, sent by A. E. Potwin, East Windsor; **27241**, sent by D. W. Ives, Wallingford; **27255**, sent by J. W. Alsop, Avon; **27260**, sent by H. R. Stone, Southbury; **27869**, sent by W. E. Wheelock, Quinebaug; **27258** and **27259**, sent by The Coles Co., Middletown; and **27261**, sent by H. B. Coger, Botsford. These contained 42.56, 41.25, 39.38, 42.63, 41.19, 38.19, 38.25, 40.69, 41.25, 41.69, 40.75 and 42.19 per cent. protein, respectively, practically satisfying the guaranty in all cases. It is obvious that the guaranty gives no very definite idea of the amount of protein, being that of a low-grade article with only 6.2 per cent. of nitrogen while the larger number of these samples have 6.6 per cent. or more. Such a low guaranty is "safe" for the seller, but not very exact for the buyer. The difficulty of getting from the mills any accurate statement of the quality of their output has been mentioned on page 25. To give a statement which is very far below the actual composition is not meeting the legal requirement. How wide a variation is permissible has not yet been determined.

27833, Humphreys, Godwin & Co., Memphis, sent by D. W. Ives, Wallingford, contained 38.88 per cent. protein.

25962, Humphreys, Godwin & Co., Memphis, guaranty 41 per cent. protein, sent by Rockville Milling Co., Rockville, contained 40.75 per cent protein.

27258, sent by Humphreys, Godwin & Co., Memphis, contained 37.63 per cent. protein.

27013, sent by The Coles Co., Middletown, without guaranty, contained 39.25 per cent protein.

25928, and **26294**, *Owl Brand*, F. W. Brode & Co., Memphis, guaranty, 41 per cent. protein, sent by The Coles Co., Middletown, contained 41.56 and 43.62 per cent. protein, respectively.

25931, National Feed Co., St. Louis, guaranty 41 per cent. protein, sent by F. D. Lawton & Son, Unionville, contained 42.37 per cent. protein.

25936, J. E. Soper Co., Boston, guaranty 41 per cent. protein, sent by Wheeler & Co., Bridgeport, contained 42.44 per cent. protein.

26988, sent by The C. W. Campbell Co., Westerly, contained 37.94 per cent protein.

27029, Memphis C. S. P. Co., Memphis, guaranty 41 per cent. protein, sent by M. D. Leonard & Co., Watertown, contained 39.63 per cent. protein.

27030, and **28022**, S. P. Davis, Little Rock, Ark., guaranty 41 per cent. protein, sent by Wm. H. Hammond, Hampton, and F. U. Wadhams, Torrington, contained 38.88 and 41.88 per cent. protein, respectively.

27240, W. Newton Smith, Baltimore, Md., guaranty 41 per cent. protein, sent by H. K. Brainard, Thompsonville, contained 38.50 per cent. protein.

27864, Farmers Cotton Oil Co., Americus, Ga., guaranty 41 per cent. protein, sent by J. W. Alsop, Avon, contained 37.56 per cent. protein.

Cotton Seed Feed Meal.

The sample analyzed was slightly below guaranty in fat. Its selling price is $3.80 less per ton than that of standard cotton seed meal, yet it contains only a little more than half as much protein and fat and two and one-half times as much fiber. It is a mixture of hulls and meal. While in the South such a mixture is much used as feed, Connecticut farmers cannot afford to pay freight on hulls for such a purpose.

Linseed Meal, Sampled by the Station.

The four samples of old process meal analyzed satisfied their guaranties. The average price of this meal is $2.75 per ton higher than last year.

Oil Cake Feed.

A sample of this imported feed, made by J. Bibby & Sons, Liverpool, and sent by W. A. Hamblin, Suffield, had the following percentage composition:

Water	7.03
Ash	8.69
Protein	20.31
Fiber	8.69
Nitrogen-free extract	46.99
Fat	8.29

Two samples of the same material, sent by F. N. Platt, one labeled Horse Feed and the other Dairy Feed, contained 20.25 and 21.06 per cent. of protein, respectively.

This is not a pure linseed meal, as is shown by its high ash, and nitrogen-free extract and low protein content.

WHEAT PRODUCTS.

Atlantic Gluten Feed.

This material, though sold as "Gluten Feed," is a wheat, not a corn, product. The two samples analyzed satisfied their guaranties.

Wheat Bran.

Of the twenty-six samples, five had no guaranty of composition as required by law. These were **27090**, *Higginsville Bran,* **27055**, *Maple Leaf Bran,* **27216**, *Miner-Hillard Bran,* **27052**, *Niagara Bran,* and **27097**, *Voigt's Bran.* These were, however, of average quality. When their attention was called to the matter, most of the manufacturers of wheat feeds were ready to brand their goods in a way to comply with the Connecticut law. In one or two cases the manufacturers implied that it was not their business to give a guaranty as they were not bound in any way by the Connecticut law. The law of course only regulates sales within Connecticut. It is the jobber or retailer in this State who is held responsible for the proper marking of packages. Almost all manufacturers, however, mark the goods which they ship with the required guaranty, thus relieving the local dealer from the necessity of putting extra tags or labels on all packages which he sells. Connecticut dealers should, therefore, for their own protection buy goods which are shipped from the factory with the statement of guaranty attached.

The remaining twenty-one samples satisfied their guaranties, except **27125**, Hecker's Choice Bran, which was 0.67 per cent. low in fat.

Wheat Middlings.

Of the thirty samples, three had no guaranty of composition as required by law. These were **27099**, *Atlantic White Middlings,* **27053**, *Niagara Middlings,* and **27086**, *Stott's White Middlings,* all of which were of good quality.

Of the remaining twenty-seven samples, **27092**, *Barber's Fancy Low Grade Middlings,* was 1.75 per cent. below guaranty in protein and 1.84 per cent. below in fat; **27182**, *Stott's Choice Middlings,* was 0.87 per cent. below its protein guaranty.

Wheat Feed.

Of the twenty-nine samples, three did not bear the guaranty required by law. These were **27224** and **27054**, *Perfect Mixed Feed,* and **27213**, *Monarch Mixed Feed,* all of which were of standard quality.

Of the remaining twenty-six, **27230**, *Winona Mixed Feed,* **27094**, *Manhattan Mixed Feed,* and **27172**, *Queen Mixed Feed,* were 0.44, 0.26 and 0.62 per cent. below their fat guaranties.

Red Dog Flour.

The sample analyzed, **27201**, *Ben Hur Red Dog Flour,* was 0.56 per cent. below guaranty in protein and 0.89 per cent. below in fat.

Wheat bran, middlings and feed showed average increased prices over those of 1910, of $3.14, $3.03 and $3.24, respectively.

Wheat Products, Sampled by Purchasers.

26993, *Valley City Michigan Pure Wheat Bran,* sent by H. E. Clark, Middlebury, contained 16.00 per cent. protein, 1.76 per cent. below its guaranty. **26991**, *Elmco Wheat Bran,* sent by Theo. A. Stanley, contained 17.88 per cent. protein. **27871,**

Empire Mixed Feed, Powell & Co., Philadelphia, sent by M. D. Stanley, New Britain, contained 8.46 per cent. water, 4.47 ash, 15.38 protein, 5.73 fiber, 62.01 nitrogen-free extract and 3.95 fat.

A sample of *Red Dog Middlings,* **26973**, sold without guaranty, and sent by F. S. Kellogg, Danbury, analyzed as follows: water, 12.01, ash, 0.56, protein, 6.50, fiber, 0.47, nitrogen-free extract, 79.13, and fat, 1.33 per cent. It contained only about one-third the protein and one-fourth the fat usually found in red dog flour of good quality.

Maize Products.

Maize Meal.

The single sample received contained 8.88 per cent. protein.

Maize (Grain).

26029, sent by Abner Hendee, New Haven, and **26455**, sent by F. B. Newton, Plainville, contained 12.19 and 9.54 per cent. of water, respectively.

Gluten Feed.

Seven brands of true gluten feed were found on sale in the State, and eleven samples of these brands were analyzed.

All the samples satisfied their protein guaranties, the average, 25.93 per cent., exceeding the average guaranty by 3.48 per cent. One sample of *Crescent,* **26927**, and one of *Globe,* **27103**, were slightly below their guaranty in fat; but the protein in both was about 4 per cent. in excess of the guaranty. Both samples of *Cream of Corn* were branded as artificially colored.

Hominy Feed.

Fourteen samples were analyzed. **27163**, *Hardy's Hominy Chop,* had no guaranty as required by law. **27059**, *Wirthmore Hominy Feed,* was 1.09 per cent. below its fat guaranty. The two samples of *Ideal Hominy Feed* showed very different percentages of fat (4.95 and 10.15), **27128** being 2.05 per cent. below, and **27077** being 2.45 per cent. above guaranty. **27225**, *Capital Hominy Feed,* was 0.87 per cent. below its protein guaranty. All three of the samples of *Miner-Hillard's Steam Cooked Hominy Feed,* **27137**, **27177** and **27040**, were below guaranty in fat, the deficiencies being 1.26, 1.50 and 1.90 per cent.

respectively. **27095**, *Payne's Hominy Chop*, was 0.34 per cent below its fat guaranty.

Cob Meal.

The single sample analyzed contained only 1.88 per cent. protein and 0.30 per cent. fat. It was made in Kentucky and would not be worth the freight from the place of manufacture as a feed.

Maizo Red Dog Flour.

This sample, although the label stated it was made from corn, was improperly labeled "Red Dog Flour," a name which by long trade usage signifies a low-grade wheat flour. It satisfied its guaranty, but its protein content is only about half that of standard red dog flour, while its fat is somewhat higher. It is in reality a hominy feed.

Corn and Cob Meal.

Four samples were sent by H. N. Goddard, Simsbury, for protein determinations. **26345**, *White Cap Yellow Dent*, **26346**, *Yellow Dent*, **26347**, *Red Flint*, and **26348**, *Yellow Flint*, contained 8.31, 8.31, 8.44, and 9.06 per cent. protein, respectively.

Corn Feed or Screenings.

The sample, **26657**, was sent by Fred Lyman, Manchester, price, $14.60 to $15.60 per ton. It contained:

Water	9.81
Ash	1.32
Protein	8.19
Fiber	8.68
Nitrogen-free extract	70.32
Fat	1.68

RYE PRODUCTS.

Two samples of middlings and one of feed satisfied their guaranties. One sample of middlings, **27067**, was 0.87 per cent. below its protein guaranty.

BUCKWHEAT PRODUCTS.

The two samples analyzed were of very different quality. **27158** was very high grade and satisfied its guaranty. **27170**, which did not bear the required guaranty, contained 9.31 per cent. less protein and 2.75 per cent. less fat than **27158.** The deficiency in quality was due to incomplete separation of the flour, as the hulls were not excessive.

A sample of *Buckwheat Feed,* **27234,** The Birkett Mills, Penn Yan, N. Y., sent by C. W. Hutchinson, Hebron, contained 16.25 per cent. protein and 3.99 per cent. fat. The quantity of hulls in this sample was very excessive.

Oat Products.

Oats (Grain).

26140, sent by J. J. & F. Ahern, Hartford, contained 8.2 mgms. of sulphur dioxid per 100 gms. of grain. The practice of sulphuring oats to bleach them so that they will sell in a higher grade has become quite general. Horses sometimes refuse to eat bleached oats and in some cases the use of bleached oats for seed has been the cause of failure. Bleaching is likely to impair if not entirely destroy the vitality of the seed.

Ground Oats.

The single sample analyzed was of excellent quality.

Oat Hulls.

The one sample, sold as such, contained 6.75 protein, 3.13 per cent. fat and 24.53 per cent. fiber. The protein was 1.56 per cent. below guaranty.

Barley Products.

Malt Sprouts.

26937, *Ballantine's Malt Sprouts,* did not bear the required guaranty, although it was of excellent quality. One sample of *American Malting Co.'s Malt Sprouts,* **27112,** was slightly below guaranty in fat.

The five samples averaged 26.45 per cent. protein with an average cost of $26.60. In this era of high prices the use of this relatively cheap high-grade feed is worthy of every dairyman's careful consideration.

A sample of the *American Malting Co.'s* make, **27236,** sent by A. N. Beard, Milford, and guaranteed 25 per cent. protein, 1.90 per cent. fat and 14 per cent. fiber, contained water, 6.44, ash, 6.51, protein, 12.50, fiber, 21.09, nitrogen-free extract, 52.26, and fat, 1.20 per cent. It had only half the amount of protein guaranteed and one and a half times as much fiber. The amount of barley hulls in it was very excessive.

Dried Brewers' Grains.

All of the six samples analyzed satisfied their guaranties. This feed as a rule is underguaranteed, especially in protein. The samples averaged 29.84 per cent. protein and 7.25 per cent. fat, while the average guaranties were only 23.83 and 5.5 per cent. respectively. The average price of the feed was $28.83, and it is certainly one of the cheapest high-grade feeds on the market.

Dried Distillers' Grains.

27113, *Ajax Flakes,* contained 0.81 per cent. less protein and **27189**, *Continental Gluten Feed,* contained 1.75 per cent. less protein than was guaranteed. *Ajax Flakes* and *Continental Gluten Feed* are high-grade products of quite similar composition. The Biles' product is a much lower grade material, and $8.50 less per ton is asked for it. "Gluten Feed" is a misnomer when applied to Distillers' Grains.

Miscellaneous Feeds.

Dried Beet Pulp.

This material, a by-product of sugar beet factories, is a comparatively new feed in this State. It is a carbohydrate rather than a protein feed. Feeding experiments in other states have demonstrated its value, as its carbohydrates appear to be present in a very assimilable form.

The three samples analyzed satisfied their guaranties.

Dried Molasses Beet Pulp.

This feed is simply *Dried Beet Pulp* to which about 10 per cent. of molasses has been added.

The single sample examined satisfied its guaranty.

Alfalfa Meal.

The single sample examined satisfied its guaranty.

Wheat and Corn Feed.

27215, "Colonial Middlings," is not middlings in the trade usage of that term, which properly applies only to a wheat product.

This is a mixture of wheat and corn by-products. It does not meet its guaranteed fat content by 0.63 per cent. Its selling price, $34.00 per ton, is $1.13 higher than the average of wheat middlings and it contains 4 per cent. less of protein and three-quarters of 1 per cent. less of fat.

Corn and Oat Feeds.

Two samples of true provender, that is, ground corn and oats, were analyzed, and both were of good quality.

Chop Feeds.

Here are included those feeds which are chiefly mixtures of corn and oats products, some brands also containing small amounts of common salt. In some cases the "oats" are chiefly oat hulls. On the average they contain about three times as much fiber as true provender. *Haskell Stock, Monarch Chop* and *Winner Chop Feed* contain hominy. All of the twelve samples analyzed satisfied their guaranties except **27145**, *Victor Feed,* in which the fat was slightly below its guaranty. The high percentages of fiber in **27105**, **27082**, **27087**, **27206**, **26935** and **27145**, indicate the use of considerable hulls in these mixtures.

Wheat and Corn Cob Feeds.

Two of the three samples analyzed were sold as *Mixed Feed,* a name properly belonging by trade usage only to mixtures of wheat bran and middlings. The tags accompanying all the samples stated that they were composed of "wheat bran, ground corn, cob meal." All the samples satisfied their guaranties, but contained 2 per cent. less protein than the same brands had last year. They sold for $4.50 less per ton than genuine wheat feed, and contained less than three-fifths as much protein.

Proprietary Horse Feeds.

Seven samples were analyzed. **27122**, *Bonnie Horse Feed,* had 1.31 per cent. less of protein, and **27079**, *Algrane Horse Feed,* 0.87 less of protein and 0.44 per cent. less of fat than was guaranteed. The other five samples satisfied their guaranties.

Buffalo Horse Feed contains cracked corn, whole oats and wheat and corn products.

Bonnie Horse Feed, Algrane Horse Feed, and *V-B Horse Feed* contains corn, oats and wheat products, the second also containing some salt.

Husted Steam Cooked Feed contains whole and cracked corn, whole oats and rolled wheat.

Purina Feed contains cracked corn, oats, dried brewers' grains, alfalfa and hominy and salt.

Schumacher's Special Horse Feed contains cracked corn, whole oats, barley and oat products, and salt.

Proprietary Dairy and Stock Feeds.

Sixteen samples were analyzed. **27006**, *Blatchford's Calf Meal,* had somewhat less than the guaranteed amount of protein. **27048**, *Wirthmore Balanced Ration Feed,* was 0.26 per cent. low in fat. **27185**, *Daisy Dairy Feed,* was 0.91 per cent. low in fat, with 2.5 per cent. excess of protein. **27165**, *Blue Ribbon Dairy Feed,* was 0.87 per cent. low in protein and 1.02 per cent. low in fat. **27034**, *Quaker Dairy Molasses Feed,* was 1.31 per cent. low in protein. **27073**, *Schumacher's Calf Meal,* was 1.12 per cent. low in protein and 0.76 per cent. low in fat. **27231**, *V-B Dairy Feed,* was 4.25 per cent. low in protein. The remaining samples substantially satisfied their guaranties.

Sucrene Dairy Feed contains cotton seed meal, oats and barley products, malt sprouts, wheat screenings, molasses and salt.

Union Grains Biles' Ready Ration contains wheat and corn products, distillery residues, malt sprouts, cotton seed and linseed meals and salt.

Blatchford's Calf Meal contains linseed, cotton seed and leguminous meals, wheat products, fenugreek and salt.

Unicorn Dairy Ration contains distillers' grains, wheat and corn products, barley residues, malt sprouts, cotton seed and linseed meals.

Wirthmore Balanced Ration contains wheat bran, malt sprouts, barley residues, corn products, cotton seed and linseed meals and a small amount of oat hulls.

Wirthmore Stock Feed contains hominy and oat products.

White Cross Stock Feed contains corn, oats, wheat and barley products and salt.

Daisy Dairy Feed contains corn and oat products, alfalfa, wheat screenings, cotton seed meal, molasses and salt.

Husted Molasses Feed contains corn and oat products, cotton seed and linseed meals, molasses and salt.

Blue Ribbon Dairy Feed contains corn, oats and wheat products, malt sprouts, cotton seed meal and molasses.

Quaker Dairy Molasses Feed contains oat and flax products, wheat screenings, cotton seed meal, molasses and salt.

Schumacher's Calf Meal contains ground oats, wheat products, linseed meal and casein (statement of manufacturer).

Schumacher's Stock Feed contains corn, oats, barley and wheat products, salt and a small amount of cotton seed meal.

Protena Dairy Feed contains corn products, dried brewers' grains, alfalfa, cotton seed meal, wheat screenings and salt.

V-B Dairy Feed contains corn, oats and wheat products, and linseed and cotton seed meals.

Dairy Feeds, Sampled by Purchasers.

A sample of *Sucrene Dairy Feed,* **27033,** guaranty 16.50 per cent. protein and 3.50 per cent. fat, sent by G. F. McArthur, Newtown, contained 11.46 per cent. water, 8.35 ash, 17.38 protein, 11.46 fiber, 47.40 nitrogen-free extract and 3.95 fat.

Another sample of this same feed, **27001,** sent by H. E. Botsford, Bridgeport, was examined for weed seeds. A few seeds of pigweed were found and occasional seeds of foxtail and smart weed.

Proprietary Poultry Feeds.

Thirteen samples was analyzed. **27121,** *Bonnie Dry Mash,* and **27159,** *Purity Poultry Mash,* did not bear guaranties as required by law. **27130,** *Eaton's Perfection Mash Mixture,* was 1.87 per cent low in protein. **27116,** *Park & Pollard's Dry Mash Feed,* was 3.75 per cent. low in protein. The other eleven samples satisfied their guaranties.

Buffalo Poultry Feed contains corn, hominy, wheat, rolled oats and gluten feed.

Wirthmore Poultry Mash contains corn, oats and wheat products, and alfalfa.

Perfection Mash Mixture contains corn, wheat and oats products, alfalfa, kaffir corn, animal matter, charcoal, bone, salt and milk albumen (statement of manufacturer).

Bonnie Dry Mash contains wheat, oats and corn products, millet and animal matter.

Purity Poultry Mash contains wheat bran, corn, alfalfa, meat scrap and salt.

H. O. Poultry Feed contains, wheat bran, corn, oats, hominy and probably some gluten feed.

Husted Laying Mash contains wheat and corn products, rolled oats and cotton seed meal.

Park & Pollard's Dry Mash Feed contains corn, wheat, oats, barley, alfalfa, bone, animal matter and salt.

Park & Pollard's Growing Feed contains corn, wheat and barley products, bone, animal matter and salt.

Park & Pollard's Fattening Feed contains corn, oats and wheat products, salt and a little cotton seed meal.

Purina Chicken Chowder Feed contains corn, wheat, alfalfa, charcoal, animal matter, salt and possibly a little linseed meal.

American Poultry Feed contains corn, barley, wheat and oats products, and cotton seed meal.

V-B Mash for Laying Hens contains corn, oats and wheat products, alfalfa, animal matter and linseed meal(?).

Poultry Feeds, Sampled by Purchasers.

26272, *Our Own Lay Mash(?)*, The Rugg and Faber Co., Seymour, sent by the manufacturers, contained 17.88 per cent. protein. **25989,** *"Chicken Feed,"* sent by C. A. Cowles, Plantsville, contained 20.75 per cent. protein.

Beef Scrap.

The single official sample, **27110,** *Shay's Beef Scrap,* did not bear the required guaranty, but the manufacturer, when attention was called to it, arranged for suitable tags.

Beef Scrap, Sampled by Purchasers.

26076, *Meat and Bone Chicken Scrap,* sent by S. M. Crowell, Middletown, contained 3.27 per cent. water, 43.06 per cent. ash and 36.63 per cent. protein. **26106,** *Darling's Beef Scrap,* guaranty 55 per cent. protein, **26107,** *Frisbie's Beef Scrap,* guaranty 40 per cent. protein, and **26108,** *Breck's Beef Scrap,* guaranty 43 per cent. protein, all sent by P. G. Hawley, Southbury, contained 57.50, 39.06 and 40.81 per cent. protein, respectively. **27008** and **27009,** *Shay's Beef Scrap,* sent by S. M. Crowell, Middletown, contained 42.19 and 32.50 per cent. protein, respectively. **27018,** *Beef Scrap,* sent by F. H. Rolf, Guilford, contained 8.94 per cent. water, 34.99 ash, 39.38 protein, 1.14 fiber, 3.54 nitrogen-free extract and 12.01 fat.

Cracker Waste.

27027, sent by C. M. Jarvis, Berlin, contained 7.38 per cent. water, 1.57 ash, 7.75 protein, 0.54 fiber, 67.56 nitrogen-free extract and 15.20 fat.

Summary.

The following table shows the number of samples analyzed, the number sold without the required guaranty, and also the number which failed to meet the manufacturer's guaranty.

Kind of Feed.	No. of Samples.	No. with Guaranty.	No. Without Guaranty.	*Low in		
				Protein.	Fat.	Both.
Cotton Seed Meal	10	10	..	1	..	..
Cotton Seed Feed Meal	1	1	..	..	..	..
Linseed Meal	4	4	..	..	..	..
Wheat Gluten Feed	2	2	..	..	..	..
Wheat Bran	26	21	5	..	1	..
Wheat Middlings	30	27	3	1	1	1
Wheat Feed	29	26	3	..	3	..
Gluten Feed	11	11	..	..	..	..
Hominy Feed	14	13	1	..	6	..
Rye Products	4	4	..	..	..	..
Buckwheat Middlings	2	1	1	..	..	..
Malt Sprouts	5	4	1	..	1	..
Dried Brewers' Grains	6	6	..	..	..	..
Dried Distillers' Grains	3	3	..	1	..	..
Dried Beet Pulp	4	4	..	..	..	..
Provender	2	1	1	..	..	..
Corn and Oat Feeds and Chop Feeds	12	12	..	..	1	..
Wheat and Corn Cob Feeds	3	3	..	..	..	..
Horse Feeds	7	7	..	1	1	..
Dairy and Stock Feeds	16	16	..	2	3	1
Poultry Feeds	13	11	2	2	..	..
Beef Scrap	1	..	1	..	..	..
Miscellaneous Feeds	4	4	..	1	1	..
Feeds not requiring guaranty	3	..	3	..	..	..
Total	212	191	21	9	18	2

* Deficiencies of less than one per cent. protein and 0.25 per cent. fat are ignored in this tabulation.

Digestibility of Feeding Stuffs by Ruminants.

Table I shows the digestion coefficients, or percentages of the food elements which are digestible by neat cattle (Lindsey's Compilation, 17th Report Mass. (Hatch) Agrl. Station, 1911, page 29 *et seq.*).

Some of these figures are the results of only a very few tests, and all of them represent short periods of feeding and must be regarded as showing comparative digestibility of the feeds only very roughly. Like chemical composition, statement of the digestibility of a feed is only a single "pointer" to the feeder, helpful, if it is not over-valued.

TABLE I.

DIGESTION COEFFICIENTS.

	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Cotton Seed Meal	84	35	78	94
Linseed Meal, new process	84	74	80	89
Linseed Meal, old process	89	57	78	89
Corn Meal	67	..	92	90
Hominy Meal	65	67	89	92
Gluten Feed	85	87	90	81
Wheat Bran	77	39	71	63
Wheat Middlings	77	30	78	88
Wheat Feed	78	62	77	87
Rye Feed	80	..	88	90
Oats	77	31	77	89
Buckwheat Middlings	85	17	83	89
Malt Sprouts	80	34	69	100
Dried Distillers' Grains	73	95	81	95
Dried Brewers' Grains	81	49	57	89
Provender	71	48	83	87
Wheat and Corn Cob Feed	63	28	71	92
Dried Beet Pulp	64	84	91	..
Oat Hulls	62	32	33	92
Cob Meal	17	65	60	50

The Average Composition, Digestibility and Selling Price of Commercial Feeds.

Table II contains a summary of the facts given in more detail in Table III, and shows, first, the average composition of these feeds as determined by the present inspection, arranged according to their protein content; second, the amount of digestible matter in each feed, as far as we have been able to calculate it; and third, the average retail prices of the feeds in October and November last.

The feeds are tabulated in six groups. The following statement gives the average number of pounds of digestible protein, fiber and nitrogen-free extract, and fat purchasable for one dollar in each of these groups:

Digestible Nutrients Purchasable for One Dollar.

Group.		Protein.	Fiber and Nitrogen-free Extract.	Fat.
1	Containing over 30 per cent. protein	17.1	20.8	3.2
2	" 25 to 30 " "	14.2	28.2	3.0
3	" 20 to 25 " "	12.7	34.0	2.2
4	" 15 to 20 " "	8.5	33.4	3.1
5	" 10 to 15 " "	5.0	33.4	3.3
6	" less than 10 " "	4.0	41.1	1.5

The variations in the amounts of digestible fat supplied in the different groups are small, but the differences in the other two food compounds are marked. Protein is by far the more expensive of these two, more than one-sixth of it being nitrogen, the element most generally lacking in our soils, most expensive to buy in fertilizer, and most necessary to "balance" the feeding rations of our stock.

If the feeder is mainly concerned in getting protein for his grain feed, he certainly cannot afford to buy feeds of the last three groups containing less than 20 per cent. of total protein. But even if he wishes to buy starchy food, he can get more for the same money in group three than in four or five and only one-sixth less than in six.

In this era of high prices economy demands that the feeder shall give the closest attention to the cost of the feeds he buys. Table II shows that for $27.00 per ton he may buy feeds containing from 10 to 26 per cent. of protein; again for from $32.00 to $33.00 he may buy feeds ranging from 9 to 41 per cent. of protein. Failure to observe this lack of relation between cost and the needed nutriment supplied may explain why in many cases the dairy business is no longer profitable.

TABLE II.—AVERAGE COMPOSITION OF FEEDS AND SELLING PRICE.

	In 100 pounds of feed are contained pounds of						In 100 pounds of feed are contained pounds of digestible				
	Water.	Ash.	Protein (N x 6.25).	Fiber.	Nitrogen-free Extract.	Ether Extract (fat).	Protein.	Fiber.	Nitrogen-free Extract.	Fat.	Cost per ton.
I. Protein over 30 per cent.											
Cotton Seed Meal	6.88	6.41	40.84	8.56	29.13	8.18	34.3	3.0	22.7	7.7	$32.80
Linseed Meal, old process	8.79	5.84	35.13	7.75	35.84	6.65	31.3	4.4	28.0	5.9	42.75
Buckwheat Middlings, high grade	10.00	4.68	32.50	7.34	37.09	8.48	27.6	1.2	30.7	7.5	32.00
Gluten Feed, Atlantic	6.21	0.93	30.94	1.05	60.13	0.74	26.3	0.8	53.5	3.6	33.50
II. Protein 30-25 per cent.											
Dried Brewers' Grains	7.13	3.16	29.84	12.74	39.88	7.25	24.2	6.2	22.7	6.5	28.83
Gluten Feed, Continental	5.78	4.29	29.25	7.49	39.59	13.60	21.4	7.1	32.1	12.9	34.00
Ajax Flakes	6.62	5.13	29.19	8.98	38.56	11.52	21.3	8.5	31.2	10.9	33.00
Unicorn Dairy Ration	7.04	3.48	28.29	8.60	46.43	6.16	....	....	....	....	33.00
Gluten Feed, Globe	7.33	3.93	27.06	6.57	52.01	2.50	23.5	5.0	46.3	2.1	31.50
" " Buffalo	8.77	4.85	27.00	6.39	49.85	3.14	23.0	4.9	44.4	2.6	32.25
" " Crescent	8.92	5.43	26.50	6.64	50.13	2.38	22.5	5.0	44.6	2.0	33.00
Malt Sprouts	8.00	5.84	26.45	11.96	46.33	1.42	21.2	4.1	32.0	1.4	26.60
Wirthmore Balanced Ration	7.38	4.84	26.44	9.58	47.02	4.74	....	....	....	....	32.00
Gluten Feed, Cream of Corn	7.38	3.65	25.57	6.55	54.24	2.61	21.7	5.0	48.3	2.2	32.00
" " Clinton	10.01	1.06	25.31	7.35	52.81	3.46	21.5	5.6	47.0	2.9	32.00
III. Protein 25-20 per cent.											
Union Grains, Biles' Ready Ration	7.52	5.41	24.31	8.50	46.41	7.85	....	....	....	....	33.00
Blue Ribbon Dairy Feed	7.13	6.92	24.13	11.00	47.34	3.48	....	....	....	....	32.00
Gluten Feed, Cedar Rapids	8.81	1.04	23.25	6.53	57.08	3.29	19.8	5.0	50.8	2.7	32.00
" " Bay State	5.62	1.13	23.19	6.78	60.25	3.03	19.7	5.2	53.6	2.5	30.00
Buckwheat Middlings, low grade	12.06	2.60	23.19	5.17	51.25	5.73	19.7	0.9	42.5	5.1	31.00
Cotton Seed Feed Meal	6.71	4.84	22.69	21.20	39.80	4.76	....	....	....	....	29.00
Husted Molasses Feed	10.33	6.74	22.25	8.24	47.95	4.49	....	....	....	....	31.00
Protena Dairy Feed	8.40	6.53	20.94	13.64	45.61	4.88	....	....	....	....	32.00
IV. Protein 20-15 per cent.											
V-B Dairy Feed	8.32	3.20	17.75	8.92	57.00	4.81	....	....	....	....	34.00
Daisy Dairy Feed	7.81	8.11	17.56	12.15	52.28	2.09	....	....	....	....	30.00
Wheat Middlings	9.97	4.23	17.32	5.92	57.45	5.11	13.3	1.8	44.8	4.5	32.87

TABLE II.—AVERAGE COMPOSITION OF FEEDS AND SELLING PRICE—*Continued.*

	In 100 pounds of feed are contained pounds of						In 100 pounds of feed are contained pounds of digestible				
	Water.	Ash.	Protein (N x 6.25).	Fiber.	Nitrogen-free Extract.	Ether Extract (fat).	Protein.	Fiber.	Nitrogen-free Extract.	Fat.	Cost per ton.
Rye Feed	11.33	3.29	17.19	3.60	61.43	3.16	13.8	....	54.1	2.8	$32.00
Wheat Mixed Feed	9.19	5.39	16.95	7.18	56.47	4.82	13.2	4.5	43.5	4.2	31.52
Sucrene Dairy Feed	9.92	8.29	16.50	12.41	48.96	3.92	....	....	....	....	28.00
Red Dog Flour	10.55	2.65	16.44	3.10	63.15	4.11	....	....	....	....	34.50
Wheat Bran	8.58	6.28	16.22	9.22	54.81	4.89	12.5	3.6	38.9	3.1	29.79
Rye Middlings	10.23	3.55	16.09	4.17	62.72	3.24	....	....	....	....	30.33
Biles' Rye Distillers' Grains	6.31	1.23	15.69	13.61	55.20	7.96	11.5	12.9	44.7	7.6	25.00
V. Protein 15-10 per cent.											
Quaker Dairy Molasses Feed	7.86	7.56	14.69	15.25	50.64	4.00	....	....	....	....	27.00
Purina Feed	9.70	4.86	13.56	10.11	57.71	4.06	....	....	....	....	30.00
Ground Oats	8.55	3.30	12.94	8.47	61.93	4.81	10.0	2.6	47.7	4.3	35.00
Bonnie Horse Feed	9.25	3.12	12.69	7.11	62.99	4.84	....	....	....	....	34.00
Buffalo Horse Feed	6.74	3.08	11.88	8.31	65.53	4.46	....	....	....	....	32.00
Husted Steam-cooked Feed	9.37	2.07	10.63	4.29	69.12	4.52	....	....	....	....	36.00
V-B Horse Feed	8.26	3.30	10.63	9.61	63.63	4.57	....	....	....	....	30.00
Hominy Feed	8.81	2.43	10.55	3.80	67.19	7.22	6.9	2.5	59.8	6.7	32.86
Schumacher's Stock Feed	7.63	3.75	10.31	9.92	64.39	4.00	....	....	....	....	32.00
White Cross Stock Feed	9.90	3.22	10.31	4.01	67.86	4.70	....	....	....	....	36.00
Wirthmore Stock Feed	8.03	3.36	10.19	7.00	63.97	7.45	....	....	....	....	33.00
Algrane Horse Feed	8.25	3.50	10.13	9.39	65.17	3.56	....	....	....	....	32.00
VI. Protein under 10 per cent.											
Wheat and Corn Cob Feed	8.37	3.72	9.88	14.64	60.24	3.15	6.2	4.1	42.8	2.9	27.00
Maizo Red Dog Flour	9.04	1.98	9.75	1.94	70.34	6.95	....	....	....	....	32.00
Provender (Ground Corn and Oats)	10.37	1.75	9.69	3.18	70.65	4.36	6.9	1.5	58.6	3.8	37.50
Schumacher's Special Horse Feed	9.10	3.18	9.44	7.16	67.49	3.63	....	....	....	....	33.00
Dried Beet Pulp	6.69	3.59	9.08	18.79	61.33	0.52	5.8	15.8	55.8	....	28.00
Corn and Oat Feeds	8.56	3.40	8.90	9.17	65.64	4.33	6.3	4.4	54.5	3.8	30.42
Corn Meal	11.52	1.49	8.88	1.58	72.24	4.29	5.9	....	66.5	3.9	32.00
Dried Molasses Beet Pulp	8.40	4.06	8.88	17.74	60.39	0.53	5.7	14.9	55.0	....	29.00
Oat Hulls	5.97	6.53	6.75	24.53	53.09	3.13	4.2	7.8	17.5	2.9	....
Cob Meal	6.96	1.22	1.88	32.45	57.19	0.30	0.3	21.1	34.3	0.15	....

NOTES REGARDING THE YIELD OF ALFALFA.

By E. H. Jenkins.

After many failures we have now a sufficient number of successes on a considerable scale to prove that alfalfa can be grown in Connecticut under proper conditions, on a variety of soils, that it is reasonably hardy, that as a soiling crop it takes the place of "summer pasture" which very often amounts to little or nothing, and while it is not easy to hay it in all seasons, fair success has followed curing it under caps even in "catching" weather.

Among other things needing further study is to find out, with some accuracy, how much it will yield in our climate year after year, what is its composition here and what is its effect on the land in the course of years. Estimates need to be followed by weights.

Through the kindness and coöperation of Col. C. M. Jarvis of Berlin, who has some 80 acres in alfalfa and is aiming at 300 acres, we have weighed and analyzed the alfalfa crops this year from a measured acre on his farm. After a fine corn crop the piece had been seeded down and staid in grass for six years, receiving from time to time a top dressing of manure. In 1908 it gave a good crop of timothy but in 1909 the crop was poor.

In the spring of 1910 the land was well dressed with manure and sown to alfalfa. In the spring of 1911 one-half of the acre was top-dressed with manure which did not increase the crop on that part of the field.

It was cut three times, June 27, August 12 and October 12. In judging the yield it is to be considered that the summer was very dry, resulting generally in very short crops.

The yields, in pounds per acre, of feed and of plant food in each cutting and in the whole crop were as follows:

	First Cutting.	Second Cutting.	Third Cutting.	Total.
Water	632	565	800	1997
Ash	418	116	158	692
Protein	831	190	339	1360
Fiber	1533	325	418	2276
Nitrogen-free Extract	2022	442	669	3133
Fat	106	25	36	167
Total	5542	1663	2420	9625

[Continued on page 256.]

TABLE III.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	OIL SEED PRODUCTS.	
	Cotton Seed Meal.	
27132	Dove Brand. F. W. Brode & Co., Memphis, Tenn.	*Danbury:* Keeler Grain Co.
26931	Owl Brand. F. W. Brode & Co., Memphis, Tenn.	*Simsbury:* R. H. Ensign
27173	Buckeye. Buckeye Cotton Oil Co., Cincinnati, O.	*Willimantic:* H. A. Bugbee
27197	" " " " "	*Middlefield:* A. E. Miller
27217	——— Central Oil & Fertilizer Co., Cordele, Ga.	*Waterbury:* Spencer Grain Co.
27101	Dixie Brand. Humphreys, Godwin & Co., Memphis, Tenn.	*New Haven:* R. G. Davis
27065	Selden. Memphis Cottonseed Products Co., Memphis, Tenn.	*Wallingford:* Gallagher Bros.
27186	Dirigo Brand. W. Newton Smith, Baltimore, Md.	*Thompsonville:* H. K. Brainard.
27160	Prime. J. E. Soper Co., Boston	*Danielson:* Young Bros. Co.
27168	Pioneer. " " " "	*Willimantic:* E. A. Buck Co.
		Average guaranty
		Average of these 10 analyses
		Average digestible
	Cotton Seed Feed Meal.	
27148	Creamo Brand. Tennessee Fiber Co., Memphis, Tenn.	*Yantic:* A. R. Manning
		Guaranty
	Linseed Meal, Old Process.	
27081	American Linseed Co., New York	*New Britain:* C. W. Lines Co.
27221	Kelloggs & Miller, Amsterdam, N. Y.	*New Milford:* G. T. Soule
27107	Guy G. Major Co., Toledo, O.	*Shelton:* Ansonia Flour & Grain Co.
27211	Metzger Seed & Oil Co., Toledo, O.	*Hartford:* G. M. White & Co.
		Average guaranty
		Average of these 4 samples
		Average digestible
	WHEAT PRODUCTS.	
	Atlantic Gluten Feed.	
27120	Atlantic Starch Works, Westport	*Wesport:* Manufacturer
27205	" " " "	*Middletown:* Meech & Stoddard
		Average guaranty
		Average of these 2 analyses
		Average digestible
	Wheat Bran.	
27051	Pennant Rich. Allen Baker Comm. Co., St. Louis	*Branford:* S. V. Osborn
27076	Sunlight Winter. American Cattle & Poul. Food Co., Binghamton, N. Y.	*Meriden:* Grain & Feed Co.
27209	Badger. Berger Crittenden Mill. Co., Milwaukee, Wis.	*Hartford:* L. C. Daniels Grain Co.
27204	Bernet, Craft & Kauffman Mill. Co., St. Louis	*Middletown:* Meech & Stoddard.
27156	Jersey. Geo. C. Christian, Minneapolis, Minn.	*Moosup:* T. E. Main & Sons
27151	Newport. Chas. M. Cox Co,, Boston	*Yantic:* A. R. Manning
26933	Coarse. Crookston Mill. Co., Crookston, Minn.	*Collinsville:* Collinsville Grain Co.
27089	Coarse. Eagle Roller Mill Co., New Ulm, Minn.	*Plainville:* Eaton Bros.

Sampled in 1911.

Station No.	Pounds per Hundred. Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
27132	7.40	6.68	41.19	7.29	29.36	8.08	$35.00
26931	7.44	6.18	43.81	6.46	28.11	8.00	33.00
27173	5.67	6.79	44.44	7.28	27.97	7.85	32.00
27197	6.23	6.31	41.06	8.20	29.99	8.21	32.00
27217	7.95	5.67	39.25	9.10	28.87	9.16	34.00
27101	6.11	5.87	38.69	11.34	30.27	7.72	32.00
27065	8.11	6.98	40.63	8.65	27.77	7.86	33.00
27186	8.64	6.46	38.25	9.95	27.88	8.82	31.00
27160	6.22	5.61	38.56	10.63	30.71	8.27	32.00
27168	5.06	7.58	42.50	6.65	30.42	7.79	34.00
.....	....	....	**39.36**	....	....	**6.28**	....
.....	**6.88**	**6.41**	**40.84**	**8.56**	**29.13**	**8.18**	**32.80**
.....	....	....	**34.3**	**3.0**	**22.7**	**7.7**	....
27148	6.71	4.84	22.69	21.20	39.80	4.76	29.00
.....	....	....	**22.00**	....	....	**5.00**	....
27081	7.98	5.70	36.63	7.38	35.62	6.69	45.00
27221	10.27	4.84	35.81	7.57	34.24	7.27	45.00
27107	8.15	6.58	32.38	8.98	37.44	6.47	39.00
27211	8.77	6.25	35.69	7.06	36.08	6.15	42.00
.....	....	....	**31.25**	....	....	**5.25**	....
.....	**8.79**	**5.84**	**35.13**	**7.75**	**35.84**	**6.65**	**42.75**
.....	....	....	**31.3**	**4.4**	**28.0**	**5.9**	....
27120	5.70	0.96	33.44	0.91	58.39	0.60	33.00
27205	6.72	0.91	28.44	1.19	61.87	0.87	34.00
.....	....	....	**27.00**	....	....	**0.50**	....
.....	**6.21**	**0.93**	**30.94**	**1.05**	**60.13**	**0.74**	**33.50**
.....	....	....	**26.3**	**0.8**	**53.5**	**0.6**	....
27051	8.50	7.30	15.63	9.65	54.19	4.73	28.00
27076	8.59	6.66	15.13	7.68	57.34	4.60	32.00
27209	9.24	6.65	16.25	9.84	53.51	4.51	31.00
27204	8.94	6.48	16.81	9.30	54.01	4.46	29.00
27156	7.99	6.07	15.94	9.57	55.33	5.10	28.50
27151	6.82	7.03	16.06	9.13	56.10	4.86	28.00
26933	10.07	5.77	16.44	9.38	53.03	5.31	31.00
27089	9.07	6.51	15.75	10.60	52.92	5.15	30.00

Table III.—Analyses of Commercial Feeds

Station No.	Brand.	Retail Dealer.
	Wheat Products.—*Continued.*	
	Wheat Bran.	
27222	Lucky. Federal Milling Co., Lockport, N. Y.	*New Milford:* Geo. E. Ackley Co.
27167	Gwinn's. Gwinn Milling Co., Columbus, O.	*Putnam:* Bosworth Bros.
27125	Choice. Hecker-Jones-Jewell Mill Co., New York	*Greenwich:* J. P. Johnson
27090	Higginsville Milling Co., Higginsville, Mo.	*Plainville:* Eaton Bros.
27161	Anchor. Kemper Mill & Elev. Co., Kansas City, Mo.	*Danielson:* Young Bros. Co.
27080	L. K. Bran	*New Britain:* C. W. Lines Co.
27055	Maple Leaf Milling Co., Canada	*Guilford:* Morse & Landon
27216	Miner-Hillard Mill. Co., Wilkesbarre, Pa.	*Waterbury:* D. L. Dickinson & Son
27171	Coarse. New Ulm Milling Co., New Ulm, Minn.	*Willimantic:* H. A. Bugbee
27052	Niagara Falls Milling Co.	*Guilford:* G. F. Walter
27118	Northwestern Cons. Mill. Co., Minneapolis, Minn.	*Norwalk:* Holmes, Keeler & Selleck
27060	Peninsular Mill Co., Flint, Mich.	*No. Haven:* Coöperative Feed Co.
27131	Pillsbury's, Minneapolis, Minn.	*Ridgefield:* S. D. Keeler
27039	Russell Miller Milling Co.	*Cheshire:* G. W. Thorpe
27047	Stott's, Detroit, Mich.	*Plantsville:* C. O. Cowles
27097	Voigt Milling Co., Grand Rapids, Mich.	*New Haven:* R. G. Davis
27180	Bigjo. Wabasha Mill. Co., Wabasha, Minn.	*Stafford Springs:* G. L. Dennis
27045	Coarse. Washburn-Crosby Co., Minneapolis, Minn.	*Plantsville:* T. B. Atwater
		Average of these 26 analyses
		Average digestible
	Wheat Middlings.	
27099	*White. Atlantic Macaroni Co., Long Island City, N. Y.	*New Haven:* R. G. Davis
27154	Ballard's Ship Stuff. Ballard & Ballard, Louisville, Ky.	*Norwich:* Norwich Grain Co.
27104	Banner. Banner Milling Co., Buffalo, N. Y.	*Ansonia:* Flour & Grain Co.
27092	Fancy Low Grade. Barber Milling Co., Minneapolis, Minn.	*Bristol:* W. O. Goodsell
27226	Claro. Claro Milling Co., Lakeville, Minn.	*Winsted:* E. Manchester & Sons
27194	Wirthmore. Chas. M. Cox Co., Boston	*Suffield:* Arthur Sikes
27123	Standard. Wm. G. Crocker, Minneapolis, Minn.	*So. Norwalk:* M. T. Hatch
27135	White. Duluth Superior Mill. Co., Duluth, Minn.	*Danbury:* F. C. Benjamin & Co.
27166	Lucky. Federal Milling Co., Lockport, N. Y.	*Putnam:* Bosworth Bros.
27202	Ben Hur Standard. Hennepin Mill. Co., Minneapolis, Minn.	*Middletown:* Meech & Stoddard.
27057	Standard Fine. Hubbard Mill. Co., Mankato, Minn.	*Guilford:* Morse & Landon
27044	Seal of Minn. Standard. New Prague Flouring Mill Co., New Prague, Minn.	*Plantsville:* T. B. Atwater
27053	Niagara Falls Milling Co.	*Guilford:* G. F. Walter
27178	White. Northwestern Consolidated Mill. Co., Minneapolis, Minn.	*Stafford Springs:* G. L. Dennis

* Statement of dealer.

SAMPLED IN 1911—*Continued.*

Station No.	Pounds per Hundred. Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
27222	9.57	6.24	16.69	9.65	52.64	5.21	30.00
27167	8.16	5.75	17.44	7.56	56.61	4.48	30.00
27125	9.36	6.28	15.94	8.72	55.37	4.33	32.00
27090	8.00	7.24	15.31	8.60	56.22	4.63	30.00
27161	8.24	6.55	16.06	8.80	55.91	4.44	28.00
27080	8.61	5.56	16.81	9.49	54.25	5.28	31.00
27055	9.24	5.36	15.63	9.67	54.81	5.29	29.00
27216	9.22	6.16	15.56	8.53	56.47	4.06	32.00
27171	6.81	6.16	17.06	9.19	55.32	5.46	28.00
27052	8.70	6.74	15.00	11.54	53.29	4.73	30.00
27118	8.15	6.29	16.69	9.36	54.35	5.16	30.00
27060	9.03	5.89	16.00	8.71	55.95	4.42	29.00
27131	9.02	6.43	16.00	10.17	53.28	5.10	30.00
27039	7.74	6.24	19.63	8.84	51.91	5.64	28.00
27047	8.44	5.79	16.94	8.37	55.10	5.36	30.00
27097	8.34	5.70	15.13	8.11	58.40	4.32	29.00
27180	9.40	5.69	16.06	8.91	54.35	5.59	30.00
27045	7.71	6.76	15.88	10.29	54.34	5.02	31.00
.....	**8.58**	**6.28**	**16.22**	**9.22**	**54.81**	**4.89**	**29.79**
.....	....	....	**12.5**	**3.6**	**38.9**	**3.1**	....
27099	11.27	3.72	17.75	5.79	55.90	5.57	31.00
27154	8.93	3.90	17.56	4.62	60.44	4.55	32.00
27104	10.18	4.16	17.75	5.65	56.99	5.27	33.00
27092	9.88	1.93	16.25	1.30	67.48	3.16	31.00
27226	10.47	5.17	18.06	7.21	53.43	5.66	31.00
27194	10.68	4.14	17.06	5.46	57.50	5.16	35.00
27123	10.00	4.88	17.31	7.12	55.17	5.52	32.00
27135	10.40	4.09	17.63	5.75	56.60	5.53	34.00
27166	9.16	4.62	19.00	7.09	54.39	5.74	32.00
27202	10.12	4.88	17.13	7.13	55.64	5.10	31.00
27057	10.23	5.13	17.44	8.68	52.76	5.76	32.00
27044	8.87	4.35	19.06	5.25	56.27	6.20	33.00
27053	9.42	5.12	17.19	8.91	54.03	5.33	33.00
27178	9.59	4.93	16.75	8.22	54.75	5.76	33.00

TABLE III.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	WHEAT PRODUCTS.—*Continued.*	
	Wheat Middlings.	
27061	Peninsular Milling Co., Flint, Mich.	*No. Haven:* Coöperative Feed Co.
27187	Pillsbury's A, Minneapolis, Minn.	*Thompsonville:* H. K. Brainard.
27041	" B, " "	*Cheshire:* G. W. Thorpe
27219	" XX Daisy, " "	*New Milford:* G. T. Soule
26936	Bixota. Red Wing Mill. Co., Red Wing, Minn.	*New Haven:* W. E. Crittenden
27196	Standard. Russell Miller Milling Co.	*Middlefield:* A. E. Miller
27182	Climax. David Stott, Detroit, Mich.	*So. Manchester:* G. W. Strant
27085	Pennant. " " " "	*Plainville:* F. B. Newton
27086	White. " " " "	*Plainville:* F. B. Newton
27228	White. Thompson Milling Co., Lockport, N. Y.	*Torrington:* D. L. Talcott
27164	Choice. Valley City Mill. Co., Grand Rapids, Mich.	*Putnam:* F. M. Cole
26934	Bigjo. Wabasha Milling Co., Wabasha, Minn.	*Unionville:* F. D. Lawton
27192	Flour. Washburn-Crosby Co., Minneapolis, Minn.	*Suffield:* Spencer Bros.
27049	Standard. Washburn-Crosby Co., Minneapolis, Minn.	*East Haven:* F. A. Forbes
27106	Star. Western Star Mill. Co., Salina, Kan.	*Shelton:* Ansonia Flour & Grain Co.
		Average of these 29 analyses
		Average digestible
	Mixed Feed.	
27091	White Satin. Barber Milling Co., Minneapolis, Minn.	*Bristol:* W. O. Goodsell
27230	Winona. Bay State Mill. Co., Winona, Minn.	*Torrington:* D. L. Talcott
27210	Vermont. Chapin & Co., Milwaukee, Wis.	*Hartford:* G. M. White & Co.
27062	Regent. Chas. M. Cox Co., Boston.	*No. Haven:* Coöperative Feed Co.
27176	" " " " "	*Colchester:* M. Klingon
27056	Boston. Duluth Superior Mill. Co., Duluth, Minn.	*Guilford:* Morse & Landon
27223	Lucky. Federal Milling Co., Lockport, N. Y.	*New Milford:* Geo. E. Ackley Co.
27068	Garland. Garland Milling Co., Greensburgh, Ind.	*Wallingford:* E. E. Hall
27169	H. L. Halliday Mill. Co., Cairo, Ill.	*Willimantic:* E. A. Buck Co.
27094	Manhattan. Hecker-Jones-Jewell Mill. Co., New York	*New Haven:* R. G. Davis
27172	Queen. Hecker-Jones-Jewell Mill. Co., New York	*Willimantic:* H. A. Bugbee
27038	Sunshine. Hunter-Robinson-Wenz Mill. Co., St. Louis	*Hamden:* I. W. Beers
27190	Kehlor's Milling Co., St. Louis	*Hazardville:* A. D. Bridge's Sons
27108	Crescent. Kemper Mill & Elev. Co., Kansas City, Mo.	*Derby:* Peterson-Hendee Co.
27136	Snowflake. Lawrenceburg Roller Mills Co., Lawrenceburg, Ind.	*Bethel:* Johnston & Morrison
27150	Pennant. National Milling Co., Toledo, O.	*Yantic:* A. R. Manning
27224	Perfect. Niagara Falls Milling Co.	*New Milford:* Geo. E. Ackley Co.
27054	" " " "	*Guilford:* G. F. Walter
27133	Fancy. Pillsbury's, Minneapolis, Minn.	*Danbury:* Keeler Grain Co.

SAMPLED IN 1911—*Continued.*

Station No.	Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
	Pounds per Hundred.						
27061	10.32	3.69	16.94	4.68	59.77	4.60	32.00
27187	10.11	4.19	17.81	5.09	58.07	4.73	34.00
27041	8.54	5.53	15.50	9.99	55.28	5.16	32.00
27219	10.76	3.48	17.88	3.17	59.94	4.77	36.00
26936	10.27	4.71	18.88	6.23	54.04	5.87	31.00
27196	10.39	5.05	17.75	7.11	54.12	5.58	31.00
27182	9.90	4.38	17.13	6.04	57.26	5.29	35.00
27085	9.59	4.29	17.69	5.47	57.85	5.11	33.00
27086	10.55	3.14	17.13	3.70	61.22	4.26	35.00
27228	10.31	3.60	15.69	5.28	60.92	4.20	34.00
27164	8.87	3.89	16.31	4.50	61.51	4.92	33.00
26934	9.80	4.64	18.19	7.29	54.19	5.89	33.00
27192	10.12	4.25	17.13	5.96	57.39	5.15	35.00
27049	8.68	4.83	17.00	7.70	56.48	5.31	30.00
27106	10.86	3.34	19.38	3.33	59.21	3.88	34.00
.....	**9.95**	**4.26**	**17.45**	**6.00**	**57.20**	**5.14**	**32.80**
.....	....	....	**13.3**	**1.8**	**44.8**	**4.5**	....
27091	9.60	4.82	16.81	6.52	57.00	5.25	32.00
27230	11.08	4.62	17.19	6.14	56.41	4.56	33.00
27210	9.69	4.82	16.94	6.11	57.70	4.74	33.00
27062	10.29	5.40	16.56	8.23	53.77	5.75	29.00
27176	7.50	4.96	15.31	7.89	59.21	5.13	32.00
27056	9.75	4.92	16.56	8.39	55.10	5.28	31.00
27223	9.65	5.16	17.94	7.04	55.60	4.61	31.00
27068	9.30	5.69	16.44	7.06	57.39	4.12	30.00
27169	7.71	5.12	16.75	6.76	59.38	4.28	32.00
27094	9.00	5.43	16.69	7.61	56.53	4.74	29.00
27172	9.13	5.85	15.88	8.45	55.81	4.88	31.00
27038	7.42	5.78	19.31	7.23	55.60	4.66	30.00
27190	9.63	5.86	16.38	7.09	56.27	4.77	31.00
27108	8.75	5.60	16.31	7.37	57.72	4.25	31.00
27136	9.33	5.86	17.06	6.91	56.24	4.60	32.00
27150	7.03	5.02	16.75	6.28	59.16	5.76	32.00
27224	8.34	5.16	16.69	7.19	57.64	4.98	32.00
27054	9.30	4.81	16.69	7.29	57.12	4.79	33.00
27133	10.06	5.06	17.19	6.26	56.56	4.87	33.00

20

TABLE III.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	WHEAT PRODUCTS.—*Continued.*	
	Mixed Feed.	
27093	Fanchon. Quality Mills, Enterprise, Kas.	*Bristol:* W. O. Goodsell
27096	Occident. Russell Miller Milling Co.	*New Haven:* R. G. Davis
27078	Gold Mine. Sheffield King Mill. Co., Minneapolis, Minn.	*New Britain:* C. W. Lines Co.
27144	Try-Me. Sparks Milling Co., Alton, Ill.	*New London:* P. Schwartz Co.
27179	Wabash. " " " Terre Haute, Ind.	*Stafford Springs:* G. L. Dennis
27213	Monarch. F. W. Stock & Son, Hillsdale, Mich.	*Hartford:* Smith Northam Co.
27084	Honest. David Stott, Detroit, Mich.	*Plainville:* F. B. Newton
26925	Farmers' Favorite Cow. Valley City Mill Co., Grand Rapids, Mich.	*Torrington:* F. U. Wadhams
27229	Waggoner-Gates Mill. Co., Independence, Mo.	*Torrington:* D. L. Talcott
27191	Superior. Washburn-Crosby Co., Minneapolis, Minn.	*Suffield:* Spencer Bros.
		Average of these 29 analyses
		Average digestible
	Red Dog Flour.	
27201	Ben Hur. Hennepin Mill. Co., Minneapolis, Minn.	*Middletown:* Meech & Stoddard
	MAIZE PRODUCTS.	
	Gluten Feed.	
27071	*Bay State. J. E. Soper, Boston	*Meriden:* A. Grulich
		Guaranty
		Digestible
27043	Buffalo. Corn Products Refining Co., New York	*Cheshire:* G. W. Thorpe
27129	" " " " " "	*Springdale:* Monroe & Palmer
		Average guaranty
		Average of these 2 analyses
		Average digestible
27199	Cedar Rapids. Douglas & Co., Cedar Rapids, Iowa	*Middletown:* Meech & Stoddard
		Guaranty
		Digestible
27139	Clinton. Clinton Sugar Refining Co., Clinton, Iowa	*Mystic:* Grain & Feed Co.
		Guaranty
		Digestible
27046	†Cream of Corn. American Maize Products Co., New York	*Plantsville:* C. O. Cowles
27127	†Cream of Corn. American Maize Products Co., New York	*Stamford:* W. L. Crabb
		Average guaranty
		Average of these 2 analyses
		Average digestible
27147	Crescent. Corn Products Refining Co., New York	*New London:* Beebe & Bragaw
26927	Crescent. Corn Products Refining Co., New York	*Torrington:* F. U. Wadhams
		Average guaranty
		Average of these 2 analyses
		Average digestible

* Statement of Dealer. † Labelled "Colored."

SAMPLED IN 1911—*Continued.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
27093	8.58	5.76	19.50	7.22	54.60	4.34	32.00
27096	9.96	4.68	18.94	7.18	53.84	5.40	30.00
27078	9.04	5.10	16.56	7.06	57.64	4.60	32.00
27144	9.57	5.39	17.69	7.30	55.62	4.43	30.00
27179	9.84	7.86	16.75	6.99	53.90	4.66	32.00
27213	9.37	5.34	17.63	7.85	54.21	5.60	34.00
27084	9.28	5.51	16.31	7.05	57.01	4.84	33.00
26925	10.16	5.26	16.13	6.54	57.33	4.58	32.00
27229	8.48	6.21	16.38	6.99	57.21	4.73	31.00
27191	9.80	5.28	16.19	8.09	56.18	4.46	32.00
.....	**9.19**	**5.39**	**16.95**	**7.18**	**56.47**	**4.82**	**31.52**
.....	....	....	**13.2**	**4.5**	**43.5**	**4.2**	....
27201	10.55	2.65	16.44	3.10	63.15	4.11	34.50
27071	5.62	1.13	23.19	6.78	60.25	3.03	30.00
.....	....	....	**23.00**	....	....	**3.00**	....
.....	....	....	**19.7**	**5.9**	**54.2**	**2.5**	....
27043	8.48	4.87	25.94	6.68	51.26	2.77	31.50
27129	9.05	4.83	28.06	6.11	48.44	3.51	33.00
.....	....	....	**23.00**	....	....	**2.50**	....
.....	**8.77**	**4.85**	**27.00**	**6.39**	**49.85**	**3.14**	**32.25**
.....	....	....	**22.9**	**5.6**	**44.9**	**2.5**	....
27199	8.81	1.04	23.25	6.53	57.08	3.29	32.00
.....	....	....	**20.00**	....	....	**3.00**	....
.....	....	....	**19.8**	**5.7**	**51.4**	**2.7**	....
27139	10.01	1.06	25.31	7.35	52.81	3.46	32.00
.....	....	....	**20.00**	....	....	**3.00**	....
.....	....	....	**21.5**	**6.4**	**47.5**	**2.8**	....
27046	7.02	2.99	25.94	6.90	54.67	2.48	32.00
27127	7.75	4.31	25.19	6.20	53.82	2.73	32.00
.....	....	....	**23.00**	....	....	**2.50**	....
.....	**7.38**	**3.65**	**25.57**	**6.55**	**54.24**	**2.61**	**32.00**
.....	....	....	**21.7**	**5.7**	**48.8**	**2.1**	...
27147	8.56	5.03	25.94	7.00	50.98	2.49	33.00
26927	9.28	5.83	27.06	6.28	49.28	2.27	33.00
.....	....	....	**23.00**	....	....	**2.50**	....
.....	**8.92**	**5.43**	**26.50**	**6.64**	**50.13**	**2.38**	**33.00**
.....	....	....	**22.5**	**5.8**	**45.1**	**1.9**	....

TABLE III.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	MAIZE PRODUCTS.—*Continued.*	
	Gluten Feed.	
27058	Globe. Corn Products Refining Co., New York	*Guilford:* Morse & Landon.....
27103	" " " " "	*Ansonia:* Flour & Grain Co.....
		Average guaranty ....
		Average of these 2 analyses .....
		Average digestible ....
	Hominy Feed.	
27142	M. F. Baringer, Philadelphia	*New London:* Arnold Rudd Co.
		Guaranty ....
27126	Buffalo Cereal Co., Buffalo, N. Y.	*Stamford:* W. L. Crabb ....
26932	" " "	*Collinsville:* F. W. Konold .....
		Average guaranty ....
		Average of these 2 analyses .....
27059	Wirthmore. Chas. M. Cox Co., Boston	*No. Haven:* Coöperative Feed Co.
		Guaranty ....
27128	Ideal. Elevator Milling Co., Springfield, Ill. ...	*Springdale:* Monroe & Palmer..
27077	" " " " ...	*Kensington:* S. E. & W. G. Brown
		Average guaranty ....
		Average of these 2 analyses .....
27163	*Chop. R. J. Hardy & Sons, Boston...........	*Danielson:* Young Bros. Co.....
		Guaranty ....
27225	Capital. Hunter-Robinson-Wenz Mill. Co., St. Louis	*Canaan:* Ives & Pierce ....
		Guaranty ....
27137	Steam-cooked. Miner-Hillard Mill. Co., Wilkes-barre, Pa.	*Westerly:* C. W. Campbell .....
27177	Steam-cooked. Miner-Hillard Mill. Co., Wilkes-barre, Pa.	*Colchester:* M. Klingon.........
27040	Steam-cooked. Miner-Hillard Mill. Co., Wilkes-barre, Pa.	*Cheshire:* G. W. Thorpe........
		Average guaranty ....
		Average of these 3 analyses .....
27155	*Patent Cereal Co., Geneva, N. Y.	*Moosup:* T. E. Main & Sons....
27036	" " " "	*Hamden:* I. W. Beers ....
		Average guaranty ....
		Average of these 2 analyses .....
27095	Chop. Wm. H. Payne & Son, New York	*New Haven:* R. G. Davis ......
		Guaranty ....
		Average guaranty of 14 hominy feeds ....
		Average of 14 analyses..........
		Average digestible ....
	Corn Meal.	
27184	Ground by Little & McKinney, Manchester	*Manchester:* ....
		Digestible ....
	Cob Meal.	
27200	A. Waller & Co., Henderson, Ky.	*Middletown:* Meech & Stoddard.
	Maize Red Dog Flour.	
27152	Chas. A. Krause Mill. Co., Milwaukee, Wis. ...	*Norwich:* Chas. Slosberg......
		Guaranty ....

* Statement of dealer.

SAMPLED IN 1911—*Continued.*

Station No.	Pounds per Hundred. Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
27058	8.14	4.07	27.69	6.58	50.82	2.70	30.00
27103	6.53	3.78	27.63	6.57	53.20	2.29	33.00
.....	....	....	23.00	....	....	2.50	...
.....	7.33	3.93	27.66	6.57	52.01	2.50	31.50
.....	....	....	23.5	5.7	46.8	2.0	....
27142	9.20	2.55	10.25	4.14	65.77	8.09	34.00
.....	....	....	9.00	....	....	6.00	....
27126	9.85	2.34	10.56	3.69	66.16	7.40	32.00
26932	10.26	2.39	10.31	3.50	66.21	7.33	32.00
.....	....	....	10.00	....	....	7.00	....
.....	10.05	2.37	10.44	3.59	66.18	7.37	32.00
27059	9.59	2.51	10.63	3.99	66.87	6.41	32.00
.....	....	....	9.50	....	....	7.50	....
27128	9.40	2.34	11.25	3.62	68.44	4.95	35.00
27077	8.28	3.05	11.25	4.40	62.78	10.15	34.00
.....	....	....	11.00	....	....	7.35	....
.....	8.84	2.70	11.25	4.05	65.61	7.55	34.50
27163	8.22	2.78	10.56	4.35	65.65	8.44	32.00
.....	....	....	....	....	....	...	....
27225	7.56	2.44	10.13	4.52	67.94	7.41	35.00
.....	....	....	11.00	....	....	7.00	....
27137	9.23	2.29	10.25	3.40	68.59	6.24	33.00
27177	8.81	2.29	10.75	3.44	68.71	6.00	33.00
27040	7.25	1.90	10.00	2.74	72.51	5.60	32.50
.....	....	....	10.00	....	....	7.50	....
.....	8.43	2.16	10.33	3.19	69.94	5.95	32.83
27155	9.14	2.31	10.69	3.70	66.32	7.84	32.00
27036	8.93	2.29	10.31	3.79	67.12	7.56	32.00
.....	....	....	10.00	....	....	7.00	....
.....	9.04	2.30	10.50	3.74	66.72	7.70	32.00
27095	7.67	2.46	10.81	3.83	67.57	7.66	32.00
.....	....	....	11.00	....	....	8.00	....
.....	....	....	10.19	....	....	7.21	....
.....	8.81	2.43	10.55	3.80	67.19	7.22	32.86
.....	....	....	6.9	2.5	59.8	6.7	....
27184	11.52	1.49	8.88	1.58	72.24	4.29	32.00
.....	....	....	5.9	....	66.5	3.9	....
27200	6.96	1.22	1.88	32.45	57.19	0.30	....
27152	9.04	1.98	9.75	1.94	70.34	6.95	32.00
.....	....	....	8.50	....	....	5.00	....

TABLE III.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	RYE PRODUCTS.	
27050	Middlings. Boutwell Mill. & Grain Co., Troy, N. Y.	*East Haven:* F. A. Forbes
27067	Middlings. Miner-Hillard Mill. Co., Wilkes-barre, Pa.	*Wallingford:* E. E. Hall
27175	Middlings. Washburn-Crosby Co., Minneapolis, Minn.	*Colchester:* M. Klingon
27088	Feed. Osceola Mill & Elev. Co., St. Croix Falls, Wis.	*Plainville:* Eaton Bros.
	BUCKWHEAT PRODUCTS.	
27158	Middlings. Quinebaug Grist Mill, Danielson	*Danielson:*
		Digestible
27170	Middlings. Miner-Hillard Mill. Co., Wilkes-barre, Pa.	*Willimantic:* H. A. Bugbee
		Digestible
	OAT PRODUCTS.	
	Ground Oats.	
27174	Ground by H. A. Bugbee, Willimantic	*Willimantic:*
		Digestible
	OAT HULLS.	
27198	Canadian Cereal & Mill. Co., Toronto, Ont.	*Middletown:* Meech & Stoddard
	BARLEY PRODUCTS.	
	Malt Sprouts.	
27037	American Malting Co., Buffalo, N. Y.	*Hamden:* I. W. Beers
27112	" " " "	*Bridgeport:* Vincent Bros.
27208	" " " "	*Hartford:* L. C. Daniels Grain Co.
		Average guaranty
		Average of these 3 analyses
26937	*P. Ballantine & Sons, Newark, N. J.	*New Haven:* W. E. Crittenden
26928	M. G. Rankin & Co., Milwaukee, Wis.	*New Haven:* J. T. Benham
		Guaranty
		Average of these 5 analyses
		Average digestible
	Dried Brewers' Grains.	
27149	Anheuser-Busch Brew. Asso., St. Louis	*Yantic:* A. R. Manning
		Guaranty
27117	Farmers' Feed Co., New York	*Norwalk:* Holmes, Keeler & Selleck
		Guaranty
27214	Bull Brand. Farmers' Feed Co., New York	*Waterbury:* D.L.Dickinson & Son
		Guaranty
27134	Peerless. Penn. Grain & Feed Co., Philadelphia	*Danbury:* F. C. Benjamin & Co.
		Guaranty
27100	Providence Brewing Co., Providence, R. I.	*New Haven:* R. G. Davis
		Guaranty
27195	Pilsner. Rosekrans-Snyder Co., Philadelphia	*Suffield:* Arthur Sikes
		Guaranty
		Average of these 6 analyses
		Average digestible

* Statement of dealer.

SAMPLED IN 1911—*Continued.*

Station No.	Pounds per Hundred. Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
27050	10.60	3.56	16.38	4.05	62.22	3.19	31.00
27067	11.00	3.14	14.13	3.43	65.26	3.04	29.00
27175	9.09	3.94	17.75	5.03	60.71	3.48	31.00
27088	11.33	3.29	17.19	3.60	61.43	3.16	32.00
27158	10.00	4.68	32.50	7.34	37.00	8.48	32.00
.....	....	....	**27.6**	**1.2**	**30.7**	**7.5**	....
27170	12.06	2.60	23.19	5.17	51.25	5.73	31.00
.....	....	....	**19.7**	**0.9**	**42.5**	**5.1**	....
27174	8.55	3.30	12.94	8.47	61.93	4.81	35.00
.....	....	....	**10.00**	**2.6**	**47.7**	**4.3**	....
27198	5.97	6.53	6.75	24.53	53.09	3.13	....
27037	7.58	6.15	25.88	14.36	44.79	1.24	25.00
27112	8.66	5.85	26.06	11.61	46.13	1.69	25.00
27208	6.41	5.58	26.31	12.89	47.48	1.33	29.00
.....	....	....	**23.67**	....	....	**1.33**	....
.....	**7.55**	**5.86**	**26.09**	**12.95**	**46.13**	**1.42**	**26.33**
26937	8.02	6.17	28.75	9.73	45.96	1.37	27.00
26928	9.33	5.44	25.25	11.23	47.28	1.47	27.00
.....	....	....	**25.00**	....	....	**1.50**	....
.....	**8.00**	**5.84**	**26.45**	**11.96**	**46.33**	**1.42**	**26.60**
.....	....	....	**21.2**	**4.1**	**32.0**	**1.4**	....
27149	7.30	3.64	28.94	13.70	39.35	7.07	30.00
.....	....	....	**24.00**	....	....	**7.00**	....
27117	7.07	2.85	29.19	12.40	40.69	7.80	30.00
.....	....	....	**27.00**	....	....	**6.00**	....
27214	5.89	2.99	30.06	12.23	41.11	7.72	30.00
.....	....	....	**22.00**	....	....	**6.00**	....
27134	8.46	3.15	31.06	11 90	37.75	7.68	27.00
.....	....	....	**23.00**	....	....	**4.00**	....
27100	7.51	3.23	30.06	12.93	39.82	6.45	26.00
.....	....	....	**22.00**	....	....	**5.00**	....
27195	6.53	3.12	29.69	13.30	40.57	6.79	30.00
.....	....	....	**25.00**	....	....	**5.00**	....
.....	**7.13**	**3.16**	**29.84**	**12.74**	**39.88**	**7.25**	**28.83**
.....	....	....	**24.2**	**6.2**	**22.7**	**6.5**	....

Table III.—Analyses of Commercial Feeds

Station No.	Brand.	Retail Dealer.
	Barley Products.—*Continued.*	
	Dried Distillers' Grains.	
27113	Ajax Flakes. Ajax Mill. & Feed Co., Buffalo..	*Bridgeport:* Vincent Bros......
		Guaranty ....
		Digestible ....
27227	Rye. The J. W. Biles Co., Cincinnati, O.......	*Winsted:* E. Manchester & Sons
		Guaranty ....
		Digestible ....
27189	Continental Gluten Feed. Continental Cereal Co., Peoria, Ill............................	*Hazardville:* A. D. Bridge's Sons
		Guaranty ....
	Miscellaneous Feeds.	
	Dried Beet Pulp.	
26926	Michigan Sugar Co., Alma, Mich...............	*Torrington:* F. U. Wadhams....
		Guaranty ....
27035	Owosso Sugar Co., Owosso, Mich.	*Hamden:* I. W. Beers ....
26930	" " " " "	*Granby:* N. J. Trench ....
		Average guaranty ....
		Average of these 3 analyses . ...
		Average digestible ....
	Dried Molasses Beet Pulp.	
26924	Michigan Sugar Co., Saginaw, Mich.	*Torrington:* F. U. Wadhams ...
		Guaranty ....
	Alfalfa Meal.	
27181	Albert Dickinson Co., Chicago	*Rockville:* Edward White.......
		Guaranty ....
	Mixed Feeds.	
	Corn and Oats Feeds and Chop Feeds.	
27188	Provender. Ground by A. D. Bridge's Sons, Hazardville.............................	*Hazardville:* ....
27069	Bufceco Stock Feed. Buffalo Cereal Co., Buffalo, N. Y.	*Meriden:* A. Grulich ....
		Guaranty ....
27105	Chop Feed. Buffalo Cereal Co., Buffalo, N. Y.	*Shelton:* Ansonia Flour & Grain Co. ....
		Guaranty ....
27153	Stock Feed. W. H. Haskell & Co., Toledo, O.	*Norwich:* Chas. Slosberg.......
		Guaranty ....
27162	Purity Special Stock Feed. The Wm. S. Hills Co., Boston	*Danielson:* Young Bros. Co. ...
		Guaranty ....
27082	De-Fi Feed. The H. O. Co., Buffalo, N. Y.....	*New Britain:* C. W. Lines Co. .
		Guaranty ....
27087	New England Stock Feed. The H. O. Co., Buffalo, N. Y.	*Plainville:* F. B. Newton.......
		Guaranty ....
27064	Monarch Chop Feed. Husted Milling Co., Buffalo, N. Y.	*Wallingford:* Gallagher Bros. ..
		Guaranty ....
27203	Steam Cooked Feed. Imperial Grain & Mill. Co., Toledo, O.	*Middletown:* Meech & Stoddard
		Guaranty ....
27206	Korn-Oato Feed. Meech & Stoddard, Middletown....................................	*Middletown:* Meech & Stoddard
		Guaranty ....
26935	Boss Feed. Quaker Oats Co., Chicago	*New Haven:* W. E. Crittenden .
		Guaranty ....

SAMPLED IN 1911—*Continued.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
27113	6.62	5.13	29.19	8.98	38.56	11.52	33.00
.....	....	....	30.00	....	....	11.00	....
.....	....	....	21.3	8.5	31.2	10.9	....
27227	6.31	1.23	15.69	13.61	55.20	7.96	25.00
.....	....	....	16.00	....	....	5.00	....
.....	....	....	11.5	12.9	44.7	7.6	....
27189	5.78	4.29	29.25	7.49	39.59	13.60	34.00
.....	....	....	31.00	....	....	13.50	....
.....	....	....	21.4	7.1	32.1	12.9	....
26926	7.39	3.94	9.31	18.67	60.22	0.47	29.00
.....	....	....	8.00	....	....	0.40	....
27035	5.40	3.45	9.63	18.89	62.03	0.60	27.00
26930	7.27	3.37	8.31	18.80	61.75	0.50	28.00
.....	....	....	8.00	....	....	0.50	....
.....	6.69	3.59	9.08	18.79	61.33	0.52	28.00
.....	....	....	5.8	15.8	55.8	....	....
26924	8.40	4.06	8.88	17.74	60.39	0.53	29.00
.....	....	....	9.00	....	....	0.50	....
27181	8.24	10.83	15.19	26.55	37.57	1.62	35.00
.....	....	....	12.00	....	....	1.00	....
27188	11.56	1.75	9.56	3.63	69.23	4.27	37.00
27069	9.20	2.60	9.19	7.90	65.81	5.30	32.00
.....	....	....	8.00	....	....	4.00	....
27105	8.51	3.52	8.25	12.03	63.94	3.75	29.00
.....	....	....	7.00	....	....	3.00	....
27153	6.44	2.71	9.50	6.11	69.20	6.04	32.00
.....	....	....	8.00	....	....	4.00	....
27162	7.59	2.73	9.69	7.20	68.84	3.95	30.00
.....	....	....	10.00	....	....	3.25	....
27082	7.37	4.96	8.31	14.81	61.25	3.30	28.00
.....	....	....	8.00	....	....	3.00	....
27087	7.79	4.50	8.88	10.17	64.63	4.03	31.00
.....	....	....	9.00	....	....	4.00	....
27064	9.00	4.17	9.75	7.14	64.02	5.92	30.00
.....	....	....	7.50	....	....	3.50	....
27203	9.17	1.76	9.81	2.74	72.08	4.44	38.00
.....	....	....	8.50	....	....	4.00	....
27206	10.75	3.07	8.44	9.50	64.52	3.72	31.00
.....	....	....	7.00	....	....	3.00	....
26935	9.10	3.28	8.94	8.99	65.67	4.02	31.00
.....	....	....	8.00	....	....	3.00	....

TABLE III.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	MIXED FEEDS.—*Continued.*	
	Corn and Oats Feeds and Chop Feeds.	
27145	Victor Feed. Quaker Oats Co., Chicago	*New London:* P. Schwartz Co.
		Guaranty
27109	White Diamond Feed. Quaker Oats Co., Chicago	*Milford:* E. L. Oviatt
		Guaranty
27083	Winner Chop Feed. David Stott, Detroit, Mich.	*Plainville:* F. B. Newton
		Guaranty
	Wheat and Corn.	
27215	*Colonial Middlings, Hilliard Mill Co., Wilkes-barre, Pa.	*Waterbury:* D. L. Dickinson & Son
		Guaranty
	Wheat and Corn Cob Feeds.	
27157	Sterling Mixed Feed, Indiana Mill. Co., Terre Haute, Ind.	*Danielson:* Quinebaug Grist Mill
27098	Kennebec Feed. J. E. Soper Co., Boston	*New Haven:* R. G. Davis
27070	Blue Grass Mixed Feed. A. Waller & Co., Henderson, Ky.	*Meriden:* A. Grulich
		Guaranty of above feeds
		Average of these 3 analyses
		Average digestible
	Proprietary Horse Feeds.	
27074	Horse Feed. Buffalo Cereal Co., Buffalo, N. Y.	*Meriden:* Grain & Feed Co.
		Guaranty
27122	Bonnie Horse Feed. Manuel T. Hatch, So. Norwalk	*So. Norwalk:* Manuel T. Hatch.
		Guaranty
27079	Algrane Horse Feed. The H. O. Co., Buffalo, N. Y.	*New Britain:* C. W. Lines Co.
		Guaranty
27102	Steam Cooked Feed. Husted Mill. Co., Buffalo, N. Y.	*New Haven:* R. G. Davis
		Guaranty
27143	Purina Feed. Ralston Purina Co., St. Louis	*New London:* Arnold Rudd Co.
		Guaranty
26929	Schumacher's Special Horse Feed. Quaker Oats Co., Chicago	*Granby:* N. J. Trench
		Guaranty
27111	V-B Horse Feed. Vincent Bros., Bridgeport	*Bridgeport:* Vincent Bros.
		Guaranty
	Proprietary Dairy and Stock Feeds.	
27218	Sucrene Dairy Feed. American Milling Co., Chicago	*Thomaston:* L. E. Blackmer
		Guaranty
27138	Union Grains, Ready Ration. The J. W. Biles Co., Cincinnati, O.	*Westerly:* C. W. Campbell
		Guaranty
27066	Calf Meal. Blatchford's Calf Meal Factory, Waukegan, Ill.	*Wallingford:* E. E. Hall
		Guaranty
27042	Unicorn Dairy Ration. Chapin & Co., Milwaukee, Wis.	*Cheshire:* G. W. Thorpe
27220	Unicorn Dairy Ration. Chapin & Co., Milwaukee, Wis.	*New Milford:* G. T. Soule
		Guaranty
		Average of these 2 analyses
27048	Wirthmore Balanced Ration Feed. Chas. M. Cox Co., Boston	*East Haven:* F. A. Forbes
		Guaranty
27146	Wirthmore Stock Feed. Chas. M. Cox Co., Boston	*New London:* Beebe & Bragaw
		Guaranty

* See page 227.

SAMPLED IN 1911—*Continued.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
27145	9.33	3.44	8.19	10.48	65.84	2.72	28.00
.....	....	....	7.00	....	....	3.00	....
27109	9.52	2.67	8.63	7.38	68.46	3.34	31.00
....	....	....	8.00	....	....	3.25	....
27083	8.15	3.12	9.06	8.30	65.53	5.84	32.00
.....	....	....	8.00	....	....	4.00	....
27215	10.45	3.02	13.44	3.83	64.89	4.37	34.00
.....	....	....	12.00	....	....	5.00	....
27157	7.39	3.91	10.06	14.49	60.70	3.45	28.00
27098	9.25	3.55	9.75	14.42	59.80	3.23	26.00
27070	8.48	3.71	9.81	15.02	60.22	2.76	27.00
.....	....	....	9.00	....	....	2.00	....
.....	**8.37**	**3.72**	**9.88**	**14.64**	**60.24**	**3.15**	**27.00**
.....	....	....	6.2	4.1	42.8	2.9	....
27074	6.74	3.08	11.88	8.31	65.53	4.46	32.00
.....	....	....	10.00	....	....	4.00	....
27122	9.25	3.12	12.69	7.11	62.99	4.84	34.00
.....	....	....	14.00	....	....	4.00	....
27079	8.25	3.50	10.13	9.39	65.17	3.56	32.00
.....	....	....	11.00	....	....	4.00	....
27102	9.37	2.07	10.63	4.29	69.12	4.52	36.00
.....	....	....	9.00	....	....	4.00	....
27143	9.70	4.86	13.56	10.11	57.71	4.06	30.00
.....	....	....	12.50	....	....	4.00	....
26929	9.10	3.18	9.44	7.16	67.49	3.63	33.00
.....	....	....	9.26	....	....	3.25	....
27111	8.26	3.30	10.63	9.61	63.63	4.57	30.00
.....	....	....	9.00	....	....	3.00	....
27218	9.92	8.29	16.50	12.41	48.96	3.92	28.00
.....	....	....	16.50	....	....	3.50	....
27138	7.52	5.41	24.31	8.50	46.41	7.85	33.00
.....	....	....	24.00	....	....	7.00	....
27066	9.08	5.05	24.25	5.47	50.70	5.45	70.00
.....	....	....	25.00	....	....	5.00	....
27042	6.60	3.28	30.94	7.81	45.88	5.49	33.00
27220	7.48	3.69	25.63	9.39	46.99	6.82	33.00
.....	....	....	26.00	....	....	5.50	....
.....	**7.04**	**3.48**	**28.29**	**8.60**	**46.43**	**6.16**	**33.00**
27048	7.38	4.84	26.44	9.58	47.02	4.74	32.00
.....	....	....	26.00	....	....	5.00	....
27146	8.03	3.36	10.19	7.00	63.97	7.45	33.00
.....	....	....	9.00	....	....	4.00	....

TABLE III.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	MIXED FEEDS.—*Concluded.* *Proprietary Dairy and Stock Feeds.*	
27212	White Cross Stock Feed. Albert Dickinson Co., Chicago	*Hartford:* Smith Northam Co. Guaranty
27185	Daisy Dairy Feed. Great Western Cereal Co., Chicago	*Manchester:* G. W. Kuhney Guaranty
27063	Husted Molasses Feed. Husted Mill. Co., Buffalo, N. Y.	*Wallingford:* Gallagher Bros. Guaranty
27165	Blue Ribbon Dairy Feed. Quaker Oats Co., Chicago	*Putnam:* F. M. Cole Guaranty
27034	Quaker Dairy Molasses Feed. Quaker Oats Co., Chicago	*Hamden:* I. W. Beers Guaranty
27073	Schumacher's Calf Meal. Quaker Oats Co., Chicago	*Meriden:* A. Grulich Guaranty
27072	Schumacher's Stock Feed. Quaker Oats Co., Chicago	*Meriden:* A. Grulich Guaranty
27140	Protena Dairy Feed. Ralston Purina Co., St. Louis	*Mystic:* Grain & Feed Co. Guaranty
27231	V-B Dairy Feed. Vincent Bros., Bridgeport	*Torrington:* F. U. Wadhams Guaranty
	Proprietary Poultry Feeds.	
27207	Poultry Feed. Buffalo Cereal Co., Buffalo, N. Y.	*New Britain:* Stanley-Svea Grain Co. Guaranty
27193	Wirthmore Poultry Mash. Chas. M. Cox Co., Boston	*Suffield:* Arthur Sikes Guaranty
27130	Perfection Mash Mixture. Eaton Grain & Feed Co., Norwich, N. Y.	*Ridgefield:* S. D. Keeler Guaranty
27121	Bonnie Dry Mash. Manuel T. Hatch, So. Norwalk	*So. Norwalk:* M. T. Hatch
27159	Purity Poultry Mash. Wm. S. Hills Co., Boston	*Danielson:* Young Bros. Co.
27075	Poultry Feed. The H. O. Co., Buffalo, N. Y.	*Meriden:* Grain & Feed Co. Guaranty
27114	Laying Mash. Husted Milling Co., Buffalo, N. Y.	*Bridgeport:* Standard Feed Co. Guaranty
27116	Dry Mash Feed. Park & Pollard Co., Boston	*Bridgeport:* Standard Feed Co. Guaranty
27115	Growing Feed. " " "	*Bridgeport:* Standard Feed Co. Guaranty
27119	Fattening Feed. " " "	*Norwalk:* Holmes, Keeler & Selleck Guaranty
27141	Chicken Chowder Feed. Purina Mills, St. Louis	*Mystic:* Grain and Feed Co. Guaranty
27183	American Poultry Feed. Quaker Oats Co., Chicago	*So. Manchester:* G. W. Strant Guaranty
27124	V-B Mash for Laying Hens. Vincent Bros., Bridgeport	*Greenwich:* J. P. Johnson Guaranty
	Beef Scrap.	
27110	C. M. Shay, Groton	*Bridgeport:* Vincent Bros.

SAMPLED IN 1911—*Concluded.*

Station No.	Pounds per Hundred. Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
27212	9.90	3.22	10.31	4.01	67.86	4.70	36.00
.....	....	....	**10.00**	....	....	**3.50**	....
27185	7.81	8.11	17.56	12.15	52.28	2.09	30.00
.....	....	....	**15.00**	....	....	**3.00**	....
27063	10.33	6.74	22.25	8.24	47.95	4.49	31.00
.....	....	....	**18.00**	....	....	**4.00**	....
27165	7.13	6.92	24.13	11.00	47.34	3.48	32.00
.....	....	....	**25.00**	....	....	**4.50**	....
27034	7.86	7.56	14.69	15.25	50.64	4.00	27.00
.....	....	....	**16.00**	....	....	**3.50**	....
27073	8.32	3.92	17.88	1.58	61.06	7.24	65.00
.....	....	....	**19.00**	....	....	**8.00**	....
27072	7.63	3.75	10.31	9.92	64.39	4.00	32.00
.....	....	....	**10.00**	....	....	**3.25**	....
27140	8.40	6.53	20.94	13.64	45.61	4.88	32.00
.....	....	....	**20.00**	....	....	**3.00**	....
27231	8.32	3.20	17.75	8.92	57.00	4.81	34.00
.....	....	....	**22.00**	....	....	**4.00**	....
27207	9.16	3.24	16.50	4.89	61.01	5.20	40.00
.....	....	....	**15.00**	....	....	**4.00**	....
27193	9.90	3.34	12.31	6.31	64.45	3.69	40.00
.....	....	....	**12.00**	....	....	**3.00**	....
27130	6.34	23.32	18.13	7.65	39.96	4.60	45.00
.....	....	....	**20.00**	....	....	**4.00**	....
27121	9.72	5.60	16.06	7.15	57.01	4.46	38.00
27159	9.03	8.57	18.63	6.09	51.90	5.78	38.00
27075	8.10	3.17	18.19	6.30	58.80	5.44	40.00
.....	....	....	**17.00**	....	....	**5.50**	....
27114	9.19	3.70	17.88	4.89	59.34	5.00	40.00
.....	....	....	**15.00**	....	....	**3.00**	....
27116	9.60	8.81	16.25	7.00	55.02	3.32	47.00
.....	....	....	**20.00**	....	....	**3.00**	....
27115	10.48	8.97	16.19	2.71	58.13	3.52	47.00
.....	....	....	**10.00**	....	....	**3.00**	....
27119	8.58	4.54	10.56	8.72	63.08	4.52	45.00
.....	....	....	**10.00**	....	....	**3.00**	....
27141	10.26	7.06	17.06	7.16	55.07	3.39	45.00
.....	....	....	**16.00**	....	....	**2.00**	....
27183	10.81	2.71	12.63	3.76	66.36	3.73	37.00
.....	....	....	**12.00**	....	....	**3.50**	....
27124	8.92	8.30	21.19	8.59	48.11	4.89	45.00
.....	....	....	**21.00**	....	....	**4.00**	....
27110	6.46	35.64	36.31	....	.....	17.26	50.00

	First Cutting.	Second Cutting.	Third Cutting.	Total.
Nitrogen	133	30	54	217
Phosphoric Acid	33	7	11	51
Potash	83	25	56	164

The analysis of each crop is given below and also the average composition of the three cuttings together:

	First Cutting.	Second Cutting.	Third Cutting.	Average of the three.
Water	11.40	34.00	33.04	20.75
Ash	7.55	7.00	6.54	7.19
Protein	15.00	11.46	14.01	14.13
Fiber	27.66	19.48	17.26	23.65
Nitrogen-free Extract	36.48	26.57	27.64	32.54
Fat	1.91	1.49	1.51	1.74
	100.00	100.00	100.00	100.00
Calculated Water-Free:				
Ash	8.52	10.59	9.77	9.04
Protein	16.93	17.39	20.92	17.81
Fiber	31.22	29.51	25.78	29.85
Nitrogen-free Extract	41.17	40.26	41.27	41.10
Fat	2.16	2.25	2.26	2.20
	100.00	100.00	100.00	100.00

Four samples of soil were drawn in different places on this acre field and as many from an acre strip adjoining which had received the same tillage and treatment until 1910 when it was cultivated and in 1911 was planted to potatoes with commercial fertilizers. The percentage of moisture and nitrogen in the two soils on November 5 after abundant fall rains were:

	Under Alfalfa.	Under Potatoes.
Moisture in six inches surface soil	20.49	18.06
" " next six inches of soil	18.72	15.94
Nitrogen in surface soil	0.251	0.251
" " subsoil	0.125	0.088

It is hoped that these same data may be gathered yearly from this land. Facts for a single year are of course not very conclusive. The following things are worth noting:

The acre produced 4.8 tons of hay in one year.

The first cutting yielded more than the two later cuttings together.

The first cutting was very dry; the second and third, as the analyses show, were too moist to put in the barn. They were stacked in the yard and there was some slight loss from moulding.

The three cuttings have somewhat different composition: the first, being probably somewhat more mature, has, in the water-free substance, a somewhat lower percentage of protein and higher percentage of fiber than the later cuttings.

The following statement compares the amount and character of feed and also the quantities of nitrogen, phosphoric acid and potash in this crop of alfalfa, with the average amounts in three tons of mixed meadow hay or three tons of red clover; yields which would be considered large for the summer of 1911. The figures represent pounds per acre.

	Alfalfa.	3 tons Meadow Hay.	3 tons Red Clover.
Ash	692	318	570
Protein	1320	474	906
Fiber	2276	1668	1446
Nitrogen-free Extract	3133	2568	2076
Fat	167	132	102
Nitrogen	217	80	133
Phosphoric Acid	51	19	28
Potash	164	97	145

Alfalfa yielded considerably more of every feed ingredient (400 more pounds of protein) than a good clover crop and vastly more than meadow hay.

The merits and the defects of alfalfa and the methods of getting it established on farms have been discussed many times by the writer in farmers' meetings and in print. It is not our purpose to further discuss those matters here but only to give some definite figures regarding the yield of the crop.

Two other samples of alfalfa hay have been analyzed; **27005** is the first cutting on the Station's Centerville field, **27023** is the fourth cutting from one of Mr. C. M. Jarvis' large fields. The figures are as follows:

	27005 As harvested.	27005 Water-free.	27023 As harvested.	27023 Water-free.
Water	11.12	.....	29.82	.....
Ash	8.53	9.60	6.59	9.39
Protein	17.31	19.48	16.80	23.94
Fiber	22.86	25.72	15.81	22.53
Nitrogen-free Extract	37.93	42.67	29.41	41.90
Fat	2.25	2.53	1.57	2.24
	100.00	100.00	100.00	100.00

A sample of alfalfa meal, 25956, bought by C. M. Jarvis, contained 14.50 per cent. protein.

Bean Pods and Straw.

26030 and **26031**. The sample was sent by Fred. Lyman of Manchester, who states that it represents a car lot from a New York State shipper, who "claimed a large per cent. of protein." The cost is $13.50 per ton delivered. He reports that cows eat the pods ravenously but discard the straw.

The sample was carefully divided by us into pods and fine leaves, which make up 56 per cent. of weight of the sample, and stems, 44 per cent. Their composition is as follows:

	Pods and Leaves.	Stems.	Composition of the Whole.	Average Clover hay.
Water	5.98	4.65	5.40	15.0
Ash	8.82	5.52	7.36	7.6
Protein	5.88	6.25	6.04	13.2
Fiber	26.39	44.47	34.35	24.2
Nitrogen-free Extract	51.97	38.44	46.03	37.4
Fat	0.96	0.67	0.82	2.6
	100.00	100.00	100.00	100.0

Good clover hay Mr. Lyman can buy for $17.00. Obviously there can be no profit in paying $13.50 for bean pods and straw.

Amount of Water in the Corn Crop at Harvest.

A sample of ears of corn from L. S. White, Collinsville, 27239, was from a crop of 8435 lbs. of ears from a measured acre, of which 6690.64 lbs. was shelled corn and 1744.36 lbs. was cob. The shelled corn contained 27.9 per cent. of water and the cob 43.93 per cent.

The stover from this crop contained at harvest 56.87 per cent. of water.

PART IV.

ELEVENTH REPORT

OF THE

STATE ENTOMOLOGIST OF CONNECTICUT

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

I transmit herewith my eleventh annual report as State Entomologist of Connecticut.

As is the custom, the financial statement covers the state fiscal year, but otherwise the report covers the calendar year of 1911.

Respectfully submitted,

W. E. BRITTON,
State Entomologist.

REPORT OF THE RECEIPTS AND EXPENDITURES OF THE STATE ENTOMOLOGIST FROM OCTOBER 1ST, 1910, TO SEPTEMBER 30TH, 1911.

Insect Pest Account.

RECEIPTS.

From E. H. Jenkins, Treasurer	$3,000.00
Account of 1910, balance	1,091.96
Sale of electrotypes	1.79
	$4,093.75

EXPENDITURES.

For Field, office and laboratory assistance:		
B. H. Walden, salary	$1,080.00	
A. B. Champlain, salary	930.00	
D. J. Caffrey, salary	180.82	
E. B. Whittlesey, salary	364.00	
Other assistance	94.15	
		$2,648.97

Printing and Illustrations	$ 87.65	
Postage	62.73	
Stationery	14.03	
Telegraph and telephone	1.25	
Express, freight and cartage	11.08	
Library	109.15	
Laboratory apparatus and supplies	78.62	
Office supplies	46.75	
Traveling expenses	267.53	
Balance, cash on hand	765.99	
		$4,093.75

Gypsy Moth Control Account.

RECEIPTS.

From E. H. Jenkins, Treasurer	$4,000.00
Account of 1910, balance	17.95
	$4,017.95

EXPENDITURES.

For Salary, labor, board of scouts, etc.:			
D. J. Caffrey, salary	$ 749.18		
Labor, board of scouts, etc.	2,320.05		
		$3,069.23	
Printing and illustrations		257.96	
Tools and supplies		207.34	
Telegraph and telephone		1.68	
Express, freight and cartage		16.94	
Rental of storehouse		28.50	
Traveling expenses		267.33	
Balance, cash on hand		168.97	
			$4,017.95

Memorandum:—This account of the State Entomologist has been duly audited by the State Auditors of Public Accounts.

DEPARTMENT PUBLICATIONS.

By W. E. BRITTON.

Tenth Report of the State Entomologist (Part IX of the Station Report for 1909-10); 56 pages, 14 text figures, 8 plates; 9000 copies distributed in March, 1911.

Report of Committee on Injurious Insects; Proceedings Connecticut Pomological Society, 1911, p. 27. 4 pages.

The Leopard Moth as a Pest of Apple Nursery Stock; *Journal of Economic Entomology,* Vol. IV. p. 298, June, 1911. 1 page, 1 plate.

A Hemipterous Fisherman; *Entomological News,* Vol. XXII. p. 372, October, 1911. 1 page.

The Pyralid, *Omphalocera dentosa* Grote, a Pest of Barberry Hedges; *Journal of Economic Entomology,* Vol. IV. p. 521, December, 1911. 4 pages, 1 plate.

Vacation Notes in the Adirondacks; *Journal of Economic Entomology,* Vol. IV. p. 544, December, 1911. 2 pages.

How to Get Rid of Ants; Special Bulletin, September, 1911. 1 page. 1000 copies.

How to Get Rid of Flies; Special Bulletin, September, 1911; 2 pages. 1000 copies.

The Brown-Tail Moth; Special Bulletin. Colored placard showing and describing brown-tail moth and its injury. 3000 copies. September, 1911.

By W. E. Britton and B. H. Walden.

Guide to the Insects of Connecticut; Bulletin 16, State Geological and Natural History Survey. Hartford, 1911.

Part I. General Introduction. 38 pages, 3 figures, 5 plates. By W. E. Britton.

Part II. The Euplexoptera and Orthoptera of Connecticut. 129 pages, 63 figures, 6 plates. By B. H. Walden.

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

Tests of Summer Sprays on Apples and Peaches (Part VII. of Station Report of 1909-10). 35 pages, 8 plates. February, 1911. 9000 copies.

Tests of Summer Sprays on Apples and Peaches in 1910; Connecticut Farmer, Jan. 28, 1911. 1 page.

By W. E. Britton and G. A. Cromie.

The Leopard Moth; Bulletin 169 of this Station. December 1911. 24 pages, 6 figures, 8 plates. 3000 copies.

By B. H. Walden.

The Locust Borer; *Connecticut Farmer,* July 15, 1911.

By A. B. Champlain.

Some Carabidæ Taken in Connecticut; *Psyche,* Vol. XVIII. p. 35, February, 1911. 2 pages.

Notes on Coleoptera from Connecticut; *Psyche,* Vol. XVIII. p. 170, October, 1911. 4 pages.

Personnel of Department Staff.

W. E. Britton, Ph.D.	*State and Station Entomologist.*
B. H. Walden, B.Agr.	*Assistant.*
Donald J. Caffrey, B.S.	*Assistant.*
Alfred B. Champlain*	*Assistant.*
Miss E. B. Whittlesey	*Stenographer.*

Mr. B. H. Walden, who has been in the department since March, 1902, has continued as general assistant and has been in charge of all work during my absence. Mr. D. J. Caffrey has remained in charge of all gypsy and brown-tail moth field work,

* Resigned September 30th.

and has also aided in the inspection of nurseries, this work coming at a time when he was not needed on the gypsy moth work just mentioned. Mr. Alfred B. Champlain, who began as assistant April 1st, 1910, resigned, to take effect September 30, 1911, to accept a new position in the Division of Economic Zoology, Harrisburg, Pa. His place has not yet been filled, but it will be necessary to obtain someone for it before the opening of next season. Mr. J. K. Lewis, a student of the Massachusetts Agricultural College, was employed from the latter part of February until September 9th, to help inspect imported stock and in the gypsy moth work at Wallingford. Local help was chiefly employed in the gypsy moth field work at both Wallingford and Stonington.

A. W. Yates of Hartford and H. W. Coley of Westport have also continued as apiary inspectors, being paid by the day.

Miss E. B. Whittlesey has continued as stenographer, working half of each day in this department. During her vacation the letters were written by Miss Ruth I. Meeker.

All of the persons mentioned have been faithful and efficient, and the success of the work is in large measure due to them.

Chief Lines of Work.

The activities of the department for the season have been directed along the lines required by law in regard to suppressing the gypsy moth at Stonington and Wallingford, and the brown-tail moth in Windham County; the inspection of apiaries and of growing nursery stock, and of orchards on request. All imported stock that can be classed as hardy trees and shrubs that could be found has been examined for pests. This work is not required by law, and there is no provision for it, but on account of the brown-tail nests found on such stock brought in from France during 1909 and 1910, it seemed necessary to continue the inspection for the protection of the state.

Much time and effort were expended in the summer spraying work in coöperation with the botanical department. This work was carried on in eleven different orchards, and about 688 apple and 231 peach trees were sprayed with various substances, mostly commercial and home-made preparations of lime and sulphur, and including several other preparations, to note the effect upon insect troubles and plant diseases, as well as upon the foliage. In gathering data to show the results of these experiments, it was necessary to count and score 93,000 apples and 24,000 peaches. A full account of these tests will be published as Part V of this report.

Several minor experiments and studies have been carried on during the year, namely: trials of various substances applied to young pine trees to prevent damage by the weevil, *Pissodes strobi* Peck; life history studies on *Omphalocera dentosa* Gr., a moth whose larva is a pest of barberry hedges, the result of which has been published in an article in the Journal of Economic Entomology for December, 1911, page 521; a sawfly damaging a blackberry plantation near New Haven; the leopard moth and its injuries to shade trees, Bulletin 169 (also contained in this report), by W. E. Britton and G. A. Cromie, superintendent of trees in the city of New Haven.

Mr. Champlain reared four hymenopterous parasites of the genus *Pezomachus* from spiders' eggs found under stones, etc., and an undescribed Buprestid beetle of the genus *Agrilus* from galls on hop hornbeam.

In response to a request sent to this office, Mr. Walden, during his vacation in August, examined a large salt marsh area in Eastern Massachusetts, and recommended treatment to rid the locality of mosquitoes. Mr. Walden has in several cases given advice regarding, and occasionally personal supervision of, fumigation to destroy insect pests in dwellings and storehouses.

Thirty-eight orchards, gardens and greenhouses have been examined during the year and advice given regarding treatment.

The collection has been materially increased during the year by the work of members of the department staff.

The manuscript of a check-list of the insects of Connecticut, consisting of over 400 typewritten pages, prepared by W. E. Britton, has been finished and awaits publication as a bulletin of the State Geological and Natural History Survey.

Considerable time has been given to work of an educational nature, such as institute talks and exhibits at fairs.

On the station farm at Mount Carmel, purchased a year ago, about four acres were planted last spring to apples and peaches for experimental purposes, and this orchard will be used jointly by the entomological and botanical departments for testing various sprays and other kinds of treatment for insect and fungous troubles.

SUMMARY OF INSPECTION AND OFFICE WORK FOR 1911.

289 samples of insects received for identification.
54 nurseries inspected.
51 regular certificates granted.
5 parcel certificates granted.
38 orchards and gardens examined for insects.
854 boxes and packages imported nursery stock examined.
162 apiaries containing 1571 colonies inspected.
84 apiaries containing 431 colonies found infested with European foul brood and treated.
2672 letters written on official work.
66 mail and express packages sent out.
14 addresses made before granges, farm institutes and civic organizations.

EXHIBITS.

The entomological department furnished a part of the general exhibit made by the station at six agricultural fairs in September and October and also a two days' exhibit on the station grounds, October 27th and 28th. The places and dates of the exhibits were as follows:

Connecticut Fair, Hartford,	Sept. 4- 9
Norfolk Agricultural Association, Norfolk,	Sept. 14-15
Windham County, Brooklyn,	Sept. 19-21
State Fair, Berlin,	Sept. 25-30
Danbury Fair, Danbury,	Oct. 2- 7
Stafford Fair, Stafford Springs,	Oct. 10-12
Station Grounds, New Haven,	Oct. 27-28

About 1500 square feet of table space was covered by the exhibit of the entomological department, besides numerous photographs and charts hung on the walls and over the center table. Additional space was occupied at the exhibit on the station grounds, because the exhibit of another department had to be shown at Boston at the same time, and the entomological department supplied material to fill a portion of the vacant space.

The appearance of a part of the entomological exhibit is shown on Plate I. Its chief features were special exhibits of the gypsy moth and measures for controlling the pest; the brown-tail moth; foul brood disease of bees; the leopard moth; the seventeen-year locust and its distribution in Connecticut in 1911; malarial and non-malarial mosquito wrigglers; twenty or more species of living caterpillars; cases illustrating garden insects, forest insects, shade tree insects, fruit insects; a large display of the more striking and common insects of Connecticut in all orders; many life-history sets of injurious species in Riker mounts; plaster casts of fruit, and fresh fruit attacked and injured by insects and fruit kept perfect by spraying; insecticides and spraying apparatus. All objects, cases and special exhibits were explained by uniform printed labels.

To keep labels in their proper place, supply fresh food for caterpillars, answer questions and explain the exhibits and methods of control, required the constant presence of one or more entomologists, and the preparation of the material took far more time and attention than the exhibition of it.

ENTOMOLOGICAL FEATURES OF 1911.

The weather conditions must be considered as bearing some relation to the scarcity or abundance of insect life. The season of 1911 was characterized by one of the most severe droughts ever known, and many plants, even orchards and woodland trees, were injured in various places by it, and the yield of field crops greatly diminished. Specimens of leaf scorch were sent to the station from all parts of the state. Many injurious insects, especially grasshoppers, white grubs and aphids, cause more damage in dry seasons, due in part, no doubt, to the comparative absence of certain fungous and bacterial enemies which require moisture for their development.

The green apple aphis, *A. pomi* DeG., and the rosy apple aphis, *A. sorbi* Kalt., were both more abundant than in 1910, and in some cases the latter caused a severe check to the development of the fruit. This species is especially prone to attack bearing trees, and is usually found on the fruit clusters.

Cut worms caused much damage, and there were many complaints and inquiries regarding them.

The chinch-bug, *Blissus leucopterus* Say, normally rather rare in Connecticut, seemed to be more abundant than usual, and many specimens were taken in the sweeping done in general collecting.

Canker worms were abundant locally, as they have been for many years. In fact, they do much damage somewhere each year, but do not continue to be abundant in the same locality more than three or four years. At the station grounds, where the fall canker worm has been abundant for about four years, it is now diminishing, and probably it will be six or seven years before it again does serious damage. Apple orchards in the vicinity of Newtown and Danbury were stripped of their leaves, and the writer noticed much damage in North Haven, Wallingford and Mount Carmel. In the station orchard at Mount Carmel and in the orchards of Mr. W. W. Stevens of Northford and Mr. B. O. Jones of Centerville, where we conducted spraying tests, some damage was done before the first spraying. Mr. Walden observed them upon elm and apple trees at Middletown, and injuring apple foliage in Woodbridge. Specimens and complaints were also received from Fitchville and New Milford. Early spraying with lead arsenate, say before the middle of May, will of course prevent injury.

The maple leaf-stem sawfly, *Priophorus acericaulis* MacG., was more prevalent than for several years, not only around New Haven, but specimens of its work were received from Glastonbury, Meriden and Derby, and letters describing it, from several other localities. A brief account of the life history of this insect and the damage caused by it will be found on page 305.

The season brought to notice the great damage to the shade trees of towns and cities along the coast caused by the leopard moth, *Zeuzera pyrina* Linn. The moths, especially the males, were common around electric arc lights about July 1st, and Mr. Champlain caught several of them. The destruction of the trees was the reason for investigating this pest, and Bulletin 169 was issued in December. It gives a full account of the insect, with history and treatment, and is reproduced on page 317 of this report. Examples of this insect and its work were shown at the station grounds October 27th and 28th.

Probably the most important entomological feature of 1911 was the appearance of Brood II of the periodical cicada or seventeen-year locust. The species was scheduled to appear in Connecticut, and we were on the lookout for it. There were many exaggerated newspaper stories regarding this curious insect, but we were able to obtain fairly complete records of its distribution and occurrence, much more so probably than have ever been made of any previous occurrence of this or any other brood in the state. The insect aroused much popular interest, and a case, showing the different stages, with injury to trees, and a map showing its distribution in the state, was exhibited at the fairs. See page 296 of this report for an account of the periodical cicada or seventeen-year locust.

Mr. Walden found an apparently new pest of cultivated blackberries in a field in Highwood near New Haven, and he made a partial study of the insect, which proved to be a sawfly of the family Lydidae. Publication is withheld until the life-history data are more complete.

Good progress was made in suppressing the gypsy moth in the state. No caterpillars were found at Stonington, and at Wallingford the number was not great. The scouts examined the north-east corner of the state during February and March, and found that the brown-tail moth had spread westward from where it was found last year, in Putnam and Thompson, into the towns of Woodstock and Pomfret, and southward into Killingly. By far the worst infestation was in the city of Putnam. We may fairly expect this insect to extend itself four or five miles further each year until the whole state is infested, but the work of the men in cutting off and burning the winter nests must necessarily check it. An account of this work is given on page 281 of this report.

Adults were reared from larvæ feeding on barberry, and proved to be a pyralid moth, *Omphalocera dentosa* Gr. This was made the subject of a brief article in the Journal of Economic Entomology, which is included in this report, page 292.

Late in September there was a swarm of the brown cotton moths, *Alabama argillacea* Hubn., in New Haven and other Connecticut towns. It seems that there was a heavy migration of the adults of this insect from the cotton fields of the South, where it was unusually abundant. A note on page 340 further explains this phenomenon.

The bud moth, *Tmetocera ocellana* Schiff., was rather abundant and caused some damage in the apple orchards on the station farm and on the farms of Mr. C. K. Andrews at Mount Carmel and Mr. W. W. Stevens of Northford, where spraying experiments were conducted. Specimens were also received from Greenwich, West Cheshire, Mystic, New Britain, East Windsor and Union, and Mr. Walden observed its work on an orchard in Woodbridge. Early spraying with lead arsenate is the remedy. An account of this insect may be found in the Report of this Station for 1909, page 353.

The spiny elm caterpillar, *Euvanessa antiopa* Linn., was probably more abundant throughout the state than since 1906. Many persons find the larvæ, and take them to be gypsy moth caterpillars, though the latter are clothed with stiff, simple hairs instead of branched spines. The spiny elm caterpillar feeds in clusters, usually on elm, poplar or willow, and is described in the Report of this Station for 1906, page 260. Specimens of the insect were received during the season from Cobalt, Manchester, Salisbury, South Willington, Botsford, Hartford, East Woodstock, Farmington, Norwalk, Mystic, New Haven and Branford.

The elm leaf beetle, *Galerucella luteola* Mull., was very abundant in cities and towns where the trees were not sprayed. The dry season was especially favorable to this insect, which is destroyed in large numbers by a fungus if moisture is abundant during the latter part of July, the pupating season. Specimens were received from New Hartford, Pine Meadow, Stamford and Noroton.

The birch bucculatrix, described in the last report (1910, p. 701), which defoliated birch trees over a large area of the state in 1910, was present in 1911, but in no instance was it as abundant or causing such complete defoliation.

The woolly maple leaf scale, *Phenacoccus acericola* King, is increasing as a pest of sugar maples in cities and towns, and in New Haven and Hartford it is now necessary to practice control measures to hold it in check.

The San José scale, *Aspidiotus perniciosus* Comst., is no longer feared by the commercial orchardists, and it seems to be on the wane in many parts of the state, especially on old trees. On young orchard and nursery trees, however, it multiplies rapidly, and Mr. F. A. Bartlett writes that 1911 seems to have been a particularly good year for the San José scale, and that trees which seemed to be nearly free last spring are now badly infested.

The white pine weevil, *Pissodes strobi* Peck, was especially prevalent during the season, and is damaging forest plantations throughout the state, though more destructive in some sections than in others. The treatment generally recommended is to cut out the leaders and either destroy them before the insects emerge or place them in a cage covered with wire gauze to permit the escape of any parasites, but not of the beetles. Some preliminary tests of various substances for the purpose of preventing infestation were made last season, and are reported on page 307 of this report. It is hoped that a careful study can be made of this insect under Connecticut conditions in the near future.

INSPECTION OF CONNECTICUT NURSERIES.

Fifty-four nursery inspections were made during the calendar year, and fifty-one regular certificates granted. Two inspections were made of each of three nurseries, one inspection in the spring and the other at the regular time in the fall.

In addition to the regular nurseries, a number of private individuals who wished to send shipments of native plants, fruit stock or ornamental shrubs into other states found that they could not do so without a certificate of inspection. In order to meet such demands, it has been our practice to examine the stock and issue a certificate to be attached to each car, box, bale or package, and applying only to the contents thereof. As a rule, there are but few cases of this sort. Five such certificates were issued in 1911.

The annual inspection of growing nursery stock was commenced September 2d, and on account of delays occasioned by stormy weather and making exhibits at the fairs, was not completed until about the middle of November. The work was done by Messrs. Walden, Champlain, Caffrey, Lewis and Britton.

Most of the nurseries were freer from San José scale even than last year, due to the care and treatment given the growing stock by the owners and managers. Though it is true that the scale is less injurious than formerly, especially on old trees, it will soon cover young trees and trees in nursery rows if they become infested and are not treated. In the larger fruit nurseries of this state it is now the general practice to spray the growing trees with a miscible oil or lime-sulphur mixture. The budsticks are fumigated or dipped in oil mixture, and in one large nursery the stocks are treated with lime-sulphur in spring before the newly-set buds start. More or less spraying is also done with Scalecide during summer to check aphids, leaf-hoppers and scale insects. Such treatment of course is expensive, but results in a cleaner and better growth of stock, little of which needs to be destroyed at inspection time, and it pays in the end.

The list of nurserymen receiving certificates in 1911, which is given below, contains more names than last year. Of the last year's list one has dropped the nursery business, and three new ones have entered it. Two nurseries have changed hands, and are included under new names. Three regular nurseries were omitted from the list last year because the treatment prescribed by the state entomologist had not been carried out by the end of the year covered by the report. These are all reinstated. One new nursery, inspected for the first time in the spring of 1911, changed hands before the annual fall inspection and both names are included in the list. Though the list contains 48 names, there are but 47 nurseries.

LIST OF NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1911.

Name of Firm.	Location.	Certificate issued.	Number of certificate.
Atwater, C. W.	Collinsville	Sept. 26,	424
Barnes Brothers Nursery Co.	Yalesville	Oct. 17,	434
Beattie, Wm. H.	New Haven	Nov. 22,	462
Bowditch, J. H.	Pomfret Center	Sept. 29,	425
Brainard Floral & Nursery Co.	Thompsonville	Nov. 2,	443
Braley & Co., S. A.	Burnside	Nov. 9,	453
Bretschneider, A.	Danielson	Nov. 7,	450
Brooks Brothers	Westbrook	Dec. 5,	465
Burroughs, Thos. E.	Deep River	Oct. 3,	426
Burr & Co., C. R.	Manchester, Buckland, Durham	Oct. 6,	427
Chapman, C. E.	North Stonington	Oct. 31,	441
Comstock & Lyon	Norwalk	Oct. 11,	431
Conine Nursery Co., F. E.	Stratford	Oct. 6,	428
Conn. Agricultural College	Storrs	Nov. 21,	461
Conn. Agr. Experiment Station, Forest Nursery (S. N. Spring, State Forester, New Haven)	New Haven, Hamden, and Rainbow	Nov. 16,	459
Conway, W. B.	New Haven	Oct. 28,	439
Cross Highway Nurseries	Westport	Nov. 14,	457
Dehn & Bertolf	Greenwich	Oct. 17,	433
*Doorly, C. C.	Sound View	May 31,	419
Dwyer, John E.	Manchester	Oct. 9,	429
East Rock Park Nursery (G. X. Amrhyn, Supt. of Parks)	New Haven	Sept. 18,	422
Elm City Nursery Co.	New Haven	Sept. 18,	421
Gardner's Nurseries (2)	Cromwell	Nov. 4,	447
Hilliard, H. J.	Sound View	Dec. 8,	466
Houston & Sons, J. R.	Mansfield Depot	Nov. 16,	458
Hoyt's Sons, Stephen	New Canaan	Sept. 25,	423
Hubbard & Co., Paul M.	Bristol	Nov. 7,	451

* Succeeded by Mr. Hilliard.

Name of Firm.	Location.	Certificate issued.	Number of certificate.
Hunt & Co., W. W.	Hartford	Oct. 11,	430
Kellner, H. H. (2)	Danbury	Oct. 16,	432
Kelsey & Sons, David S.	West Hartford	Nov. 4,	448
Keney Park Nursery (G. A. Parker, Supt. of Parks)	Hartford	Nov. 11,	456
Malone, Est. of Geo. W.	New Haven	Nov. 29,	463
Mount Carmel Forestry and Nursery Co.	Mt. Carmel	Nov. 3,	445
Munro, Charles	New Haven	Oct. 28,	438
Northeastern Forestry Co.	Cheshire	Nov. 3,	444
New Haven Nurseries	New Haven	Oct. 24,	436
Phelps, J. Wesson	Bolton	Nov. 1,	442
Pierson, A. N.	Cromwell	Sept. 2,	420
Platt Co., The Frank S.	New Haven	Nov. 20,	460
Purinton, C. O.	Hartford	Nov. 3,	446
Ryther, O. E.	Norwich	Oct. 28,	440
Schleichert, F. C.	Bridgeport	Dec. 1,	464
Scott, J. W.	Hartford	Oct. 26,	437
Sierman, C. H.	Hartford	Nov. 6,	449
Stanhope, B. P.	Old Lyme (address Niantic)	May 19,	418
Streckfus, H. P.	Litchfield	Nov. 10,	455
Turner, Charles	Hartford	Oct. 21,	435
Vidbourne & Co., J.	Hartford	Nov. 7,	452
Woodruff, C. V.	Orange	Nov. 9,	454

INSPECTION OF IMPORTED NURSERY STOCK.

BY W. E. BRITTON AND B. H. WALDEN.

As recorded in the Reports of this Station for 1909, page 328, and 1910, page 667, several winter nests of the brown-tail moth have been brought into Connecticut on nursery stock imported from foreign countries, especially France, and had these nests not been found and destroyed it is probable that at least two infested centers in the central and western portions of the state would have become established. As no federal legislation had been enacted covering the matter, it devolved upon each state to protect its own interests by causing such stock to be inspected and the pests destroyed. Consequently, in 1911, an attempt was made to inspect all woody nursery stock coming into the state as in the two preceding years, and we asked the nursery men to coöperate by informing us promptly on the receipt of stock at their nurseries in the following circular letter:

NEW HAVEN, CONN., Jan. 19, 1911.

Dear Sir:—Two years ago thousands of nests of the Brown-tail Moth, *Euproctis chrysorrhœa* Linn., were brought into the United States on nursery stock from France, and in the absence of any system of Federal inspection, this infested stock was shipped into nearly all of the Eastern States. Fifty-two of these nests were found on stock shipped into Connecticut, out of 224 boxes and packages examined. Again last year 14 nests were found on stock shipped from France to three Connecticut nurseries, five out of 707 boxes and packages being infested. If such stock is not inspected, the Eastern nurseries will soon become infested and the business seriously injured.

I therefore request you to notify me at once of any importations received from any foreign country during the fall or winter, or of any shipments expected this spring, so that an inspection can be made. Please hold all boxes and packages without unpacking until an inspector can reach your nursery. We will examine the stock as promptly as possible after receiving notice that the goods have arrived at your nursery.

Very truly yours,

W. E. BRITTON,
State Entomologist.

NOTICES REGARDING IMPORTED STOCK.

Notices were received from the Bureau of Entomology at Washington, D. C., of the arrival of goods at port of entry in most cases. The New York State Department of Agriculture kindly notified us of several shipments, as did officials of a few other states, and in one or two cases notice was received direct from the customs officials. Some stock arrived, however, and was inspected, of which no notice was received except from the importing nurseryman. In a number of cases the notice was so incomplete or contained such errors as to make it impossible to trace the stock. These shipments were usually consigned to private parties, for planting on their own or their friend's estates, but were just as liable to bring in pests as though consigned to regular nurserymen. In several instances nurserymen in other states, on receiving large importations, reshipped certain boxes and packages, without inspecting or repacking, into Connecticut. Several notices regarding such cases were received from the New York State Department of Agriculture.

INCREASE IN IMPORTED STOCK.

The amount of nursery stock brought into this country from abroad is rapidly increasing each year, presumably because on account of cheap labor it can be grown there cheaper than here.

For many years fruit stocks for root grafting or budding have been imported and we should expect that the rarer varieties of flowering and ornamental trees and shrubs would be brought into the United States from the older countries. But all kinds of nursery stock are now being imported, even such common and easily grown species as California privet and Japanese barberry. Most of this stock imported, however, comes in small sizes, and the nurseryman grows it for one or more seasons before selling it. In addition to the regular nursery importations, thousands of Manetti rose seedlings, azaleas, Easter lilies, bay trees, lily of the valley and flowering bulbs are brought into Connecticut each year by florists not engaged in nursery business. But, as the customs officials are not conversant with the differences, they are supposed to notify the Bureau of Entomology of the arrival of all living plant material. No attempt was made in Connecticut to inspect bulbs, lily of the valley pips, or herbaceous stock.

The increase is shown by the number of boxes and parcels inspected during the past three years.

Year.	Number of boxes and parcels inspected.
1909	306
1910	707
1911	854

Sources of Imported Nursery Stock.

Holland still leads, with France second, as a source of nursery stock brought into Connecticut. Probably this holds true in about the same proportions for the Northeastern United States. There is also a large increase in stock from Belgium, England and Japan. The number of boxes, etc., examined from each country is shown below.

Country.	Number of boxes bales and parcels.
Holland	449
France	154
Japan	109
England	91
Scotland	2
Belgium	15
Ireland	14
Germany	2
Miscellaneous	18
Total	854

Pests Found: A Rust on Junipers from Japan.

No brown-tail nests or gypsy moth egg-masses were found on imported stock this year, though on several trees portions of the web remained, showing that the stock had been infested and the nests removed before shipping. Gypsy moth egg-masses were found in New York and possibly some other states.

In shipments received at two Connecticut nurseries from Japan, 55 plants of *Juniperus chinensis* var. *compacta* and 49 plants of *Juniperus tachibyaku* were infested with a rust identified by Dr. Clinton, botanist of this station, as *Gymnosporangium Japonicum* Syd. This rust showed as orange-colored gelatinous pustules on the stems. It has another stage which is a well recognized and quite injurious disease of pomaceous fruit trees in Japan.

All the plants mentioned above were obviously infested, and were burned. Others of the same kinds in the same shipments were planted out and isolated from pomaceous fruit trees to be watched by Dr. Clinton, and destroyed if found diseased.

Legislation.

Attempts to secure national legislation providing for the inspection of imported nursery stock have been continuous for the past fourteen years. Action has been delayed on account of a pressure of other matters, but more especially by the legislative committee of the National Nurserymen's Association, which objected to certain features of the measures proposed. A history of the whole subject would be out of place here, but various bills have been introduced, modified, rejected, or action postponed. At first it was planned to have the stock inspected at ports of entry, but this was found impracticable, and the idea was abandoned. Even this feature of federal inspection has now been dropped, and the work will probably be left for the States, even if the bill now before Congress is passed. At the meeting of the Official Horticultural Inspectors in Washington, December 28th and 29th, a conference was held with representatives of the inspectors, nurserymen, and Bureau of Entomology, and certain changes in the bill now before Congress were agreed upon, and all promised to help get action upon it. Copies of this bill as amended have not been distributed but the measure provides for a system of permits and notification that will be much more efficient than the present practice. In that respect at least it will be a benefit.

It seems almost necessary, therefore, to continue the inspection of plant material brought into Connecticut from foreign countries, though the inspection of such stock in 1911 necessitated 115 trips, and consumed time equivalent to ninety days, or the working days of nearly three and one-half months for one man. The cost of the work, including salary and traveling expenses, amounted to more than $500.00, and some financial provision should be made by the state to cover the expenses of the work.

INSPECTION OF APIARIES IN 1911.

The law passed by the legislature in 1909 provided for the inspection of apiaries on complaint in order to suppress the bacterial diseases commonly known as "foul brood." One season's work had been done under this law, and the results published in my last report (Report of this Station for 1909-1910), page 669.

Five hundred dollars was the amount of the appropriation for this work for the period of two years, but as there was no restriction on the amount to be used each year, and as there was a demand for inspections, the money was all used in 1910. Consequently there were no funds for inspection work in 1911, and the Connecticut Beekeepers' Association introduced a resolution asking the legislature to make an increased appropriation and also to make part of it available for use in 1911. Though this resolution was somewhat changed by the committee on agriculture, to which it was referred, and the appropriation greatly reduced, the following measure was passed:

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

Section 1. The sum of nine hundred dollars is hereby appropriated to be paid out of any money in the treasury not otherwise appropriated, for carrying out the provisions of Chapter 185 of the public acts of 1909, concerning the suppression of contagious diseases among bees; said moneys to be available as follows: one-third thereof upon the passage of this act, one-third during the year 1912, and one-third during the year 1913.

Section 2. This act shall take effect from its passage.

Approved May 25, 1911.

Thus three hundred dollars became immediately available, and duly acredited vouchers amounting to $299.94 were paid by the State Treasurer for the inspection work done between May 25th and August 1st. After this appropriation for the year had been exhausted, this office received notification from the state apiary inspector of Massachusetts about some suspected apiaries near the boundary line, with a request that they be inspected. As the case seemed to be important, and as it seemed advisable to coöperate as far as possible with an adjoining state in controlling the disease, Mr. Yates was sent to make the inspections, and the costs thereof, amounting to $23.14, were borne by this office from the general funds. The entire cost of the printed matter, inspection blanks, correspondence, and maintenance of the card index and records open to public inspection, as required by the law, are also borne by this office from its general funds, so as to leave more money for the actual work of inspecting and treating the apiaries.

Messrs. H. W. Coley of Westport and A. W. Yates of Hartford have continued as inspectors, as in 1910. Mr. Coley has jurisdiction over the four southern counties (Fairfield, New Haven, Middlesex and New London), and Mr. Yates the four northern counties (Litchfield, Hartford, Tolland and Windham) of the state.

The number of apiaries and colonies examined, and the cost of the work, are shown below:

Apiaries Inspected in 1911.

		Apiaries.	Colonies.
Number inspected		162	1571
Infested, European foul brood		84	431
Other troubles:			
Pickled Brood	8 cases		
Spring Dwindle	1 case		
Wax Moth	1 case		
Cost of Inspection, paid by state			$299.94
" " station			23.14
Total			$323.08
Average cost per apiary			$1.99
Average cost per colony			.21

Results of Inspection and Treatment.

The foul brood found in Connecticut in 1910 and 1911 has all been the European species. During 1910, 76 per cent., or over three-fourths of the apiaries, and 49 per cent., or nearly one-half of the colonies, examined were found infested. The inspection work of 1911 shows that only 51 per cent. of the apiaries and 27 per cent. of the colonies examined were infested. Moreover, of the colonies treated for the disease in 1910 and again examined in 1911, less than one per cent. (0.8) were found diseased.

These figures show the value of the inspection work and treatment. In all cases where the disease was found, the inspectors treated the colonies by shaking upon clean frames and foundation, or showed the owners how to do it, using, of course, the proper cautions and disinfectants. The old hives were disinfected, and a few of the worst infested colonies were destroyed, but there is no need of destroying any colonies or supplies if the disease is taken in time.

The state has not as yet been well covered, almost no complaints being received from Litchfield and New London counties, and inspection can be made only on complaint. Any beekeeper, however, may sign his own complaint. It is probable that on further examination the disease will be found in all parts of the state.

In order to make the work thoroughly effective, authority should be given this office to inspect apiaries on suspicion or without waiting for complaints, especially in and around those infested centers which without treatment may continue for a long time to be distributing points for the disease. An appropriation of at least five hundred dollars per annum is needed and should not be considered unreasonable.

PROGRESS IN CONTROLLING THE GYPSY MOTH IN CONNECTICUT IN 1911.

By W. E. Britton and Donald J. Caffrey.

The gypsy moth, *Porthetria dispar* Linn., was first discovered at Stonington in March, 1906, and a colony was found at Wallingford in December, 1909. Brief accounts of progress in exterminating the insect in each infested area will be found in each of the previous reports of this station issued since the pest was discovered. Though most of the work done was paid for out of state funds appropriated for this purpose, we wish to acknowledge the coöperation of the Bureau of Entomology in sending trained scouts to examine not only the infested areas but also much territory outside of it. The accompanying map, figure 1 on page 280, shows the location of the gypsy moth colonies in Connecticut.

Stonington Infestation.

Mr. Caffrey, with two men, began scouting for egg-masses on January 9th, 1911. Mr. Rogers furnished one scout, Mr. Miller, who also went over the same ground working part of the time by himself and some of the time with Mr. Caffrey. Mr. Miller found three fragments of egg-clusters under the edge of the lower stones of a wall near the ground a short distance from Mr. Koelb's house. All three would hardly equal one good-sized egg-mass, and may have all been deposited by one moth, perhaps disturbed in the act. It is not known whether or not these eggs were fertilized, as they were at once treated with creosote.

The summer work began May 1st, in charge of Mr. Fred Hoadley, under direction of the writers. Mr. Caffrey spent several days in Stonington in June scouting for caterpillars and inspecting the work. Three thousand five hundred trees were banded with burlap and about 100 with tanglefoot. From one to four men were employed, as needed. A number of tin patches were applied to cover cavities. The burlap bands were all removed and the work for the summer ceased on August 16th.

Though this work was carried on as in former seasons, no caterpillars could be found, and it looks as if the pest had been exterminated from Stonington. Further scouting has been done there this winter, and no egg-masses found, but the region must be examined with care next season to make sure. The statistics of the Stonington work are as follows:

Record of Gypsy Moths Destroyed at Stonington.

Year.	Egg-masses.	Caterpillars.	Cocoons.
1906	73	10,000	47
1907	118	2,936	200
1908	76	2,560	44
1909	6	98	0
1910	1	146	1
1911	3	0	0

Wallingford Infestation.

Mr. Caffrey, with men, started scouting work at Wallingford on November 7th, 1910. The first egg-mass was found November 14th, high up in an apple tree on South Main street. On November 22d an unusually large egg-mass was found at No. 40 Williams street. In all 23 egg clusters were found at Wallingford and the scouting work was finished on January 7th, 1911.

Work was resumed April 20th, by pruning and replacing tin patches. Tanglefoot bands were applied commencing April 25th. The first caterpillars were found on May 12th in their first stage on North Whittlesey avenue.

Commenced banding trees with burlap May 14th. First caterpillar was found under bands June 6th. Commenced turning bands June 8th. First spraying done on May 22d. On the 29th one dead caterpillar was noticed, which had been killed by the spray. On June 20th Mr. Caffrey observed many dead caterpillars killed by the poison. At this time they were from one and one-half to two inches in length.

On June 27th the first pupa, a male, was found in the breeding cage. The next day about fifty caterpillars were found in some low cherry bushes near the Whittlesey avenue dump. The brush was cut and burned at once with oil. The first pupa was found out of doors on July 6th. On July 10th the first adult, a male, emerged in the breeding cage, and the first one outside, a female, was found on July 25th.

The work on trees and turning burlap was continued until the middle of August, and a total of 1,551 caterpillars, 15 cocoons and two adults were found and destroyed, in addition to the egg-masses already mentioned, and the very large number of caterpillars killed by the poison spray and the tanglefoot bands.

The burlap bands were all removed and the summer work closed on August 17th.

Mr. Caffrey, with three men, began scouting for egg-masses November 20th, and two federal scouts began work December 6th and finished December 23d. The entire infested area was thus carefully examined by both state and federal scouts, and altogether only five egg-masses could be found.

The statistics of the year's work at Wallingford are given below:

Egg-masses destroyed	23
Caterpillars destroyed	1551
Cocoons destroyed	15
Adults destroyed	2
Trees banded with burlap	8556
Trees banded with Tanglefoot	469
Trees sprayed (not including shrubs)	116
Trees infested	216

The following figures show the number of insects destroyed since the discovery of the infestation at Wallingford:

RECORD OF GYPSY MOTHS DESTROYED AT WALLINGFORD.

Year.	Egg-masses.	Caterpillars.	Cocoons.
1910	8234	8936	96
1911	23	1551	15

The following table shows the cost of all work in Connecticut in suppressing the gypsy and brown-tail moths:

COST OF GYPSY MOTH WORK IN CONNECTICUT.

Including both Stonington and Wallingford Infestations.

Year.	State Funds.	Federal Funds.	Total per Year.
1906	$1,500.00		$1,500.00
1907	4,550.00	$ 272.00	4,822.00
1908	2,550.00	77.00	2,627.00
1909	1,503.22	42.00	1,545.22
1910	4,560.22	1,411.36	5,971.58
1911	4,017.95	4,660.22	8,678.17
Total	$18,681.39	$6,462.58	$25,143.97

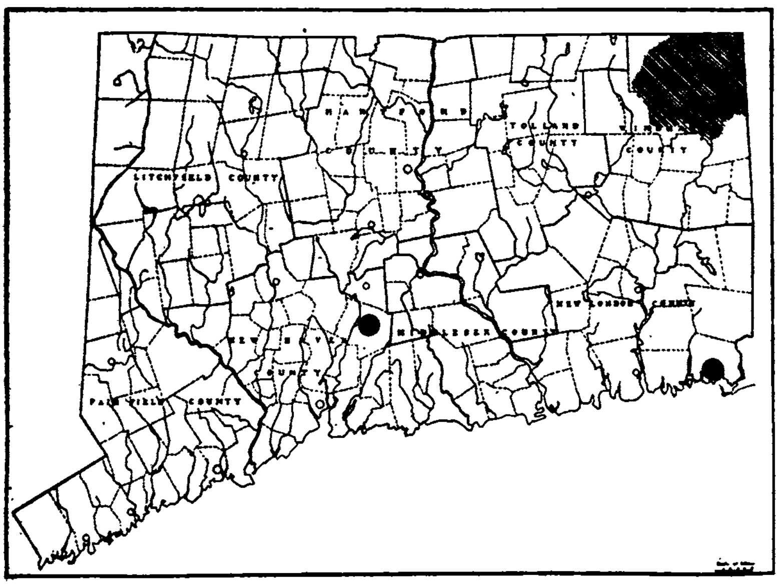


FIG. 1. Map of Connecticut. Shaded area denotes brown-tail moth infestation. Black dots show location of gypsy moth colonies.

CHECKING THE SPREAD OF THE BROWN-TAIL MOTH IN CONNECTICUT IN 1911.

By W. E. Britton and Donald J. Caffrey.

The discovery of the brown-tail moth, *Euproctis chrysorrhœa* Linn., at Putnam and Thompson in the spring of 1910 was recorded in the last report of this station (see Report for 1910, page 683). At that time the trees were covered with foliage, so it was very difficult to ascertain the extent of the territory infested. However, the work of the insect was apparent through a small area in Thompson and around the center of the city in Putnam.

During the winter and early spring of 1911, from February 6th to April 20th, the towns of Thompson, Woodstock, Putnam, Pomfret and part of Killingly were scouted for the winter nests, in order to determine the limit of infestation and also to cut off and burn the nests when found. Two men were taken from Wallingford who were familiar with the work, and the local authorities at Putnam helped us by removing many of the nests from the trees in that city.

Of course it was impossible to find and remove all nests from the thick woodlands, the oaks especially, with their dead and clinging leaves, making the nests very difficult of detection; but all the open country, the orchard land and the partially wooded areas adjoining the towns and villages were effectively covered.

Methods of Work.

The nests, which are nearly always at the extremities of the twigs and may be readily seen during the winter months, were removed by means of long-handled tree pruners. One of these tree pruners could be extended to a length of about twenty feet, so it was possible to remove many of the nests without getting into the trees. Many of the trees, however, especially the elms, oaks, maples and larger fruit trees, had to be climbed to get within reach of the nests, and then a twelve-foot pruner was used, as it could be handled much more easily in climbing about the tree than a longer one. Ladders were often necessary to reach the lower branches of the large trees. The use of climbing irons for this purpose should be avoided as much as possible except on worthless trees or those with a very rough bark. When clipping off the nests, care was taken not to remove any more of the twig than necessary, and after being clipped, the nests were placed in a thick paper bag, which, with its contents, was burned at the close of each day's work. When only a few nests were found, they were wrapped in paper and burned in an ordinary stove, but generally a furnace was available when larger quantities of the nests were taken.

When examining orchards for nests, our practice was to have each man walk in the aisle between two rows of trees, looking through the branches to his left and right. The man in the next aisle does the same, and in this way each tree in every row is examined very quickly, as the nests are very easily discovered by a man familiar with his work. When the trees were in irregular clumps or standing alone, each man looked over the branches on one tree, going completely around it, and then passed on to the next tree. In all cases when looking over trees, the sky is used as a background if possible, which makes the nests more easily seen. The white silk connecting the nest with the branch is very conspicuous, and helps to distinguish the brown-tail moth nest from those of other insects.

The great majority of the nests were found on fruit trees, although some were found on elm, maple, oak, sycamore, cherry, hawthorn, birch and syringa. The extent of the area infested by the brown-tail moth is shown on the accompanying map, figure 1, page 280.

From July 4th to July 18th, when the adults were flying, Mr. D. M. Rogers stationed two men at Putnam to examine all trains headed westward or southward to remove the adult brown-tail moths, and 75 adults in trains and around the station were thus destroyed.

An account of the work in each town follows:

THOMPSON.

In the town of Thompson the nests were very scattering, being mostly confined to the western half of the town and along the Massachusetts state line. Along the Rhode Island state line but very few nests were found. The greatest number were in Thompson village and immediate vicinity, 47 nests being discovered at this point. During the previous May some spraying had been done to control the pest on the N. B. Ream place in the village (see Report for 1910, page 684), and but for this fact the number of nests would have been larger. At Grosvenordale six nests were found; at North Grosvenordale, ten nests; in East Thompson, which is in the extreme northeastern corner of the town and of the state, only four nests; Wilsonville, three nests; Quinebaug and New Boston, eighteen nests, and West Thompson, five nests. Others were scattering between these villages, except in the eastern and southeastern part of the town, where only two scattered nests were found. A total of 112 nests were destroyed in the entire town.

Putnam.

The city of Putnam was quite badly infested, nearly every tree in the city having one or more nests. Some of the trees were badly defoliated the previous summer, and many of the inhabitants were afflicted with the "brown-tail rash" caused by the poisonous and irritating hairs which break off from the caterpillars and adults.

In the early part of the winter Mr. J. H. Osgood, the local tree warden, had removed about 4,000 nests from some of the worst infested trees in the center of the city, as far as his time and the funds at his command would permit. This saved us much labor.

The remaining trees in the township were examined, and it was found that the heaviest of the infestation was confined to the city limits, with a few nests outside. Some of the trees in the city yards were treated first, and at 139 Elm street five apple trees had 201 nests on them, while at 131 Elm street a pear tree had 64 and a syringa 27 nests. Just west from the railroad station, near the John O. Fox Lumber Company, four apple trees in one yard contained 431 nests, of which one large apple tree had 145 and another 125 nests. In this same yard 91 nests were taken from a large elm tree, which required much climbing, as they were on the tips of the highest branches. At East Putnam two nests were found, and at Putnam Heights three nests. In the eastern and southern parts of the town the nests were very scattering, one being taken a half-mile from the state line, and three others at a distance of about two miles from the line. In the western and southern parts they were found up to the town line. In the entire town of Putnam a total of 5,989 nests were destroyed, including those reported by Mr. Osgood.

Woodstock.

In Woodstock the infestation was largely confined to the apple orchards in the eastern and southern parts of the town, some of which were quite extensive, and much time was required to inspect them. In South Woodstock many of the orchards were badly infested, and 882 nests were found in this village and vicinity. The worst infestation in this region was on the property of Mr. Harrington, near the town line of Pomfret, where a total of 681 nests were cut from twenty-five apple trees, one large tree alone containing 166 nests. The trees surrounding this section, however, were only slightly infested. At Harrisville the nests were scattered over a large territory. At Woodstock Center 43 nests were found, at East Woodstock 27 were reported, and at North Woodstock only six were found in the village itself, but scattering nests were taken in the surrounding country. In the western half of the town the nests were few and far between, five being found in West Woodstock, with two others in surrounding territory. None were reported from Woodstock Valley or the extreme northwestern part of the town; but at Kenyonville, in the southwest corner of the town, one nest was found on an apple tree near the barn of a milkman who each day had been driving to and from South Woodstock. In the entire town of Woodstock 937 nests were destroyed.

Pomfret.

The nests were very scattering in Pomfret, with the exception of one or two orchards near Pomfret Center, where fifty of them were found, and in the northeastern corner, in territory adjoining Putnam. The nursery of J. H. Bowditch was given especial attention, but no nests were found there. At Pomfret Landing, in the southeastern part of the town, five nests were reported, at Pomfret Station two nests, at Utley Hill two nests, and one at Ragged Hill, in the extreme northwestern part of the town. Nothing was reported from Abington or Elliotts', or along the southern border of the town. In the town of Pomfret 89 nests were destroyed.

Killingly.

Only the northern half of Killingly, including the borough of Danielson, was examined for brown-tail nests. This territory appeared to be the edge of the infestation in Connecticut, only six nests being found in this town, of which one was taken at East Killingly, one at Killingly Center, one at Break Neck Hill, one near the northern town line of Putnam, and one at Mashentuck Hill. The entire borough of Danielson was given a very careful examination, and one nest was found in the northern part, near Elmville.

Colored Placards Issued.

A colored placard 11 x 14 inches in size and containing illustrations of the brown-tail moth and information regarding it was issued in September, 1911, as a special bulletin of the station, and printed in an edition of 3,000 copies. A copy was sent to each library, each grange hall and railroad station in Connecticut. The New York, New Haven and Hartford and the Central Vermont railroad companies kindly consented to coöperate with this office by not only allowing these placards to be placed in their stations, but by issuing orders to their agents to post them. A halftone reproduction of this placard may be seen on Plate II, *b*.

Summary.

The result of the work in this section shows that the brown-tail moth, in the course of its natural spread from the adjoining infested area in Massachusetts and Rhode Island, has established itself in the towns of Thompson, Woodstock, Putnam, Pomfret and part of Killingly in Connecticut. A total of 7,133 nests were found and destroyed in these infested towns, of which 112 were in Thompson, 937 in Woodstock, 5,989 in Putnam, 89 in Pomfret and six in Killingly.

Though it will be impossible to eradicate the brown-tail moth, as can be done with isolated colonies of the gypsy moth, the former can be more readily controlled, and by careful work prevented from doing any serious damage.

Colored placards were issued giving illustrations and information regarding the insect, and the cards were posted in public places such as libraries, railroad stations and grange halls throughout the state.

The previously infested towns will be scouted again this winter, and all nests found will be destroyed. It is also planned to examine the surounding towns and those along the boundary lines of Massachusetts and Rhode Island, to determine any further spread of the insect.

THE ONION MAGGOT (*Phorbia ceparum* Meigen).

By Donald J. Caffrey.

Introduction.

The name "onion maggot" is applied to the small white maggot or grub attacking the bulb or root of the onion plant and belonging to the genus *Phorbia* (*Pegomyia*) of the Dipterous family Anthomyidae. It is well named the onion maggot for it seems never to have been recorded on any other food plant.* Economically it is very important, ranking with the cabbage maggot and seed corn maggot as a destructive pest to the growers of vegetable root crops.

The onion maggot was first described by Meigen in 1830, but its ravages had been noticed and recorded in Europe long before that time, and it had been known and widely distributed as a serious pest of onions from time immemorial.

In the United States it has been present for many years, probably being introduced from Europe in some shipment of its food. Records are present showing the pest to be very destructive throughout the Eastern and Middle States in 1854 and again in 1863. Its distribution in this country is now widespread.

In Connecticut the onion maggot has frequently been reported as doing considerable damage, and many inquiries are sent to the station concerning it. At Greens Farms, Southport, and around New Haven in 1904 it was very abundant and caused much injury to the onion crop, killing from one-fourth to one-third of the plants in large fields.

Character of the Damage.

The presence of the onion maggot is first shown by the plants changing to a yellowish color and finally wilting, while the lower or outer sheaf of the surrounding plants has also become affected

* Slingerland, N. Y. (Cornell) Agr. Expt. Sta., Bull. 78, p. 496, 1894.

in the same manner. The leaves of these plants have become soft and flaccid to the touch, and in general have a sickly appearance. Examination will show that the cylindrical root of the young plant has been nearly cut asunder, so that only the outer epidermal tissue or shell remains. Inside of this remaining tissue one or more maggots may be found feeding. If the plant is more advanced and the bulb partly formed, a hole may be found bored either in the side or on the bottom of the onion, and one maggot is present in the interior. More commonly, however, several maggots of different sizes are found in a large irregular cavity in the center, and the earth around the orifice is wet and slimy, forming a large muddy mass, into which the maggots crawl to rest when not feeding. If the onion bulb has been infested for a longer period, it may be found soft and putrid except the lower part, which, being nourished by the fibrous rootlets, remains sound. The larger worms looking for fresh food will crawl into this remaining part to feed, so that sometimes a thronged mass of worms may be found at this point. In the recent attacks recorded from Connecticut, the highest and dryest portions of the field seemed to be preferred by the pest, and in such places the first signs of infestation will probably be found.*

Life History.

The adult fly passes the winter in the pupa stage in the ground, and emerges with the first warm days of spring, when the plants are usually just above ground. From two to six and sometimes more eggs are laid singly on particular plants here and there through the field. According to Fitch,† the adults seem to prefer certain plants to the exclusion of others. The eggs are loosely placed on the plant above the surface of the ground between the sheath or collar and in the crevices between the leaves, and are perceptible to the naked eye. The eggs hatch in a week or ten days, varying with the temperature.

After hatching, the young maggot or larva burrows its way down inside the sheath until it reaches the root, leaving a discolored streak to mark its progress, and begins feeding upon the interior of the root. Later, when the bulb is formed, the entrance

* Britton, Rept. Conn. Expt. Sta., p. 214, 1904.

† Fitch, Rept. on Noxious Insects of New York, XI, p. 487.

may be made from the side or bottom, and several maggots may be found in the interior of each. The maggot attains full growth in about two weeks, and pupates generally in the surrounding ground, although it has been known to pupate within the onion. The pupa stage lasts about a fortnight, and then the adult fly emerges to lay eggs for another brood.

There are several broods each season, varying with the locality and weather conditions. The last brood of larvæ pass the winter in the pupa stage, and adults emerge in the spring.

DESCRIPTION.

Eggs. Laid singly and are perceptible to naked eye. White and smooth in appearance and elongated-oval in form. Size, .04 inch long and .01 inch broad.

Larva or **Maggot.** Glossy, dull white and smooth in appearance, of an elongate-conical form, tapering to a point at its head or forward end. When crawling and elongated, nearly the whole length of the body becomes tapering. At the extreme forward end the jaws appear as two black hooks, and show through the skin as a short black stripe. Near the head are seen the breathing organs, and the alimentary vessel appears as a stripe along the middle of the back. Hinder end of body is cut off obliquely, and on its flat surface are two small elevated brown points or spiracles, and on the margin are eight small tooth-like projections, of which the lower two are larger, while slightly in advance of these are two small processes which aid the maggot in crawling.

Pupa. In pupation, as is the case in most dipterous families, the skin of the larva hardens and changes to a chestnut-brown color, with a stain of black at each end, to form the pupa-case or puparium, inside of which the true pupa is found. This true pupa is a short, white body, showing a jointed abdomen, and with the wings and legs of the future fly appressed to its surface.

Adult. Resembles the common house fly, though smaller and more distinctly gray in color. Male, ash-colored, with black bristles and hairs and a white face. Three dark lines run along the body between the wings, while particularly noticeable is a row of long black spots along the middle of the abdomen. Female, more ochreous or ashy gray in color, with a yellowish white face. The row of long black spots along the middle of abdomen is not as distinct as in the male. Shown on Plate VIII, *e*.

The sexes are recognized by the eyes, which in the male are close together and large enough to occupy nearly all of the head, while in the female the eyes are smaller and farther apart.

NATURAL ENEMIES.

One species of golden-eyed flies of the genus *Chrysopa** has been found in great numbers in infested fields destroying many eggs of the onion maggot.

Several species of predaceous beetles have been observed feeding upon maggots in the field, the most important being a small staphylinid beetle. Minute parasitic wasps and predatory mites have been found infesting eggs in great numbers.

None of these natural enemies, however, do enough to lessen the numbers of the pest from year to year, as they confine their operations largely to individuals, and cannot be relied upon to relieve the grower from active work against the maggot.

CONTROL METHODS.

The onion maggot has proved to be a very difficult pest to control after it has once gained a firm foothold. Therefore methods of prevention must be largely relied upon to forestall damage, and to this end the following practices are recommended.

By clean culture, prevent as many insects as possible from reaching maturity and multiplying. Clean out sheds and other outbuildings, and burn the rubbish out of doors. Remove previously infested plants carefully, and burn them, to destroy all maggots that may be feeding in the roots, this step being of great importance. All crop remnants, such as root cuttings, and all wild or volunteer plants about the place should also be burned. Having made the land as clean and free from infestation as possible, plant on ground not infested the previous season and as far as possible from any land that has been infested, as the flies are not known to migrate very far to lay their eggs. Then regulate the time of planting so that the adult, which emerges with the first warm days of spring, will have laid its eggs before the main crop of plants appear. When feasible, an earlier trap crop may be planted, which after becoming infested may be carefully

* Fitch, Rept. on Noxious Insects of New York, XI, p. 493.

removed and destroyed. Planting in hills seems to be of value, as the maggots find it difficult to work their way from one infested hill to another. Fertilize well with some quick acting mineral fertilizer, avoiding stable manure, rotted leaves, or other organic fertilizers, as they are apt to induce infestation. In addition, protect the plants and prevent the eggs from being laid about them or the maggots from getting to the roots, by applying some material or covering on the surface of the ground around the stem of the plant, for which purpose the following substances are used:

PREVENTIVES.

Sand and Kerosene. A cupful of kerosene to a bucket of sand applied to the base of the plants along the rows, to prevent the parent flies from depositing their eggs. This will also kill young maggots attempting to work through it.

Carbolized Lime. Three pints of lime slaked to a thin cream, in a gallon of water with a tablespoonful of *crude* carbolic acid, applied around the plant has proved very successful.

Glue and Bran. A mixture of 2 lbs. of glue, one gallon of water and ½ lb. of bran placed tightly around the plant prevents the young maggot from getting into the tissue beneath after it hatches.

Mineral Fertilizers. Kainit, nitrate of soda and sulphate or chloride of potash are useful as deterrents, especially when used just before or just after the ground has been wet. They may be used as a top dressing before planting, or applied afterwards as near as possible to the roots, the earth being turned away for this purpose. These fertilizers also stimulate plant growth, helping the plant to recover from maggot injury.

Other substances used frequently as repellents are powdered charcoal, powdered white hellebore, powdered tobacco, dry lime, dry unleached wood ashes, and pulverized gas lime. Salt between the rows has proven of value in some cases. Any of these preventives for best results must be applied early, and immediately after plants are set or have made their appearance above ground.

REMEDIES.

If the maggots succeed in getting a foothold, the infested plants should be taken up carefully, providing they are few in number, and their maggot contents destroyed. If this fails to stop the infestation, other means may be tried.

Carbolic Acid Emulsion. Add to 1 lb. of soap boiled in 1 gallon of water, ½ gallon of *crude* carbolic acid, and dilute the whole with 50 parts of water. This is perhaps the best of the remedies for general use, as it is a strong killing agent and is also said to act as a preventive. It is used to best advantage a day or two after plants are started, and should be repeated every week or ten days until the last of May in the North.

Paraffine Oil and Sand. Spread broadcast among the onions and then water the plants. It has been found very efficient in many cases as a killing agent.

Lime and Liquid Manure. Five lbs. of fresh burned lime slaked in 100 gallons of liquid manure, stirred ten minutes and applied with a sprinkler is of value, although the use of organic manures generally is not recommended.

Carbon Disulphide. Injected around the roots this is efficient in some soils, but is not practicable on a large scale.

Hellebore Decoction. Applied as soon as eggs are noticed and continued at intervals of five or six days.

Kerosene Oil sprayed upon the soil is of some value.

Hen Manure which has been covered with soil to retain ammonia is reported to be useful.

Stress is laid upon the fact that differences in soil, condition and composition make a difference in the relative efficiency of any treatment, either remedial or preventive. It should also be borne in mind that the more maggots destroyed each year the less will remain to propagate for the coming year, so that if active measures are used for two or three years the infestation will be so reduced that keeping the pest in check becomes a comparatively easy task.

LITERATURE.

Aldrich. Catalogue of North American Diptera, Smithsonian Misc. Collections, Vol. XLVI. p. 555. 1905.
Bethune. Ann. Rept. Ent. Soc. Ontario, p. 43. 1880.
Britton. Rept. Conn. Agr. Expt. Sta., p. 214. 1904.
Chittenden. Bur. Ent. Circ. No. 63. 1906.
Chittenden. Insects Injurious to Vegetables, p. 245. 1907.
Fernald. Mass. Agr. Expt. Sta., Bull. 12, p. 17. 1891.
Fitch. Report on the Noxious Insects of New York, XI, p. 487. 1866.
Glover. Rept. U. S. Dept. of Agr., p. 563, 1864; p. 133, 1872.

Harris. Insects Injurious to Vegetation, p. 617. 1862.
Lintner. Rept. N. Y. State Entomologist, I, p. 172. 1882.
Osten Sacken. Catalogue of the North American Diptera, Smithsonian Misc. Collections, p. 168 (2d ed.). 1878.
Packard. Guide to the Study of Insects, p. 411 (9th ed.). 1889.
Quaintance. Fla. Agr. Expt. Sta., Bull. 34, p. 305. 1896.
Sempers. Injurious Insects and the Use of Insecticides, p. 141. 1894.
Slingerland. N. Y. Cornell Agr. Expt. Sta., Bull. 78, p. 495. 1894.
Smith. N. J. Agr. Expt. Sta. Rept., p. 579. 1905.
Smith. N. J. Agr. Expt. Sta., Bull. 200, p. 10. 1907.
Smith. Economic Entomology, p. 363. 1896.
Sturgis. Rept. Conn. Agr. Expt. Sta., p. 139. 1894.
Treat. Injurious Insects of the Farm and Garden, p. 53. 1887.
Walsh. Practical Entomologist, Vol. II, p. 64. 1867.
Weed. Insects and Insecticides, p. 203. 1891.

THE PYRALID (*Omphalocera dentosa* Grote), A PEST OF BARBERRY HEDGES.*

On August 12th, 1908, Dr. F. P. Gulliver of Norwich, Conn., sent to the station some curious black and white caterpillars which were feeding upon the leaves of common barberry, *Berberis vulgaris* Linn. This plant, though introduced from Europe, has become naturalized in New England and is far more common in Connecticut than the native species *B. canadensis* Pursh. The writer was away on a vacation, and his assistant, Mr. Walden, who was in charge of the department, not recognizing the caterpillars, wrote to Dr. Gulliver asking him to send more material, which he kindly did. The writer examined the caterpillars on his return September 1st, but they were entirely unfamiliar to him. In his experience of fourteen years in the state he had not at that time ever seen the species before. A few specimens were inflated, and the others placed in the breeding cages for the purpose of rearing the adults, but none were obtained. The following season the insect was not observed by anyone connected with this office.

In 1910, however, this insect was more abundant than previously, and a number of caterpillars were found feeding not only upon the common barberry, *B. vulgaris* and its purple-leaved form, but also on the Japanese barberry, *B. Thunbergii* D. C., which is

* This paper was printed in the Journal of Economic Entomology, Vol. IV, page 521, December, 1911.

used rather extensively for hedges, though not as commonly as California privet, and on another species of barberry. Enough material was secured in 1910 to enable us to rear the adults, and both sexes were obtained. See note in last Report, page 711, 1910.

During the annual task of inspecting nurseries the work of this insect was observed in 1910, especially about New Haven, and in 1911 its work was again noticed.

Habits and Injury.

The adults emerged in the insectary from April 10th to 20th, but they do not appear in the open until about the first of July. On July 3d, 1911, specimens were collected by the writer on the screen door of his house, the moths having been attracted by the light in the hall. As there is a low hedge of Japanese barberry in front of the house and only a few feet away, they were doubtless there for the purpose of ovipositing, and later a few caterpillars were found on this hedge.

The writer and his assistants hunted for the eggs, but could not find them. Presumably they are laid on the leaves of the food plant. The writer's hedge was slightly attacked in both 1910 and 1911. In one instance a tall hedge of *B. vulgaris* near the writer's home was almost entirely stripped of leaves at the top for a distance of two or three rods, leaving only the old webs containing the excrement, and rendering the hedge very unsightly. Spraying with lead arsenate would, of course, be the remedy.

The larva spins a web in which is collected the excrement, giving to the web a brown or dark grey color. This forms a case in which the larva lives and feeds. It is usually about two inches long and from three-eighths to one-half inch in thickness, though varying greatly in size and sometimes being several inches long. The case is attached to the leaves or twigs of the barberry and often includes both, as well as the fruit. As the eggs are laid about July 1st, it is usually a month later before larvæ or nests are noticed, and often two months later before they are conspicuous. After the leaves drop the old nests or webs disfigure the plants throughout the winter unless removed. The larvæ do not pupate in the nests, but go into the ground and transform in a tough cell, oval or oblong in shape and made of particles of soil held together by silk threads.

Identity and Literature.

On account of the appearance and characteristic position of this moth when at rest with wings folded, as well as the antennal tufts of the male, it was thought to be a Deltoid, and specimens were sent for identification to Professor J. B. Smith, who kindly replied as follows:

"Yours of the 5th inst. came duly to hand, and so did the box of specimens. The latter proved to be not Deltoids or Noctuids at all!—they belong to one of the Pyralid families, and the species is *Omphalocera dentosa*. I am under the impression that this species was described and figured in one of the Government publications, but have no note on the subject, and can't be sure at the present time. I know that nothing much has been written concerning the species."

In searching the more accessible works for the literature of the species, only two references could be found. One of these was the original description which is included in this article, and the other a brief note by Dr. H. G. Dyar in an article entitled, "A Review of the North American Pyralinae" (Proceedings Entomological Society of Washington, Vol. X, p. 101, 1908), giving records as follows:

"*Omphalocera dentosa* Grote.

"New Haven, Conn. (A. H. Verrill); Plummer's Island, Maryland, June 6, 1902 (H. S. Barber); Ames, Iowa, June 6, 1896 (C. P. Gillette); Black Jack Springs, Texas (Wm. Barnes); Dallas, Texas, May 31, 1896 (Dept. Agr., No. 6351), larvæ on *Berberis*. I have also a female from Durango, Colorado, that is less vinous in tone and more darkly colored, perhaps a distinct species, but with the present material I do not venture to separate it.

"Larvæ received from Mr. A. H. Verrill, which I think belong to this species, are black with many white dots, without the red lines of *cariosa*."

Dr. H. T. Fernald has also kindly examined the card index in his office and consulted his father's catalogue, and assures me that no other references occur there.

As the literature seems to be scanty, this brief article is submitted for publication in the hope that it may be of help to other workers who may collect or observe the caterpillars on barberry.

Description.

Adult. The species was described from a female specimen by Grote, in Bull. U. S. Geological and Geographical Survey of the Territories, Vol. VI, No. 2, p. 272, as follows:

"*Omphalocera dentosa* n. s.

♀ A little larger than *cariosa,* with quite a different color, being dusty olive brown, without any reddish brown tinges. The median space is dark blackish brown. The pattern of ornamentation is the same, but the outer line is composed of well-defined and rather broad, open teeth. The line is double, filled in by a pale shade, and is brought a little nearer the margin over the median nervules than in *cariosa.* The interspaces beyond the t. p. line show dentiform shadings of the lighter and darker colors of the wing. The fringes are dark. The terminal dots do not contrast as much as in *cariosa.* The veins are darker marked. *O. dentosa* has the under surface fuscous with a common external double line near the border, which seems a little less strongly dentate than in *cariosa.* The abdomen is furnished with brown tufts on the dorsum in both forms. In place of the discal mark (?) there is a pale dot on the subcostal vein and one below it on median vein, quite distinct in *cariosa,* hardly evident in *dentosa,* which expands 40 mil."

I have not been able to find any description of the male, and take it to be undescribed, but in the specimens reared it closely resembles the female in color and markings. The median space is smaller and less well-defined, the markings are slightly less distinct, and it is smaller in size. Both sexes have the dark brown or black tufts on the dorsum of the abdomen, and the male has the brown antennal tufts and the longer anal tufts which are sexual characters.

The specimens reared are somewhat more of a reddish brown tint than one would expect from Grote's description, yet there is a distinct olive tint on the basal two-thirds of the secondaries.

Larva. Length, about one and one-half inches, thickness about three-sixteenths of an inch; somewhat flattened and thicker laterally than vertically. Ground color black dorsally, brown ventrally. Marked dorsally and laterally by small white irregular-shaped spots arranged rather irregularly as follows:—Two transverse rows on each segment as seen dorsally; three longitudinal rows as seen in lateral view, one nearly in line with the spiracles, one above and one below, these being in addition to the transverse dorsal rows of spots. Sometimes a fourth longitudinal row may be made out below the other three and at the base of the legs and pro-legs. Head dark brown or black, sculptured or pitted and shining; marked with white patches more or less irregular in shape, the arrangement not entirely symmetrical. Legs black and shining, with white patches on the first and second basal joints. Head and body sparsely covered with nearly straight light and dark hairs of medium length.

The larvæ, adults and nests are shown on Plate III. Credit is due to my assistants, Messrs. B. H. Walden and A. B. Champlain, to the former for making the photographs and to the latter for the drawing of the larva. Also to Professors J. B. Smith and H. T. Fernald for the courtesies already mentioned.

THE PERIODICAL CICADA OR SEVENTEEN-YEAR LOCUST IN CONNECTICUT IN 1911.

Brood No. II of the periodical cicada or seventeen-year locust, *Tibicen septendecim* Linn., was scheduled to appear in the central portion of Connecticut in 1911, so we were on the watch for it. The station collection contains examples of this brood collected in Branford in 1894, by Dr. W. C. Sturgis, then botanist of this station. But in 1894 no attempt was made to obtain records or to study the distribution of the insect in the state. In 1903, Brood XI was expected, and though we made many observations and inquiries, we did not obtain a single record.

Consequently, 1911 seemed to afford an excellent opportunity to collect data, and in addition to the observations made by the office force, much information was gathered from other sources. On June 1st, five hundred return postal cards were issued to fruit growers, entomologists, and others, particular care being taken to include at least two observers in every town in the state. The following request was sent out on the return postal cards:

OFFICE OF STATE ENTOMOLOGIST.
AGRICULTURAL EXPERIMENT STATION.
NEW HAVEN, CONN.

June 1, 1911.

Dear Sir:

In a few days the seventeen-year locust or periodical cicada (Brood II) is due to emerge from the ground in Connecticut, where it has appeared every seventeen years since 1724. Though not of great economic importance, on account of its peculiar life history this insect is of great interest, and this office seeks records of distribution in the state.

Will you therefore kindly fill out the attached return post card, giving any notes regarding the presence or absence of this insect in your locality this year? Please return this information on or before July 1st.

Thanking you in advance, I remain,

Very truly yours,

W. E. Britton,

State Entomologist.

The results of the postal card canvass are as follows:

Return postal card requests issued	500
Cards returned	134
Failed to report	366
Reports of insects being present	47
Reports of insects not present	87
Number of counties infested	3
Number of towns infested	21
Number of towns not infested	58
Number of towns not reported	89

A number of additional reports were received from correspondents and acquaintances who had made observations at one or more points in the state. From all the data gathered, it is evident that Brood II of the periodical cicada appeared in 1911 in the same localities as in previous cicada years. It was present in the following counties and towns:

Hartford County: Avon, Berlin, Farmington, New Britain, Plainville, Rocky Hill, Southington, West Hartford.

New Haven County: Branford, Cheshire, East Haven, Guilford, Hamden, Meriden, New Haven, North Branford, North Haven, Wallingford.

Middlesex County: Cromwell, Durham, Killingworth, Middlefield, Middletown.

The area occupied by Brood II in Connecticut in 1911 is shown on the accompanying map, figure 2, on page 298.

Abundance in Particular Localities.

Though the shaded portion of the map indicates the area where the adult cicadas were found, it should be understood that they by no means occupied the whole of this area. As a rule, they occupy high ground, and do not breed on the lower levels. They were especially abundant on some, though not all, of the dry wooded trap rock ridges, and here their song or rattling noise could be heard for a long distance. In some of the areas, intervening, however, the cicadas are seldom if ever seen. For instance, none were found on the station grounds and only a few were noticed on the station farm at Mount Carmel, but on the ridge west of the farm the noise at times was almost deafening. One observer described the noise as being "like a great many mowing machines going at once."

In the following localities they were particularly abundant: West Rock and the ridge toward the north; Mt. Carmel and

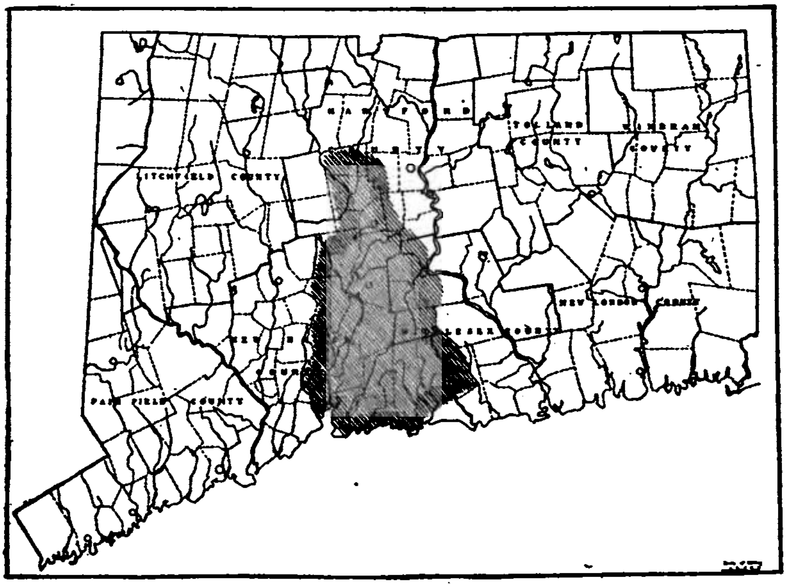


FIG. 2. Map of Connecticut showing area occupied by Brood II of the periodical cicada in 1911.

the ridge northward; Hanging Hills and vicinity, Meriden; Shuttle Meadow district, Southington; Rattlesnake Mountain, Farmington; Talcott Mountain, West Hartford; Lamentation Mountain, Rocky Hill; East Meriden; Middlefield; East Wallingford; Wallingford; North Haven; and Guilford.

Mr. E. C. Warner, who has a farm and orchards in the town of North Haven near Clintonville, reported on June 10th that the cicadas were very abundant in one of his peach orchards on the north side of a piece of woodland, and that he counted 136 pupa skins on one tree. On June 27th he reported that much injury had been done by the ovipositing, causing the branches to break and the leaves to wither and turn brown. Similar conditions existed also in the peach orchards of F. H. Benton, Z. P. Beach, W. A. Henry & Son, and C. O. Young, Wallingford; J. T. Molumphy, Berlin; C. N. Burnham, C. E. Lyman, Middlefield; R. Wilcox & Sons, Guilford; and H. F. Baumgardt, Hamden.

Ovipositing occurred in the woodland generally, and the broken branches dried up, giving the trees a brown appearance as if scorched by fire. In some of these thickly infested areas the cicadas were much more abundant than seventeen years ago, while in other localities they were less abundant. Mr. Willis I. Savage of Berlin stated as follows: "The ground in a neighboring orchard that was uncultivated was covered with them, so that they could be picked up by the quart. They seem to be in larger numbers than seventeen years ago." Mr. E. Rogers of the Shuttle Meadow district, Southington, wrote: "There are more than there were seventeen years ago." Mr. Marcus Cooke of Wallingford says: "More are seen here than seventeen years ago." Mr. J. Norris Barnes of Yalesville wrote: "These insects are present in the woods in the locality of the old Hough and Barnes orchard site, where seventeen years ago they were very abundant." On the other hand, Mr. S. G. Cooke of Branford states: "Not as many as thirty-four years ago, when they did great damage in my apple orchard. When they appeared seventeen years ago, I gave them a good dose of Paris green mixed with ashes while they were helpless, which killed most of them. Very few there this year." A friend who observed the cicadas in 1894 told me that the trees on the east slope of Saltonstall Ridge in East Haven were brown on the northern part of the ridge, but that the limits of injury reached only about half its length, and was sharply defined, the southern half of the ridge being green. As no such appearance could be noticed in 1911, or important injury detected in the locality, it is fair to assume that the cicadas were scarce there, or at least much less abundant than seventeen years ago.

Date of Appearance.

The first account that came to my notice regarding the presence of the cicadas was from a Southington correspondent, published in a New Haven newspaper of April 29th, 1911, stating that workmen on the farm of Benjamin Parkin plowed up countless numbers of the pupæ. The records of first emergence of the adults, so far as reported, are as follows: Farmington, May 12th, A. B. Cook; Unionville, June 4th, A. A. Moses; Avon, June 4th, J. W. Alsop; New Britain, about June 1st, D. N. Camp; Elmwood, June 3d, F. H. Stadtmueller; Berlin, May 28th, W. I. Savage; Rocky Hill, June 3d, Miss M. J. Harris; Middletown, June 2d, F. E. Boardman; Durham, May 28th, H. J. Nettleton; Killingworth, June 7th, Mrs. M. I. S. Evarts; Wallingford, about May 25th, A. T. Henry, May 31st, G. A. Hopson, June 1st, C. D. Hall, June 2d, M. A. Cooke; Branford, June 2d, S. G. Cooke. The cicadas were thickest about the middle of June, and then began to decrease in numbers, and soon after July 1st they had disappeared.

Damage to Trees.

Though the pupæ come out of the ground and crawl upon the trunks, branches and foliage of trees and shrubs, and the adults emerge, leaving the old shells hanging there, they produce no appreciable injury to the trees except the splintering of the twigs caused by the females in laying their eggs. Several correspondents wrote to this office that the cicadas were eating up their trees. But as the adults are sucking insects, they could at most only suck out a little of the sap, and could not devour any of the tissues. In laying eggs, however, by means of the sharp, tough and horny parts of the ovipositor, the female is able to puncture the hard wood and lay eggs in it. The ovipositor consists of three spear-shaped pieces or blades, the lateral ones having serrated edges for cutting. These pieces slide lengthwise upon each other, and are very effective in mutilating the twigs.

The eggs are laid in longitudinal rows of punctures along the under side of the twigs of the previous season's growth, having a diameter of between one-fourth and one-half inch. Where there are many punctures in a twig it is often so weakened that it breaks in the wind, and though sometimes falling to the ground, it usually hangs, and the leaves dry and turn brown. There is damage to the trees, no doubt, from the effects of great numbers of the larvæ sucking at the roots, but this injury is difficult to observe or estimate, and probably is usually attributed to other causes.

The greatest damage noticed by the writer was where peach trees had been used for egg-laying. The weight of the fruit caused the twigs to break and hang down, and the fruit as well as the leaves withered. In portions of the orchards mentioned nearly all the fruit was destroyed. Some twigs had five or six peaches each, and broke very readily from their own weight. Nearly all hung, however, until the wood became dry and brittle before separating entirely from the tree. In addition to the loss of the crop for the season, about a season's wood growth was destroyed, leaving little or no chance for the formation of fruit buds for the following year. On apple and other fruit trees the results were similar, though apparently much less serious than with peach trees.

On rapid growing trees the scars soon heal, but on trees making a slow growth they do not heal for several years. Ordinarily, however, there is little or no permanent injury to the tree, and soon after the insects disappear the orchardist thinks little about them. The accounts of serious injury which one reads in newspapers are generally based upon the imagination or upon other causes, and are not the verdict of men who have given careful study to the subject. The appearance of the splintered twigs is shown on Plate V, *b*.

Habits and Life History.

Some six or seven weeks after the eggs are laid in the twigs, the young cicadas hatch from them, drop to the ground, and work their way into it, going twelve or eighteen inches beneath the surface. Here they live a subterranean life for seventeen years, where it is difficult to follow their movements and development. Yet this has been done in three or four cases by the Bureau of Entomology, and it was found that the larvæ molted four times, the fourth molt usually occurring about the tenth year. They burrow chiefly with their forelegs, suck the juices from the small roots from one-eighth to three-sixteenths of an inch in diameter, and upon such food they subsist for the full period of seventeen years, when the pupæ crawl out of the ground, leaving round exit holes about three-eighths of an inch in diameter. Sometimes these holes are very close together, and in several instances came out of the middle of a private road, where the ground was very hard and solid. Earlier records of Brood II show that in some cases the pupæ make cones or huts by raising the soil up around their burrows to a height of two or three inches. None of these were observed in Connecticut in 1911.

The pupa crawls up the trunks of trees or upon the twigs or leaves, the stems of weeds, or upon buildings and fences, and soon the skin splits along its back and the adult cicada emerges, at first a greenish white, limp, soft body. It remains near, clinging to the surface with wings hanging downward, and soon hardens and assumes its normal appearance. Within a week or so after emerging from the shell the adults have mated and the female has begun to lay eggs. As all do not emerge at the same time, some adults may be found for a period of about six weeks.

The old shells remain upon the trunks and branches for a long time. I counted nearly a hundred on the trunk of one tree in Wallingford, and Mr. Warner counted 136 on one tree in North Haven.

The rattling noise is made entirely by the males, which have curious sound boxes or drums on the under side of the body just back of the legs at the base of the abdomen.

Description.

Egg. About 2 mm. long, white or pale yellow, transparent, slender, curved and pointed at both ends.

Larva. Dirty white, light brown or yellowish color. A wingless grub, with forelegs modified for burrowing, and with sucking mouth; resembling pupa. More or less hairy.

Pupa. About one inch long, nearly three-eighths inch thick, light brown or tan in color, with prominent legs, the fore pair fitted for burrowing. Head and eyes prominent, antennæ relatively small and inconspicuous. Abdomen large. Thorax and abdomen smooth and shiny. Head and legs hairy.

Adult. Wingspread of about three inches. Body from one to one and one-fourth inches long, about three-eighths of an inch thick. Wings transparent, shiny. Costa bright orange-yellow, other veins fuscous shading to orange at base of wings. Margins and marginal cells more or less fuscous-shaded, the shading and venation at base of marginal cells forming a W near the apex of each forewing. Body dark brown or black above, waxy. Ventral surface of body and legs brown shading to orange. Eyes bright coral red in life, color mostly disappearing in death.

Antennæ filamentous, inconspicuous, tapering, 6-jointed, black. The female has a sharp-pointed abdomen with a horny ovipositor folded up on the ventral surface near the tip. The male has a larger and more blunt abdomen, with a pair of sound boxes or drums on the under side at the base, just back of the rear legs.

The appearance of the adults and pupal shells may be seen on Plates IV and V, and in figure 3.

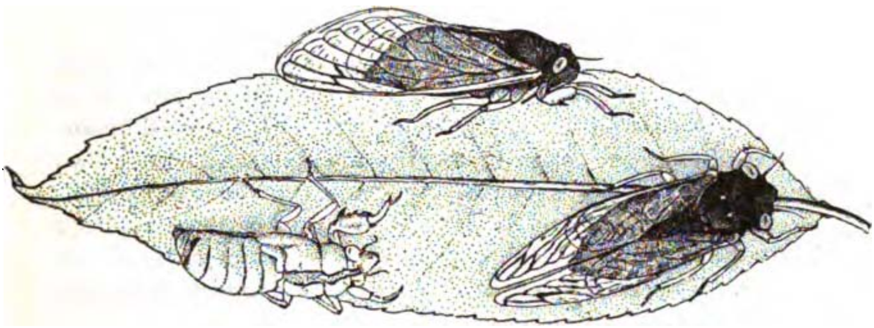


FIG. 3. Periodical cicada, adults and pupa shell on leaf. Natural size.

NATURAL ENEMIES.

No parasites were reared from cicada eggs in Connecticut in 1911, though four species of dipterous (two-winged flies) larvæ are known to feed upon them in the United States. Four species of hymenopterous (four-winged flies) insects are known to parasitize the eggs, though only one of these, *Lathromeris cicadæ* How., is at all abundant. This has been found sufficiently abundant in some parts of the country to considerably check the periodical cicada. Several species of mites are also known to feed upon cicada eggs.

This insect has predaceous enemies, one of the most important of which is the large digger wasp or cicada killer, *Sphecius speciosus* Dru., which stings the adult cicada and carries it away to its underground nest to serve as food for the young wasps. The sting paralyzes but does not kill the cicada, and the wasp lays an egg on the body of the cicada, upon which the young wasp larva feeds. No doubt predaceous ground beetles devour some of the newly hatched young, as well as the emerging pupæ.

It is probably true that birds devour large numbers of cicadas. Hundreds of cicada wings were seen on the ground in many places in Wallingford, Guilford and other towns, and Mr. Orrin Gilbert observed similar conditions at Middletown. Marlatt mentions* the investigations of Mr. A. W. Butler, who found thirty-one species of birds that fed upon the periodical cicada in Southeastern Indiana in 1885. The most important of these were the English sparrow, and among native birds, the robin, blackbird, catbird, red-headed woodpecker, flicker, towhee, and orchard oriole. In the list of less important cicada enemies we find the thrushes, Baltimore oriole, several sparrows and fly catchers, and the crow. We made no observations on the subject in this state, but it seems to be recognized by at least some of the farmers of Connecticut that crows feed upon cicadas. From two different sources, Berlin and Middletown, the reports stated that crows do not bother corn when cicadas are present in abundance.

A fungus described in 1851 as *Massospora cicadina* by Peck destroys many adults, especially males, in some parts of the country. This appears on their bodies as a greenish mold, but was not observed on cicadas in Connecticut in 1911.

Preventive Measures.

It is hardly practicable to enforce any measures for the destruction of the larvæ or pupæ in their subterranean chambers, except in a restricted way on private grounds and over small areas. Carbon disulphide injected into holes twelve inches deep, one for each square yard, the holes closed, will undoubtedly prove fatal to the larvæ.

The pupæ and adults may be gathered by hand and destroyed for the protection of choice trees or shrubs on private grounds. Mr. Abner Hoopes of West Chester, Pa.,† had a field of nursery stock containing some 240,000 peach trees near the edge of woodland infested by Brood X in 1902. Seven men were employed for over two weeks, and by actual count these men each destroyed more than 1,000 cicadas every day, or a total of about 100,000 altogether. Nevertheless, in spite of this work, Mr. Hoopes lost 12,000 out of the 240,000 trees from the attacks of the cicadas.

Small and choice specimen trees may be saved from injury by covering them with mosquito netting.

* Bureau of Entomology, Bull. 71, p. 138. 1907.

† Entomological News, Vol. XVIII, p. 108. 1907.

The newly emerged adults may be easily destroyed by dusting with fresh insect powder or pyrethrum in the early morning, while the dew is on them. Spraying with kerosene emulsion seems to be fairly satisfactory in destroying the adults, especially if diluted not more than five or six times.

Various repellent substances have been tried from time to time, and Slingerland* found some evidence that ordinary whitewash will partially prevent them from ovipositing, especially if there are untreated trees near at hand. Alwood† observed that where orchard trees were sprayed with Bordeaux mixture they were injured considerably less than those untreated. Though we have no real evidence, it seems probable that a spray of dilute lime-sulphur, such as is now used on the foliage for summer spraying, might be even more effective as a repellent than Bordeaux mixture.

For a more detailed account of the periodical cicada or seventeen-year locust the reader should consult Bulletin No. 71, Bureau of Entomology, U. S. Department of Agriculture, by Dr. C. L. Marlatt, a publication from which the writer has drawn freely in preparing this paper. It contains a series of maps showing the distribution of each brood, and also gives a complete bibliography regarding this insect, up to the time of its publication in 1907.

Descriptions of other kinds of cicadas occurring in Connecticut may be found in Entomological News, Vol. XVIII, p. 16, 1907.

THE MAPLE LEAF-STEM BORER.

Priophorus acericaulis MacG.

The life history of this insect was first discovered in 1906, and published in Entomological News, Vol. XVII, page 313, and mentioned in the report of this station for that year, page 295, and it was again rather common in 1911. Specimens of its work were received on May 25th from Brookfield Center and from Glastonbury, on May 31st from Meriden, and on June 1st from Derby. It was also noticed in New Haven, Wallingford, and several other towns by entomologists from this office. Apparently it was more

* Bureau of Entomology, Bull. 71, p. 143. 1907.
† Bureau of Entomology, Bull. 40, p. 75. 1903.

abundant in 1911 than it has been since 1906. The insect is one of the sawflies, and was first described by Dr. A. D. MacGillivray from material sent him from this office, in Canadian Entomologist, Vol. XXXVIII, page 306, September, 1906. As no adequate account of the species or illustrations of its work have ever appeared in the station publications, this brief article is included here in hope that the illustrations on Plate VI may enable someone to recognize the trouble.

Characteristic Injury.

The petioles or stems of the leaves are tunneled by the larvæ, and break off at a point half to quarter of an inch from the blades. The blades fall late in May and early in June, often covering the ground, while the stems or petioles remain upon the tree until ten days or two weeks later, when they are shed and drop to the ground. Property owners not understanding the trouble are greatly alarmed, and fear that the tree will lose all of its leaves. In the very worst cases that have come to my notice, however, not more than one-third of the leaves dropped. If there is a storm about June 1st, often a large number of leaves are taken off in one or two days.

Life History and Habits.

The egg is laid on the stem at the base of the leaf-blade about the first week in May, though probably oviposition extends over two or three weeks. There is no record regarding the time necessary for the eggs to hatch. The larvæ tunnel in the stems for about a month, often eating out the inside completely, and leaving only a cylinder of epidermis closely packed with castings. The stem thus keeps its shape, or perhaps is somewhat swollen, but it has no strength. The epidermal tissue is usually eaten nearly through when the larva approaches maturity, about three weeks after hatching, and the stem breaks off at this point. The greater portion of the stem hangs upon the tree for a week or ten days, ripens at the base as it would in autumn, and drops to the ground. The larva emerges from the stem through a hole in the side and goes into the ground three or more inches, and pupates in an earthen cell resembling the cell of the common currant worm, a closely allied species. The adult emerges the following May, and is a small four-winged fly with transparent wings, black antennæ, head and thorax, and with honey-yellow abdomen and legs.

The egg is colorless, about 1 mm. long and five times as long as thick, falcate or curved, with ends blunt and rounded. The full-grown larva is about one-third of an inch long and one-sixteenth of an inch in thickness, light yellow, with dark yellow or light brown head. Egg and larva are shown in figure 4.

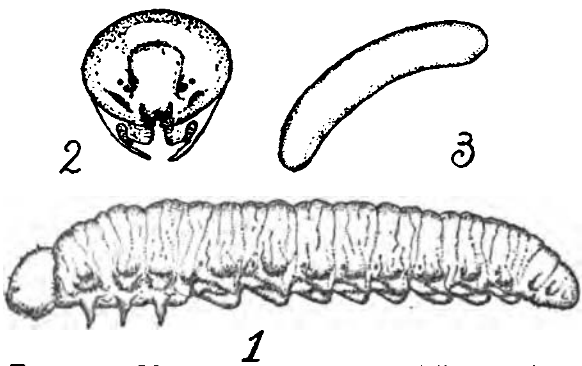


FIGURE 4. Maple leaf-stem borer. 1, full-grown larva; 2, head of same; 3, egg. All greatly enlarged.

NATURAL CHECKS AND REMEDIES.

A single example of a chalcidid parasite, still undetermined, but resembling *Pteromalus*, was reared from the material in the breeding cages.

No experiments have been made with remedies, but as it took seven years to finally obtain the adults of this species, it is evidently not hard to destroy. The knowledge of its life history indicates that if the ground under the infested trees be cultivated, or sprayed with kerosene emulsion about June 15th, when the larvæ are going into the ground, a large proportion of them will be destroyed.

RECORD OF PRELIMINARY TESTS TO PREVENT DAMAGE BY THE WHITE PINE WEEVIL.

BY W. E. BRITTON AND B. H. WALDEN.

The white pine weevil, *Pissodes strobi* Peck, is the most serious insect pest of young white pines in Connecticut. This insect has been present in the state for many years, but its injury has greatly increased during the past few seasons, owing to the fact that the white pine is being extensively planted as a forest tree. The larva of the weevil bores in the terminal shoot or leader of the past season's growth, usually killing it in one season, thus checking the tree for one year. If this was the extent of the injury, one of the lateral branches would gradually assume an upright position, taking the place of the leader, but this in turn is often killed by the weevil, so that in a few seasons the tree is but a stunted bush.

The common practice has been to cut out and burn the leaders containing the larvæ as soon as the injury is noticed. As the adult weevils pass the winter in the ground and come out about the first of May and feed upon the leaders for a few days before depositing eggs in them, treating the leaders either to poison or repel the adults was suggested. Extensive experiments in this direction were prevented by other work, but a few preliminary tests were made in a small field owned by Mr. E. Kent Hubbard of Middletown. The trees were eight to ten feet high, and had been injured seriously by the weevil in previous seasons. The applications were made May 17th, probably after some eggs had been laid as a number of adults were present at this time. Mr. Wickson, the superintendent, observed a pair of adults on May 13th, and treated a number of trees on that date. The materials used and the results are given in the following table:

Materials used.	No. trees treated.	No. trees losing leaders.	Remarks.
Paste lead arsenate,* 4 lbs. in 50 gallons water, 1¼ oz. per gal.	9	1	No injury from treatment.
Paste lead arsenate, 4 ozs. in 1 gallon water..............	11	3	No injury from treatment.
Commercial lime and sulphur, 1 pint in 1 gallon water........	3	0	No injury from treatment.
"One for All," 8 ozs. in 1 gallon water..................	8	0	Nearly all leaders treated showed injury.
Whale-oil Soap, 8 ozs. in 1 gallon water..................	8	1	No injury from treatment.
Tree Tanglefoot..............	3	1	No injury from treatment.
Checks......................	10	6	

* This treatment made by Mr. Wickson May 13th. All other treatments made May 17th.

The applications should have been made about May 1st, or perhaps earlier in certain seasons. The lead arsenate applied May 13th appeared to give better results than the stronger mixture (at the rate of 12 lbs. in 50 gallons) applied five days later. Though these experiments are not extensive enough to form any definite conclusions, they indicate that considerable injury from the weevil can be prevented by spraying the leaders with lead arsenate at the proper time. Trees up to four or five feet high could be sprayed with a good knapsack pump at a small cost.

There were not enough trees sprayed with lime and sulphur to form any conclusions. It would simply act as a repellent, and must be tested further to note its value, also to watch the effect on the trees; yet in this case not even the pine leaves were injured by the mixture, which was of the same strength as is commonly used on dormant fruit trees to kill San José scale. Whale-oil soap is more expensive to use than the materials above mentioned. Tree Tanglefoot is impracticable on account of the difficulty in applying it, and on account of injury "One for All" of the composition and proportions used must be abandoned, though the manufacturer claims that its composition has been changed so that no injury now follows its use.

THE CHERRY TENT-MAKER OR CHERRY TORTRIX.

Archips cerasivorana Fitch.

This insect was first described by Fitch in his third report on the noxious insects of New York, page 382, but seems to have been seldom mentioned in literature. As it attacks chiefly the choke cherry, it can scarcely be considered as an injurious insect, and this may explain the small number of references. Nevertheless, the nests are very conspicuous, and may be seen by any observer. For this reason a note regarding it is included here.

According to Weed,* the eggs are laid in summer in flattened masses on the bark of choke cherry bushes near the ground. Though at first yellow, the egg-cluster soon turns dark brown, and is almost indistinguishable from the bark except on close inspection. These eggs do not hatch until the following spring, when the larvæ crawl to the top of the bush and there construct their nest or tent, which is generally cone-shaped, being largest

* Bureau of Entomology, Bull. 26, n. s., p. 33. 1900.

at the base near the ground, and tapering upwards until it reaches a sharp point at the top. The entire bush is enveloped and the branches drawn together and fastened by the web, inside of which the caterpillars feed. An illustration from the U. S. Department of Agriculture, used in Smith's Economic Entomology, figure 371, shows between fifteen and twenty of these tents close together, and some of them apparently as high as a man's head. Usually they are less abundant, but may be seen singly or in clusters of a few nests each in clumps of choke cherry bushes along the roadsides or hedgerows. Specimens were received in 1911 from Roxbury and Milford. There is but one brood each year.

Though the choke cherry is the principal food plant, it also feeds upon the garden cherry and upon birch, especially *Betula populifolia*. Kellicott* stated that in 1882 this insect was "too abundant in certain ornamental birches in Buffalo." Spraying with lead arsenate would, of course, prevent damage.

The caterpillar is reddish brown in color, about one and one-fourth inches in length, and with a dark brown shiny head.

The adult moth has a wingspread of about an inch. Fore-wings reddish brown, with darker brown patches. Secondary wings and under surface lighter reddish brown. Adult, larva, pupa and nest are shown on Plate VII.

THE POPLAR MOCHA-STONE MOTH OR TENT-MAKER.

Melalopha (Ichthyura) inclusa Hubn.

A note in last year's report, page 710, mentions the prevalence of this insect, which also continued to be abundant in 1911. The caterpillars feed gregariously upon the different kinds of poplars and willows, and make small webs which remain on the twigs and resemble the winter nests of the brown-tail moth. The caterpillars do not remain in the nests, however, through the winter, like the brown-tail caterpillars. They rest in them while feeding, but pupate in September or early October. The empty webs hang to the twigs after the leaves fall, and are frequently mistaken for brown-tail nests.

* Fifth Report U. S. Ent. Commission, p. 505. 1890.

Evidently there are two generations annually, as the larvæ are found during May and June and during August and September, and the adults appear in March and may be taken during April and May, and again in July and August. The loosely spun cocoons may be found between partially folded leaves on the ground. Ordinarily this insect is not sufficiently abundant to cause much damage, and when it does appear in numbers, spraying the trees with lead arsenate is a satisfactory remedy.

The fully matured caterpillar is about one and one-half inches long and between three-sixteenths and one-fourth inch in thickness, body nearly cylindrical, with first and second and eleventh and twelfth segments tapering. Color dark brown or black. with four narrow dorsal lines honey-yellow in color; three similar lines show laterally above the spiracles, and below them the entire body color, including prolegs, is honey-yellow, excepting the true legs, which are black. Head black, somewhat shining, covered with soft hairs. On each of the fourth and eleventh segments there is a closely set pair of high, pointed tubercles, dark brown in color, bearing hairs. Body more or less thickly covered with soft curved hairs, white and light brown in color.

The adult moth has a wingspread of about one and one-fourth inches, color light brownish gray, with apical third of wings darkened with reddish brown or fawn and marked with fine white lines. Head dark brown, and a patch of the same color upon the thorax has margins extending in convergent lines to a point at the base of the secondaries.

Both larva and adult moth are shown on Plate VII, *a*. This insect is also called the poplar defoliator and the poplar prominent.

THE COLORADO POTATO BEETLE.

Leptinotarsa decemlineata Say.

BY B. H. WALDEN.

The Colorado potato beetle or "potato bug," as it is often wrongly called, is probably one of the best known insects in the state, but as many inquiries are being received about it as well as for literature regarding it, the following account is given.

The Colorado potato beetle, as the name suggests, is supposed to be a native of Colorado, where it was first observed feeding upon one of the nightshades common in that region. Through the introduction of the potato by the western settlers, the beetle found a food plant preferable to the native nightshade, and began to spread eastward over the sections in which potatoes were then grown. The insect was described in 1824 by Thomas Say, but did not begin to attract attention as a pest of potatoes until about 1865, when the insect had crossed the Mississippi river in its eastward journey. The potato beetle reached the Atlantic coast about 1872-73. The spread of the insect had been so rapid that in 1876 it covered about one-third of the United States, and methods of treatment were discussed at a meeting of the Connecticut Board of Agriculture held during that year.*

The insect is too well known to need detailed description. The adults, which are of a yellowish color with ten longitudinal black stripes on the wing covers, pass the winter in the ground and emerge early in the spring, often before the potato plants appear above ground. The beetle feeds for a few days, when the female lays a number of masses of orange-colored eggs, usually on the underside of the leaves. The eggs hatch, depending upon the temperature, in 4-10 days. The larvæ or "slugs" become full-grown in about 16 days to 3 weeks and then go into the ground to pupate. The adults of the second brood begin to appear in about two weeks. There are two broods each season. The egg-laying period may extend considerably over a month, so that the insect is found in all stages nearly all summer, and the adult beetles often cause as much injury as the larvæ.

Other cultivated plants often seriously injured by the Colorado potato beetle are egg plants, tomatoes, tobacco and occasionally peppers. It feeds readily on any of the wild solanaceous plants, and in the absence of these has been known to attack cabbage, thistle and mullen.

Remedies. It is interesting to note that the Colorado potato beetle was the first insect against which an arsenical poison was used. In small fields the beetle can be kept in check by jarring the adults into a pan of kerosene, and picking off any egg-masses at the same time. Large fields are treated with arsenical poisons. Paris green was one of the first poisons employed for this purpose, and is extensively used at the present time. It can be

* Conn. State Board Agriculture Report for 1876, pp. 263-268.

applied dry while the dew is on the plants by means of a powder gun at the rate of about one pound to the acre. The objection to this method is that many of the powder guns cannot be accurately adjusted to evenly distribute so small a quantity of material, and many of the plants will be burned by an excess of Paris green, while others will not receive sufficient poison to be effectual. A better method is to mix the Paris green with 10-20 parts of cheap flour, sifted land plaster or air-slaked lime before applying It is always advisable to add lime (air-slaked) to neutralize the soluble acid usually contained in Paris green, and if this is done no injury will result. Large plants can be much more thoroughly treated by spraying. The Paris green should be used at the rate of one pound in 100 gallons of water to which two pounds of fresh slaked lime has been added. It can be combined with Bordeaux mixture, which is used to control blight, without the addition of the extra lime.

Lead arsenate is replacing Paris green in spraying potatoes as in all other spraying with arsenicals. The paste lead arsenate should be used at the rate of three pounds in 50 gallons of water, or the dry lead arsenate at the rate of 1½ pounds in 50 gallons of water. The lead arsenate is less liable to injure foliage, sticks to the leaves much better than Paris green, and one application is often as effectual as two or more of the latter.

Poison should be applied as soon as the young larvæ begin to hatch, and the number of applications to be given will depend upon the abundance of the pest as the season advances.

Often only an occasional plant will be infested at first and with a small amount of poison in a compressed air knapsack sprayer one can treat these in a short time. Frequently this will reduce the numbers so that no further treatment will be necessary.

Dr. J. B. Smith of New Jersey recommends spraying potatoes as soon as the beetles begin to feed in order to kill these before the eggs are laid.

Attention is called to the following articles for a more complete account of the Colorado potato beetle:

The Colorado Potato Beetle. Report of New Jersey Agr. Expt. Station, pp. 452-458. 1895.

The Colorado Potato Beetle. Circular No. 87, Bureau of Entomology, U. S. Dept. Agr. 1907.

THE PEACH SAWFLY IN CONNECTICUT IN 1911.

By B. H. Walden.

The peach sawfly, *Pamphilius persicum* MacG., which was discovered in the state in 1906 and found to be not only a new enemy of the peach but an undescribed species, was discussed in the Seventh Report of the State Entomologist.*

In the orchard of Barnes Brothers at Yalesville, which was sprayed in 1907, the treatment was so successful that the insect has not again appeared in sufficient numbers to require further treatment, but it has spread gradually to other orchards, and is now well distributed throughout the central and eastern part of New Haven county, is present in the western portion of Middlesex county, and probably extends into the southern part of Hartford county. In 1910 considerable injury was reported in the orchards of Barnes Brothers at Durham and in the orchards of Charles E. Lyman at Middlefield, although as far as we learned no peach trees were sprayed during that season to control this insect. The peach sawfly also stripped many small trees in the orchard of J. A. Martin, Wallingford, in 1910, and on June 9th, 1911, the writer visited this orchard by request to learn if the insects were abundant enough to cause serious injury later. The owner stated that the adult flies were very abundant during the previous week. At the date of the visit there were very few adults present. There were, however, many hymenopterous insects (unidentified) flying about the trees which might be mistaken for the sawflies. These may have been parasites of the above pest. Eggs of the sawfly were present in a large section of the bearing orchard, and were more numerous, four to five on a leaf, in the two-year trees that were defoliated the previous season. The owner was advised to spray the young trees the following week with lead arsenate and also that part of the bearing orchard where the eggs were the most numerous, and to watch the remainder of the orchard and to spray if there was any indication of the trees being defoliated. The owner sprayed the trees as advised, including many more of the bearing trees. In all between eight thousand and ten thousand trees were sprayed

* Report Conn. Agr. Expt. Station, pp. 285-300, Pl. I-VI. 1907-08.

with lead arsenate, two lbs. to 50 gallons of water, to which was added 1½ quarts commercial lime-sulphur. No injury was reported to the foliage and the sawfly was held in check. Several isolated trees not sprayed were badly eaten.

In the Durham orchards of Barnes Brothers about 20,000 peach trees were sprayed with lead arsenate, using three lbs. in 50 gallons of water. Many of the trees were badly injured by the spray, and some trees that were given, as considered by the men, "an extra good treatment," dropped nearly all their leaves. The lead arsenate was a standard brand guaranteed to contain 15 per cent. arsenic oxide. One and one-half pounds of the lead arsenate would probably have been sufficient to kill the sawfly larvæ, as insects of this class are very readily killed. The lead arsenate used in spraying 6,000 peach trees without injury in 1907 contained less than 12 per cent. of arsenic oxide. Whether the higher percentage of arsenic oxide in the lead arsenate used in 1911 was responsible for the injury or whether the injury was due to soluble arsenic or to weather conditions, we are unable to state. The indications are that this brand of lead arsenate contained an excess of soluble arsenic, as one orchardist severely injured the foliage of apple trees from an application of it. In the station experiments the past season, peach trees were sprayed with lead arsenate combined with lime-sulphur preparations with little or no injury, as follows:

(*One orchard.*)

The first and second sprayings with dry lead arsenate, 2–50, with commercial lime-sulphur at the rate of 1–150.

Two lbs. dry lead arsenate with self-boiled lime-sulphur 8–8–50.

No injury to foliage observed.

(*Two orchards.*)

First spraying with paste lead arsenate, 3 lbs., with self-boiled lime-sulphur 8–8–50.

A very slight injury to the foliage.

A different brand of paste lead used in each orchard.

In the self-boiled lime and sulphur preparations the lime may tend to neutralize any soluble arsenic that may be present in the lead arsenate. In spraying for the peach sawfly we would advise using only 1½ lbs. of paste lead arsenate in 50 gallons of water.

HOW TO GET RID OF ANTS.

In Lawn or Garden. With a crowbar make holes eighteen inches deep in the nests. If a section of the lawn is infested, holes should be made about two feet apart over the area. In each hole pour about two fluid ounces of carbon disulphide and stop up the opening. The fumes will penetrate the tunnels and kill the ants. Fire should not be used near this liquid, which is inflammable.

In Cellar, Kitchen or Pantry. Place naphthalene flakes in the runways or around the edges of shelves and corners of rooms where the ants usually enter and travel. They are soon driven away.

FIGURE 5. Female Leopard Moth. Natural size.

THE LEOPARD MOTH.*

Zeuzera pyrina Linn. (= *æsculi* Linn.)

By W. E. Britton, *State Entomologist, and*

G. A. Cromie, *Superintendent of Trees in the City of New Haven.*

Appearance of Infested Trees.

Many of the magnificent elms that have stood as landmarks on the streets and in the central parks of New Haven and other coastwise cities of Connecticut for over a century are dying with little outward apparent cause. And not only are the veterans being destroyed, but trees of all ages suffer where apparently receiving sufficient food and moisture. Dead branches may be seen in numbers, standing above the leafy masses in the tree-tops. Each storm brings down numbers of branches, many of them in full leaf, and if the broken ends are examined, one will notice that just underneath the bark the branch has been girdled. This is the work of an insect that has only within the last few years reached Connecticut, but which has already proved itself our most serious insect enemy of shade trees,—the leopard moth.

Trees recently infested show small twigs broken over and wilted, the leaves on the ends of occasional branches turn yellow and in a few weeks drop. Trees in a later stage show a mass of dead upper branches, as shown on Plate IX, while from the trunk and larger limbs sprouts or suckers appear. Here and there branches are seen with comparatively few, small, sickly leaves. Yet when the tree is cut down the trunk and larger limbs have the appearance of perfect health.

Since the larva bores largely in the sapwood and cambium, the damage done by it is unusually severe, the work of one insect often being sufficient to kill a small tree. Remaining in the wood during the greater part of its life, it is rarely seen by the casual observer, and for the same reason no general and convenient

* This paper was published as Bulletin 169, November, 1911, in an edition of only 3,000 copies, and distributed to entomologists and others known to be interested. It is here reproduced with slight emendations.

methods of controlling it are available, as in the case of insects which eat the foliage. It does not confine its attacks to elms, but is a very general feeder, being found to some extent on nearly all our deciduous trees and larger shrubs. Like many other insect pests that have at various times become unusually destructive, this leopard moth is not a native of this country, but was introduced here probably from Europe. The number of dead branches caused by it not only threatens the life of the tree, but falling from the height to which some of our large trees have grown, are a source of great danger to property and to persons passing beneath them. In Newark, N. J., scarcely a large tree of species susceptible to attack stands to-day, uninjured by this pest, while numbers of young elms recently planted are being deformed.

In Central Park, New York City, Dr. Southwick "has removed hundreds of loads of branches killed by this insect," while in Cambridge, Mass., numbers of old elms have already been removed from this cause.

In New Haven the damage is especially severe in the older sections of the city, within a radius of one mile from the City Hall. On Central, Wooster and Broadway Greens most of the older trees have either been removed or are badly mutilated by the removal of the dead wood. In other parts of the city the insect is present, but severe damage can be found only in occasional groups of trees. Because the female moth is a poor flyer, a tree (or a group of trees) is liable to be the home of succeeding generations as long as portions of it remain alive, while trees only a short distance away are often free from the pest. The trees of New Haven are at present especially liable to injury because they are large and in long, close rows, with interlacing branches, and of species readily attacked.

This Insect a Pest in Europe.

Though apparently the leopard moth is less serious as a pest of shade trees in Europe than in this country, it nevertheless does considerable damage. Theobald[80] states that it attacks chiefly the cherry, apple, pear and plum in England, but that he has also seen young walnut trees killed by it, and furthermore that "it has been decidedly on the increase in apple trees during the last few years." He also remarks that the leopard moth has long been known as a borer into the trunks of various trees in England and all over Europe. In addition to the trees just named, Miss Ormerod[73] mentions ash, beech, birch, elm, holly, lime, oak and horse chestnut. Gillanders[78] includes the hawthorn and sycamore among the trees attacked and injured in England. Rev. J. G. Wood[66] many years ago wrote that though the leopard moth infested fruit trees in England, it seemed to do little if any harm to them. Eckstein[72] writes of the leopard moth as also attacking syringa, willow, maple, mountain ash and mistletoe in Germany, in addition to the food plants already mentioned here. Kollar[64] states that in the neighborhood of Vienna the leopard moth injures the trunks of elm, walnut, pear and apple trees. To this list, according to Judeich-Nitsche[70], may be added linden, poplar, cytisus, alder, pomegranate tree, spindle tree (*Euonymus*) and pine.

The leopard moth is figured in Atlas d'Entomologie[75] Forestiere, plate 29, by E. Henry.

The foregoing references have been cited here to show that the insect is a recognized pest of trees in Europe, although Dr. L. O. Howard, who has made several trips through Europe, states in a letter that the insect does not seem to be especially destructive in any part of Europe which he has visited.

Occurrence in Other Countries.

Though the leopard moth is found throughout Central and Southern Europe, according to the Bureau of Entomology[56] it also occurs in Asia Minor, Northern Morocco, Algeria and Southwestern Africa. Mr. South[81] states that it is also present in Corea and Japan.

According to P. Lesne,[79] this insect is the worst pest of the cork oak in Algeria, though after three years work he claims[84] to have brought it under control by the use of carbon disulphide squirted into the galleries, or better yet, placed in gelatine capsules small enough to be inserted in the burrows. The moisture in the wood dissolves the gelatine in twenty-four hours, and the fumes then kill the borers.

History of its Spread in America.

The leopard moth occurs in Europe, and is believed to have been introduced from there into the United States, though the date of its introduction is uncertain. The species is included by Walker in his list of Lepidoptera in the British Museum,[48] as occurring in North America, and by John G. Morris in his Synopsis of the Described Lepidotera of North America,[1] with a brief description, and the locality given as "North America." Two years later (1864) the late Professor A. S. Packard, in his Synopsis of the Bombycidae of the United States[2] also includes *Zeuzera pyrina* with the same statement as occurs in the Morris catalogue, from which it may have been copied. *Zeuzera pyrina* may also be found in the list (page 10) of North American Lepidoptera, published by the Brooklyn Entomological Society in 1881.

Professor John B. Smith,[14] however, doubts the identity of the species listed as *Z. pyrina* in Walker's catalogue, which Morris, and probably Packard, had followed. Smith visited the British Museum and was unable to find any specimens or records[18] there to warrant Walker's citation that *Z. pyrina* occurred in North America at the time his catalogue was issued.

The first definite record of the occurrence of the leopard moth in America is a short note by Mr. Jacob Doll in Papilio,[8] which states: "A fine example of this well-known European species was taken in a spider's web in Hoboken, N. J., in June, last, by Mr. Schmitz. It was alive and was endeavoring to escape from the web. The specimen is now in the collection of Mr. B. Neumoegen." This was written in 1882, and the moth taken in 1881.

Entomological News for March, 1904,[46] states that this specimen was a female, and was captured in 1879 instead of 1881. Be that as it may, the destructive work of the moth was observed in Central Park, New York City, in 1884, by Dr. E. B. Southwick, and in 1887 at Newark and in 1889 at Arlington and Orange, New Jersey. In 1894, Dr. Southwick pronounced it one of the worst insect pests attacking shade trees.[27]

In 1894, Smith stated[28] that Col. Nicholas Pike reported that the leopard moth occurred in Connecticut. It was soon noticed in cities near New York, though spreading much faster toward the northeast along the coast than in any other direction. In 1905, Dr. Felt[47] reported the pest at Kensico, N. Y., a point twenty-five miles north of New York City. The earliest Massachusetts record that we can find is that of a male taken by Mr. C. A. Frost[50] at Medford, July 1st, 1903. In 1907, Professors

C. H. and H. T. Fernald[49] called attention to the presence of the insect in the vicinity of Boston. In 1909, the senior author learned of its great destructiveness to the trees of Cambridge. Mr. E. H. Armstrong has observed its work at Taunton, Fall River and New Bedford, and Chapman[63] reports its presence at Concord, Lowell and Lawrence, as well as at many other places

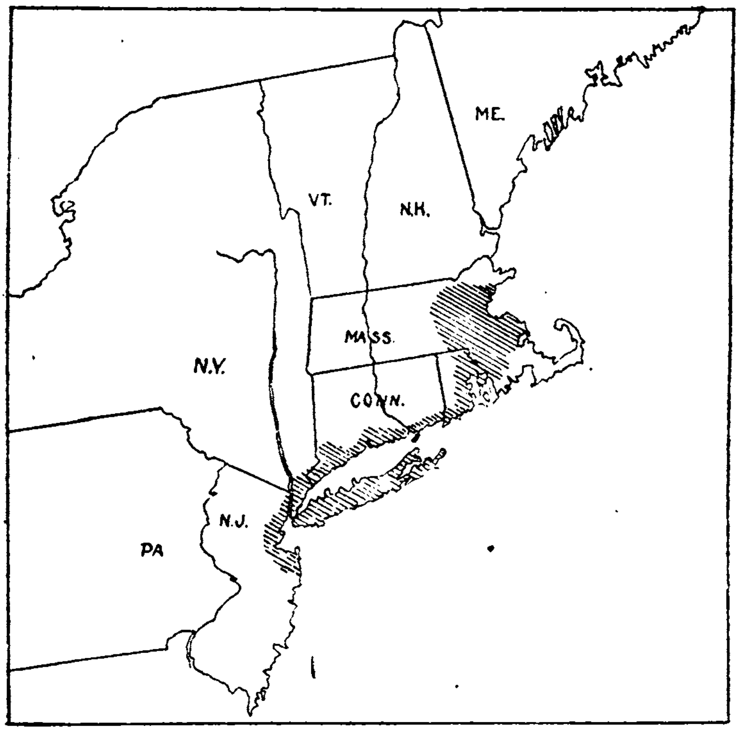


FIGURE 6. Shaded area shows present distribution of the leopard moth in the northeastern states. Cape Cod may also be infested but we have no records to show it.

nearer Boston. Mr. Armstrong is authority for the report that the insect occurs at Providence, Newport, Westerly and East Greenwich, in Rhode Island.

The leopard moth is reported by Professor Smith[88] as occurring as far south as Long Branch, N. J., and Mr. Bartlett has seen it at Asbury. At the present time, as is shown by the map, Fig. 6, the insect occurs from Asbury, N. J., at least to the vicinity of Lawrence, Mass., and in nearly every city along the coast, between these points, much damage has been done by it to shade trees. We have no records of the occurrence of the insect at points more than twenty-five miles inland. It is difficult to explain why it should spread so much more rapidly toward the northwest, along the coast, than in any other direction. Chapman questions[63] whether the infestation around Boston may not have resulted from a separate and later importation.

Distribution and Spread in Connecticut.

Though, as already stated, the leopard moth was reported to have reached Connecticut by 1894,[28] the first definite record that has come to our notice is that of Mr. H. M. Russell, now of the Bureau of Entomology, who formerly lived in Bridgeport, Conn. Mr. Russell collected specimens of the leopard moth at Bridgeport in 1901.[56]

The first Connecticut specimen in the collection of this station was taken in New Haven, July 1st, 1907, by Professor H. W. Foote of Yale University. Since then a number of specimens, chiefly males, have been taken around electric lights. Mr. A. B. Champlain, a former assistant in entomology at this station, collected and observed the males during 1910 and 1911, at several arc lights, including those near the station on Prospect street.

The photograph on Plate IX was taken on the New Haven Green in 1908, and shows that the pest had then been at work for some time, as is evidenced by the dead terminal branches.

Mr. E. H. Armstrong of the Providence Forestry Company, Inc., has informed the senior author that he has observed the work of the leopard moth in New Haven, New London, Mystic and Stonington and that with the exception of Cambridge, Mass., he considers New Haven the worst infested spot that has come under his notice.

Mr. F. A. Bartlett of the H. L. Frost & Bartlett Company states in a letter that he has observed the work of the insect in practically every town and city along the Connecticut coast this year, and that it has been especially serious at Bridgeport and less so at Stamford and South Norwalk. He also saw a little of its work at Danbury, which is about twenty-five miles inland.

Mr. D. J. Caffrey, assistant in charge of the gypsy moth work, observed, in 1911, many trees showing the characteristic leopard moth injury at Wallingford, about twelve miles from the coast.

In September, 1910, the leopard moth was found infesting young apple trees in a nursery at New Canaan, Conn., the adult insect was reared from the larva, and a short account was published in the Journal of Economic Entomology[61] for June, 1911. This locality was less than ten miles from the coast. The insect was found again in the same field in September, 1911.

Description.

Adults.—Wing expanse from two and one-half to three inches in the female and about one and three-fourths inches in the male. Wings dirty white and semitransparent, with a yellow or brownish front margin to the fore wings and the same color extending along the principal veins. The wings are marked with metallic blue dots, as shown in the accompanying illustrations, Figure 1, and Plate XVI, *a*. The markings are much more

Figure 7. Leopard moth caterpillar. Dorsal and lateral views, natural size.

Figure 8. Pupa, natural size.

pronounced in the female than in the male, which sometimes has very faint dots. Color much brighter in the female. Thorax white or yellow dorsally, with six blue-black spots, three in a row on each side. Ventral side, black; abdomen, black, with more or less whitish pubescence, and the female has an extensile three-jointed ovipositor, by means of which eggs are laid under the edges of bark; legs, black; the second and third pairs of femora bearing whitish woolly hairs. The female has thread-like and the male feathery antennæ. The female is shown in Figure 1, and both sexes on Plate XVI, *a*.

Egg.—The eggs are about the size of a pinhead, or one-sixteenth of an inch long, oval, somewhat pointed, and salmon or orange-yellow in color. They are usually laid singly or in groups of two, three, or four each. Shown on Plate XVI, *b*.

Larva.—Length about two and one-fourth inches, dirty white, dull yellow, or flesh-colored, marked with dark brown or black tubercles, each bearing a short bristle. The fourth to the tenth segments inclusive bear two pairs of tubercles, the front pair being closer together than the rear pair. The second, third, eleventh and twelfth segments have smaller tubercles arranged more nearly in transverse rows. Laterally, there is a row of brown tubercles just above and another row just below the spiracles. A second row of smaller tubercles may be seen on the bases of the legs and pro-legs. The large cervical shield and smaller anal shield are dark brown. Head, dark brown, with upper part of front lighter. Legs, light brown. The larva is shown in Figure 7, and on Plate XVI, *c*.

Pupa.—About one and one-half inches long, scarcely tapering, anal extremity, blunt; dark brown in color. On the proximal and distal margins of each abdominal segment there is dorsally a ridge consisting of a number of short, black spines or teeth, pointing backward. Similar spines or hooks, projecting forward, occur on the ventral surface of the posterior segment. Shown in Figure 8.

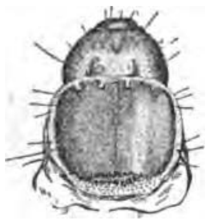


FIGURE 9. Head and cervical shield of larva, much enlarged.

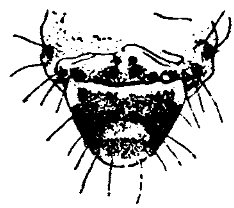


FIGURE 10. Anal plate of larva, much enlarged.

All stages of the leopard moth are shown in the accompanying illustrations.

LIFE HISTORY AND INJURY.

Just as the manuscript of this bulletin was ready for the printer, a publication on the same subject by James W. Chapman,[63] and published by the Bussey Institution of Harvard University, came to hand. Mr. Chapman, by original observations, has made an important contribution to the habits and life history of this insect, and we have, therefore, revised several paragraphs in this bulletin, to include the chief results of Mr. Chapman's studies.

The adult moths appear during a period extending from May to September, according to the circular issued by the Bureau of Entomology.[56] In New Haven, however, by far the greater number are found during the early part of July, while specimens have been secured during late June and the first week in August. The male is much the smaller, and flies with ease, being attracted by the electric lights. The female has a heavy body, and flies very little, preferring, if possible, to lay eggs on the same tree where she emerged from the pupa. For this reason, high trees, isolated, and one hundred feet or more away from others injured by the leopard moth, may remain uninfested for years, while continuous rows of trees with branches touching are soon infested throughout.

The moths eat nothing and live at the most but a few days, the male dying immediately after copulation, the female as soon as the eggs are laid. One female captured by the junior author lived three days.

The eggs are inserted in crevices in the bark, or beneath plates of bark, one to several in a place, usually in the higher branches of the tree. They may, however, be laid on larger branches or on the trunks of small trees. They are less than one-sixteenth of an inch in length, oval, and yellowish or salmon colored. Several observers, including the junior author, have found the eggs laid by females in confinement, in several masses, due, no doubt, to the unwillingness of the female to deposit them sooner than necessary under unsuitable conditions. Numbers of the borers, just hatched, were found, and in every case they were working singly, usually just above a bud or twig on one of the smaller branches. This, according to J. W. Chapman,[63] means that the new larvæ do not enter the branch at the place where they hatch, but crawl some distance to the smaller twigs. Although this is the rule, the junior author has found several which had entered branches two to five inches in diameter, taking advantage of crevices in the bark. Each female may deposit from 400 to 800 eggs.

The larvæ hatch within a few days (ten days, according to Mr. Walker[26]), being plentiful in the latter part of July, and immediately commence their destructive work, boring into the branches. A careful examination of the twigs of an infested tree will show a slight amount of the white, powdery sawdust expelled by each larva during the first few days after hatching. In a few days the character of the expelled frass changes to small cylindrical pellets, light golden or brown in color.

Several experiments made by Mr. J. W. Chapman[63] are of value in showing the activity of the newly-hatched larvæ. A number of these were placed at the base of a fresh lilac bush and soon commenced to climb. On reaching the twigs, they were at once taken off and again placed at the base, when they would immediately commence climbing again. In this way four of those making the greatest progress had in four hours traveled distances varying from twenty-five to eighty feet.

Other experiments showed that some of the more recently hatched larvæ were able to crawl from fifty to one hundred feet on the ground, through grass and rubbish, while others nearly full-grown would move very little, but would protect themselves by spinning together small particles of sticks and dirt.

Growth is rapid, and the larvæ reach a length of about an inch by the end of the first season. The general tendency is for the insect to work upward from the hatching point, or from any opening made for expelling the frass. Small twigs are hollowed out, leaving little but a shell of bark, and small branches may be girdled, causing them to break off during a heavy rain. Where the young hatch in larger branches, the regular burrows are often varied by small, irregular patches eaten out of the inner bark. Branches too small, in a dying condition, or otherwise unsuitable, are vacated, the insect crawling on the outside of the bark and making a fresh entry on another and usually larger branch. A burrow may strike a knot or small branch, when, after going back several inches, the insect starts in a new direction. New outlets may be made, and the use of old ones discontinued from time to time. These outlets are always in some protected situation on the under side of a branch or in a crotch. They are kept covered with a closely woven silk web, this being broken and remade each time the frass is expelled. In one case the web was broken by the junior author and remade by the insect five times within an hour. This web certainly helps to conceal the hole, and may be used to keep out air, parasites, ants and other insects. Unlike the galleries of the sugar maple borer, those of the leopard moth are kept clear, all frass being removed as soon as a small pile has accumulated, and cement sidewalks under badly infested trees are often littered with the brownish pellets expelled from the burrows.

During the latter part of October the larvæ leave the outer wood and bore slanting holes upwards and into the wood two inches or more from the bark, where they remain in a dormant stage over winter. Sharp[74] cites Kalendar to the effect that the larva forms a temporary cocoon in which it passes a winter sleep before again feeding in the spring, but this is not the case in Connecticut, as Mr. Cromie has taken numbers of naked larvæ from the branches during winter.

The boring is continued in the same manner during the next summer, but the damage done is now much greater, both the insect and the branches attacked being larger. Branches four to eight inches in diameter may be entirely girdled, or large patches of wood may be eaten out. The wounds made the preceding year now show at their worst, the bark falling away, and ugly ridges being made where they have partially healed.

When fully grown, the larvæ are about two and one-fourth inches in length, and most of them do not enter the pupa state until the early part of the succeeding summer, when they are nearly two years old. The writers have reason to believe that some of those hatched early change to pupæ and complete the life cycle as those appearing latest during the next year. However, those passing the second winter continue active boring in the spring, changing to brownish pupæ in May or later. This is done in a small chamber within a few inches of where the larva has previously cut its way almost through the bark. It also further protects itself, before pupating, by a fine web placed between itself and the place of exit. In from four to six weeks the pupa cuts through the bark and, by means of protuberances on the abdominal segments, wriggles itself partially out of the hole, where it leaves the shell or pupa case after it flies, as may be seen on Plates XI, *b,* and XV.

As shown before, this insect attacks to some extent nearly every tree, native or exotic, growing in this region, except evergreens, so that a full list is not necessary. However, in New Haven the American elm is one of the kinds most severely attacked, while, owing to its dark, plated bark, even on the smaller branches, the insects in it are very hard to detect. With it, in amount of injury done, may be classed the silver maple and the sycamore maple. Other common species often seriously injured are ash, English elm, basswood or linden, tulip, sugar, red and Norway maples, poplar and horsechestnut. The honey locust, sycamore, sweet gum, and oak seem much less liable to attack, in many cases, in New Haven, remaining uninjured, although standing in rows with affected elms.

Natural Enemies and Checks.

In this country no parasites have been recorded that hold the leopard moth in check. In Europe a chalcidid parasite of the subfamily Encyrtinae, *Litomastix* (*Copidosoma*) *truncatella* Dalm., has been reared by E. A. Fitch. (Entomological Magazine, Vol. XVIII, p. 116.) This and an ichneumonid, *Schreineria zeuzeræ* Schrein (not Ashm.), are mentioned in a letter to Mr. Cromie from the American Consul-General at Berlin, the information being received by him from the Kaiserliche Biologische Anstalt für Land- und Forstwirtschaft in Dahlem-bei-Steglitz. The former, *L. truncatella,* is probably the same as was reared in this country from the cabbage looper, *Plusia brassicæ* Riley. (Rept. of Ent. U. S. Dept. Agr. 1883, p. 121.)

An examination of hundreds of the caterpillars and pupæ, as well as the burrows made by them, shows that the leopard moth is remarkably free from natural enemies of all kinds. In no case was there evidence of either parasitic or predaceous insects. Dr. L. O. Howard, who has given some attention to the subject, has not found that any effective parasitic check exists even in Europe, though he has promised to bring to America the species known to occur there. Mr. Cromie found in New Haven a caterpillar dead in its burrow and full of small maggots, but these proved to be a Phorid fly, *Aphiochæta nigriceps* Loew., which probably did not attack the borer until after it had died from some other cause. This was the only indication found of an insect being destroyed while in its burrow. All pupæ, the stage generally exhibiting parasitism, seemed to have developed properly. Undoubtedly some check to the insect must exist before the burrow is developed, because of the small number of burrows found as compared with the large number (several hundred) of eggs, laid by each female. Either the female is unable to deposit any large number of her eggs in proper situations, and they thus fail to hatch, or the eggs themselves are largely eaten by the birds or insects found in cities. The writers have noticed that English sparrows search for and apparently find food on elms infested by the leopard moth in July, when the eggs should be plentiful and the young borers just hatching, but their prey might have been other insects. In many cases small holes, barely started by newly hatched larvæ, were found vacant, indicating that birds had secured the insects before they were able to enter the wood.

As the leopard moth is a pest chiefly of cities and towns, it is thought that certain birds, especially woodpeckers, assist in checking it, especially in the country districts. The habits of the moths in flying about electric lights would lead one to expect that many of them might be eaten by bats and night-flying birds. It is also believed that sparrows sometimes may feed upon the eggs or young larvæ. Smith states[58] that the leopard moth is a serious pest only where the English sparrow has driven away the native birds.

No other explanation can be given of the scarcity of the leopard moth in the country, adjacent to infested towns, except the presence of insectivorous birds. This tendency of the insect to become a pest only within cities and towns is noted by several English, French and German writers, as well as in this country. Mr. James Walker of Newark, N. J., states that infested elms placed in a nursery outside the city limits of Newark were rid of the larvæ by woodpeckers. This coincides with a statement made by P. Lesne,[79] who mentions having seen in Northern Algeria numerous woodpecker holes ending in the burrows of the leopard moth. While traveling from one branch to another, a habit of this insect, it is exposed to the attacks of birds. Mr. J. W. Chapman[68] also cites evidence of squirrels in the Boston parks chewing the smaller branches to secure the larvæ, which they relish.

Especially in early summer, numbers of small girdled branches in full leaf are broken off by storms. Nearly all of these contain the caterpillar which has done the girdling, and the branch soon wilts and dies. Though most of the larvæ desert the branch within two or three days after it falls, the junior author has found several of these shrunken and in a dying condition on the branch, showing that the insect cannot sustain life on the dead wood. It is also evident that very few of those which leave the branch are able to again find and climb a large tree. On city streets these branches are usually gathered at once and destroyed because of their hindrance to traffic. In parks it is even more necessary that this should be done, as here the insects can easily leave the fallen branches and enter shrubbery or small trees.

Remedial Treatment.

In view of the protected life led by this insect, treatment is especially difficult. Tunneling under the bark during the greater part of its life, it is not affected by arsenical or contact sprays. The protracted period during which it may appear as a moth hinders effective action against the adult. Isolated trees recently infested, and small trees with smooth bark, can be saved by a thorough inspection two or three times a year, followed by the removal of badly infested branches and the destruction of larvæ found, either by the injection of carbon disulphide (bisulphide) into their burrows or the insertion of a hooked wire to draw them out. Large trees badly infested should be cut down at once.

Unfortunately, this insect lives so concealed a life as to attract little attention until it is well distributed in a town or city and serious damage has been done to the trees. Where not already present, all planting stock should be bought from nurseries free from this pest,—probably in a district not yet affected. A careful watch must be kept for its first appearance, when, because of the inability of the female to make long flights, the removal of the trees for a couple of hundred feet around the affected section will form a quarantine that will greatly help to keep it in check. Special attention can then be given to all trees in and close to the affected area. Most citizens are averse to having trees removed from in front of their property until they are very far gone, but stern measures are necessary in preventing the spread of this insect.

Electric Lights. The moths are attracted by the strong arc lights used for street lighting, and numbers of them, largely males, could be secured in the flying season by sending men around to collect them from nine to twelve o'clock at night, or by the payment of a small bounty to boys, according to the quantity collected. This method of check, especially where females are secured, is of immense value, as it is much easier to prevent eggs being laid than to find the larvæ, which would otherwise hatch.

Mr. J. W. Chapman,[68] during the month of July, had placed in the Harvard College yard three six ampere arc lights, without globes or reflectors. About twelve inches beneath each light a pan three inches deep and twenty-four inches in diameter was suspended by wires. The pan was then half filled with water, with a thin film of kerosene on top. These lights were run as traps during the first two weeks of July, the insects being attracted to the lights and then falling into the pan and being killed by the oil. In this way 279 male and 58 female moths were taken. Undoubtedly if the traps had been placed during June, when the moths first began to fly, a correspondingly larger number would have been taken.

Removal of Affected Branches. Trees badly affected are best removed, as the pruning of large numbers of branches leaves only mutilated specimens not worth the cost of the repeated inspection and treatment required.

Pruning should be done while the tree is in foliage, preferably twice a year, once in spring and once in late summer. The number, size and color of the leaves is the best guide as to affected branches. The tendency is not to remove many of these, which, if left, will probably die later in the season, or at least harbor numbers of eggs and of the young larvæ whose work does not yet show. All dead branches should be removed at a point well below the beginning of the green wood, so as to be more likely to secure the insects doing the damage. Branches containing small leaves, leaves thin or yellowish in color, or those where the leaves are few and scattered, are sure to be infested, and should be removed.

Inspection, and Destruction of Larvæ. On large numbers of trees over fifty feet in height, the expense of this method is prohibitive, and the difficulty of locating the insects renders it impracticable. Especially is this so with elms of even smaller size, because of the rough, scaly bark on all but the smallest twigs. Also on such trees the branches are very numerous, long, slender and horizontal, making climbing in some places impossible.

To find out how successfully this method could be applied to large elms, the junior author selected several badly infested ones, sixty to eighty feet high, and had two of his best climbers treat them under his personal inspection, without limiting them as to time. Then live branches which had thus been carefully examined were cut from the tree and the bark peeled with a draw knife, exposing all leopard moth galleries. Less than twenty-five per cent. of the larvæ on the infested branches had been secured while on the tree. Also, Mr. Chapman, in describing the experiments in Harvard College yard, states that previous to placing the trap lamps, in which over three hundred moths were secured, "the yard had been patrolled since early spring by three men, who spent their entire time searching out and destroying the larvæ and pupæ of the moth."[68] On smaller trees, in New Haven, especially of species with smooth bark, it was found possible, by a thorough inspection, to secure practically all of the older larvæ.

In East Orange, New Jersey, where there are few elms, and the trees are, as a rule, from ten to fifty feet in height, the following method, carefully applied for three years, has placed the leopard moth under control:—Gangs of men, trained to the work, in August and September of each year look on the ground and sidewalk under every tree for the piles of brownish pellets and sawdust dropped by the borers. Carefully spotting the branch over each pile, the man climbs the tree and, if experienced, can locate nearly every hole, which, at that time, is covered by the silk web, when the insect is either secured with a wire, or carbon disulphide is injected from a small oilcan, and the hole stuffed with putty or soap.

Although the burrows are usually well cleared of frass, allowing the fumes of the carbon disulphide free access, there may be other outlets to the burrow, so the method of securing the insect with a wire is surer. A piece of No. 16, soft, steel wire is used, one end being bent into a very small hook, and sharpened from time to time by cutting the end of the hook in a slanting direction with a pair of linesman's pliers. Often the insect cannot be reached without cutting the burrow open for some distance with a stout jackknife, but this is easily done, as there is only the bark to cut through, and the real injury is not increased. If the branch is found to be nearly girdled, it had better be cut off.

In this way the larger larvæ (those in their second summer), which, of course, are found in the larger branches, are destroyed, preventing the laying of eggs the following summer. The same method is followed out the succeeding fall, when the younger larvæ, which, by this time, have grown large and come down to the larger branches, are also procured.

In high trees, the wind so scatters the falling pellets as to make it impossible to ascertain from their location on the ground the number or location of the insects in the tree.

Disposal of Infested Wood. It is very often not convenient in large towns or cities to burn the infested wood secured after storms or by the trimming and removal of trees. Often the wood could be utilized by people in the vicinity in which it is collected, or it may be left at some nearby public dump.

During the spring of 1911, the junior writer secured a number of branches broken off by storms, and containing larvæ. The borers remained in the wood for a few days, until the leaves began to wilt and the wood commenced to dry, when most of them left the branches. Unable, however, to find new green branches to enter, they soon grew thin and died. Mr. Chapman,[63] with older larvæ, secured later in the season, found that the borers were able to exist during the winter in wood removed from the tree and to emerge as moths the following spring. Unless the wood is to be used immediately, or placed in a dump where they will soon be buried by ashes, dirt, etc., branches secured by trimming or blown down by storms should be burned.

Care in Planting. Until some effective check is found for this insect, it is best not to plant too heavily those species of trees which are especially liable to attack. Species with short, strong branches, covered with smooth bark, should be given the preference, being more easily inspected and taken care of by the methods just given. Planting the young trees a greater distance apart than usual, makes it more difficult for the insect to spread from one tree to another.

In this connection, it might be said that, in Brooklyn, one of the first cities in America to be infested, Mr. J. J. Levison reports the insect as far less injurious than formerly, although no direct measures have been taken for its control, and the junior author has seen there rows of elms and other trees almost untouched by this insect.

Care of Trees. Although trees in good health are not immune to attack, many authorities claim that they are less liable to injury than unthrifty trees. It is certain that in New Haven the greatest damage by the leopard moth has been done to trees on streets where the conditions are most adverse to tree life, and at least wounds are more easily healed, and recovery after attack is surer, where the trees are kept in a thrifty condition.

BIBLIOGRAPHY.

AMERICAN.

1 1862 Morris, J. G. Synopsis Lepidoptera North America (Smithsonian miscellanous collections), p. 125 (N. A.).

2 1864 Packard, A. S. Proceedings Philadelphia Entomological Society, iii, p. 390 (N. A.).

3 1882 Doll, J. Papilio, vol. ii, p. 34.

4 1888 Graef, E. L. Entomologica Americana, vol. iv, p. 162.

5 1889 Angelman, J. B. Entomologica Americana, vol. v, p. 28 (Newark, 1887).

6 Grote, A. R. Entomologica Americana, vol. v, p. 7.

7 Smith, J. B. Report New Jersey Agricultural Experiment Station, p. 279.

8 1890 Chittenden, F. H. Entomologica Americana, vol. vi, p. 218 (note re distribution).

9 Machesney, C. P. Entomologica Americana, vol. vi, p. 31 (Arlington).

10 Riley, C. V. and Howard, L. O. Insect Life, vol. ii, p. 290 (note re Smith's article in Garden and Forest).

11 Smith, J. B. Insect Life, vol. ii, p. 386 (correction of preceding).

12 Smith, J. B. Garden and Forest, vol. iii, p. 30.

13 1891 Southwick, E. B. Report Entomological Society of Ontario, xxii, p. 78 (recent destruction in New York).

14 Smith, J. B., et al. Canadian Entomologist, vol. xxiii, p. 221 (discussion at meeting).

15 1892 Lintner, J. A. Report New York State Entomologist, vol. ix, p. 426 (brief acct.).

16 Pike, N. Insect Life, vol. iv, p. 317 (illus. article).

17 Riley, C. V. and Howard, L. O. Insect Life, vol. iv, p. 77-8 (notes of correction).

18 Smith, J. B. Canadian Entomologist, vol. xxiv, p. 136 (remarks on Walker's citation; doubts identity).

19 Smith, J. B. Entomological News, vol. iii, p. 206 (note).

20 Southwick, E. B. Insect Life, vol. iv, p. 61 (note).

21 1893 Riley, C. V. and Howard, L. O. Insect Life, vol. v, p. 204 (note of correction).

22 1894 Neumoegen, B. and Dyar, H. G. Journal New York Entomological Society, vol. ii, p. 160 (descr. *pyrina*).

23 Riley, C. V. and Howard, L. O. Insect Life, vol. vi, p. 40 (note on number of eggs).

24 Riley, C. V. and Howard, L. O. Insect Life, vol. vi, p. 377 (note on habits).

25 Smith, J. B. New Jersey Agricultural Experiment Station, Bull. 103, p. 9.

26 1894 Smith, J. B. Report New Jersey Agricultural Experiment Station, p. 519 (good acct.).
27 Southwick, E. B. Report Entomological Society Ontario, xxv, p. 107 (recent destruction in New York).
28 1895 Smith, J. B. Insect Life, vol. vii, p. 138 (report by Pike from Connecticut).
29 Southwick, E. B. Insect Life, vol. vii, p. 136 (mention of injury).
30 1896 Smith, J. B. Economic Entomology, p. 287 (brief illus. acct.).
31 1897 Smith, J. B. Report New Jersey Agricultural Experiment Station, p. 397 (mention).
32 Webster, F. M. Ohio Agricultural Experiment Station Bull. 77, p. 48 (illus. acct.).
33 1898 Beutenmüller, Wm. Bombycine Moths of Vicinity of New York, Bull. Amer. Museum Natural History, vol. x, p. 445 (descr. and note, illus.).
34 Felt, E. P. Report of Commissioners of Fisheries, Game and Forests, iv, p. 16 (illus. acct.).
35 Smith, J. B. Report New Jersey Agricultural Experiment Station, p. 385 (mention).
36 1899 Felt, E. P. New York State Museum, vol. vi, No. 27, p. 50 (brief acct., illus.).
37 Smith, J. B. Insects of New Jersey, Suppl. Report N. J. Board of Agriculture, p. 497 (brief acct., illus.).
38 Smith, J. B. Report New Jersey Agricultural Experiment Station, p. 445 (mention).
39 1900 Britton, W. E., et al. Connecticut Agricultural Experiment Station Bull. 131, p. 13 (mention).
40 Felt, E. P. New York State Museum, vol. viii, No. 37, p. 23 (note, illus.).
41 MacCartney, B. F. Report Pennsylvania Department of Agriculture, p. 94 (brief illus. acct.).
42 1901 Felt, E. P. Report New York State Entomologist, xvii, p. 745 (occurrence at Newark, N. Y.).
43 Smith, J. B. Report New Jersey Agricultural Experiment Station, p. 480 (mention; not so destructive).
44 1903 Gibson, A. Report Entomological Society Ontario, xxxiv, p. 61 (mention).
45 Holland, W. J. Moth Book, p. 376 (illus. acct.).
46 1904 Doll, J. Entomological News, vol. xv, p. 110.
47 1905 Felt, E. P. Insects Affecting Park and Woodland Trees, vol. i, p. 75 (full acct., illus.).
48 Smith, J. B. New Jersey Agricultural Experiment Station Bull. 181, p. 29 (brief acct.).
49 1907 Fernald, C. H. and H. T. Report Massachusetts Agricultural Experiment Station, p. 155 (short note, damage near Boston).

50 1907 Frost, C. A. Psyche, vol. xiv, p. 63 (appearance in Mass. in 1903).
51 1908 Britton, W. E. Report Connecticut Agricultural Experiment Station, p. 847 (presence in Conn.).
52 Smith, J. B. Report New Jersey Forest Commission, p. 89.
53 Smith, J. B. Report New Jersey Agricultural Experiment Station, p. 315 (mention).
54 1909 Britton, W. E. Report Connecticut Agricultural Experiment Station, p. 356 (acct.).
55 Fernald, C. H. and H. T. Report Massachusetts Agricultural Experiment Station, part 2, p. 72 (mention).
56 Howard, L. O. and Chittenden, F. H. Bureau of Entomology Circular 109 (full acct., illus.).
57 Reiff, Wm. Psyche, vol. xvi, p. 28 (larva in oak).
58 Smith, J. B. Insects of New Jersey, rev. ed., Report New Jersey State Museum, p. 516 (illus. acct.).
59 1910 Britton, W. E. Journal Economic Entomology, vol. iii, p. 436 (mention).
60 Britton, W. E. Report Connecticut Agricultural Experiment Station, p. 664 (mention).
61 1911 Britton, W. E. Journal Economic Entomology, vol. iv, p. 298 (on nursery stock, illus.).
62 Solotaroff, Wm. Shade Trees in Towns and Cities, p. 182 (illus. acct.).
63 Chapman, J. W. The Leopard Moth and other Insects Injurious to Shade Trees in the Vicinity of Boston. Bussey Institution, Harvard University (full acct.).

EUROPEAN.

The authors have made no attempt to give a complete list of European writings on the leopard moth. A few are here cited from works on hand to indicate the status of the insect as a pest in Europe.

64 1840 Kollar, V. Insects Injurious to Gardeners, Farmers, etc., p. 207 (brief acct.).
65 1854-66 Walker, F. List of Specimens of Lepidopterous Insects in the Collection of the British Museum.
66 1873 Wood, J. G. Insects at Home, p. 428 (brief illus. acct.).
67 1874 Kaltenbach, J. H. Die Pflanzenfeinde, pp. 73, 184, 429, 548, 774 (mention of food plants).
68 1890 Ormerod, E. A. Manual of Injurious Insects, p. 320 (brief illus. acct.).
69 1892 Ormerod, E. A. Text Book of Agricultural Entomology, p. 132 (mention, illus.).
70 1895 Judeich (J. F.)-Nitsche (H.) Forstinsektenkunde, p. 773 (illus. acct.).

71 1895 Schlich, Wm. Manual of Forestry, vol. iv, p. 264 (descr. note about injury and food plants).
72 1897 Eckstein, K. Forstliche Zoölogie, p. 479 (brief acct.).
73 1898 Ormerod, E. A. Hand Book of Orchard and Bush Fruit Insects, p. 132 (illus. acct.).
74 1901 Sharp, D. Cambridge Natural History, vol. vi, p. 395 (mention).
75 1903 Henry, E. Atlas d'Entomologie Forestiere, p. 29 (illus.).
76 1904 Theobald, F. V. Report on Economic Zoölogy, ii, p. 30 (note).
77 1905 MacDougall, R. S. Journal Board of Agriculture (London), 12, No. 2, p. 115. Abstract Expt. Sta. Record, vol. xvii, p. 1092 (remedial treatment).
78 1908 Gillanders, A. T. Forest Entomology, p. 247 (brief illus. acct.; sycamore, hawthorn).
79 Lesne, P. Compt. Rend. Academy Science (Paris) 146, p. 493 (great damage to cork oak in Algeria).
80 Theobald, F. V. Report on Economic Zoölogy, p. 24 (brief note).
81 1909 South, R. The Moths of the British Isles, p. 348.
82 Theobald, F. V. Insect Pests of Fruit, p. 46 (illus. acct.).
83 Theobald, F. V. Report on Economic Zoölogy, p. 29 (brief note, illus.).
84 1911 Lesne, P. Compt. Rend. Academy Science, 152, p. 1269. Abstract Expt. Sta. Record, vol. xxv, p. 464 (larvæ in cork oak).

SUMMARY.

The leopard moth occurs in Europe and parts of Asia and Africa, and was probably accidentally introduced into this country from Europe more than thirty years ago, being first noticed at Hoboken, N. J., and later spreading toward the north and east along the coast. At the present time it is found from Asbury, N. J., to Lawrence, Mass., but has not been taken more than twenty-five miles inland.

The larvæ or caterpillars cause great damage to nearly all kinds of shade trees by boring in the branches just under the bark and cutting large galleries, often across the grain, thus girdling them. Dead branches extending above the mass of foliage in the tree-tops are a sign of attack, and many twigs will be broken off or wither during the summer. The pest has been especially destructive to elm and silver maple trees in the coast cities and towns of Connecticut, but is not so abundant in the open country. It has caused much damage also in the cities of New Jersey, New York City, Providence, Cambridge and Boston.

The adult moths are dirty white, with semitransparent wings marked with metallic blue dots. These have an expanse of one and three-fourths inches in the male to two and one-half inches in the female. The larva is yellow or dirty white, marked with brown or black dots, and about two inches long. See illustrations.

The moths appear about July 1st, the males being very common around electric lights, and the females lay eggs singly or in groups of two, three or four, in the crevices of the bark or near the buds. The larvæ, hatching in a few days, begin to tunnel in the twigs, and by the end of the season are about one inch in length. They leave the small branches and crawl over the bark to enter larger ones, cutting large galleries in them and expelling the frass through round holes, which they soon close with silk webs. During October the borers go deeper into the wood, and remain through the winter two inches or more beneath the bark. They pupate in their burrows the second spring, and before the moth emerges the pupa works itself partly out of the opening, and the adult flies away, leaving the empty case protruding from the burrow.

There are few natural checks, only one parasite being known in this country and four in Europe. It is believed, however, that certain birds, especially woodpeckers, prevent the spread of the leopard moth in the open country. Many larvæ are doubtless killed by the breaking off of the branches, which in cities are carted away and destroyed.

Removing infested branches; injecting carbon disulphide (bisulphide) into the burrows, and stopping the opening; probing with a hooked wire for the larva; are some of the methods of control.

Planting species of trees not badly infested, like oaks, honey locust and sycamore, and especially those kinds that do not grow very large, and have a smooth bark; placing trees further apart, so that the larvæ cannot easily crawl from one to the other; and keeping the trees well nourished and vigorous, are the chief preventive measures.

HOW TO GET RID OF FLIES.

Flies breed in filth and then travel over food. They are especially attracted by filth and by the odors of the pantry and kitchen. Coming from foul and decaying animal and vegetable matter, their feet and bodies carry many germs which may be and are deposited upon human food. Several important diseases of mankind are spread in this way, including typhoid fever, cholera and dysentery.

Though flies may breed in any decaying animal or vegetable matter, probably ninety-five per cent. of them develop in stable manure.

Life Period. Each female may lay 120 eggs, which hatch in less than twenty-four hours, and the maggot and pupa stages each last about five days, making only ten days from the egg to the adult fly. The adult fly may live for many weeks.

Abolish Breeding Places. Prevent the breeding of flies by not allowing manure to accumulate about stables. It should be removed once each week. If not feasible to do this, keep it in a screened shed or cellar, or treat it with oil every few days. Garbage cans and swill tubs should be covered, and not kept near the kitchen. Sanitary closets should be maintained.

Screen all Human Habitations. In order to reduce the danger of contracting disease through the agency of flies, these insects should not only be reduced in numbers, but even the few should be kept out of houses. All rooms should be provided with screens. It is especially important that the dining room, kitchen and pantry should be kept free from flies, and it is equally important to keep flies from the sick room.

Food should never be exposed to flies.

To Kill Flies in Houses. 1. One of the best fly poisons is formalin mixed with water in about five per cent. strength, exposed in a shallow dish. The flies will drink it and die. Professor R. I. Smith of the North Carolina Station recommends one tablespoonful of commercial formalin to a half-pint cup of half milk and half water, placed on a shallow plate, with a slice of bread in the liquid. The bread gives more surface upon which the flies may alight. Formalin fly poison is not dangerous to use and is especially successful in reducing an abundance of flies if the room can be closed and if they do not have access to any other form of moisture.

2. Traps are also serviceable.

3. A liberal use of insect powder (Pyrethrum) in a tight room will stupefy the flies and they may be swept up and burned.

4. Sticky preparations such as "Tanglefoot" fly-paper will catch many flies.

5. Use wire fly-killers to destroy stragglers.

BRIEF NOTES.

A Migration of the Cotton Moth into Connecticut. During the last week of September a swarm of brown moths appeared in New Haven and probably other Connecticut towns and cities. It was the cotton moth, *Alabama* (*Aletia*) *argillacea* Hubn., from the Southern States, which in its larval stage feeds only upon cotton, and is believed not to hibernate in the United States, except possibly in Texas. The great abundance of this insect in the South in 1911 was mentioned by Mr. W. D. Hunter in a paper given at the Washington meeting of the American Association of Economic Entomologists, December 27-29, 1911. Considerable injury to the cotton plant resulted from the attacks of the caterpillars.

In New Haven, the moths were resting by hundreds on the walls of the railroad station, and other buildings, especially near the water front, were literally covered. The following account was copied from one of the local papers:

Army of Moths Nearly Tie Up Railroad.

"Swarms, several of them, containing a few millions, more or less, of brown moth millers have descended on Union station, and the trainmen's shanty, and for a time so large was the number of the invading host that they made folks about the depot think a heavy storm was coming up. The moth millers settled themselves at the east end of the station on platform pillars on the side of the depot and some more swept to the west end and beyond and cluttered up the walls of the trainmen's shanty just west of the station to such an extent that there was scarcely a spot where the boards could be seen. The visitors were most active when the sun came out periodically during the day.

It was reported that they settled so thickly on the rails near the yard master's shack in the Water street yard that a switcher with a small string of cars behind it could not get under headway because the wheels of the locomotive, passing over the millers, slipped."

Another newspaper stated that the brown-tail moth had reached the city in great numbers, and threatened to do much damage. On September 25th I counted thirty of these moths inside a closed trolley car on Whitney avenue on the way to my office. During a residence of nearly eighteen years in New Haven I have never before observed or collected this insect, though the station collection contains specimens taken in Waterbury by Mr. H. S. Woolley. Such a swarm is therefore unusual, but the migration in 1911 was extensive and widespread, according to reports in Science by Professor H. T. Fernald, who observed the moths at Amherst, Mass., and Mr. J. L. Randall, who reports them at Pittsburgh, Pa. Dr. Henry Skinner, in Entomological News for November, page 415, records them as being present in great numbers at Philadelphia, and Mr. R. A. Muttkowski, in the same journal for February, 1912, page 83, records the abundance of the moths in the vicinity of Milwaukee, Wis. In the Ottawa Naturalist for 1911, page 129, Mr. Arthur Gibson reports it as being unusually abundant throughout Western Ontario in September, 1911. A single example was received from Mr. H. S. Douglas of New London. Professor John B. Smith states* that, though the cotton moth does not breed in New Jersey, "each year adults fly north in considerable numbers after midsummer, and some of these flights reach us, as a swarm or in scattering individuals."

A Dipterous Parasite of the Imperial Moth. Mr. Champlain collected a chrysalis of the imperial moth, *Basilona imperialis* Dru., cutting it out of the ice on the edge of a pond at Lyme, Conn., December 4th, 1910. On February 6th, 1911, the chrysalis was fractured and showed six Tachinid puparia inside. On April 20th a perfect specimen emerged of one of our large Tachinid species, *Latreillimyia bifasciata* Fabr. This fly has a body about half an inch long, thorax grey or pruinose, abdomen black, with two yellow bands on last two segments. Body more or less covered with stiff hairs or bristles.

A Borer in Spruce Twigs. On June 4th, 1910, a spruce twig containing a borer was received from a local nursery. The borer was a lepidopterous larva not familiar to us, and was placed in the breeding cages. The adult proved to be a small pyralid moth, and was identified by Dr. H. G. Dyar of the U. S. National Museum as *Dioryctria abietella* D. & S. Dr. Dyar stated that the specimen was typical, and like those from Europe, but was different from those reared in this country from pine cones.

Prevalence of Hickory Bark Borer. The hickory bark borer *Scolytus quadrispinosus* Say has caused much damage to native hickory trees, especially in the southwestern part of the state, during the season. Some trees in New Haven show signs of attack. This is the same beetle that in 1901 killed more than 110 hickory trees on the Hillhouse place in New Haven. The infested trees were cut, which is about the only remedy. An account of this insect may be found in the Report of this Station for 1901, page 267, and the beetles and their work are shown on Plate VIII of that report. Utilizing the trees for timber and fuel and destroying the bark and refuse before May 1st will kill most of the overwintering beetles in the bark.

The Apple-Leaf Crumpler. On May 12th, 1911, a case-bearer with trumpet-shaped case on apple was received from Mr. E. D. Curtis of Litchfield. Adult moths appeared in the breeding cages June 21st, and proved to be the apple-leaf crumpler,

* Report N. J. State Museum: Insects, p. 471. 1909.

Mineola indiginella Zell. The larva also feeds upon plum, cherry and quince, but is seldom destructive, especially if spraying is generally practiced to control the codling moth. The adults are shown on Plate II, *a*.

Chrysanthemum Leaf-Miner or Marguerite Fly. On April 8th we received from R. H. Comstock of Milford a plant of marguerite daisy having leaves infested with the chrysanthemum leaf-miner or marguerite fly, *Phytomysa chrysanthemi* Kow. The leaves were badly tunneled by the larvæ, some of which had pupated in the tunnels. On April 16th the first adult, a small two-winged fly, emerged, and by April 20th a good series of adults had been obtained. This is probably a native American insect, and attacks chrysanthemums, marguerites, feverfew, cinerarias, eupatoriums and tansy. The eggs are laid in or on the under sides of the leaves and after hatching the minute larva mines or tunnels in the tissues of the leaf between the upper and lower epidermal layers, the mined areas showing as whitish markings on the green leaves. The damage has been so great in some instances that the growers had to abandon the commercial growing of these plants. Gathering and destroying the infested leaves, especially the first ones to appear, has been practiced with good results. Where greenhouses can be fumigated with hydrocyanic acid gas, this would undoubtedly prove the most effective of any treatment. It is also probable that some of the oil or nicotine sprays may penetrate sufficiently to destroy the larvæ.

Tent Caterpillars. The apple tent caterpillar, *Malacosoma* (*Clisiocampa*) *americana* Harr., has not been very common in the vicinity of New Haven for several seasons. Apparently it is more abundant elsewhere, judging by the letters received. Specimens were sent from Westport, Stamford, New Haven, Union, and Lisbon. This insect has been mistaken for the gypsy moth, but is entirely different in appearance, as the caterpillar is more decidedly brown in color, and with a more prominent white dorsal line than the gypsy caterpillar. Neither does the former bear prominent tubercles, or such conspicuous bristly hairs. Moreover, the tent caterpillar is found chiefly on apple and wild cherry, and it makes a nest in the forks of the branches, remaining within the nest at night and during stormy weather, but going out of it to feed on pleasant days. When about fullgrown, the caterpillars have a habit of clustering on the outside of the nest, where they are very conspicuous. An account of this insect may be found in Bulletin 139, and in the Report of this Station for 1902, page 139.

The forest tent caterpillar, *M. disstria*, was twice received from Hartford. This species makes no tent, but the caterpillars feed singly, often clustering on the trunks of trees when fullgrown and ready to pupate. The forest tent caterpillar has a decided though peculiar blue tint, and instead of a continuous white dorsal line, a row of keyhole-shaped white spots along the back.

Woolly Pine Aphids, *Chermes pinicorticis* Fitch and *Chermes pinifoliæ* Fitch. Frequently pine trees growing in woodlands or in ornamental plantings in parks and private grounds are infested by this insect, which forms upon the smooth bark white cottony or woolly patches. If we examine the flocculent matter, we find it made up of small brown plant lice or aphids, each bearing a large number of wax filaments or threads, thus giving it the cottony appearance. This insect is usually found on the shaded trunk of the tree, sometimes nearly covering it and again only in small patches. This is called the woolly pine bark aphid, *C. pinicorticis*.

Another and larger species, *C. pinifoliæ*, known as the woolly pine-leaf aphid or pine-leaf Chermes, occurs on the leaves, the young settling around the whorls of branches and feeding especially on the new and tender growth. Though no careful study of these insects has been made in Connecticut, it is certain that both species occur here, and probably often on the same trees.

An infestation of one and possibly of both forms together occurred in the white pine plantation of the Middletown Water Company in Middlefield. In response to inquiries, we advised that the trees be sprayed with kerosene emulsion. A visit to the plantation was made June 22d, 1911. Men were then spraying, and had already treated about 7,000 trees out of 38,000 planted there. The others were sprayed later. The trees were set in 1904, and though a few trees here and there had died from root injury, most of them had made a good growth.

The kerosene emulsion spray was successful in killing the woolly aphids, as the white patches disappeared and there was only an occasional slight injury to the leaves of the trees.

The Woolly Apple Aphis. The woolly apple aphis, *Schizoneura lanigera* Hausm., causes some injury to apple trees in Connecticut, though undoubtedly it is a much more serious pest in territory further south and west. Specimens were received in 1911 from Seymour, West Haven, Clinton and Putnam. Occasionally in the nursery a tree is seen with the insects on trunk or lower branches, and often the characteristic bluish white woolly or cotton appearance is noticed on large trees, especially in wounds or cankered areas which are prevented from healing because the aphids cluster there and suck out the sap for their food. On small branches an irregular knotty formation usually results from the attacks of the aerial form, and the root form causes similar irregular swellings upon the roots. This is thought to be due to the poisoning of the parts attacked.

The root form survives the winter, and the aphids migrate in spring to the trunk and branches. In late fall a generation of winged aphids appears, and these migrate and lay eggs in the crevices of the bark, thus starting new colonies.

The aerial form may be easily destroyed by spraying with kerosene emulsion, soap and water, or miscible oil. The root form may be eradicated by the use of carbon disulphide in the soil, and the free use of powdered tobacco has been tested with satisfactory results. In setting new orchards in a section where the woolly aphis causes much damage, it is advisable to mix the tobacco dust with the soil placed about the roots.

The Elm Scale. *Gossyparia spuria* Modeer. This scale insect was sent from New Haven, Yalesville, and Toronto, Canada, during June. This is one of the soft scales, having no shell or armor, and is dark brown with a marginal fringe of white wax resembling cotton or wool. The insect is oval in shape, about an eighth of an inch long, and has a tendency to locate in the cracks and crevices between the plates of bark, especially on young trees. It feeds by sucking out the sap. It sometimes attacks and kills the lower branches of medium-sized trees. There is but one generation each year, and the young are born alive about the middle of June. At first they settle along the veins on the under sides of the leaves but later return to the branches. Honeydew is freely exuded and drips upon the ground. A spray of kerosene emulsion or of common soap and water (1 lb. in 8 gallons) applied at any time of the year will kill this insect. An illustration showing the appearance of the elm scale may be found in the Report of this Station for 1905, Plate III, *c*.

The Woolly Maple Leaf Scale. The woolly maple leaf scale, *Phenacoccus acericola* King (see Report for 1905, p. 226 and Plate VII), is rapidly increasing as a pest of sugar maples, in the cities and villages of Connecticut. Samples of this sucking insect were received twice each from Bridgeport, Danbury and Ansonia, and once each from New Haven, Middletown and Greenwich, between July 12th and October 16th. Many trees seriously infested have been observed in New Haven, Hartford, Wallingford and other places, and Mr. G. A. Cromie, superintendent of trees in the city of New Haven, states that over fifty infested trees needed spraying this winter in New Haven. A forceful stream of water from the hose will dislodge many of the insects from the crevices of the bark in summer, and spraying with ten per cent. miscible oil in winter is recommended by Professor J. B. Smith of New Jersey for the bark form, while the leaf form cannot well be sprayed, but by burning the fallen leaves most of the insects are destroyed. Mr. F. A. Bartlett, however, states that the sugar maple is sometimes damaged by a fifteen per cent. oil application, when other kinds of maples are not injured.

The Locust Borer. The section of a trunk of a black locust tree filled with insect galleries sent to this office in July (see Plate VIII, *e*) showed the work of the larvæ of a beetle known as the locust borer, *Cyllene robiniæ* Forst. It has been stated that this pest is the greatest obstacle to the cultivation of the locust tree in the Eastern United States.

The eggs are deposited in the crevices of the bark during September. These soon hatch and the young larvæ feed in the inner bark until winter. During the following spring they bore into the heart-wood, and are often numerous enough to completely honeycomb the trunk with their galleries. The fullgrown larva is about three-fourths of an inch in length, somewhat flattened and club-shaped. The larvæ pupate within the galleries during the latter part of July and the beetles emerge early in September. The beetle is about three-fourths of an inch long, dull black in color with transverse yellow markings. The beetles are often abundant during the fall on the flowers of golden-rod, feeding on the pollen. The locust borer does not attack other plants.

As a rule the locust is not of sufficient value to warrant any treatment. Its value as a honey plant has been questioned. Even though the locust may blossom freely each year, only during an occasional season do the bees appear to obtain much honey from this species.

Where one is especially desirous of saving the trees it has been recommended to coat their trunks late in August with whitewash to which Paris green or lead arsenate has been added. Badly infested trees should be cut out and burned during the winter to destroy the larvæ. Trees only slightly infested could be treated with carbon disulphide during the early summer. A few drops of this liquid should be injected into the opening where there are indications of fresh borings, and the opening closed with moist earth or putty.

B. H. W.

Ortho-Arsenite of Zinc. This arsenical poison is manufactured by an insecticide firm in California to meet the demand for a substitute for lead arsenate, which is supposed to cause arsenical poisoning or injury to trees through the bark, especially in the black alkali sections of the west. The ortho-arsenite of zinc is a white powder containing about 40 per cent. of arsenic oxide, fully twice the amount contained in the average paste lead arsenate, and the cost somewhat less than the latter.

A quantity of the ortho-arsenite of zinc was purchased by Mr. E. M. Ives of Meriden, who sent a small sample to the station. The chemical department tested a portion of this and found it to contain very little soluble arsenic. Several small trees, including apple, peach and plum, were sprayed May 12th with ortho-arsenite of zinc, some at the rate of 3 lbs. in 50 gallons of water and the others at the rate of 1½ lbs.

The trees were examined four days later and no injury to the foliage was observed from either treatment.

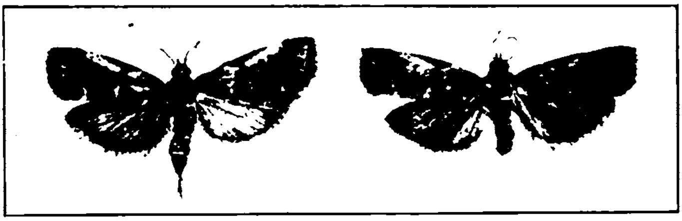
Mr. Ives sprayed about 15 bearing apple trees with the material and noticed no injury to the foliage. A second application to the same trees was made seven days after the first, using ¾ of a pound of ortho-arsenite of zinc to 50 gallons of water. The foliage was so badly injured that some of the trees dropped many of their leaves. Mr. Ives had been spraying with paste lead arsenate, but stated that this mixture was all drawn from the pump and barrel before putting in the arsenite of zinc.

The manufacturers agreed to send this department some of the material for further tests, but this was not received.

B. H. W.

PLATE I.

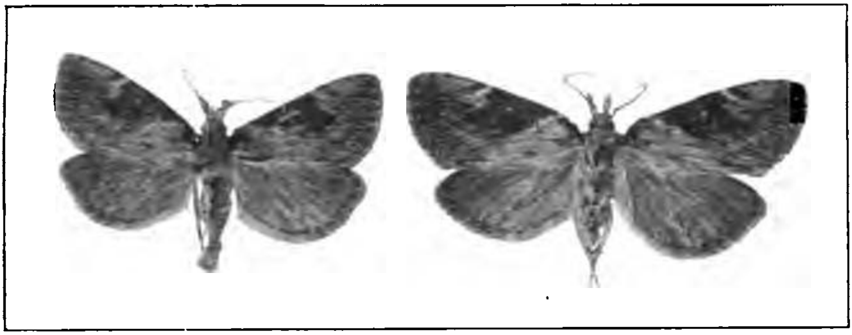
A portion of the Entomology Exhibit at the Fairs.



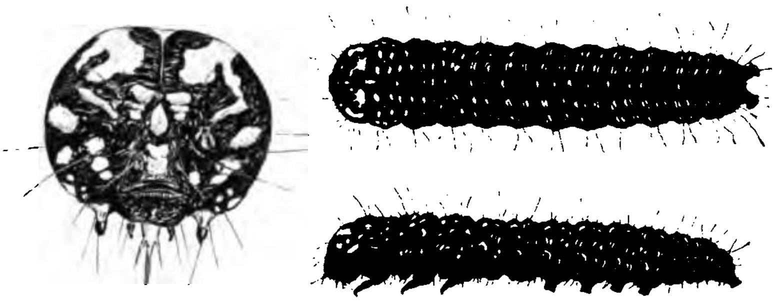
a. Adult of the apple leaf-crumpler *Mineola indiginella* Clem. Twice natural size.

b. Fac simile of the brown-tail moth placard.

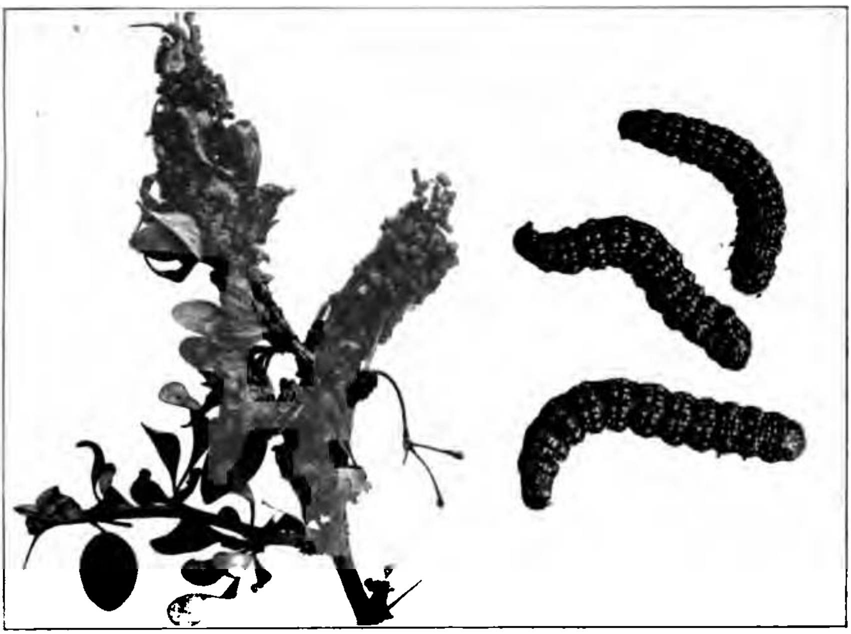
APPLE LEAF CRUMPLER AND BROWN-TAIL MOTH.



a. Adults nearly twice enlarged; male at left.



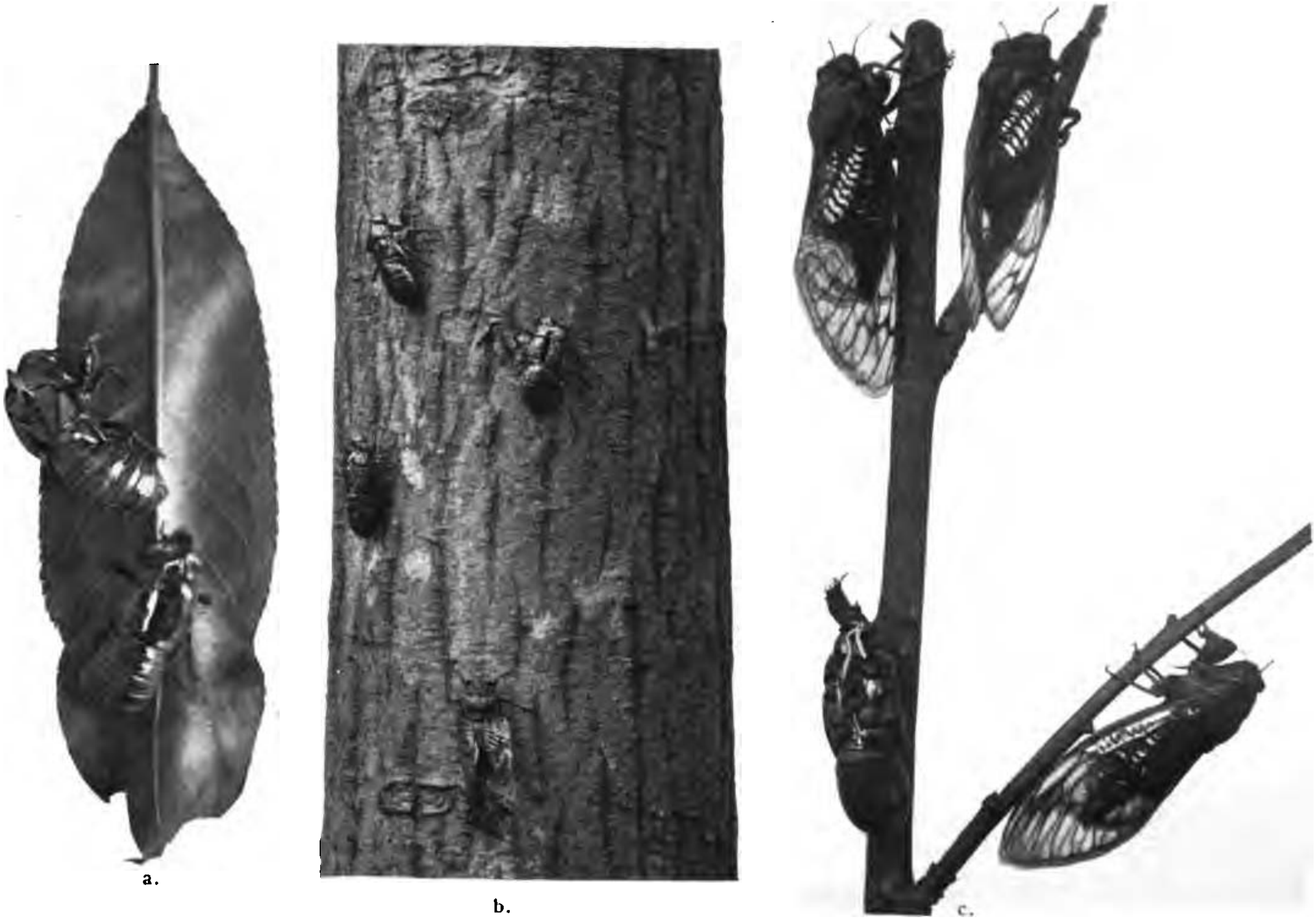
b. Larva dorsal and lateral views, about twice enlarged; front view of head at left, greatly enlarged.



c. Nest at left natural size, larvæ at right twice enlarged.

Omphalocera dentosa Gr. A PEST OF BARBERRY HEDGES.

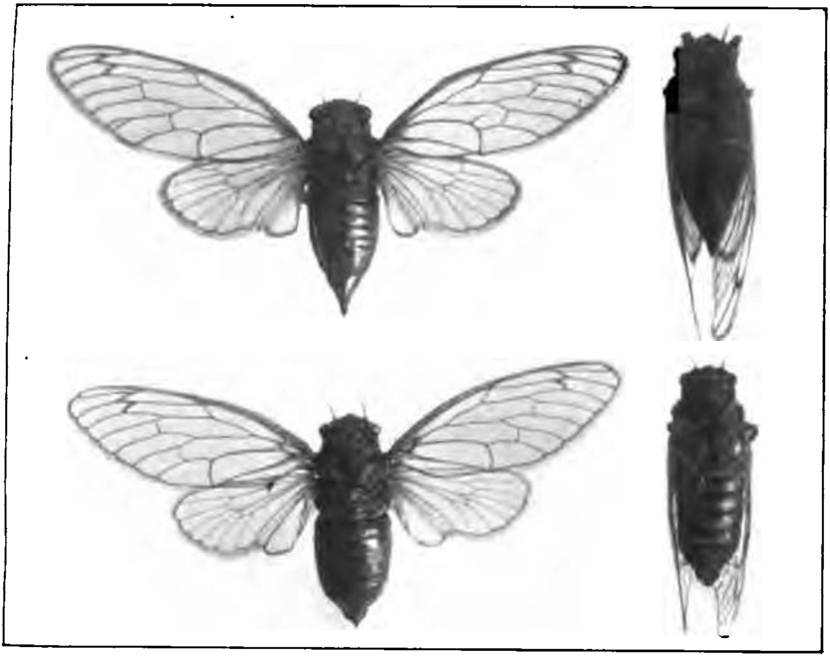
PLATE IV.



a. b. c.

a, pupal shells on leaf ; b, adult and pupal shells on tree trunk ; c, adults and pupal shell on twigs; a and c natural size, b much reduced.

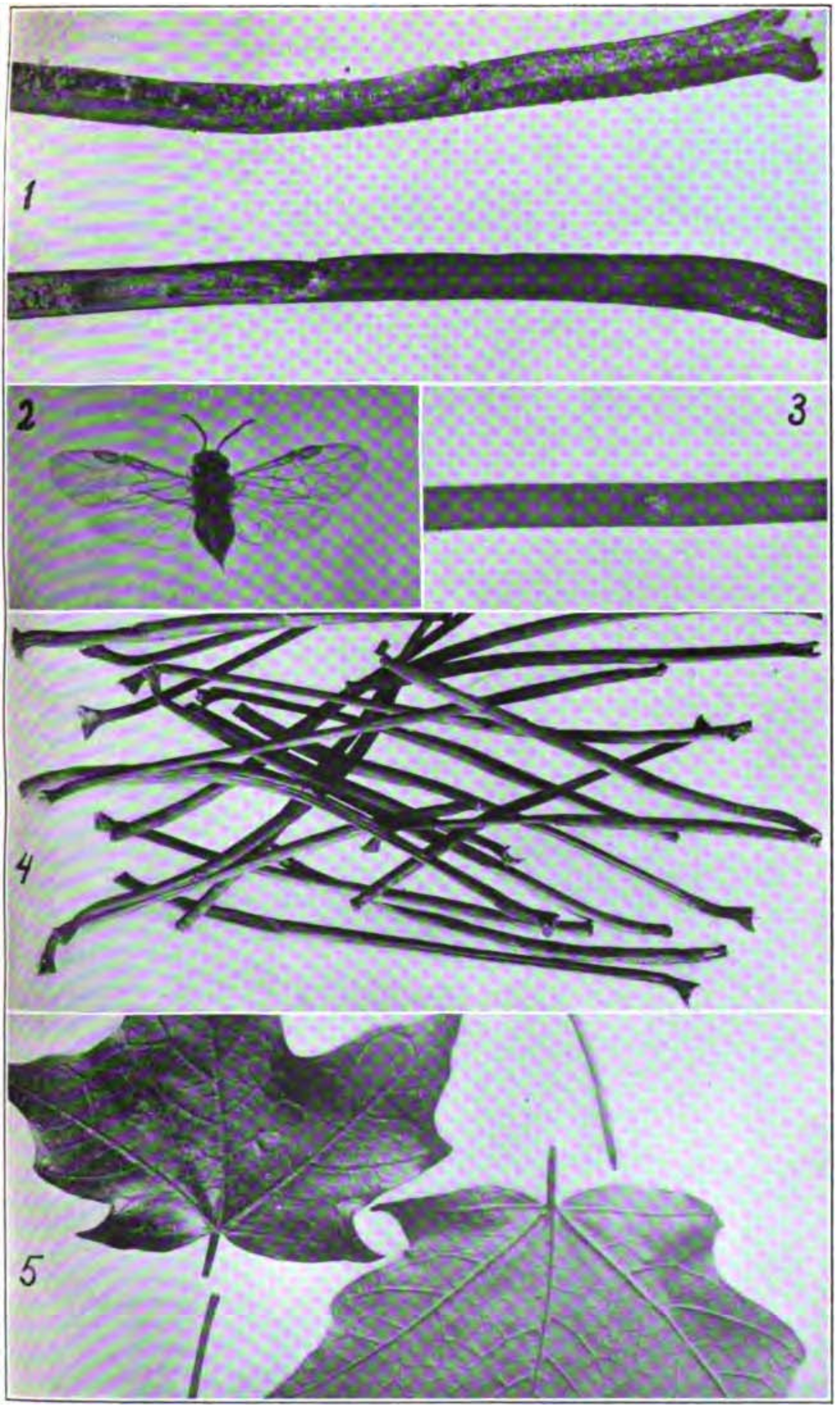
THE PERIODICAL CICADA



a. Males (below) and females (above). Natural size.

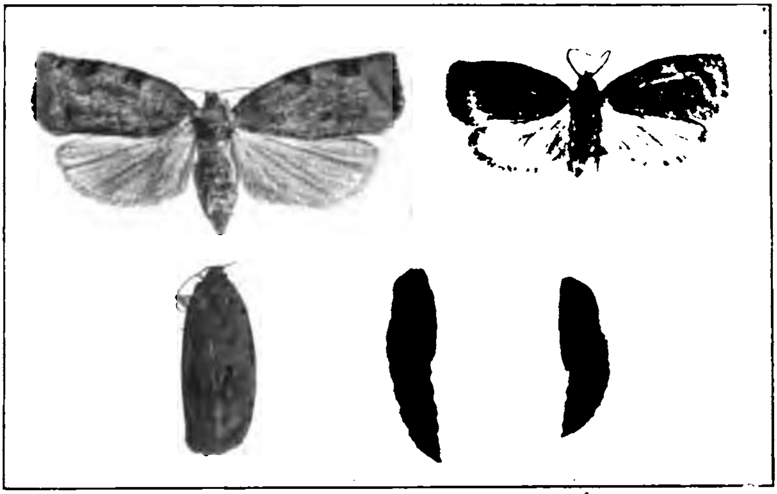
b. Twigs mutilated by the females in laying eggs.

THE PERIODICAL CICADA.



1, larva in stem ; 2, adult female ; 3, exit hole of larva in stem ; 4, stems which have been severed ; 5, leaves with severed stems.

THE MAPLE LEAF-STEM BORER AND ITS WORK.



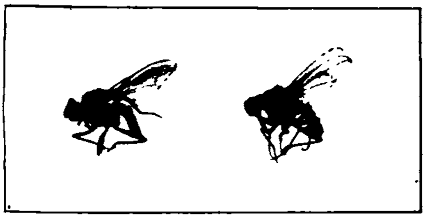
a. Pupæ and adults. Twice enlarged.

b. Nests or tents. Much reduced.

THE CHERRY TENT-MAKER.

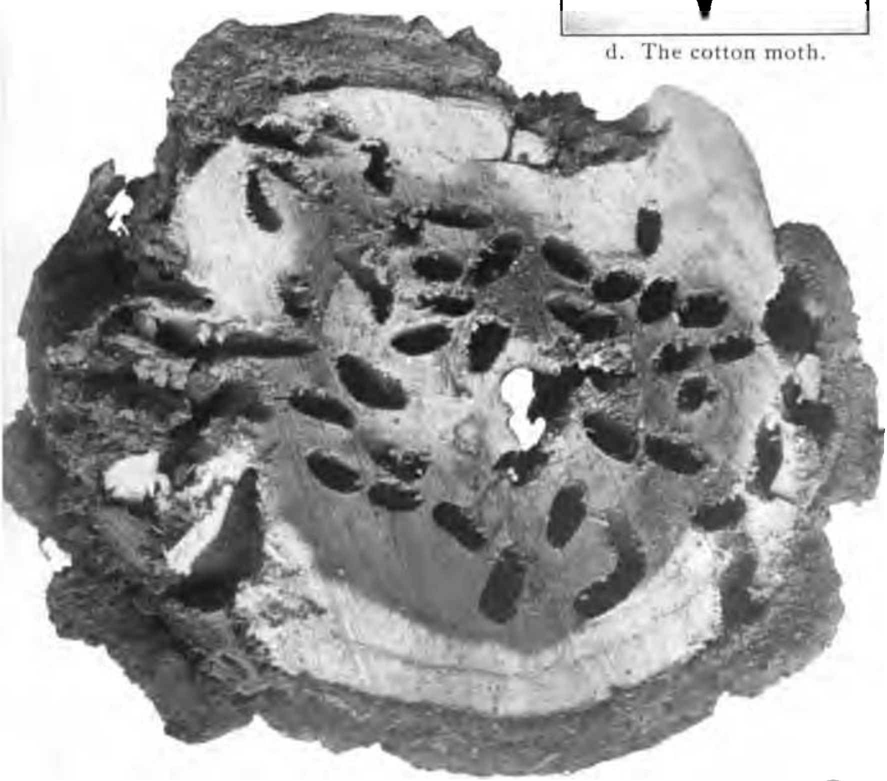
a. The poplar tent-maker, larva, pupa and adults.

b. Parasitized cocoon of imperial moth.



c. The onion fly, twice enlarged.

d. The cotton moth.



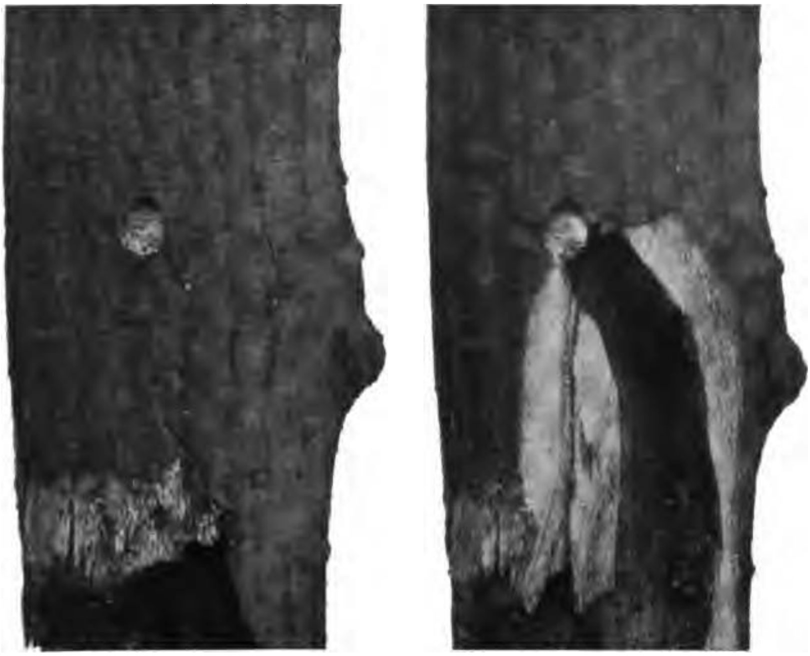
e. Cross section of locust tree showing injury by locust borer.

MISCELLANEOUS INSECTS. All except c natural size.

Trees injured by leopard moth show dead terminal branches. View on New Haven Green. Photo. loaned by Geo. Dudley Seymour.

WORK OF LEOPARD MOTH.

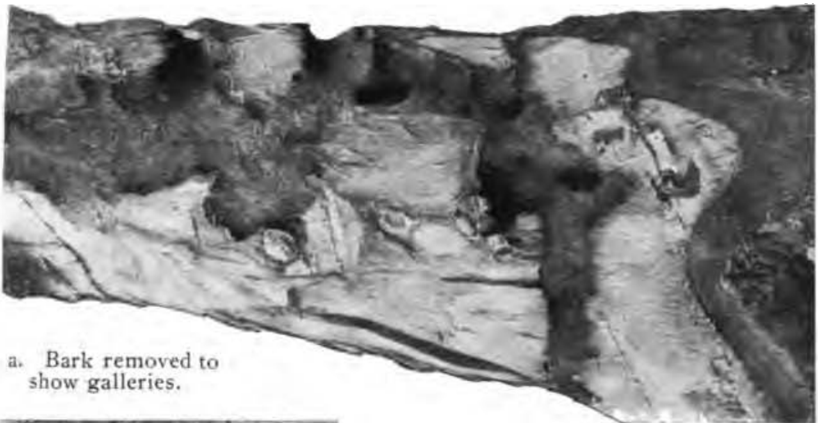
PLATE X.



a. White web closing outlet; wood cut away to show burrow. Twice natural size.

b. Branch girdled and broken.

LEOPARD MOTH BURROWS.

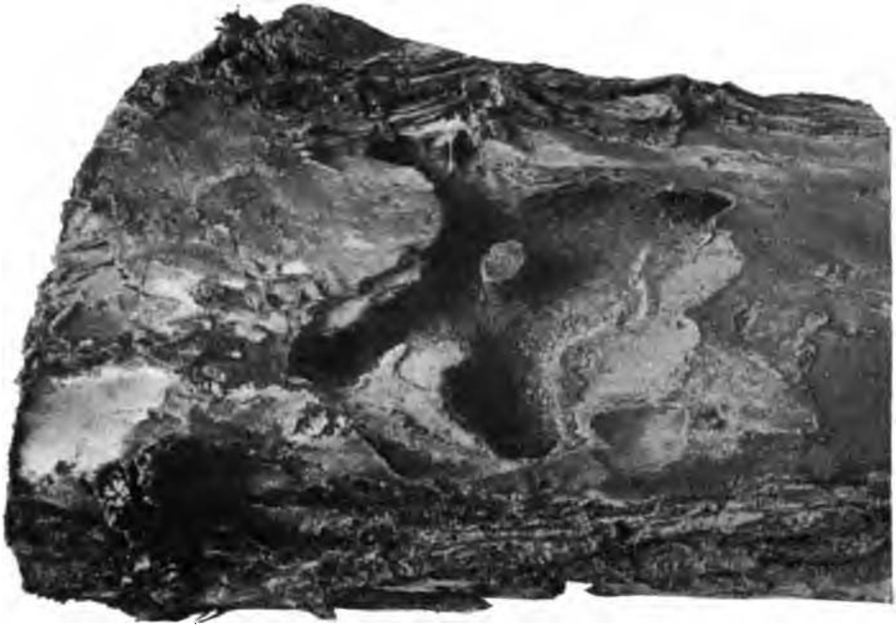


a. Bark removed to show galleries.

b. Wound on maple trunk beginning to heal. Pupa case above.

c. Winter resting place of larva. Natural size.

LEOPARD MOTH GALLERIES.



a. Elm branch showing galleries of the leopard moth larva.

b. Elm branch girdled by larva and broken.

LEOPARD MOTH INJURY.

Appearance of galleries in large branches.

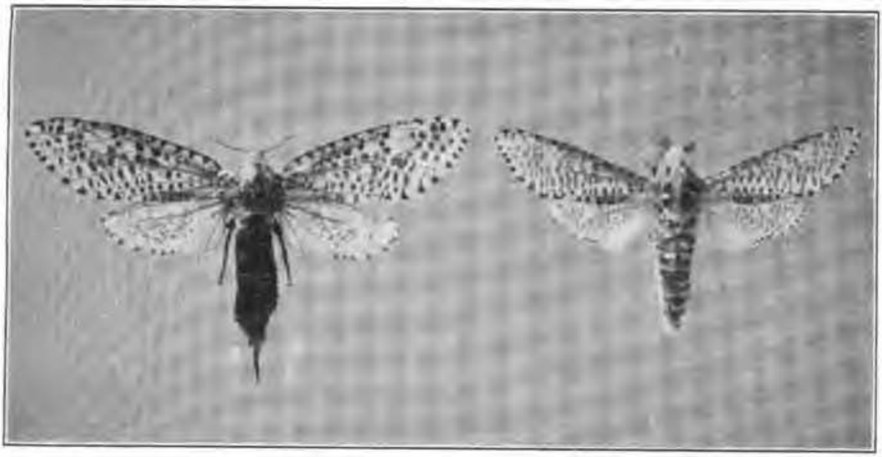
ELM BRANCHES GIRDLED BY LEOPARD MOTH.

Dead branches with bark removed to show galleries.

ELM BRANCHES KILLED BY LEOPARD MOTH.

Male leopard moth reared from apple nursery stock.

LEOPARD MOTH, JUST EMERGED.



a. Adult leopard moths, female at left. Natural size.

b. Eggs, greatly enlarged. Photo. loaned by J. W. Chapman.

c. Larva in its burrow. Natural size.

EGGS, LARVA AND ADULTS OF LEOPARD MOTH.

PART V.

TESTS OF SUMMER SPRAYS ON APPLES, PEACHES, ETC.

By G. P. Clinton, S.D., *Botanist*, and
W. E. Britton, Ph.D., *Entomologist*.

CONTENTS.

Introduction. Beginning in 1889, when Professor Thaxter described in the annual report for that year some miscellaneous spraying experiments with Bordeaux mixture, this Station has year by year carried on spraying experiments against the fungi and insects that attack our different fruits. The most extensive of these were made on apples and peaches in 1910, and described in Part VII, pages 583 to 618 of the Biennial Report for 1909-10. The present bulletin is a continuation and extension of those experiments. In 1910 the spraying tests were made in seven different apple orchards in different parts of the State, and something like 317 apple trees, varying from those just set out to large trees, were given from one to four treatments. There were also sprayed 160 peach trees in four different orchards. To determine the results, the trees were not only watched during the season, but at harvest 60,000 apples and 25,000 peaches were individually examined, and the presence of each particular spray, fungous and insect injury was recorded.

In the work of 1911, reported in the present paper, we not only continued and extended the spraying work with apples and peaches, but also made some miscellaneous experiments, in a smaller way, on pears, quinces, plums, cherries and currants. The number of trees and bushes that were sprayed from two to three times during the year were apples 688, pears 25, quinces 8, peaches 231, plums 42, cherries 156, currants 90.

To determine the results of this year's tests, there were examined and noted as previously 93,000 apples and 24,000 peaches, thus making for the two years' examination 153,000 apples and 49,000 peaches. These experiments have thus been extensive and varied enough to justify some general conclusions regarding the summer spraying of apples and peaches in this State, especially concerning the fungicidal efficiency and probable spray injury of commercial lime-sulphur sprays as compared with Bordeaux mixture. As these were the chief points under investigation, the main experiments are now concluded and reported here.

A 50-gallon barrel of spray mixture will thoroughly spray from four to ten large to medium-sized apple trees and, as a rule, from ten to eighteen medium to small trees. A barrel of mixture will cover from twenty to thirty-five bearing peach trees, according to their size.

We have tried a great variety of spraying apparatus in these experiments, making most use of that employed at the farm where the experiments were conducted. Two of these were gasoline power sprayers, of which that used at the Henry farm, shown in Plate XVII, a, proved to be a very compact and useful type. Ordinarily, however, in the smaller Connecticut orchards, the hand pump, mounted on the side of the barrel, is the most convenient form of spraying apparatus. This pump may be one of several different makes, but should be powerful enough to supply two lines of hose and keep up a pressure of from seventy-five to one hundred pounds. With the detached horizontal pumps (see Plate XVII, b), which are more powerful, a pressure of one hundred to one hundred and fifty pounds can be had, while with power sprayers even a higher pressure may often be easily maintained. On the whole, however, one hundred to one hundred and twenty-five pounds pressure is sufficient unless one wishes a very misty spray. For orchard work the disc type of nozzles has now almost entirely supplanted the Bordeaux and Vermorel nozzles, and this type was used in our experiments. See Plate XVIII, b.

The writers wish especially to acknowledge their indebtedness to the various growers in whose orchards these experiments were carried on during the two years. Much of the details of the work of spraying and fruit examination was in the hands of the writers' assistants, E. M. Stoddard of the botanical and B. H. Walden and A. B. Champlain of the entomological departments.

TYPES OF SPRAYS USED.

Cost of Materials. From dealers we have obtained prices of the materials and brands of sprays used in our experiments. These prices are those obtaining in January, 1912, f. o. b., for moderate amounts of material, such as the average farmer purchases. From these prices we have worked out the cost of the different sprays per barrel of fifty gallons. In the cost of the fungicides, however, we have not included the cost of the lead arsenate included as an insecticide, as this is not always used. As we have ordinarily used this in the paste form at the rate of three pounds per fifty gallons, and as the price ranges from seven to eleven and one-half cents per pound (when purchased in one hundred pound lots), the cost of the insecticide when used with the fungicide adds twenty-one to thirty-five cents to the cost per barrel. Neither do these prices include the cost of transportation, or making up and applying the mixtures. The following figures show the variation in prices of materials used:

Commercial lime and sulphur, \$7.00 to \$10.00 per barrel, according to brand, etc. Lead arsenate, paste form, \$7.00 to \$11.50 per one hundred pounds, according to brand, etc. Lead arsenate, dry form, \$16.50 to \$22.00 per one hundred pounds, according to brand, etc. Lime, seventy-five to eighty-seven cents per one hundred pounds, according to brand and size of barrels. Sulphur, \$2.50 to \$2.95 per one hundred pounds, according to kind, etc. Copper sulphate \$5.50 to \$7.50 per one hundred pounds, according to where purchased and whether ground or in crystals.

Types of Sprays. In the following paragraphs we describe the various fungicides (A to F) and insecticides (G), and have grouped them under headings indicating their general relationship.

A. *Bordeaux Mixture.* This fungicide is made by pouring weak solutions of copper sulphate and freshly slacked lime water together, or the former into the latter, thereby producing a mixture with a blue suspended sediment of copper hydroxide, which is generally considered the fungicidal agent. Ordinarily the home-made mixtures are superior to the commercial ones, as well as cheaper. For years Bordeaux mixture has been the standard fungicide for the treatment of a great variety of fungous diseases. Owing to its tendency to russet the fruit and burn the foliage of apples, especially in wet seasons, there has been a demand, particularly in recent years, when any blemish on an apple is apt to detract from its commercial value, for some modification of Bordeaux mixture, or the substitution of some fungicide of equal value that will not so injure the fruit and foliage. Weather conditions, especially late spring frosts, also seem to be important factors in the russeting of apples, since in some years there is considerable russeting of certain varieties that have not been sprayed at all.

Our experiments have shown that on the whole Bordeaux has the best fungicidal value of any of the sprays tried, and in 1911, when we used the weaker strength, not nearly so much russeting resulted. Ordinarily Bordeaux is used in the 4–4–50 formula; that is, four pounds copper sulphate, four pounds of fresh lime, and fifty gallons of water. This strength we now believe should be used on apples only in the first spraying, on the unfolding leaves, before the blossoms have opened. The subsequent sprayings should be of the 1–4–50 formula, that is, using only one pound of copper sulphate. Lead arsenate is the insecticide commonly used with Bordeaux, and apparently this is not responsible for the russeting or burning, as that occurs with Bordeaux used alone. Compared with the commercial lime-sulphur sprays, even weak Bordeaux is apt to produce more russeting on such susceptible varieties as Baldwin. The cost of the home-made Bordeaux per barrel varies with the strength used, as follows: 4–4–50 formula, from twenty-five to thirty-four cents; 1–4–50 formula, from eight to eleven cents. This would make the average cost of material for three sprayings, one of the 4–4–50 and two of the 1–4–50 strength, from fourteen to nineteen cents per barrel.

B. *Commercial Lime-Sulphurs.* These are preparations of lime, sulphur and water boiled together in certain proportions, usually 60–125–50, whereby a certain amount of lime and sulphur combine forming soluble polysulphides of lime, which represent the fungicidal and insecticidal ingredients of the amber-colored liquid as it appears on the market. The lime-sulphur solution was first used in the West, and has been used extensively for eight or nine years in Connecticut, on dormant trees to kill San José scale, but during the past three or four years it has been considerably used in much weaker solution as a summer spray for fungi. The different brands, as placed on the market in concentrated form, usually test from twenty-six to thirty-four degrees Baumé. The common practice is to use from one to one and one-half gallons of these concentrated solutions to fifty gallons of water for summer spraying. The strength of the lime-sulphur solutions, both concentrated and diluted, may be determined by the use of hydrometers* if they do not contain other matters, like salt, etc.

Numerous tests of commercial lime-sulphur solutions as summer sprays for apples by various experimenters during the last few years have given encouraging results. Some of these tests have shown a fungicidal value nearly equal to that of Bordeaux, while the injury to the fruit and leaves has been considerably less, especially as regards russeting of the fruit. Our tests in 1910, when apple fungi were not very troublesome, showed these sprays to have nearly the same fungicidal value as Bordeaux mixture, and to cause very little russeting as compared with the latter. In 1911, however, when fungi were much more abundant, we did not get such uniform results in controlling them, especially the sooty blotch, with lime-sulphur sprays as with Bordeaux. There was also some russeting and considerable scald (more of the latter than with Bordeaux), especially with certain brands. It

* Hydrometers made especially for testing lime-sulphur solutions may be purchased from the Bausch & Lomb Optical Company of Rochester, N. Y. While these are valuable for testing the concentrated solutions, we are inclined to believe that their use by orchardists in making up dilute solutions will be limited.

is quite unlikely that scald will usually be as prevalent as last season, since the unusual hot weather in July was responsible for scald on some apples not sprayed at all.

The insecticide commonly used with the lime-sulphur sprays is lead arsenate, and there is some question whether or not the injury is due to it. Used alone, lead arsenate in our experiments has not caused as much injury as when used with lime and sulphur. This seems to indicate that it is the combination of the two that produces the injury. The recent work of Stewart of Pennsylvania seems to show that the injury can be largely eliminated by the use of pure lead ortho-arsenate. When this is used with the lime-sulphur no soluble arsenate, which is known to be very injurious to vegetation, is formed. While the lime-sulphur solutions promise to be valuable as apple sprays, they have not yet been tested as long or as thoroughly as the Bordeaux. We are not yet ready to recommend them to the exclusion of Bordeaux, especially on those varieties not so liable to russeting or on those very susceptible to fungous attack.

The concentrated lime-sulphur solutions are made on a large scale by some of our orchardists somewhat cheaper than they can be purchased of the manufacturers. It takes some apparatus and attention to details to manufacture them, and for the ordinary grower it is apparently cheaper and more satisfactory in the end to buy the commercial brands. Their cost, diluted ready for use in the orchard, depends somewhat on the amount used. At the rate of one and one-quarter gallons they cost from seventeen and one-half to twenty-five cents per barrel of spraying mixture, according to the brand used. As there is no sediment, lime-sulphur is easily diluted and applied, and when diluted is not nearly so disagreeable in spraying as when used as a winter spray. The following are the brands used in our experiments:

Blanchard. This was used in two apple orchards each year, and gave fairly good results as a fungicide. Very little leaf injury or russeting resulted, though a little scald showed in one orchard in 1911. It was used without lead arsenate in one peach orchard in a small way in 1911, at a strength of 1–150, and gave fairly good results in controlling scab, with very little injury to the foliage, and none to the fruit. The density test in 1911 was 31° Baumé at 24° C.

Grasselli. In 1910 this was used in three apple orchards, and in 1911 in two apple orchards and one peach orchard. It gave fair results as an apple fungicide in 1910, but in one orchard in 1911 it did not control sooty blotch nearly as well as did the Bordeaux. There was no conspicuous leaf injury, and as a whole not much russeting, though in the Stevens orchard in 1911 this injury was nearly as conspicuous as that on the Bordeaux trees, while there was even more scald. Considerable injury to the peach foliage resulted in the Henry orchard when used at the rate of 1–150 with lead arsenate added. In 1910 it tested 33¾° B. at 23° C., and in 1911 32¾° at 15½° C.

Niagara. This was used only in 1910, in four apple and one peach orchard. This brand was said to have some lime sediment in it to prevent burning. It showed fair fungicidal value, and gave about the same amount of russeting and leaf injury as did the other brands used in the same orchard. In one case quite a little scald resulted on a certain variety. On peach foliage, used at a strength of 1–75 with lead arsenate added, some little injury resulted, less, however, than might be expected at this strength. It tested 33¼° B. at 23° C.

Sherwin-Williams. In 1910 this was tried in four apple orchards, and in 1911 in four apple orchards and one peach orchard. Comparatively little russeting or leaf injury was noticed from it on apples, and only a little scald in 1911. A little injury to cherry and peach foliage was noticed in 1911, but not at all conspicuous. It seemed to have fair fungicidal value. In 1910 it tested 33½° B. at 23° C., and in 1911, 34° B. at 12° C.

Sterling. This was not tried in our general spraying experiments, being used only on a few trees in our Centerville orchard in 1911 to note its effect on foliage. No conspicuous injury resulted at a strength of 1–50. It only tested 29½° B. at 21° C.

Thomsen. The results of this spray, which was used in two apple orchards only in 1911, were rather unsatisfactory, as in both cases more or less leaf injury (see Plate XX, b), some scald, and in one case considerable russeting, resulted. It did not give as good results in preventing sooty blotch, etc., as did the Bordeaux and another lime-sulphur used in the same orchard. The strengths used were 1¼ and 1 to 50, with lead arsenate added. It only tested 29° B. at 21° C.

Vreeland. This was used only in a small way in one apple orchard in 1911. No very evident injury to the foliage or fruit resulted from two sprayings at a strength of 1¼–50, with lead arsenate added, but more sooty blotch developed than on the Bordeaux trees, though considerably less than on the checks. It tested 34° B. at 15° C.

C. *Self-boiled Lime-Sulphur.* This is a home-made lime-sulphur preparation, and contains only a small amount of polysulphides in solution, with a large amount of free sulphur and slaked lime as sediment. The sulphur is brought into solution only by the heat developed by the slaking lime. It was first advocated by Scott, of the United States Department of Agriculture, as a substitute for Bordeaux on apples, and later as the best spray for peaches.

We have made the 8-8-50 formula as follows: Eight pounds of fresh lime are started slaking in a barrel with a little water (warm water preferably in cool weather) and when the mass has begun to heat in good shape, eight pounds of sulphur flour is quickly sifted in and thoroughly stirred with the slaking lime. This, at the consistency of a rather thick paste, is allowed to heat for fifteen minutes from the time the sulphur is added, when it is cooled down with additional water. The mixture is stirred and strained into the spray barrel to remove the coarser sediment, and diluted to the fifty gallons.

The trouble in making this mixture is even greater than in making Bordeaux, and there is more bother in spraying because of the coarser sediment. It possesses fungicidal value almost equal to Bordeaux, and apparently somewhat better than the commercial lime-sulphur at one and one-quarter strength. It varies, however, in strength and value with the heat developed in boiling it, and as a rule it is better, in order to obtain sufficient heat, to make it up in three-barrel lots at a time.

We used this fungicide in three apple orchards in 1910, and in two in 1911, also in our experimental orchards at Centerville. We used it each year in all of the peach orchards that were sprayed, also somewhat on cherries, plums and currants. While it has considerable merit as a fungicide on apple, it has caused some russeting and scald, though not nearly as much russeting as Bordeaux, but about the same as the commercial lime-sulphur. Taking everything into consideration (difficulty of making, some injury, fair to good fungicidal value), we see no particular advantage in its use as a fungicide for apples. For peaches, however, and likewise for cherries and plums, where there is always danger of burning from Bordeaux, and also often from the commercial lime-sulphurs, especially if used with lead arsenate, we believe that it is the best fungicide to use, especially since it has given very good results, and produced on the whole the least injury of any spray tried. Its cost per barrel varies from twenty-six to thirty cents.

D. *Miscellaneous Sulphur Sprays.* We include under this heading several commercial sprays differing from straight lime-sulphur in having some other substance than lime and sulphur entering into their composition. These sprays have caused more injury than the others to foliage when used as directed by their manufacturers. Apparently, in some cases at least, this is due to the use of some caustic other than lime, such as soda or potash, to bring the sulphur into solution, and this alone, or when combined with an insecticide, produced more or less serious injury to the foliage. The three brands that we have used are as follows:

Sulfocide. This is a somewhat darker and more viscid substance than the commercial lime-sulphur solutions. It has been used in two apple orchards, one each year, besides in our Station experimental orchard, and in two peach orchards. It cannot be used with lead arsenate, because a soluble arsenate is formed that severely burns the foliage. In 1910, with Paris green, one-half pound to the barrel, but without lime added, we found it producing more or less injury both to apples, at a strength of 1–200, and to peaches at a strength of 1–400. Without the poison, at these strengths, much less injury was caused. In 1911, used on apples, as recommended by the manufacturer, at the rate of 1–300, with only one-quarter pound Paris green per barrel, and with the addition of lime, little injury resulted, but it is questionable whether at these strengths it possesses sufficient fungicidal and insecticidal values. On peaches in 1911, without poison, used in two sprayings, one at the strength of 1–500, and one at the strength of 1–600, little injury resulted, but it was too weak to do much good as a fungicide. From the results of our experiments with the spray, we do not recommend its use at all on peaches. It costs twenty-five cents per barrel at the 1–200 rate, and seventeen cents per barrel at the 1–300 rate. It tested 39½° B. at 20° C., but this means little. The manufacturers claim thirty per cent. of sulphur in solution.

Bogart's Sulphur Compound. This is a dark, rather thick liquid, something like Sulfocide in appearance. It evidently has more or less oil in it, as indicated by its rather viscid nature and low specific gravity, 16° B. at 23° C. It has been used only at the Station experimental orchard, but both in 1910, at the strength of 1½–50 and 1–75, and in 1911 at the strength of 1–100, when lead arsenate was used with it, there resulted considerable injury to the foliage. This was apparently due to the presence of the lead arsenate, since when used at the rate of 1–100 in 1911 without this poison it produced no injury. Apparently, like Sulfocide, this has some alkali present, which unites with the lead arsenate to form a soluble arsenate which is injurious to vegetation. Whether or not Paris green, with the addition of lime, could be used in it without this injury, was not determined. The cost per barrel was twenty-five cents when used at the rate of 1–100.

One-for-All. This is a paste somewhat resembling axle-grease in appearance, and is said to consist of wool grease, sulphur, and some poison. It was used only in 1910 in one apple orchard, at the rate recommended by the manufacturers, five or six pounds to fifty gallons of water, but this produced such serious injury to the foliage that it has not been tried since. Formerly this was made with an arsenite as the insecticide, and this probably explains the resulting injury. The manufacturer states that lead arsenate is now used as the insecticide. The cost was thirty to thirty-six cents per barrel, according to whether five or six pounds were used, but this included the cost of the insecticide as well.

E. *Atomic Sulphur.* This is a chemical preparation in which pure sulphur is said to exist as extremely finely divided particles. It is placed on the market both with and without lead arsenate. As sulphur alone has been long considered a fungicide of some value, and as some think that it is the sulphur finally liberated in the commercial lime-sulphur that gives its fungicidal action, there was some reason to suppose that this commercial preparation would have value. All our experiments have showed it to have a fungicidal value apparently about equal to that of Bordeaux. The Atomic sulphur comes in the form of a clay-like sediment, covered with a little water. It is rather difficult to thoroughly stir it up in this, ready for further dilution. Once diluted in the spray barrel, it requires some agitation to keep it in suspension, but remains suspended rather better than one might expect.

It was used only in 1911, at the rate of ten and twelve pounds to fifty gallons of water. In every case where used, one, and in most cases two of the sprayings, were with the form containing lead arsenate, so we cannot state what is the effect on vegetation of the Atomic sulphur by itself. It was used in one apple and three peach orchards, also on some cherries and currants. We had not expected any trouble from this mixture, and yet in every case, except with the cherries, there was more or less injury to the foliage and also considerable scald on the fruit of both apples and peaches. No doubt part of the scald can be attributed to the extremely hot weather, but in most cases it was worse with this fungicide than with others in the same orchard. Because of this injury, the difficulty of mixing, and its high cost, which amounts to ninety-three cents to $1.11 per barrel, according to strength, including the cost of lead arsenate, we cannot recommend this as highly as we could wish, on account of its evident fungicidal value.

F. *Sulphur and Lead Arsenate.* This is a home-made preparation consisting of three pounds lead arsenate paste, six pounds sulphur flour, mixed together with a little water into a paste and then diluted to fifty gallons with water. It was based on the belief that sulphur has more or less fungicidal value. The lead arsenate helps to keep the sulphur in suspension, and causes it to adhere to the foliage. The mixture, however, requires constant agitation, and easily clogs the nozzles. It was tried in 1910 in two, and in 1911 in five apple orchards. It showed some value as a fungicide in 1910, but in 1911 seemed to be of little value, especially against fruit speck and sooty blotch. On the whole, it produced very little injury on the foliage, and very little russeting of the fruit, perhaps less than anything else tried except lead arsenate alone. On account of its poor mixing qualities, the necessity of the use of poison when at times none is needed, and its apparent low fungicidal value, we cannot recommend it for general use. It costs, including the lead arsenate, from thirty-six to fifty-two cents per barrel.

G. *Lead Arsenate, etc.* We used this chiefly in the form of paste, at the rate of three pounds in fifty gallons of water, and of the following brands: Ansbacher's, Grasselli's, Sherwin-Williams', Swift's and Vreeland's. Ordinarily no injury resulted from its use alone, in most cases the amount of russeting being no greater than that on the unsprayed fruit. It probably has some fungicidal value, chiefly by lessening insect attacks, and thereby lessening fruit speck and general rot. This was especially true in 1911, and on the whole, trees sprayed that year with lead arsenate had less sooty blotch than the check trees. While in our experiments we had no direct injury from lead arsenate when used alone, no doubt part of the injury caused by the various fungicides when used in combination with it can be traced to the formation of soluble arsenates. We have heard, however, of some cases where lead arsenate used alone, for some unaccounted reason, produced serious injury. There was one case, where part of the trees of the same variety in the same orchard and sprayed the same day had the foliage badly injured, while others did not.

In the dry form, Vreeland's and Devoe & Raynolds' were the only brands used. These were used at the rate of one and one-half pounds per barrel, and when used alone or in combination with lime and sulphur, seemed to have about the same value as the paste forms. Their relative cost per barrel is about the same, or a little higher, than the latter.

Ortho-arsenite of zinc, supposed to be especially valuable because of non-injurious action on the foliage, caused very considerable injury (see Plate XX, a) where it was used by Mr. Ives in one of his orchards. He used it at a strength of three-quarters pound to fifty gallons, and saw no injury after the first spraying, but soon after the second was made, which was seven days later than the first, the leaves began to drop, until about one-half had fallen off. We do not know the explanation of this, as the same brand tested by us in an experimental way gave no injury.

GENERAL RESULTS OF TWO YEARS EXPERIMENTS.

APPLES.

Experimental Conditions. As stated elsewhere, these experiments have been carried on in a variety of orchards in different parts of the State, under varying conditions. Some of the orchards have been well kept up as regards cultivation, pruning, fertilization and spraying, while with others the reverse has been true. The trees ranged in age from those just set out in our own experimental orchard, and those just coming into bearing in some of the commercial orchards, up to trees at least fifty years old.

We have aimed in our experiments to include at least the more common commercial varieties of the State, as well as those especially subject to fungous and insect attack. Most of our work has been on the Baldwin and Greening, as these are the two chief commercial, as well as family, varieties grown here. The following are the twenty-one varieties from which more or less extensive data were obtained: Baldwin, Colvert, Early Harvest, English Russet, Fall Pippin, Gravenstein, Greening, Hubbardston, Hurlburt, Jonathan, King, Mann, Pound Sweet, Red Astrachan, Roxbury Russet, Russet, Spitzenburg, Strawberry, Sutton, Sweet Apple, Yellow Transparent.

Our usual method was to select orchards that promised favorable conditions for experimentation, and then, just before blossoming time, those trees best suited for our purpose and which gave promise of a crop of apples, were reserved for our work. In most cases we furnished the materials, and the owners supplied the apparatus and the necessary extra labor for spraying. In the fall we aimed to be on hand when the apples were picked. Where the apples were not too numerous, all on the tree were taken for the counts, but with a full-bearing tree, often only from 500 to 1,000 from different parts of the tree were taken. These were all examined for fungous, insect, or spray injury, and each particular kind listed. The records of each tree were kept separate, but in our tables the data from the same varieties having the same treatment are combined. The details of the results for 1910 were not published because of lack of room, and because fungous injury was not so prevalent that year. The results of 1911, however, are given in detail in the tables that follow.

In comparing the results, care has to be used not to draw unwarranted conclusions, since there is considerable variation in the manner in which the various fungicides under different conditions act in preventing fungous and insect attacks, as well as in causing injury. There is also great difference in the susceptibility of different varieties to attack, in abundance of fungi and insects present in different seasons, or in different orchards, and even on different trees in the same orchard. The safest method is to compare only varieties in the same orchard, near together, which, except for spraying, have had exactly the same treatment. We can take the same number of trees of different varieties in one or more orchards and fairly safely compare one treatment with another. In our tables we have even sometimes combined the data when the varieties were not the same, so that extra care is needed here in judging the combined figures. However, we have given sufficient data for one to judge of the combinations made and the conditions that existed.

Immune and Susceptible Varieties. Fungi. We have mentioned that different varieties vary greatly in their behavior toward fungi even under the same conditions. This resistance or tolerance also varies with the same variety toward different fungi. While apparently we have no variety entirely immune to any one, to say nothing of all fungi, still the difference in different varieties is marked enough to attract attention. According to our observations the varieties especially subject to *scab* are Early Harvest, Fall Pippin, Newtown Pippin, McIntosh, Fameuse, Strawberry, Wine Sap, and under some conditions, Greening. Yellow Bellflower has also been sent to the Station as a susceptible variety. On the other hand, Baldwin and Russets of various kinds are rarely injured to any extent. As regards *rust,* the following varieties have been found susceptible, some of the first mentioned being quite so: Betchel's Flowering Crab, Wealthy, Fallowater, Missouri Pippin, Hurlburt, Delicious, Jonathan, Sutton, Russet, Spitzenburg, King; and Westfield Seek-no-further, Rome Beauty and Black Twig have been sent in as susceptible varieties. Baldwin and Greening seem to be varieties not badly attacked. *Sooty blotch* was most conspicuous, at least, on green-skinned varieties, especially on Greening and Mann, and also somewhat on Fall Pippin, and while common on Russet and Baldwin, is not nearly so evident. *Fruit specks* of various kinds have appeared especially on Baldwin, Spitzenburg, Jonathan, Red Astrachan, Fall Pippin, King, and light-skinned seedlings. *Rot* is likely to occur on any variety when fully matured, but perhaps the early summer varieties, Fall Pippin, and Greening in storage, suffer more than the others.

Insects. Varieties of apples do not show as marked susceptibility or immunity regarding attacks of insects as they manifest regarding fungous diseases. On the other hand, it is well known and commonly recognized that early ripening, especially the sweet and less acid varieties, are more liable to be attacked and severely injured by the *apple maggot* or *railroad worm* than the late or very acid kinds. It is easy to understand why the early kinds are attacked, as flies of nearly all kinds are always most abundant in late summer and early fall. The adults, therefore, would naturally deposit eggs in the soft and ripening fruit rather than in the hard and immature apples. Strongly acid varieties are evidently not favorable for the development of the larvæ. It has often been observed that certain kinds of apples, especially Ben Davis and Rhode Island Greening, are more liable to be attacked by *San José scale* than other varieties. As regards *codling moth, canker worms, lice* and other insects, it is doubtful if one variety suffers more than another.

Spray Injuries. Under a preceding heading (Types of Sprays) we have discussed the injuries caused by the different sprays. Here we wish to describe the general kinds of injury. There are three types of injury, namely: *leaf burn, fruit russet,* and *fruit scald.*

Leaf Burn. This is a trouble not uncommon on the foliage with certain sprays under certain conditions. It varies with the type and strength of the spray, the presence or absence of a poison, and with weather conditions. That caused by Bordeaux is the most common, though there are other sprays which would, under certain conditions, be much more serious, if commonly used. With Bordeaux, at least, the trouble does not usually appear until some time after the spraying, indicating, perhaps, some chemical change in the coating that produces the injury with subsequent rain. The injury takes the form of small, reddish-brown specks, or distinct circular spots about one-quarter inch in diameter, though often these run together into extended irregular areas separated from the healthy tissues by a deeper colored border. It is frequently difficult to distinguish the small circular spots produced by spray injury from those caused by the black rot fungus, which often appears on the leaves in spring without signs of a fruiting stage.

The leaves, if seriously spotted, drop prematurely, and even some of those showing little evident injury turn yellow and drop. We have seen apple trees lose from one-half to two-thirds of their foliage in this way from Bordeaux injury, and have observed even worse injury from other sprays. The Bordeaux injury is perhaps not particularly different from that of other sprays, except possibly in its slower action and the less danger of a scorch burn, which involves all, or the greater part of, the tissues. Those sprays that contain injurious ingredients, or form injurious combinations resulting from the addition of an insecticide, usually show the injury much quicker. With Bordeaux, and perhaps this is true of some other sprays, we are inclined to believe that there is much less danger of injury on the young unfolding leaves than after they are fully grown, other conditions being the same. This is probably because the sediment on the young expanding leaves is being stretched over a wider surface all the time, and there is some protection by the hairs on the under surface, the upper smooth surface being folded together on the midrib up to a certain stage of development.

We have had some little injury from the self-boiled lime-sulphur and from the commercial lime-sulphur, but not in a conspicuous way except in one or two cases. Often the injury occurred on a certain variety or on one side of the tree a little more exposed to the sun. Atomic sulphur has not injured apple foliage much, but on peach and currant there was evident injury in some places. The miscellaneous sprays, as Sulfocide, Bogart's Sulphur Compound and One-For-All, have at certain strengths, and especially with the addition of insecticides, given very serious foliage injury, so care has to be exercised in the use of these sprays, paying especial attention to their strength, and the nature and amount of the insecticide used with them. The sulphur and lead arsenate paste spray, and lead arsenates used alone, have given no injury in our experiments, though complaints have been made to the Station of lead arsenate injury under conditions hard to explain, some of the injuries seeming to be due to the brand used, and some perhaps to the manner in which it was used. We have not studied especially the variation of different varieties in susceptibility to spray injury, though no doubt this exists in some degree. In the orchard sprayed by Mr. Ives with Ortho-arsenite of zinc, he said that the leaves of the Sutton Beauty trees suffered much less than those of other varieties, and we have had much less injury on this variety in our experiments.

Russeting. This is an injury of the fruit first showing while still small, and continuing about as evident when mature, in which the skin of a naturally smooth variety is more or less roughened after the manner of a russet apple. When very badly russeted, apples are sometimes more or less stunted in their growth, and occasionally show conspicuous cracks. No spray that we have tried develops this trouble as frequently or as badly as Bordeaux. Sometimes the self-boiled, and certain of the commercial lime-sulphurs (especially Thomsen's and Grasselli's in 1911), have caused some trouble of this kind. Dilute Bordeaux is not so liable to produce conspicuous injury, and we are now recommending that where this spray is used on the young fruit it be only of the 1–4–50 formula, though the first spraying, on the unfolding leaves, may be of the 4–4–50 strength, because of its greater fungicidal value at a critical time for scab. Of the varieties in our experiments, Baldwin showed the worst russeting. We also had serious injury on Pound Sweet, Early Harvest and Yellow Transparent, one case each. Greening, Jonathan and Spitzenburg developed more russeting than the average varieties, while Sutton and Russet developed the least. In the case of the Russets, of course, this is a natural condition, and would not show as an injury except when very prominent. An apple moderately russeted is not as imperfect an apple as one with a moderate amount of scab or sooty blotch, so that the cure is not quite so bad as the disease, if it does not affect a greater per cent. of the fruit, which, however, is sometimes the case.

Scald. This is an injury of the fruit (see Plate XIX, b) in which a deeper and continuous russeting of the tissues takes place, usually on one side or end. Like russeting, it occurs when the fruit is of small size, but is apt to become more prominent with its growth. In fact, the tissues often crack open and offer entrance to fungi, producing a subsequent dry rot. This trouble was much more frequent in 1911 than in 1910. While occurring somewhat more conspicuously with Atomic sulphur than with other sprays, it was also occasionally found on fruit sprayed with self-boiled lime-sulphur, Bordeaux, and some of the commercial brands of lime-sulphur. Some little scald was found on the unsprayed apples, but never as much as on the same varieties when sprayed. Those varieties on which the most scald was found were: Jonathan, Spitzenburg, King, Early Harvest, Baldwin, Greening and Russet.

Relation to Weather. There are two ways in which weather bears on the problem of spraying, first by increasing or decreasing fungous or insect troubles, and second, by increasing or decreasing injury from the sprays used. It is not our purpose here to discuss at length the relationship of weather and fungi. It is quite generally known that a wet season as a whole is favorable for more general and extensive development of these pests than a dry one; likewise, there is considerable connection between their extensive development and the kind of weather at certain periods of the year. These remarks apply as well to the diseases of peach, etc., as they do to the diseases of apples. For instance, a cold, wet spring means an unusual development of rust and scab of apples, and peach leaf curl. Wet weather in late August and early September means that there will be serious rotting of peaches, and is favorable for the development of the sooty blotch of apples.

The relationship of insects to weather is perhaps not so marked as that of fungi, but severe winters help to decrease San José scale, and perhaps other insects. Dry weather in spring and early summer is liable to develop aphid troubles.

It is, however, more particularly of the relation of spray injury to weather that we wish to speak. It is quite evident that the amount of russeting of apples varies greatly in different seasons, as shown by the percentages on the same varieties in 1910 and 1911 (see Table I), much more injury showing in the former year. It is also equally certain that russeting frequently develops independent of any spraying, as shown by our check trees of the different varieties each year. It is ordinarily believed that Bordeaux russeting is much worse in a season wet at the time of spraying than in one dry at that time. We believe that equally injurious are the late spring frosts, coming after the fruit has set, and to this source we attribute much of the russeting, banding and cracking found on unsprayed apples.

Scald also is certainly closely related to weather conditions, as it occurs somewhat on unsprayed fruit. It develops on the outermost apples and usually on the exposed side of the tree, namely, east of south to west of south. It developed in 1911 during the unusually hot weather of June and July. This summer was so unusual as regards heat and drought that we need not expect scald to be as common in ordinary years. While scald may apparently result as a burn, due to the presence of moisture on the fruit in the hot sun, still there is no doubt that part of it is due to chemical irritation, since it was worse with some sprays than with others.

Spray injury to the leaves, especially of the scorch type, may also bear some relation to weather conditions, such as bright sunshine at the time of spraying. Rains or dews help to dissolve chemical substances from the spray coating, which has gradually been changing in nature, and so perhaps bring about injury in time. A scorch type of leaf injury is sometimes seen on trees that have not been sprayed. Whether or not this may be due to water on the leaf in the presence of the hot sun, as is sometimes claimed, we do not know. We think, however, that it is sometimes due to a lack of sufficient moisture to replace that lost by unusual evaporation, as in the case of young trees recently set out. Because of the apparent relationship between spray injury and weather conditions, some writers have advocated that spraying should not be done on unusually bright days, especially in the hottest part of such days. We have no data along this line, but if, as others claim, the best results in preventing fungous diseases of the apple are obtained by spraying just before a rain, the

Table I.—Condensed Results of Apple Spraying Experiments in 1910 and 1911.

Treatments.	Varieties.	Apples counted in 1910.	Apples counted in 1911.	Per cent. Perfect.		Per cent. Russet, etc.		Per cent. Fungi, etc.		Per cent. Chewing Insects.		Per cent. Sucking Insects, etc.	
				1910.	1911.	1910.	1911.	1910.	1911.	1910.	1911.	1910.	1911.
1. Bordeaux Mixture	Baldwin.....	6552	5203	49.2	74.7	42.9	16.9	1.0	2.8	7.7	4.1	.5	2.0
	Greening.....	1196	6522	64.9	76.3	19.5	10.5	6.5	3.2	19.0	6.9	.3	3.7
	Pound Sweet.	·622	0	6.9	0	89.5	0	2.3	0	20.1	0	....	0
	Russets	1065	2743	64.9	84.7	.8	.1	9.5	2.2	26.0	11.2	....	2.0
	Spitzenburg .	0	763	0	68.8	0	11.5	0	3.9	0	17.3	0	.7
	All others....	0	6927	0	68.8	0	17.7	0	2.9	0	7.8	0	3.6
	*Totals..	9435	22158	50.2	74.4	38.2	13.0	2.8	2.9	12.0	7.4	....	2.9
2. Commercial Lime-Sulphurs	Baldwin......	11476	8240	65.9	71.2	22.2	14.4	3.1	11.6	9.4	3.8	.2	.6
	Greening	187	3991	56.7	80.5	11.2	3.5	4.3	6.5	38.0	5.3	....	4.3
	Pound Sweet.	4626	0	88.1	0	....	0	5.4	0	7.0	0	....	0
	Russets......	1563	213	66.3	76.5	.4	4.2	10.0	3.8	24.3	13.6	....	2.3
	Spitzenburg .	0	311	0	75.2	0	10.6	0	1.1	0	13.2	0	0
	All others....	5268	5535	84.5	86.5	2.5	5.7	5.0	1.8	7.7	6.0	.4	.1
	Totals...	23120	18290	74.5	78.0	11.7	9.2	4.5	7.2	9.8	5.1	....	1.3
3. Self-boiled Lime-Sulphur	Baldwin	3945	1092	66.8	69.0	22.8	1.8	.9	13.0	9.2	14.7	.4	1.6
	Greening	305	369	48.8	72.1	12.1	2.4	8.8	4.6	37.0	17.1	....	4.3
	Russets......	434	707	50.5	66.2	0	2.7	14.1	4.5	39.6	22.1	....	6.1
	Spitzenburg .	0	2933	0	76.5	0	8.3	0	3.0	0	12.3	0	.7
	All others ...	0	842	0	88.0	0	1.3	0	2.3	0	8.6	0	0
	Totals...	4684	5943	64.1	75.2	20.0	5.1	2.6	5.0	13.9	13.7	....	1.8
4. Sulfocide	Spitzenburg .	0	596	0	69.3	0	3.5	0	6.7	0	22.7	0	.2
	All others ...	0	1174	0	79.3	0	2.8	0	4.7	0	13.8	0	0
	Totals...	0	1770	0	75.9	0	3.1	0	5.4	0	16.8	0	.1
5. Atomic Sulphur	Spitzenburg .	0	1000	0	70.5	0	12.0	0	4.5	0	13.5	0	.4
	All others ...	0	1071	0	85.8	0	7.9	0	1.4	0	6.0	0	.2
	Totals...	0	2071	0	78.4	0	9.9	0	2.9	0	9.6	0	.3
6. Sulphur and Lead Arsenate (paste)	Baldwin.	1672	3706	72.0	69.2	17.2	8.5	1.4	18.5	9.4	3.8	.2	.7
	Greening	495	1327	90.5	69.0	....	1.1	3.6	24.6	5.9	5.7	....	0
	Russets......	0	204	0	60.3	0	0	0	28.9	0	10.8	0	0
	All others ...	0	585	0	80.0	0	2.4	0	3.2	0	14.7	0	0
	Totals...	2167	5822	76.2	70.0	13.3	5.9	1.9	18.7	8.6	5.6	....	.4
All Fungicides	Totals...	39406	56054	67.6	75.4	19.1	9.8	3.7	6.3	10.7	7.5	....	1.8
7. Lead Arsenate	Baldwin.....	1225	10164	71.5	72.9	16.7	6.3	2.2	14.9	11.2	6.2	....	.8
	Greening	0	2120	0	82.5	0	1.6	0	6.6	0	7.6	0	1.9
	Russets	587	770	69.2	46.1	.3	.9	16.0	14.9	14.8	8.7	....	41.2
	All others....	0	1204	0	88.5	0	.8	0	2.7	0	6.6	0	1.5
	Totals...	1812	14258	70.7	74.2	11.4	4.8	6.7	12.7	12.4	6.6	....	3.2
8. Checks; No treatment	Baldwin	11058	6577	60.4	36.2	19.5	12.0	3.0	34.0	17.6	25.4	1.1	1.1
	Greening	1420	4778	46.1	42.9	22.7	1.1	14.4	37.9	21.8	20.7	.2	2.0
	Pound Sweet.	638	0	71.2	0	....	0	10.7	0	19.0	0	....	0
	Russets	381	1250	24.7	46.7	....	0	11.5	13.0	68.2	40.7	....	2.8
	Spitzenburg .	0	1849	0	48.4	0	1.8	0	25.0	0	30.6	0	.8
	All others....	4433	8070	73.6	69.4	.3	1.4	5.0	11.4	21.2	17.3	....	1.9
	Totals...	17930	22524	62.1	51.1	13.9	4.4	4.9	24.8	20.0	22.8	....	1.7

* Per cents. of "Totals" in all of these tables represent per cents. figured from the total counts and not the average of the per cents. given.

selection of this cloudy period, when possible, may lessen spray injury and increase spray efficiency.

Spray Benefits. The benefits that result from spraying depend largely upon four factors: (1) fungicidal and insecticidal efficiency of the sprays used; (2) number, thoroughness, and dates of application; (3) freedom of the sprayed plants from spray injury; (4) relative abundance of fungous and insect pests. We have already discussed most of these points rather fully, and so confine our remarks here chiefly to the general results of our two years' work.

Fungi. There is considerable variation in the prevalence of fungous troubles on apples in different years, and even in the same year in different orchards. The former variation depends upon the weather conditions we have already discussed, and if we could forecast these we might be able to determine beforehand whether or not an orchard should be sprayed, and if so, how frequently. While it may not be quite so essential to spray each year in this State for fungous troubles as for insects, still, it seems on the whole a paying and necessary procedure for first-class apples. The results, however, will not always be equally good each year or in each orchard, because of variations in the four factors mentioned above.

On the whole, as far as fungi are concerned, there is no need for a winter or a dormant treatment of the trees, and this is desirable for insects only in the case of the San José scale, when the lime-sulphur sprays or the miscible oils can be used to advantage. Our remarks, then, apply only to summer spraying. In this State three sprayings keep most of the fungi and insects under control, and where fungi, especially scab, are not abundant, these may be reduced to two by omitting the first one, on the unfolding leaves. Where an orchard has been sprayed year after year we have found that as a rule the fungous troubles are less prominent than insect pests if spraying is omitted for a year. This is probably because certain of the fungi, as scab, black rot, and sooty blotch, can carry over on the branches, and repeated spraying has more or less cleaned them out there. For the same reason they are more conspicuous in an orchard that has not been sprayed for some time.

With three sprayings, having lead arsenate in the last two, we find that if the right fungicide is used, apple scab, sooty blotch, fruit speck, rot and codling moth are fairly well controlled, and these include the worst of our fungous and insect pests. On the other hand, such treatment does not give decided control of rust or black rot on the leaves. Complete removal of the diseased branches, combined with spraying, is helpful with the latter trouble, but the prevention of rust evidently requires the continuous coating of the leaves from the time they first appear in early May until the middle of July, when all danger of infection from the "cedar apple" stage is over.

The development of the various fungi on the sprayed and unsprayed trees is shown by the following table taken from all of the sprayed and unsprayed trees in 1911. Baldwin spot, while not a true fungous trouble, is included because it is often difficult to distinguish in field examination from the real fungous fruit specks. From this table it is seen that sooty blotch and fruit speck were by far the worst troubles on the unsprayed trees, and that these were greatly reduced by the treatments. The total results of all the Bordeaux treatments show that these troubles were reduced still further by that fungicide, since with it only .4% fruit speck and 1.1% sooty blotch developed. The combined data follow:

PERCENTAGES OF FUNGOUS DISEASES ON SPRAYED AND UNSPRAYED APPLES.

	Baldwin Spot.	Fruit Speck.	Rot.	Rust.	Scab.	Sooty Blotch.
All fungicides......	0.6%	0.9%	0.8%	0.1%	0.1%	3.6%
All checks..........	1.3%	6.5%	2.1%	0.1%	1.5%	13.3%

Insects. The benefits of the treatment as regards injury from the attacks of the codling moth, lesser apple worm, and other chewing insects in 1911 and 1912 are seen in Table II. Lead arsenate is slightly more effective against the codling moth when used alone or with plain sulphur than when combined with any of the fungicides, though in commercial lime-sulphur it shows less wormy fruit than in self-boiled lime-sulphur or in Bordeaux. In 1910 there were five times as many apples showing injury by the codling moth on the unsprayed or check trees as upon the sprayed trees, and more than eight times as many on the check trees as on those sprayed with lead arsenate alone or in combination with plain sulphur. In 1911 the check trees had five times as many as the average of all sprayed trees, and more than seven times as many as the trees sprayed with lead arsenate alone or with lead arsenate and sulphur. With other chewing insects the benefit is less marked. The poison in the spray only imperfectly controls the curculio, and of course is not intended to control such sucking insects as the apple louse and San José scale. Possibly the weak lime-sulphur solutions have some slight effect on the last two, but certainly the Bordeaux mixture does not.

TABLE II.—SUMMARY OF EFFECT OF ALL SPRAYS ON CHEWING INSECTS IN 1910 AND 1911. PERCENTAGES OF INJURED FRUIT.

Fungicide and Insecticide Sprays.	1910.				1911.			
	Codling Moth.	Lesser Apple Worm.	Other Chewing Insects.	Total.	Codling Moth.	Lesser Apple Worm.	Other Chewing Insects.	Total.
	%	%	%	%	%	%	%	%
Bordeaux and Lead Arsenate	9.27	.55	5.7	15.52	2.5	0.7	4.3	7.5
Commercial Lime-Sulphur and Lead Arsenate	5.32	.76	4.13	10.21	1.5	0.3	3.3	5.1
Self-boiled Lime-Sulphur and Lead Arsenate	8.03	3.13	10.03	21.24	4.2	1.8	7.7	13.7
Sulfocide and Paris Green*	....	....	....	....	6.7	3.1	7.1	16.9
Atomic Sulphur and Lead Arsenate†	....	....	.....	....	3.9	0.9	4.8	9.6
Sulphur and Lead Arsenate	3.4	0.8	2.3	6.5	1.4	0.3	3.9	5.6
Averages of above combinations	6.11	1.22	3.57	10.9	2.4	0.7	4.4	7.5
Averages of Lead Arsenate alone	3.5	0.25	8.25	12.0	1.3	0.3	4.9	6.5
Averages of all sprayed trees	5.74	1.08	4.24	11.06	2.2	0.6	4.5	7.3
Averages of all unsprayed trees	28.82	0.86	10.5	40.18	10.1	2.0	10.6	22.7

General. Our spraying experiments with the various fungicides, including an insecticide, have not always given a higher per cent. of perfect fruit than where an insecticide alone was used. This was due to the fact that the insecticide used alone has given little spray injury, while the fungicides often produce spray injury that wipes out largely or entirely the percentage gained by lessening fungous attack. Thus from Table I we see that in 1911 the percentages of perfect fruit in the combined data of all the orchards and varieties for each treatment were

* Manufacturers' directions followed. † Poison added by manufacturer.

as follows: Bordeaux, 74.4%; all commercial lime-sulphurs, 78%; self-boiled lime-sulphur, 75.2%; Sulfocide, 75.9%; Atomic sulphur, 78.4%; sulphur and lead arsenate, 70%; all the preceding fungicides, 75.4%; all lead arsenate, 74.2%; all checks, 51.1%. The preceding year the combined lead arsenate trees had even a higher percentage of perfect fruit than the combined fungicides, due to a far greater per cent. of spray russeting resulting that year. This does not mean that orchards on the whole do not need spraying with a fungicide, but rather that they need treatment with one that will produce the least amount of spray injury. It is also to be remembered that a moderate spray injury on the whole is not as bad as a moderate fungous injury or a wormy apple.

There was considerable variation between the percentages of perfect fruit from all the sprayed trees (including both fungicides and insecticides, insecticides alone) and all of the unsprayed trees in the different orchards, as shown by the following figures. For 1910: Ives orchard, sprayed trees, 67.9% perfect fruit, unsprayed, 62.5% (partially sprayed for insects); Jones orchard, sprayed, 49.1%, unsprayed, 6%; Rogers orchard, sprayed, 73.9%, unsprayed, 67.1%; Savage orchard, sprayed, 53.7%, no real checks; Smith orchard, sprayed, 78.4%, unsprayed, 71.2% (partially sprayed for insects); Stoddard orchard, sprayed, 64.2%, unsprayed, 20.2%. For 1911: Andrews orchard, sprayed, 68.8%, unsprayed, 27.9%; Clark orchard, sprayed, 76.8%, unsprayed, 61.3%; Ives 1st orchard, sprayed, 78.2%, unsprayed, 52.2%; Ives 2d orchard, sprayed 88.8%, unsprayed, 71.7%; Jones orchard, sprayed, 68%, unsprayed, 39.5%; Smith orchard, sprayed, 79.7%, unsprayed, 74.6%; Station Mt. Carmel orchard, sprayed, 74.5%, unsprayed, 55.2%; Stevens orchard, sprayed, 75.3%, unsprayed, 49.5%; Stoddard orchard, sprayed, 76.6%, unsprayed, 24.1%. Some varieties and individual trees of course showed even greater variations between those sprayed and those unsprayed. From the above data one can in almost every case pick out by the low per cent. of perfect fruit on the unsprayed trees those orchards that had not been previously sprayed. This also means that orchards that had been well sprayed in the past did not show so great a difference between the sprayed and unsprayed trees in our experiments on this account. More specific data on sprayed and unsprayed trees as regards spray injury, fungous and insect injuries of different kinds, can be obtained from the tables printed here and in our previous bulletin.

As regards the most frequently used sprays, we have compiled in the following table their rank each year as regards most perfect fruit and least amount of russeting, fungous and insect injuries. For example, in 1911, Bordeaux produced the most russeting, was first in preventing fungous attack, fourth in lessening injury by chewing insects, and third as regards perfect fruit.

TABLE III.—RELATIVE RANK OF DIFFERENT TREATMENTS EACH YEAR AS REGARDS MOST PERFECT FRUIT AND LEAST AMOUNT OF RUSSET, FUNGI, AND INSECTS.

	Perfect.		Russet, etc.		Fungi.		Chewing Insects.	
	1910.	1911.	1910.	1911.	1910.	1911.	1910.	1911.
Bordeaux*	6	3	6	6	3	1	3	4
Commercial Lime-Sulphur*	2	1	2	5	4	3	2	1
Self-boiled Lime-Sulphur*	4	2	5	3	2	2	5	5
Sulphur and Lead Arsenate†	1	5	3	4	1	5	1	2
Lead Arsenate	3	4	1	2	6	4	4	3
Checks	5	6	4	1	5	6	6	6

RECOMMENDATIONS. For the control of fungi and insects on apples in Connecticut we make the following recommendations based on the results of our two years' experiments:

(1) Winter treatment (spraying dormant trees) is necessary only in the case of the presence of the San José scale, when commercial lime-sulphur, 1-8, or miscible oils, 1-15, may be used.

(2) As a rule, three summer treatments with a fungicide are necessary to control the fungous diseases, and the last two of these should contain an insecticide. These sprayings should be made as follows: 1st, just before the blossoms open, on the young unfolding leaves (April 27th to May 10th, according to the season and variety); 2d, right after all the blossoms have fallen (May 10th to 30th); 3d, about one month later (usually June 15th to 25th).

(3) Where fungi are not prevalent, especially scab, the first treatment given above may be omitted. Occasionally, perhaps in alternate years, where fungi are quite inconspicuous and the trees have been thoroughly sprayed the previous year, the fungicide may be entirely omitted, and only the two sprayings for insects may be given.

* Also contained Lead Arsenate. † Not used extensively in 1910.

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

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

PEACHES.

Experimental Conditions. What we have already said regarding the details of spraying and of obtaining results for apples generally applies to our work with peaches. Our experiments have not been so extensive with the latter, either in the number of orchards (three each year) and varieties sprayed or in the types of sprays used. This was largely because summer spraying of peaches in this State has never been practiced to any extent, and also because there is more danger of injury from the spraying. As the orchards did not belong to the Station, we had to proceed cautiously so as to avoid serious injury.

Treatments were made at different times and with different numbers of applications to determine what are the best stages in the development of fruit for spraying, and how few treatments may be used for the general control of fungous troubles. The following varieties were included in the experiments: Belle of Georgia, Carman, Champion, Elberta, Greensboro, Hieley, Mountain Rose, Triumph, Waddell, natural seedlings, and a few trees of other varieties from which data were not collected.

The following sprays were tried: (1) commercial lime-sulphur, at strengths varying from 1–75 to 1–300, and of the following brands, Blanchard, Grasselli, Niagara, Sherwin-Williams; (2) potassium sulphide; (3) Sulfocide; (4) Atomic sulphur; (5) self-boiled lime-sulphur. Usually lead arsenate (Paris green in a few special cases) was used in one or two of the treatments. Because in previous experiments, Bordeaux, as weak as 2–4–50, had produced serious leaf injury, this fungicide was not included in the experiments.

Fungous Diseases and Insects. In 1910 considerable leaf curl developed in the Champion orchard under investigation, though this variety does not suffer perhaps on the whole as much as Elberta and some other yellow-fruited varieties. Neither of the two years were exceptional as regards the development of the brown rot fungus, though certain varieties especially subject to rot, such as Champion, Triumph, Waddell and Hieley, were among those under investigation. In 1910 considerable rot developed among the Champions, and a moderate amount in 1911, so that this variety offered the best test for controlling this disease. Among the varieties that scab badly are Elberta, Hieley, Carman, Waddell and natural seedlings. On the whole, the conditions for testing the efficiency of spraying against scab were fair each year, so that the most satisfactory results were obtained for this trouble.

As regards insects, while the sawfly was not abundant in any of the orchards, our entomologists had worked out the control of this in other experiments. Curculios were sufficiently abundant to determine how effective and necessary for their control was the addition of poison.

Spray Injury. The foliage and young twigs of the peach are more susceptible to injury from sprays than those of the apple. What has been said in regard to the influence of weather conditions on spray injury to apples applies in large part to peaches also, although the russeting type of injury does not occur. There are three general types of injury, namely, foliage burn, twig burn, and fruit scorch. The foliage injury differs from that of apple in that the tissues of the injured spots usually drop out, leaving a shot-hole effect much like the bacterial spot of peach leaf. When the injury is very severe, the leaves are partly or entirely shed, and the injury also shows on the young twigs as reddish or purplish spots much like those caused by the scab fungus. These twig burns sometimes entirely encircle the stem, and kill it. The scorch injury to the fruit did not occur in our experiments until 1911, when the hot weather at spraying time was largely responsible for its appearance. The scorch is hidden somewhat by the hairs, but shows as a larger or smaller area usually on one side, in which the tissues are of a darker color, and often crack, thereby favoring decay by brown rot.

In 1910 our experiments emphatically demonstrated that insecticides like lead arsenate, and also Paris green, could not be used with such sprays as potassium sulphide and Sulfocide without serious injury to the trees, not only causing the foliage and fruit to drop, but killing the young twigs, and even the tree itself under some conditions. Potassium sulphide alone had been used by Sturgis in this State years before, with fair success, and we also found that, without poison, used at the rate of one pound to fifty gallons of water, it caused very little injury. Sulfocide used alone at the rate of 1–400 produced only a little foliage injury, and practically none at 1–500 and 1–600.

The commercial lime-sulphurs gave variable results, but our test conditions with these were not all the same. We believe that part of this difference was due to the brands used, since with some we got more injury than with others. However, we believe that the use of lead arsenate in these was responsible for considerable of the injury, especially when it occurred where the commercial lime-sulphur was made as weak as 1–150. But before a positive statement can be made it will be necessary to test the different brands under conditions precisely alike in all respects. Without more definite data we cannot recommend the use of a poison with these sprays, and they should not be used stronger than 1–150. Even at this strength we recommend the grower to do more or less preliminary spraying with his selected brand before bringing it into general use in his orchard.

Atomic sulphur, usually containing lead arsenate and used at the rates of ten and twelve pounds to fifty gallons, caused more injury in some tests than in others. We got from a little to considerable leaf injury, twig injury in one case, and more fruit scald than with any other spray used on peaches in 1911. All of the peaches sprayed with Atomic sulphur had lead arsenate in at least one of the applications and from the variation in number and time of the applications, we are inclined to believe that the lead arsenate was largely responsible for the injury.

Self-boiled lime-sulphur (8–8–50) gave by far the least injury of any of the fungicides, even with lead arsenate present. In fact, we have had only a very little leaf injury in a few cases, no twig injury, and comparatively little fruit scald. In 1911, in the Jones orchard, we found that when lead arsenate was used with the self-boiled lime-sulphur the trees showed a little more fruit scald, with no special difference in leaf injury, which was inconspicuous in both cases.

With self-boiled lime-sulphur, the chief harm is likely to come from too late spraying, especially in a dry season, when the spray will show on the fruit as a white sediment. The rains may wash this all off from the upper side, but still leave it somewhat apparent on the under side. In this State, if no treatments are made after the tenth of July, this sediment will so largely disappear through rains and the growth of the fruit that only in exceptionally dry years on very early varieties will any harm occur. Only the looks of the fruit are affected, the taste does not seem to be injured. Handling them for marketing will also wear off much of the sediment. We had very slight trouble of this kind with one very early variety in 1910, and none at all in 1911.

Lead arsenate, when added to the fungicide, often gives a higher color to the fruit, especially when it causes a slight injury. This was particularly noticeable with Atomic sulphur in one case, where small reddish-purple specks occurred on the skin, but not prominent enough to constitute an injury.

Benefits: Fungi. The prevention of leaf curl was tested only in the Jones orchard on the Champion, which is not especially subject to this trouble. However, enough evidence was gathered both years to show that commercial lime-sulphur used as strong as 1 to 8 or 9, if applied just as the buds begin to swell, will practically prevent this trouble. Of course this treatment takes care of the San José scale at the same time. This dormant treatment, however, had little or no effect upon scab or rot. In 1910, all of the trees having this winter treatment gave just as high a per cent. of scab, and practically as high of rot, as did those not having it, neither lot having any summer treatment. In 1911, all the trees having this winter treatment and three summer treatments did not give any lower per cent. either of scab or rot than those that received only the three summer treatments.

Brown rot, as stated before, was not serious either year, yet it developed quite prominently upon the Champion checks in the Jones orchard, especially in 1910, so we have to judge of our results in preventing this trouble from our experiments in this orchard on this variety. So far as we can judge from these experiments, commercial lime-sulphur, Atomic sulphur, and self-boiled lime-sulphur were about equally effective in controlling the rot. In 1910, the per cent. of rotten peaches on all the trees sprayed with commercial lime-sulphur and self-boiled lime-sulphur was 23.3% as against 61.5% on the unsprayed trees; while in 1911 the total rot from all the trees sprayed with commercial lime-sulphur, self-boiled lime-sulphur and Atomic sulphur was 4.4% as compared with 13.5% on the unsprayed trees. In these experiments the peaches were picked as they ripened, the rotten ones being removed at each picking. The keeping quality of the sprayed fruit is better than that of the unsprayed, as shown by tests of sound peaches sprayed with self-boiled lime-sulphur as compared with sound unsprayed peaches, the former keeping at least two or three days longer on the average. Three days after picking, 78% of the unsprayed fruit had rotted as compared with 18% of the sprayed fruit.

The scab as well as rot was controlled about equally well by commercial lime-sulphur, self-boiled lime-sulphur, and Atomic sulphur. This trouble was abundant enough in all the orchards and on most of the varieties each year to give fair tests as to its control by each of these fungicides. In the Jones orchard in 1910 all the peaches sprayed with the commercial lime-sulphur and self-boiled lime-sulphur showed 4.5% scab against 13% on all the unsprayed. In the three orchards experimented with in 1911, the per cents. were as follows: Jones, sprayed, 2.1%, unsprayed, 21%; Henry's, sprayed, 7%, unsprayed, 40.5%; Ives, sprayed, 1%, unsprayed, 16.3%. The higher per cent. of scab on the sprayed trees in the Henry orchard over that in both the Jones and Ives orchards is probably due to the omission in this orchard of the first of the three treatments.

Insects. Again this year, as in 1910, the figures in the tables show no appreciable decrease in the percentage of insect injury by the use of lead arsenate. If the leaf-eating insects, like the peach sawfly, had been present in destructive numbers, then of course its effects would have been shown by the more perfect foliage, as has been demonstrated in previous experiments.

RECOMMENDATIONS. As a result of our experiments with peaches, we are able to make the following recommendations as regards the number and times of application, and the sprays to be used:

(1) Spraying of peaches while dormant is of value only in checking San José scale and leaf curl. One application of commercial lime-sulphur, 1-8, just before the buds begin to swell in spring, the first part of April, will take care of both of these troubles at the same time. If the scale is unusually prevalent, a previous application in the late fall of either lime-sulphur or a miscible oil, 1-15, will prove of additional value in killing it.

(2) For the prevention of scab and rot of peaches, it is as a rule desirable to give three sprayings, as follows: 1st, shortly after the blossoms have fallen (May 10th to May 25th); 2d, about three or four weeks later (June 5th to June 15th); and 3d, about one month later (July 5th to July 15th). If only two sprayings can be given, omit the first.

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

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

DETAILS OF EXPERIMENTS IN 1911.

APPLES.

In the following paragraphs we give the conditions and results in each orchard where experiments were carried on in 1911. Further details as to the results will be found in Tables IV, V. The owners or managers of the orchards were as follows: C. K. Andrews, Mount Carmel; H. E. Clark, Tuttle Farm, Middlebury; E. M. Ives, Meriden; B. T. Jones, Hamden; S. A. Smith & Son, Cheshire; W. W. Stevens, Clintonville; F. A. Stoddard, Munson Farm, Litchfield. Besides these, small orchards on the Centerville and the Mount Carmel farms of the Station were also used.

Andrews Orchard. *Conditions.* This was an orchard of Baldwins about fifteen years old that had not been sprayed, at least in recent years. No winter treatment was given this year. As it was said that fungi had not been especially bad the previous year, only two sprayings were given, corresponding to the second and third treatments, on May 25 and June 14. The following spray materials and strengths were used in each treatment:

(1) Bordeaux, 2-4-50, with 3 lbs. lead arsenate (Ansbacher's); (2) Sherwin-Williams lime-sulphur, 1-50, with 3 lbs. lead arsenate (Ansbacher's); (3) Thomsen's lime-sulphur, 1-50, with 3 lbs. lead arsenate (Ansbacher's); (4) sulphur and lead arsenate (Ansbacher's), 6-3-50; (5) lead arsenate paste (Ansbacher's), 3-50; (6) lead arsenate, dry (Vreeland's), 1½-50.

*TABLE IV.—PERCENTAGES OF FUNGOUS AND INSECT TROUBLES ON SPRAYED AND UNSPRAYED APPLES IN 1911.

Orchard.		Fruit Speck.	Rot.	Rust.	Scab.	Sooty Blotch.	*Total* Fungous Troubles.	Codling Moth.	Lesser Apple Worm.	Other Chewing Insects.	*Total* Chewing Insects.
Andrews .	Unsprayed	14.7	2.9	0	0	19.5	37.1	9.8	3.2	12.8	25.8
" .	Sprayed ..	3.1	0.7	0	0	9.2	13.0	0.4	0.4	3.2	4.0
Clark	Unsprayed	0.1	0.1	0.2	3.2	3.4	7.0	10.8	0.6	12.8	24.2
"	Sprayed ..	0	0.2	0	0.9	0.9	2.0	1.9	0.7	3.1	5.7
Ives, 1st..	Unsprayed	19.2	2.7	0.3	0.1	0.7	23.0	16.5	3.8	7.0	27.3
" " ..	Sprayed ..	1.1	1.5	0.4	0.1	0.1	3.2	4.1	2.1	5.3	11.5
" 2d..	Unsprayed	2.2	0.4	0	0	0.7	3.3	8.2	9.4	3.8	21.4
" " .	Sprayed ..	0.4	0.6	0.1	0	0	1.1	0.5	0.2	2.1	2.8
Jones	Unsprayed	3.2	5.9	0.1	0	27.3	36.5	14.4	0.4	9.3	24.1
"	Sprayed ..	0.9	1.6	0.0	0	3.8	6.3	4.4	0.3	10.6	15.3
Smith	Unsprayed	0	0.6	0.3	2.9	2.1	5.9	6.9	0.3	9.0	16.2
"	Sprayed ..	0	0.3	0.1	0.2	0.1	0.7	1.8	0.2	3.3	5.3
Station ...	Unsprayed	10.7	4.8	0	0	10.0	25.5	9.5	0.7	5.5	15.7
" ...	Sprayed ..	0.4	1.4	0	0	1.6	3.4	2.4	0.1	4.1	6.6
Stevens ..	Unsprayed	3.5	1.6	0	1.5	23.5	30.1	4.3	3.0	10.5	17.8
" ..	Sprayed ..	0.3	0.8	0	0.1	8.8	10.0	1.0	0.5	5.3	6.8
Stoddard .	Unsprayed	2.6	2.3	0.1	5.7	21.8	32.5	26.6	0	25.7	52.3
" .	Sprayed ..	0.8	0.9	0.1	1.6	5.3	8.7	7.1	0.1	5.1	12.3

Results. Thomsen's lime-sulphur, made in 1910, caused considerable injury to the foliage (see Plate XX, b), while little or no injury was noticed from the other sprays. It also caused more russeting and scald on the fruit than any of the others. Bordeaux was next to it as regards these fruit injuries. There was also considerable russeting on the checks.

The Bordeaux treatment gave the highest percentage of perfect fruit, largely because it reduced to a minimum the fungous troubles, especially

* The percentages of fungi are somewhat higher on the sprayed apples than they would have been if all the treatments had contained efficient fungicides, since these totals include results where lead arsenate alone was used, and also all of the fungicides, poor as well as efficient. This is well illustrated in the case of sooty blotch in the Andrews orchard, where the average per cent. for all of the sprayings as given in the table was 9.2%, while the average for the efficient Bordeaux treatment in this orchard was only 0.9%.

fruit speck and sooty blotch, which were prominent troubles in this orchard. Sherwin-Williams lime-sulphur was second as regards perfect fruit, and while not quite as good as Bordeaux in preventing fungous troubles, was better than any of the other treatments, and caused less spray injury than the Bordeaux. The trees sprayed with lead arsenate alone had less fruit speck and sooty blotch than the check trees, thus seeming to indicate some fungicidal value for this insecticide.

In this orchard a total of 25.8%, or fully one-fourth of all the apples on the unsprayed trees, showed injury from chewing insects. Half of the damage was probably caused by the codling moth, though it is often difficult to trace the injury when slight. On the sprayed trees the injury from chewing insects was reduced to 4%. In this orchard the lead arsenate was fully as effective as an insecticide when added to Bordeaux mixture as when used alone or in connection with lime-sulphur.

Clark Orchard. *Conditions.* The trees sprayed in this orchard were very young Greenings, just coming into bearing, although some older Baldwins were also included in the treatments with lead arsenate. The orchard had been given a winter treatment by the owner. Only two sprayings were made, corresponding to the second and third treatments, on May 26 and June 16–17. The following sprays were tried: (1) Bordeaux mixture, 2–4–50, with 3 lbs. lead arsenate (Swift's); (2) Grasselli's lime-sulphur, 1½–50, with 3 lbs. lead arsenate (Swift's); (3) lead arsenate paste (Swift's), 3–50.

Results. Some, but not serious, foliage injury resulted from both the Bordeaux and Grasselli's lime-sulphur, the former causing more. The trees sprayed with Bordeaux also developed considerably more russeting of the fruit than any of the others, though the per cent. was not unusually high for this treatment.

The trees sprayed with Grasselli's lime-sulphur gave the highest percentage of perfect fruit, though this was but little higher than those sprayed with lead arsenate alone. Comparatively little injury from fungi (see Table IV), even on the checks, occurred in this orchard. The Greenings sprayed with Bordeaux, which gave the best fungicidal results, had no sooty blotch and only 0.1% scab, against 4.4% sooty blotch and 4.2% scab on the check trees. Considerable Baldwin spot developed on both the unsprayed Baldwins and those sprayed with lead arsenate.

The fruit on the unsprayed trees in this orchard showed an average of 24.2%, or about one-fourth, injured by chewing insects, but the treatment by spraying reduced this to 5.7%. Lead arsenate alone gave slightly better results than when combined with a fungicide, and the percentage of fruit injured by chewing insects was slightly greater where the lead arsenate was used with Bordeaux mixture than with lime-sulphur.

Ives (1st) Orchard. *Conditions.* This was a young orchard, about seven years old, of miscellaneous varieties, which were just coming into bearing, except the Spitzenburgs, which had borne at least one small crop. The trees had received attention as regards both winter and summer spraying in previous years, and this year had been given a spraying on the dormant trees. The apples from all the trees of the same variety and treatment were picked and counted together, as some trees had no apples, others a very few, and others a considerable number. Three applications (the first omitted in the case of lead arsenate alone) were given with each spray on the following dates: May 8, May 29, and June 19. The sprays (except Sulfocide, which contained Paris green, ¼ lb.–50, with the addition of lime) also contained Vreeland's dry lead arsenate at the rate of 1½ lbs. to 50 gallons of mixture in the second and third applications, and were as follows: (1) Bordeaux mixture, 1st, 4–4–50, 2d and 3d, 2–4–50; (2) Sherwin-Williams lime-sulphur, 1–50; (3) self-boiled lime-sulphur, 8–8–50; (4) Sulfocide, 1–300; (5) Atomic sulphur, 1st, 10 lbs. to 50 gallons, 2d and 3d, 12 lbs. to 50 gallons (brand used in 2d and 3d treatments contained lead arsenate added by manufacturer); (6) lead arsenate, Vreeland's dry, 1½ lbs. to 50 gallons.

Results. Some leaf burn resulted from the Sulfocide and more from the Bordeaux, which caused quite a few leaves to drop during the season. The Atomic sulphur produced the most scald, 7.8%, though there was almost as much from the Bordeaux and self-boiled lime-sulphur treatments. On the whole, more scald showed in this orchard than in any of the others. The Bordeaux produced far more russeting here than any of the other treatments. Though no Baldwins were among the varieties sprayed, the average per cent. of russeting of all the varieties treated with the Bordeaux was 12.3%, while that for the lead arsenate, which had the lowest percentage of russeting, was only 0.3%.

The lead arsenate gave the highest percentage of perfect fruit, while the Sherwin-Williams lime-sulphur was second, though only slightly better than two other treatments. The Bordeaux, on account of spray injury, gave the lowest percentage of perfect fruit, though it was considerably ahead of the average for the checks. Fungous troubles, except fruit speck, were not very abundant in this orchard. The Bordeaux gave the best record against these, having only 2% against 22.2%, the average for the checks. Sulfocide gave the poorest results against both fungi and insects, though, because there was little spray injury to the fruit, its percentage of perfect fruit was higher than that of the Bordeaux.

The average per cent. of fruit injury by chewing insects on all unsprayed trees in this orchard was 27.3, and on the sprayed trees, 11.5. With Sulfocide and Paris green, used here as recommended by the manufacturer, there was more injury by chewing insects than with any other combination used in the orchard. Bordeaux mixture gave results equal to commercial lime-sulphur when both were combined with lead arsenate, but the percentage of injured fruit was twice as high as obtained from lead arsenate alone. With self-boiled lime-sulphur the percentage was slightly lower than with commercial lime-sulphur. Atomic sulphur, with lead arsenate added by the manufacturer, was not as effective as lead arsenate alone.

Ives (2d) Orchard. *Conditions.* This was a mixed orchard of Baldwins and several other varieties, such as Russets, Greenings and Suttons, which had been in bearing several years. In previous years it had been well protected by both winter and summer spraying. The sprayings in this orchard were made entirely by Mr. Ives, upon suggestions given by the writers, as he wished to test the relative merits of various insecticides, and to determine how essential was the use of a fungicide. Only two summer sprayings were made, and these were rather too close together, being about ten days apart. The treatments were as follows: (1) Sherwin-Williams lime-sulphur, 1¼–50, with 1½ lbs. Vreeland's lead arsenate; (2) sulphur and lead arsenate (Sherwin-Williams), 6–3–50; (3) lead arsenate paste (Sherwin-Williams), 3–50; (4) lead arsenate, dry (Vreeland's), 1½–50; (5) Ortho-arsenite of zinc, ¾–50.

Results. Some little foliage injury resulted from the Sherwin-Williams lime-sulphur, but it was not at all serious. It also caused a little fruit scald. Very serious injury followed the second application of the Ortho-arsenite of zinc, for some unexplained reason (see Plate XX, a). This eventually caused from one-third to one-half of the leaves to drop, affecting some varieties more severely than others. This insecticide also caused more russeting of the fruit than any of the other treatments.

As the Baldwins were the only variety that set fruit on a sufficient number of trees, data were taken only for this variety. On the whole, there was very little difference due to the different treatments in the percentage of perfect fruits, as all ran high, the Vreeland's dry lead arsenate giving the best results. The average for all was 88.8%, as against 71.7% on the check apples, which, however, were all from one tree. The percentage of fungous injuries in this orchard was so low, being only 4.6%, including Baldwin spot, on the checks, that very little was gained by adding a fungicide to the insecticide, especially as spray injury was increased somewhat by this.

In this orchard the sprayed trees showed an average of only 2.8% of injury from chewing insects, while the unsprayed tree gave 21.4%. The lowest percentage came from the use of Ortho-arsenite of zinc, but on account of the leaf injury caused by this poison in the orchard it is not to be recommended until further tests have been made. Next, the dry lead arsenate (Vreeland's) gave the lowest percentage of injury, though the difference between this and lead arsenate added to sulphur and to commercial lime-sulphur was very slight.

Jones Orchard. *Conditions.* This orchard was about fifteen years old, and contained a variety of apples, but chiefly Baldwins, Greenings and Russets. It had never been sprayed before, except a few of the trees which were included in our experiments of last year. The trees received no winter treatment this year, but had the previous year. The orchard was situated on a hillside, and not having been cultivated recently, suffered severely from lack of moisture during the past dry years. As last year fungous troubles, except rot, which was bad, had not been serious, only two sprayings, corresponding to the second and third, were given on May 22 and June 16. The treatments were as follows: (1) Blanchard's lime-sulphur, 1¼–50, with 3 lbs. lead arsenate; (2) self-boiled lime-sulphur, 8–8–50, with 3 lbs. lead arsenate; (3) lead arsenate paste, 3–50.

Results. No very noticeable foliage injury resulted from any of the treatments. There was also very little russeting. A little more scald occurred on the trees sprayed with Blanchard's lime-sulphur than on those receiving the other treatments, but even this was not bad.

Blanchard's lime-sulphur gave the highest percentage of perfect fruit (with the self-boiled second), showing 74.4 as against only 39.5 on the check trees. There was considerable fruit speck, rot and sooty blotch, especially the last, on the unsprayed trees. The lead arsenate alone seemed to have considerable fungicidal value, when compared with the checks. Sooty blotch on an old Greening tree (see Table V) on a different part of the farm ran as high as 47.8%, showing how prevalent this trouble may become on neglected trees in a favorable season.

An average of 24.1% of injury by chewing insects was obtained from the unsprayed trees, and the average per cent., 15.3, from the sprayed trees, is greater than in most orchards. This is probably due to the fact that most of the trees bore small crops, and in such a case, other things being equal, a larger proportion of them are attacked by insects. Lead arsenate alone gave only slightly better results than when combined with commercial or self-boiled lime-sulphur. Bordeaux mixture was not used in this orchard.

Smith Orchard. *Conditions.* This orchard received a winter treatment in this and the previous year, but no recent summer treatment until this year. Since scab had been bad last year on the Fall Pippin and Early Harvest, these were selected to try the comparative value of Bordeaux and commercial lime-sulphur in preventing this trouble. Unfortunately for the experiment, scab in 1911 was much less abundant than the previous year, seeming not to develop from the numerous twig infections because of unfavorable conditions, though there was more than in most of the orchards under experimentation this year. Three sprayings were given, on May 5, on the unfolding leaves, May 23, just after the petals had fallen, and June 15. Lead arsenate (Sherwin-Williams paste), at the rate of 3 lbs. to 50 gallons, was added in both cases in the second and third sprayings. The Bordeaux was used at a strength of 4-4-50, 2-4-50, and 1-4-50 in the successive sprayings, while the Sherwin-Williams lime-sulphur was used at a strength of 1¼-50 in each spraying.

Results. No foliage injury resulted from the sprayings, except possibly a little from the Bordeaux on a Gilliflower tree, which was not in good shape from some other cause. The Bordeaux mixture produced a very extensive, though not a very serious russeting on the Early Harvest, while scarcely any showed on the Fall Pippin. The Sherwin-Williams lime-sulphur, while not producing russeting to any extent, did cause more scald than the Bordeaux.

On account of the russeting, which marred but did not seriously injure the fruit, the lime-sulphur, with 88%, and the checks, 74.6%, both gave a higher percentage of perfect fruit than the Bordeaux. The Bordeaux and lime-sulphur had practically the same percentage of fungous injury, 0.6%, while the checks had only 5.9%, showing that these troubles were not very common here this year, scab being the most abundant.

The unsprayed trees showed an average percentage of 16.2% injured by chewing insects, and 5.3% on the sprayed trees. With the Bordeaux, lead arsenate gave 6.7% fruit injured and only 4.2% with the commercial lime-sulphur. Lead arsenate alone was not used in this orchard.

Station Orchards. *Conditions.* The Station orchard on the Webb farm at Centerville was used only in an experimental way to test the different sprays on the foliage, and no data were gathered from the fruit, since the trees were of unknown varieties, some apparently seedlings, and scarcely any two alike. It was an old, entirely neglected orchard, but due to the thorough pruning, fertilization, spraying and cultivation it has had for the past two years, a decided change in its appearance has been made.

At the new Station farm at Mount Carmel there is a small orchard consisting largely of Baldwins and Greenings. It has been neglected in the past and apparently has not been given either winter or summer spraying. This year it was given a winter treatment by us for the San José scale. Two summer sprayings were also made, the first on May 22 to 23, and the second on June 15. As a number of the sprayed trees did not produce fruit, we give here only the treatments from which data were obtained. (1) Bordeaux mixture, 2-4-50, with 3 lbs. lead arsenate (Vreeland's); (2) Thomsen's lime-sulphur, 1¼-50, with 3 lbs. lead arsenate (Vreeland's); (3) sulphur and lead arsenate (Vreeland's), 6-3-50; (4) lead arsenate (Devoe & Raynolds' and Vreeland's).

Results. Bordeaux caused a little foliage injury, but comparatively few leaves dropped. The Thomsen lime-sulphur, however, caused a noticeable injury to the foliage, the same as in the Andrews orchard. This material in each case was taken from the same barrel put up by the manufacturer in 1910, and evidently was not of as high a standard as it should have been. No doubt this injurious character has been eliminated in their later products. In July a severe hail storm injured the young fruit so that at harvest time (see Plate XIX, a) a large percentage showed the effects by evident marks or scars. In our table all such fruit is counted as perfect, if not otherwise injured. The Bordeaux caused considerable russeting of the fruit, though not of a very serious nature. This, however, reduced the percentage of perfect fruit below that of any other treatment.

The Thomsen lime-sulphur gave the highest percentage of perfect fruit, 81.5, as against 55.2 on the checks. The Bordeaux proved the most efficient fungicide, showing only 2% fungous injury, as against 5.2% for the lime-sulphur and 25.5% for the check trees. Fruit speck, sooty blotch, and rot, in the order named, were the most prominent fungous troubles.

In the Station orchard the different varieties render the results scarcely comparable, though on the whole the sprayed fruit showed 6.6% injured by chewing insects, and the unsprayed, 15.7%. As in most orchards, lead arsenate alone gave better results against chewing insects than with the

TABLE V.—RESULTS OF APPLE SPRAYING EXPERIMENTS IN 1911.

Orchard.	Treatment.	Variety.	No. of Trees Sprayed.	No. of Trees Counted.	Total Apples Counted.	Perfect.	Russeted.	Scald.	Baldwin Spot.	Fruit Speck.	Rot.	Rust.	Scab.	Sooty Blotch.	Codling Moth.	Lesser Apple Worm.	Other Chewing Insects.	Lice.	Scale.
						%	%	%	%	%	%	%	%	%	%	%	%	%	%
ANDREWS.	Bordeaux	Baldwin	7	4	2675	77.0	15.3	0.9	0.3	0.7	0.4	0	0	0.9	0.2	0.6	2.1	0.3	1.7
	Lime-Sulphur (Sherwin-Williams)	"	8	4	2801	73.0	11.1	0.7	2.7	3.9	0.6	0	0	4.6	0.6	0.5	2.9	0.1	0.7
	Lime-Sulphur (Thomsen)	"	8	4	2282	59.0	21.2	1.4	0.9	2.7	0.7	0	0	13.2	0.5	0.2	3.2	0.6	0.2
	Sulphur and Ld. Ars.	"	7	4	2666	65.5	9.3	0.7	2.0	5.0	0.5	0	0	13.4	0.4	0.6	2.7	0.0	0.9
	Ld. Ars. (Ansbacher)	"	6	4	2367	64.4	11.7	0.4	2.8	1.1	1.7	0	0	14.8	0.3	0.1	4.3	0.4	0.3
	Lead Arsenate (Vreeland, dry)	"	9	4	2480	71.7	7.5	0.7	1.0	4.8	0.5	0	0	9.8	0.3	0.3	4.3	0.2	0.1
	Total, Sprayed	....	....	....	15271	68.8	12.5	0.8	1.7	3.1	0.7	0	0	9.2	0.4	0.4	3.2	0.3	0.7
	Checks	Baldwin	....	13	3968	27.9	16.5	0.8	3.6	14.7	2.9	0	0	19.5	9.8	3.2	12.8	0.5	0.2
CLARK.	Bordeaux	Greening	13	8	2216	72.5	15.1	0.1	0	0	0.2	0	0.1	0	3.5	0.4	2.3	2.3	3.6
	Lime-Sulphur (Grasselli)	Greening	15	8	1506	83.8	2.0	2.2	0.2	0	0.5	0.2	0.5	0	1.5	1.1	3.3	3.6	1.3
	Lead Arsenate (Swift)	Baldwin	12	4	1392	70.0	0.4	0.1	24.9	0	0.2	0	0	0	0.5	0.4	3.8	0	0
	" " "	Greening	16	5	1341	83.1	1.8	0.4	0.1	0.1	0.1	0	3.5	4.1	1.0	1.1	3.3	0	1.7
	Total, Sprayed	....	....	....	6455	76.8	6.1	0.7	5.4	0.0	0.2	0.0	0.9	0.9	1.9	0.7	3.1	1.6	1.9
	Checks	Baldwin	....	4	458	48.7	2.4	0.2	15.7	0	0	0	0	0.2	9.4	0.7	24.7	0	0
	"	Greening	....	6	1450	65.3	2.4	0.1	0.7	0.1	0.1	0.2	4.2	4.4	11.3	0.6	9.0	0.3	1.7
	Total, Checks	....	....	...	1908	61.3	2.4	0.2	4.3	0.1	0.1	0.2	3.2	3.4	10.8	0.6	12.8	0.2	1.3
IVES. 1st Orch.	Bordeaux	King		....	12	100	0	0	0	0	0	0	0	0	0	0	0	0	0
	"	Jonathan		...	473	61.1	16.1	14.8	0	0	0	0	0	1.7	3.0	1.7	2.1	2.3	0
	"	Russet	53	....	23	69.6	0	0	0	0	0	0	0	0	17.4	0	13.0	0	0
	"	Spitzenburg		....	763	68.8	9.7	1.8	0	0.8	2.9	0.3	0	0	5.8	5.9	5.6	0.4	0.3
	"	Sutton		....	400	75.0	14.0	0.5	0	0	0.5	0.3	0	0	5.5	2.0	3.5	0	0
	Total, Bordeaux	....	....	....	1671	68.3	12.3	5.1	0	0.4	1.4	0.2	0	0.5	5.0	3.6	4.2	0.8	0.1

TABLE V.—RESULTS OF APPLE SPRAYING EXPERIMENTS IN 1911—*Continued.*

Orchard.	Treatment.	Variety.	No. of Trees Sprayed.	No. of Trees Counted.	Total Apples Counted.	Perfect.	Russeted.	Scald.	Baldwin Spot.	Fruit Speck.	Rot.	Rust.	Scab.	Sooty Blotch.	Codling Moth.	Lesser Apple Worm.	Other Chewing Insects.	Lice.	Scale.
						%	%	%	%	%	%	%	%	%	%	%	%	%	%
Ives. 1st Orchard (cont'd.)	Lime-Sulphur (Sherwin-Williams)	King	56	....	26	84.6	0	0	0	0	3.8	0	0	0	0	0	11.5	0	0
	" "	Pound Sweet		....	119	64.7	0	2.5	0	0	10.1	0	0	0	13.4	2.5	10.9	0	0
	" "	Russet		....	31	74.2	0	6.5	0	0	0	3.2	0	0	0	0	6.5	9.7	0
	" "	Spitzenburg		....	311	75.2	6.8	3.9	0	0.6	0.3	0	0	0	6.1	0.6	6.4	0	0
	" "	Sutton		....	348	87.4	0.3	1.1	0	0.3	0.6	0.6	0	0	2.0	0	6.3	1.4	0
	Total, S. & W. L.-S.	....	....	....	835	79.0	2.6	2.5	0	0.4	1.9	0.4	0	0	5.0	0.6	7.2	1.0	0
	Self-boiled Lime-Sulphur	King	51	....	255	87.5	0	1.6	0	0.4	2.0	0	0	0	4.3	0.8	3.5	0	0
	" "	Pound Sweet		....	26	73.1	0	0	0	0	15.4	0	0	0	11.5	0	0	0	0
	" "	Russet		....	74	77.0	0	6.8	0	0	1.4	0	0	0	4.1	0	6.8	5.4	0
	" "	Spitzenburg		....	2933	76.5	2.5	5.8	0	1.3	1.2	0.4	0.0	0.0	3.9	3.1	5.3	0.7	0.0
	" "	Sutton		....	351	92.9	0.6	0.3	0	0	0.3	0.3	0	0	1.1	0	4.8	0	0
	Total, Self-boiled L.-S.	....	....	....	3639	78.8	2.1	4.9	0	1.1	1.3	0.4	0.0	0.0	3.7	2.6	5.1	0.7	0.0
	Sulfocide (Pratt)	Jonathan	38	....	372	66.4	3.8	2.2	0	7.8	0.8	1.1	0	0.8	8.1	1.6	8.9	0	0
	" "	King		....	99	77.8	0	0	0	0	5.1	0	0	0	6.1	3.0	9.1	0	0
	" "	Russet		....	20	75.0	0	0	0	0	5.0	0	0	0	20.0	0	0	0	0
	" "	Spitzenburg		....	596	69.3	2.5	1.0	0	2.7	4.0	0	0	0	9.1	5.5	8.1	0	0.2
	" "	Sutton		....	683	86.7	0.3	1.3	0	0	0.9	0.6	0	0	3.5	1.8	5.1	0	0
	Total, Sulfocide	....	....	....	1770	76.0	1.8	1.3	0	2.5	2.2	0.5	0	0.2	6.7	3.1	7.1	0	0.1
	Atomic Sulphur (Thomsen)	Jonathan	53	....	153	69.9	9.2	11.8	0	0.7	0	1.3	0	0	3.9	0	3.3	0	0
	" "	King		....	176	83.0	1.1	13.1	0	0	1.7	0.6	0	0	2.8	0.6	4.5	0	0
	" "	Pound Sweet		....	6	100.	0	0	0	0	0	0	0	0	0	0	0	0	0
	" "	Russet		....	104	85.6	0	6.7	0	0	0	1.0	0	0	1.0	0	5.8	0	0
	" "	Spitzenburg		....	1000	70.5	2.5	9.5	0	2.8	1.5	0.2	0	0	5.9	1.6	6.0	0.4	0
	" "	Sutton		....	632	90.3	0.5	2.8	0	0	0	1.1	0	0	1.4	0.3	3.3	0.3	0
	Total, Atomic Sulphur	....	....	....	2071	78.4	2.1	7.8	0	1.4	0.9	0.6	0	0	3.9	0.9	4.8	0.3	0

TABLE V.—RESULTS OF APPLE SPRAYING EXPERIMENTS IN 1911—*Continued.*

Orchard.	Treatment.	Variety.	No. of Trees Sprayed.	No. of Trees Counted.	Total Apples Counted.	Perfect.	Russeted.	Scald.	Baldwin Spot.	Fruit Speck.	Rot.	Rust.	Scab.	Sooty Blotch.	Codling Moth.	Lesser Apple Worm.	Other Chewing Insects.	Lice.	Scale.
						%	%	%	%	%	%	%	%	%	%	%	%	%	%
Ives. 1st Orchard (cont'd).	Lead Arsenate	Greening	34	....	323	91.3	0.6	0	0	0.6	1.9	0	0	0	1.5	0.6	3.4	0	0
	" "	Pound Sweet		....	165	77.0	0	1.2	0	0	6.1	0	0	0	3.6	1.2	10.9	0	0
	" "	Spitzenburg..		....	144	79.9	1.4	1.4	0	3.5	2.1	1.4	0	0	1.4	2.1	7.6	0	0
	" "	Sutton		....	895	92.1	0.1	0.3	0	0	0.4	0.8	0	0.1	0.4	0.1	3.6	1.8	0.2
	Total, Lead Arsenate	....	....	....	1527	89.1	0.3	0.5	0	0.5	1.5	0.6	0	0.1	1.1	0.5	4.7	1.0	0.1
	Total, Sprayed	....	....	....	11513	78.2	3.3	4.1	0	1.1	1.5	0.4	0.0	0.1	4.1	2.1	5.3	0.6	0.1
	Checks.......... ...	Greening	....	....	125	74.4	0	0	0.8	0.8	4.0	0	0	0	10.4	4.8	2.4	3.2	0
	"	Jonathan	....	....	328	40.9	4.0	1.2	0	42.7	0	0	0	1.2	8.2	2.4	4.0	0	0
	"	King..........	....	....	50	54.0	0	0	0	4.0	4.0	0	0	0	18.0	0	20.0	0	0
	"	Pound Sweet ..	....	....	27	40.7	0	0	0	0	25.9	0	0	0	29.6	0	3.7	0	0
	"	Russet	....	...	59	59.3	0	0	0	0	0	0	0	0	13.6	3.4	23.7	0	0
	"	Spitzenburg....	....	....	1849	48.4	1.3	0.5	0	20.7	3.1	0.2	0.1	0.9	19.1	4.7	6.9	0.8	0.1
	"	Sutton	....	....	302	78.1	0	0	0	0.3	0.7	1.3	0	0	10.9	1.0	8.3	0	0
	Total, Checks	....	....	....	2740	52.2	1.4	0.5	0.0	19.2	2.7	0.3	0.1	0.7	16.5	3.8	7.0	0.7	0.0
Ives. 2d Orchard.	Lime-Sulphur (S. & W.) Lead Ars. (Vreel. dry)	Baldwin.......	60	....	1652	88.1	2.2	3.4	2.6	0.2	0.2	0	0	0	0.4	0.3	2.3	0.3	0.1
	Sulphur and Lead Arsenate (S. & W.) .	"	15	....	409	89.2	2.9	1.2	2.4	0.2	0.5	0.2	0	0	1.0	0.2	1.7	0.5	0
	Lead Arsenate (S. & W.)..........	"	15	....	436	89.4	1.1	2.5	0.7	0.9	1.6	0	0	0	1.1	0	2.8	0	0
	Lead Arsenate (Vreeland, dry)....	"	15	....	556	93.7	1.8	0	0.4	0.5	1.1	0	0	0	0.2	0.5	2.0	0	0
	Ortho-Arsenite of Zinc..............	"	15	....	624	85.7	5.6	1.1	4.3	0.6	0.3	0.2	0	0	0	0	1.6	0.8	0
	Total, Sprayed	....	....	....	3677	88.8	2.7	2.1	2.3	0.4	0.6	0.1	0	0	0.5	0.2	2.1	0.3	0.1
	Checks.............	Baldwin........	....	1	449	71.7	1.3	0.7	1.3	2.2	0.4	0	0	0.7	8.2	9.4	3.8	0.4	0

TABLE V.—RESULTS OF APPLE SPRAYING EXPERIMENTS IN 1911—*Continued.*

Orchard.	Treatment.	Variety.	No. of Trees Sprayed.	No. of Trees Counted.	Total Apples Counted.	Perfect.	Russeted.	Scald.	Baldwin Spot.	Fruit Speck.	Rot.	Rust.	Scab.	Sooty Blotch.	Codling Moth.	Lesser Apple Worm.	Other Chewing Insects.	Lice.	Scale.
						%	%	%	%	%	%	%	%	%	%	%	%	%	%
Jones.	Lime-Sulphur (Blanchard).	Baldwin.......	6	1	313	77.0	0.6	3.8	1.0	0	3.2	0	0	0.6	3.5	0	9.9	1.3	0
	" "	Greening......	3	2	323	70.6	0	0.3	0	0.3	2.2	0	0	0	5.3	0	9.9	9.3	2.2
	" "	Russet........	3	1	182	76.9	0	3.8	0	1.1	1.1	0	0	1.6	1.6	0	13.2	1.1	0
	Total (Blanchard, L.-S.).....	....	....	....	818	74.4	0.2	2.4	0.4	0.4	2.3	0	0	0.6	3.8	0	10.6	4.4	0.9
	Self-boiled Lime-Sulphur	Baldwin.......	4	2	1092	69.0	0.5	1.4	8.0	0.2	1.5	0	0	3.4	4.9	0.2	9.6	2.2	0.4
	" " "	Greening......	2	2	369	72.1	0.3	2.2	0	1.6	0.8	0	0	2.2	4.9	1.6	10.6	4.3	0
	" " "	King..........	2	2	210	82.4	0.5	1.4	0	1.0	1.9	0	0	0.5	4.8	0.5	7.1	0	0
	" " "	Russet........	2	2	633	64.9	0	2.2	0	0	1.6	0	0	3.3	4.9	0.5	18.0	6.0	0.2
	Total, Self-boiled L.-S......	....	....	....	2304	69.6	0.3	1.7	3.8	0.4	1.4	0	0	2.9	4.9	0.5	11.8	3.4	0.2
	Lead Arsenate.......	Baldwin.......	7	6	1765	71.6	1.0	1.4	3.8	1.7	1.7	0	0	3.0	4.5	0.2	10.8	1.1	0.1
	" "	Greening......	6	2	316	72.5	0	0.3	0	0	3.2	0	0	1.9	8.2	0	9.2	4.7	0
	" "	Russet........	3	2	770	46.1	0	0.9	0	1.7	0.8	0.1	0	12.3	1.8	0	6.9	41.2	0
	Total, Lead Arsenate	....	....	....	2851	64.8	0.6	1.1	2.3	1.5	1.6	0.0	0	5.4	4.2	0.1	9.5	12.3	0.1
	Total, Sprayed......	....	....	....	5973	68.0	0.5	1.5	2.6	0.9	1.6	0.0	0	3.8	4.4	0.3	10.6	7.8	0.2
	Checks..............	Baldwin.......	....	1	251	31.9	3.2	0	11.6	6.0	6.8	0	0	4.8	20.3	0.4	17.1	0	0
	"	Greening......	....	5	448	30.4	0.4	0	0	3.8	11.4	0	0	18.1	22.1	0.4	15.6	0.9	0
	"	" (old)......	....	1	858	44.3	0.1	0.3	0.2	0.8	2.1	0	0	47.8	4.2	0.2	1.3	0	0
	"	King..........	....	3	266	30.8	1.1	0.8	0	9.0	9.0	0.4	0	10.2	31.6	0.8	14.7	0	0
	"	Russet........	....	1	127	73.2	0	0	0	0	3.9	0	0	1.6	7.9	0	14.2	0	0
	Total, Checks......	....	....	....	1950	39.5	0.7	0.2	1.6	3.2	5.9	0.1	0	27.3	14.4	0.4	9.3	0.2	0
Smith.	Bordeaux...........	E. Harvest....	3	3	849	34.9	63.0	1.4	0	0	0.1	0	0	0	1.4	0	2.6	0	0.4
	"	F. Pippin......	3	3	2158	80.7	0.5	0.4	0	0	0.1	0	0.6	0.1	1.9	0.5	5.4	7.5	2.5
	Total, Bordeaux....	....	....	....	3007	67.8	21.4	0.7	0	0	0.1	0	0.4	0.1	1.8	0.3	4.6	5.4	1.9

TABLE V.—RESULTS OF APPLE SPRAYING EXPERIMENTS IN 1911—*Continued.*

Orchard.	Treatment.	Variety.	No. of Trees Sprayed.	No. of Trees Counted.	Total Apples Counted.	Perfect.	Russeted.	Scald.	Baldwin Spot.	Fruit Speck.	Rot.	Rust.	Scab.	Sooty Blotch.	Codling Moth.	Lesser Apple Worm.	Other Chewing Insects.	Lice.	Scale.
						%	%	%	%	%	%	%	%	%	%	%	%	%	%
SMITH.	Lime-Sulphur (Sherwin-Williams)	E. Harvest	4	3	3682	88.4	1.6	5.5	0	0	0.4	0.1	0.0	0	1.4	0.0	2.5	0	0
	" "	F. Pippin	3	3	679	85.6	0	7.4	0	0	0.4	0	0.4	0.6	4.0	0	1.6	0	0
	Total, L.-S. (S. & W.)	....	....	....	4361	88.0	1.3	5.8	0	0	0.4	0.1	0.1	0.1	1.8	0.0	2.4	0	0
	Total, Sprayed	....	....	....	7368	79.7	8.2	3.7	0	0	0.3	0.1	0.2	0.1	1.8	0.2	3.3	2.2	0.8
	Checks	E. Harvest	....	3	3355	81.5	0	1.9	0	0	0.5	0.4	1.8	0	5.9	0	7.8	0	0.4
	"	F. Pippin	....	3	1620	60.4	0	1.2	0	0	0.7	0	5.1	6.4	8.8	0.8	11.4	0.6	7.3
	Total, Checks	....	....	....	4975	74.6	0	1.7	0	0	0.6	0.3	2.9	2.1	6.9	0.3	9.0	0.2	2.6
STATION (MOUNT CARMEL).	Bordeaux	Baldwin	1	1	1425	73.1	19.1	0.4	0.8	0.1	0.7	0	0	0.1	1.1	0.1	2.9	1.8	0.9
	"	Greening	3	1	670	68.7	15.7	0.4	0	0.1	4.2	0	0	0.1	6.4	0	1.6	4.3	2.4
	Total, Bordeaux	....	....	....	2095	71.6	18.0	0.4	0.6	0.1	1.8	0	0	0.1	2.9	0.1	2.5	2.6	1.4
	Lime-Sulphur (Thomsen)	Greening	3	2	888	81.5	0.3	0.8	0	0.5	1.1	0	0	3.6	2.0	0.1	3.3	6.8	0
	Sulphur and Lead Arsenate	Colvert	1	1	275	78.9	1.1	3.3	0	0	0	0	0	3.3	1.8	0	11.6	0	0
	" "	F. Pippin	1	1	193	80.3	0	0	0	0	1.6	0	0	2.1	3.1	0	14.0	0	0
	" "	Gravenstein	1	1	117	82.1	1.7	0	0	0	0	0	0	2.6	0	0	13.7	0	0
	Total, Sulphur and Lead Arsenate	....	....	....	585	80.0	0.9	1.5	0	0	0.5	0	0	2.7	1.9	0	12.8	0	0
	Lead Arsenate	Baldwin	30	1	544	78.5	4.0	1.7	3.3	1.3	0.6	0	0	3.1	0.7	0.2	2.0	0.7	4.6
	" "	Greening		1	140	79.3	0.7	0.7	0	1.4	3.6	0	0	1.4	5.7	0	6.4	1.4	0
	Total, Lead Arsenate	....	....	....	684	78.7	3.4	1.5	2.6	1.3	1.2	0	0	2.8	1.8	0.1	2.9	0.9	3.7
	Total, Sprayed	....	....	....	4252	76.0	9.6	0.8	0.7	0.4	1.4	0	0	1.6	2.4	0.1	4.1	2.8	1.3
	Checks	Baldwin	....	1	670	56.4	3.9	2.7	4.8	13.0	4.5	0	0	5.1	7.5	0	6.1	1.8	2.1
	"	Greening	....	1	246	52.0	0	0.8	0	4.5	5.7	0	0	23.6	15.0	2.4	3.7	2.0	0
	Total, Checks	....	....	....	916	55.2	2.8	2.2	3.5	10.7	4.8	0	0	10.0	9.5	0.7	5.5	1.9	1.5

TABLE V.—RESULTS OF APPLE SPRAYING EXPERIMENTS IN 1911—*Continued.*

Orchard.	Treatment.	Variety.	No. of Trees Sprayed.	No. of Trees Counted.	Total Apples Counted.	Perfect.	Russeted.	Scald.	Baldwin Spot.	Fruit Speck.	Rot.	Rust.	Scab.	Sooty Blotch.	Codling Moth.	Lesser Apple Worm.	Other Chewing Insects.	Lice.	Scale.
						%	%	%	%	%	%	%	%	%	%	%	%	%	%
STEVENS.	Bordeaux	Baldwin	1	1	500	65.0	19.6	0.2	3.6	0.2	2.2	0	0	3.8	0.6	0	3.4	1.4	0.2
	"	E. Harvest	1	1	165	35.2	52.7	0	0	0	4.8	0	0	0	3.0	1.8	2.4	0	0
	"	Eng. Russet	1	1	742	91.0	0	0	0	0	0.3	0	0	0.5	0.8	0.1	3.6	3.6	0
	"	F. Pippin	3	2	1062	85.2	0.2	0.2	0	1.3	2.4	0	1.5	2.0	0.1	1.9	4.0	0	1.4
	"	Greening	9	7	3035	80.1	7.6	0.4	0	0.1	0.3	0.0	0	3.8	0.1	0.3	5.4	1.1	1.0
	"	King	1	1	298	75.5	10.7	0.7	0	0.3	3.7	0	0	0.3	0.7	0.3	8.4	0	0
	"	R. Astrachan	2	1	322	74.5	11.8	0	0	0	2.5	0	0	0	5.6	0.3	5.3	0	0
	"	Rox. Russet	2	2	1231	83.3	0.2	0.1	0	0.2	0.6	0	0	2.2	0.6	0.4	11.4	1.4	0.1
	"	Sweet Apple	2	1	391	66.0	22.8	0	0	0	0.8	0	0	0	7.7	0.8	2.0	0	0
	"	Y. Transparent	1	1	277	20.9	74.0	0	0	0	0.4	0	0	0	2.2	0.7	1.8	0	0
	Total, Bordeaux				8023	77.3	9.8	0.2	0.2	0.3	1.1	0.0	0.2	2.5	1.0	0.5	5.6	1.1	0.6
	Lime-Sulphur (Grasselli)	Baldwin	6	4	1192	65.5	17.4	2.2	0.3	0.7	0.5	0.1	0	11.7	0.1	0	1.5	0	0.1
	" "	E. Harvest	1	1	294	84.7	0	0	0	0	0	0	0	0	4.4	0	10.9	0	0
	" "	Greening	7	4	1274	78.3	2.4	2.9	0	0.2	0	0	0	14.3	0.2	0.2	1.7	0.1	0
	Total, L.-S. Grasselli				2760	73.4	8.6	2.3	0.1	0.4	0.2	0.0	0	11.7	0.6	0.1	2.6	0.0	0.0
	Sulphur and Lead Arsenate	Baldwin	1	1	419	68.3	6.4	1.4	0	0	0	0	0	19.8	0	0	4.1	0	0
	" "	Greening	6	3	886	66.6	0.2	0.2	0	0	0.5	0	0	30.5	0	0.2	2.5	0	0
	Total, Sulphur and Lead Arsenate				1305	67.1	2.2	0.6	0	0	0.3	0	0	27.0	0	0.2	3.0	0	0
	Total, Sprayed				12088	75.3	8.7	0.7	0.2	0.3	0.8	0.0	0.1	8.8	1.0	0.5	5.3	0.7	0.4
	Checks	Baldwin		2	580	34.8	5.7	0	0.2	5.0	2.1	0	0	33.6	4.7	2.9	13.3	0.2	0
	"	E. Harvest		1	889	77.1	0	0	0	0	0.6	0	3.0	7.3	4.6	0.2	7.3	0	0
	"	Eng. Russet		1	373	62.5	0	0	0	5.9	0.5	0	0	8.0	5.4	0.3	14.5	2.4	1.1
	"	F. Pippin		2	624	49.8	0.2	0.5	0	6.7	4.5	0	6.1	19.2	0	5.3	9.5	0	1.6
	"	Greening		3	1150	22.7	0.1	0.7	0	0.6	0.6	0	0	62.3	4.2	1.9	8.0	4.3	0.3
	"	R. Astrachan		1	505	69.3	0	0	0	11.3	1.4	0.2	0.2	0	5.7	1.6	10.3	0	0
	"	Rox. Russet		1	376	48.7	0	0	0	0.3	2.7	0	0	8.5	7.4	14.1	18.9	0	0.5
	Total, Checks				4497	49.5	0.8	0.2	0.0	3.5	1.6	0.0	1.5	23.5	4.3	3.0	10.5	1.3	0.4

TABLE V.—RESULTS OF APPLE SPRAYING EXPERIMENTS IN 1911.—*Concluded.*

Orchard.	Treatment.	Variety.	No. of Trees Sprayed.	Total Trees Counted.	Total Apples Counted.	Perfect.	Russeted.	Scald.	Baldwin Spot.	Fruit Speck.	Rot.	Rust.	Scab.	Sooty Blotch.	Codling Moth.	Lesser Apple Worm.	Other Chewing Insects.	Lice.	Scale.
						%	%	%	%	%	%	%	%	%	%	%	%	%	%
STODDARD.	Bordeaux	Baldwin	3	3	603	76.6	11.8	0	0	0.8	0.3	0	0	0	6.1	0	3.5	0.8	0
	"	Eng. Russet	1	1	340	88.2	0	0	0	0	0	0	0	0	5.6	0	4.4	1.8	0
	"	Greening	4	4	601	79.4	0	0	0	0	1.0	0	2.3	3.8	7.5	0	6.0	0	0
	"	King	1	1	108	74.1	0	0	0	2.8	0	0	0	0	7.4	0	13.0	3.7	0
	"	Rox. Russet	2	2	407	75.7	0	0	0	0.7	2.2	0	0	1.2	14.5	0	4.9	0.7	0
	"	Strawberry, etc.	7	1	412	72.8	0	0	0	4.1	1.5	0.2	8.5	0	3.9	1.0	8.0	0	0
	Total, Bordeaux		....	....	2471	78.0	2.9	0	0	1.1	0.9	0.0	2.0	1.1	7.4	0.2	5.6	0.7	0
	Lime-Sulphur (Vreeland)	Hubbardston	1	1	136	83.8	0	0	0	0	2.2	0.7	0	0	11.0	0	2.2	0	0
	" "	King	1	1	130	84.6	0	0	0	0	0.8	0	2.3	6.2	0	0	4.6	1.5	0
	" "	Mann	1	1	121	62.8	0	0	0	0	0.8	0	0	29.8	9.1	0	5.8	0	0
	Total, L.-S. (Vreeland)		....	....	387	77.5	0	0	0	0	1.3	0.3	0.8	11.4	6.7	0	4.1	0.5	0
	Sulphur and Lead Ars.	Baldwin	3	1	212	80.2	0	0	0	0.5	0.9	0	0	11.8	5.7	0	0.9	0	0
	" "	Greening	3	3	441	73.9	2.5	0	0	0	0.5	0	1.8	9.5	6.3	0	5.4	0	0
	" "	Rox. Russet	2	1	204	60.3	0	0	0	0	0.5	0	0	28.4	7.4	0	3.4	0	0
	Total, Sulphur and Lead Arsenate		....	....	857	72.2	1.3	0	0	0.1	0.6	0	0.9	14.6	6.4	0	3.9	0	0
	Total, Sprayed		....	....	3715	76.6	2.2	0	0	0.8	0.9	0.1	1.6	5.3	7.1	0.1	5.1	0.5	0
	Checks	Baldwin	....	1	201	33.8	0	0	0	4.5	0	0	0	14.9	17.4	0	26.4	6.5	0
	"	Greening	....	2	501	21.6	0	0	0	3.2	3.2	0.2	12.8	33.1	23.8	0	21.2	0	0
	"	King	....	1	104	51.9	0	0	0	1.9	1.0	0	0	0	11.5	0	29.8	5.8	0
	"	Russet	...	2	315	12.7	0	0	0	0.6	2.9	0	0	15.2	41.9	0	31.1	6.3	0
	Total, Checks		....	....	1121	24.1	0	0	0	2.6	2.3	0.1	5.7	21.8	26.6	0	25.7	3.5	0
ALL.	Bordeaux	All	....	....	22158	74.4	12.3	0.7	0.2	0.4	0.9	0.0	0.3	1.1	2.5	0.7	4.3	1.3	1.2
	Commercial Lime-Sul.	"	....	....	18290	78.0	6.5	2.8	0.8	1.1	0.6	0.1	0.1	4.6	1.5	0.3	3.3	1.0	0.3
	Self-boiled Lime-Sul.	"	....	....	5943	75.2	1.4	3.7	1.5	0.7	1.3	0.2	0.0	1.1	4.2	1.8	7.7	1.7	0.1
	*Sulfocide	"	....	....	1770	75.9	1.8	1.3	0	2.5	2.2	0.5	0	0.2	6.7	3.1	7.1	0	0.1
	*Atomic Sulphur	"	....	....	2071	78.4	2.1	7.8	0	1.4	0.9	0.6	0	0	3.9	0.9	4.8	0.3	0
	Sulphur and Lead Ars.	"	....	....	5822	70.0	5.2	0.7	1.1	2.3	0.5	0.0	0.1	14.6	1.4	0.3	3.9	0.1	0.4
	All Fungicides	"	....	....	56054	75.4	7.8	2.0	0.6	0.9	0.8	0.1	0.1	3.6	2.4	0.7	4.4	1.0	0.6
	All Lead Arsenates	"	....	....	14258	74.2	4.1	0.7	3.9	1.5	1.0	0.1	0.3	5.8	1.3	0.3	4.9	2.8	0.4
	All Checks	"	....	....	22524	51.1	3.6	0.7	1.3	6.5	2.1	0.1	1.5	13.3	10.1	2.0	10.6	0.8	0.9

* It should be remembered that these two fungicides were not so extensively tested and in only one orchard.

addition of a fungicide, though there was practically no difference between lime-sulphur and Bordeaux mixture. For some reason not easy to explain, fruit sprayed with lead arsenate and sulphur was scarcely better than that not sprayed, though all of these sprayed trees were early varieties, and had no checks of the same varieties.

Stevens Orchard. *Conditions.* Most of the trees in this orchard were at least fifteen years old and of miscellaneous varieties, that had not been sprayed recently, except possibly a winter treatment. As sooty blotch and scab had been quite troublesome previously, three summer sprayings were given, as follows: 1st, May 9; 2d, May 25; and 3d, June 19. The following treatments were tried: (1) Bordeaux mixture, 1st, 4-4-50; 2d, 2-4-50; 3d, 1-4-50; (2) Grasselli's lime-sulphur, 1¼-50; (3) sulphur and lead arsenate, 6-3-50. Swift's lead arsenate, 3-50, was used in the second and third sprayings of treatments Nos. 1 and 2, and of course in all three of treatment No. 3.

Results. There was no foliage injury with the sulphur and lead arsenate, and practically none with the Grasselli's lime-sulphur, and the little caused by the Bordeaux (mostly on Red Astrachan, Baldwin, and a sweet variety) did no particular harm. As usual, the Bordeaux caused more russeting, though not of a serious nature, than any of the other mixtures, being especially prominent on Yellow Transparent, Early Harvest, Baldwin, and a variety of sweet apple. The lime-sulphur seemed to cause considerable russeting of the Baldwin, but not of the other varieties, and it also produced more scald than the other sprays.

Despite the russeting caused by the Bordeaux, it gave the highest percentage of perfect fruit, 77.3, as compared with 49.5 on the checks. This was because it was much more effective in preventing fungous attacks, especially sooty blotch, which was quite prominent on some varieties. The unsprayed trees had 30.1% of the fruit attacked by fungi as compared with 4.1% for the Bordeaux and 12.3% for Grasselli's lime-sulphur. The sulphur and lead arsenate on the Baldwins and Greenings reduced the sooty blotch somewhat as compared with the checks of these two varieties, but not sufficiently to be considered a valuable fungicide.

In Mr. Stevens' orchard the sprayed fruit showed an average injury of 6.8% caused by chewing insects, while the unsprayed fruit showed 17.8% of injury. The percentage of injured fruit was more than twice as great from lead arsenate with Bordeaux mixture than from the same poison when used either with dry sulphur or with commercial lime-sulphur.

Stoddard Orchard. *Conditions.* The trees in this orchard were of miscellaneous varieties, varying from twenty-five to at least fifty years old. They had received no summer treatment previously, and on the whole suffered more injury from fungi and insects than any others under experimentation this year. Three treatments were given, on the following dates: 1st, May 8; 2d, May 29; and 3d, June 23. Vreeland's lead arsenate, 3-50, was used in the second and third sprayings of each treatment, and of course in all three of the one with sulphur and lead arsenate. As the material was not on hand, the first treatment with the lime-sulphur had to be omitted. The treatments were as follows: (1) Bordeaux, 1st, 4-4-50, 2d and 3d, 1-4-50; (2) Vreeland's lime-sulphur, 1¼-50; (3) sulphur and lead arsenate, 6-3-50.

Results. No leaf injury occurred from any of the sprayings except a very little from the lime-sulphur on one tree of a fall variety. Practically no scald occurred from any of the treatments. About the only russeting was on the Baldwin, produced by the Bordeaux mixture, and this was not serious.

The Bordeaux and lime-sulphur gave practically the same percentage of perfect fruit, having about 78, as compared with 24.1 on the check trees. This difference of about 54% was the greatest obtained in favor of the sprayed trees in any of the orchards under experimentation this year. Sooty blotch and scab, on certain varieties, were the worst fungous troubles in this orchard.

The fruit in this orchard showed the most serious injury from chewing insects of any in the experiments. Codling moth was chiefly responsible, though there was a large amount of injury that could not definitely be attributed to codling moth. Lesser apple worm was noticeably absent. Though the percentage of fruit injured by chewing insects was higher, 12.3%, than in any other orchard except Mr. Jones' at Hamden, a much large percentage, 52.3%, was also obtained from the unsprayed trees. The latter, therefore, exhibited more than four times as much injury from the attacks of chewing insects as the former. In this orchard the lead arsenate, though not used alone, gave slightly better results in combination with dry sulphur than with commercial lime-sulphur, and in both cases better than when used with Bordeaux mixture.

PEACHES.

In 1911, spraying experiments with peaches were conducted in the orchards of W. A. Henry & Son, Wallingford; E. M. Ives, Meriden; and B. T. Jones, Hamden; and besides some miscellaneous tests were made on the very young trees at the Station farm at Centerville. At the Station farm, only self-boiled lime-sulphur and Atomic sulphur were used, on June 1 and June 21, both sprayings and both treatments containing lead arsenate. The former produced no injury, while the latter produced considerable leaf spotting and leaf fall, also some injury to the young twigs.

In the following paragraphs we give briefly the conditions and the more general results of these experiments, while in Table VI the details of the counts are given. In determining the results, any rot showing on a peach was counted, but if only two or three inconspicuous scab spots showed, the fruit was counted as perfect. In cases where the peaches showed both rot and scab, this has been indicated in the table in a separate column. Where the rot develops very extensively, it often entirely obscures the scab that may be present, so that the percentage of scab may be somewhat less than really occurred. Likewise, rot tends to obscure any insect injury, and as it often starts from such injury, this may explain why the sprayed peaches in the Jones orchard this year and last showed more insect injury than the unsprayed.

Henry Orchard. *Conditions.* This was a comparatively young orchard, being in bearing for the second or third year, and consisting of the several varieties mentioned in Table VI. The trees in the past had received excellent care, not only as regards sprayings, but as regards all other treatment. Only two summer sprayings were given here, to determine if these, under practical orchard conditions, would yield sufficient protection against scab and rot. The sprayings were made on June 8 and July 10. The treatments were as follows: (1) Grasselli's lime-sulphur, 1st, 1–150, and 2d, 1–300; (2) self-boiled lime-sulphur, 8–8–50; (3) Sulfocide, 1st, 1–500, and 2d, 1–600; (4) Atomic sulphur, 1st, 12–50, and 2d, 8–50. No poison was used in the Sulfocide because of sure spray injury. In the first spraying of both the self-boiled and Grasselli's lime-sulphur, 3 lbs. Swift's lead arsenate was added, and in the first spraying with Atomic sulphur the brand containing lead arsenate added by the manufacturer was used.

Results. The first treatment with Grasselli's lime-sulphur caused very considerable leaf injury and fall, and also some fruit fall. As the fruit was thus thinned about right for a dry season, this did not prove so serious as it would have otherwise. The Atomic sulphur also caused considerable leaf injury, but very little was caused by the Sulfocide, and practically none by the self-boiled lime-sulphur. On account of the injury, most of the treatments were weakened in the second spraying, and the lead arsenate omitted. It seems on the whole more probable that the injury was due to the presence of lead arsenate than to the strength of the mixtures used. No injury followed the second treatment.

The self-boiled, Grasselli's, and Atomic sulphur all gave about the same percentage, 87, of perfect fruit, which considerably exceeded that given by Sulfocide, 68%, and the checks, 52%. This was because these sprays were about equally efficient in preventing scab, which was the only abundant fungous trouble, averaging 40.5% on the checks. On the whole, the Waddell and Carman varieties showed the most scab.

Peaches are injured by attacks of the plum curculio (see Report for 1910, page 609), which is more serious in the Southern States than in Connecticut. In some orchards the peach sawfly and the canker worm defoliate the trees, and in certain seasons green fruit worms and rose chafers cause considerable injury. Wherever any of these insects are prominent and liable to do damage, the foliage should be sprayed with lead arsenate. None of these insects were prevalent in this orchard. The sprayed fruit showed on the average fully as much insect injury as that not sprayed.

Ives Orchard. *Conditions.* Most of the trees used in these experiments were Hieleys just coming into bearing. These set considerably less fruit than anticipated, because of late frosts, but the treatments were given, nevertheless, as planned, and what little fruit had matured on each tree was gathered and counted. The few trees of other varieties used were old and past their prime. All had received winter treatments this year and previously. Three summer sprayings were given, as follows: May 26, June 14, and July 14. The treatments were: (1) Sherwin-Williams lime-sulphur, 1st and 2d, 1–150; 3d, 1–250; (2) self-boiled lime-sulphur, 8-8-50; (3) Atomic sulphur, 1st and 2d, 12–50; 3d, 8–50. Lead arsenate was used only in the first spraying, 2–50 of Grasselli's in Nos. 1 and 2, and that added by the manufacturer in No. 3.

Results. No especial spray injury resulted in these experiments. Rot was present only to a very limited extent, and scab only fairly abundant. The three fungicides used seemed to be about equally efficient against the latter. The percentage of scab on all the sprayed peaches was 1.0%, as against 16.3% on all the unsprayed.

In this orchard the spraying with fungicides with an insecticide added in one treatment did not seem to lessen the slight injury from chewing insects.

Jones Orchard. *Conditions.* These were somewhat neglected trees that had been in bearing from six to eight years. They had been severely winter-injured in the past, and were now showing yellows or similar trouble on some of the trees. While the orchard contained a number of varieties, only the Champions were selected for experimentation, because these rotted the most readily. Half of the trees received a winter treatment, just as the buds began to swell, April 11, with Blanchard's lime-sulphur, 1–9, for the San José scale and leaf curl. Three summer sprayings were given, as follows: 1st, May 22 (husks shedding off the young fruit); 2d, June 15 (peaches one to one and one-half inches long); 3d, July 13 (peaches nearly full-grown). The treatments given were as follows: (1) Blanchard's lime-sulphur, 1st and 2d, 1–150; 3d, 1–250; no lead arsenate used; (2) self-boiled lime-sulphur, 8-8-50, with lead arsenate, 3–50, in the 1st and 2d; (3) self-boiled lime-sulphur, 8-8-50, no lead arsenate used; (4) Atomic sulphur, 1st and 2d, 12–50; 3d, 8–50; lead arsenate in 1st and 2d. Each treatment included trees that had and had not received winter spraying.

Results. A very slight spotting of the foliage was noticed after the second spraying with the commercial lime-sulphur, but this caused no leaf fall. (A spraying with another commercial lime-sulphur *containing lead arsenate* at about this time at the Henry orchard caused serious foliage injury.) With the Atomic sulphur, however, this injury, while not serious, was much more evident, and caused some leaf fall. The Atomic sulphur, also, and to a less degree, the self-boiled lime-sulphur, caused some fruit scald, a trouble exaggerated by the dry, hot weather. The addition of lead arsenate to the self-boiled lime-sulphur, while it

TABLE VI.—RESULTS OF PEACH SPRAYING EXPERIMENTS IN 1911.

Orchard.	Treatment.	Variety.	No. of trees counted.	Total Peaches counted.	Perfect. Per cent.	Scald. Per cent.	Rot. Per cent.	Rot and Scab. Per cent.	Scab. Per cent.	Chewing Insects. Per cent.
HENRY.	Grasselli Lime-Sulphur.......	Belle of Georgia	3	450	89.3	1.8	0.2	0	0	8.7
	" " "	Carman........	1	156	85.3	0	0	0	1.3	13.5
	" " "	Elberta........	2	301	89.7	0	0	0	1.7	8.6
	" " "	Greensboro	1	284	95.1	0	0.7	0	4.2	0
	" " "	Waddell.......	2	320	76.6	0	0.3	0	11.3	11.9
		Total......	9	1511	87.4	0.5	0.3	0	3.6	8.2
	Self-boiled Lime-Sulphur.....	Belle of Georgia	3	454	84.4	0	0.4	0	0	15.2
	" " "	Carman	1	164	88.4	0	0	0	1.2	10.4
	" " "	Elberta........	2	300	89.7	0	0	0	0	10.3
	" " "	Greensboro	2	405	96.3	0	0.2	0	1.5	2.0
	" " "	Waddell.......	3	749	81.3	0	0.7	0	4.5	13.5
		Total......	11	2072	86.7	0	0.4	0	2.0	10.9
	Sulfocide	Belle of Georgia	3	445	62.7	0	0.7	0	31.2	5.4
	"	Carman........	1	152	67.8	0	0	0	20.4	11.8
	"	Elberta........	2	311	81.0	0	0.3	0	10.6	8.0
	"	Greensboro	1	128	85.2	0	1.6	0	13.3	0
	"	Waddell.......	2	299	55.5	0	0.3	0	38.5	5.7
		Total......	9	1335	68.1	0	0.5	0	25.1	6.3
	Atomic Sulphur	Belle of Georgia	3	447	90.4	0	0.4	0	0.2	8.9
	" "	Carman........	1	153	85.0	0	0	0	2.0	13.1
	" "	Elberta........	2	307	87.9	0	0	0	0.3	11.7
	" "	Greensboro	1	151	97.4	0	0	0	2.0	0.7
	" "	Waddell.......	3	486	81.9	0.2	0.2	0	2.1	15.6
		Total......	10	1544	87.4	0.1	0.2	0	1.2	11.2
	Total, Sprayed	....	39	6462	83.2	0.1	0.3	0	7.0	9.4
	Checks	Belle of Georgia	3	457	51.0	0	0.4	0	39.4	9.2
	"	Carman........	3	456	38.8	0	0.2	0	51.8	9.2
	"	Elberta........	3	474	59.7	0	0	0	30.4	9.9
	"	Greensboro	3	323	74.6	0	0.3	0	23.8	1.2
	"	Waddell.......	3	559	43.5	0	0.7	0	50.6	5.2
		Total......	15	2269	51.9	0	0.4	0	40.5	7.2
IVES.	Self-boiled Lime-Sulphur.....	Carman........	1	40	100.	0	0	0	0	...
	Checks	"	1	567	76.7	0	1.2	0	22.0	...
	Self-boiled Lime-Sulphur.....	Elberta........	1	86	96.5	0	0	0	3.5	...
	Checks	"	1	112	63.4	0	0	0	36.6	...
	Sherwin-Williams Lime-Sulphur	Hieley.........	13	49	98.0	0	0	0	0	2.0
	Self-boiled Lime-Sulphur.....	"	25	165	93.9	0	0	0	0	6.1
	Atomic Sulphur	"	13	91	100.	0	0	0	0	0
	Checks	"	21	99	45.5	0	0	0	42.4	12.1
	Self-boiled Lime-Sulphur.....	Triumph.......	1	174	97.7	0	0.6	0	1.7	...
	Checks	"	1	582	91.8	0	6.0	0	2.2	...
	Total, Sprayed	....	54	605	97.0	0	0.1	0	1.0	...
	Total, Checks	....	24	1360	79.8	0	3.1	0	16.3	...

Jones	Blanchard Lime-Sulphur, 1st treatm't	Champion	2	634	60.4	0.2	15.8	0.6	19.1	3.9
	" 1st and 2d treatment	"	2	386	90.2	0.3	2.3	0	3.1	4.1
	" 1st, 2d and 3d treatment	"	1	347	87.6	2.9	0.6	0	2.3	6.6
	" 2d and 3d treatment	"	4	524	87.6	0.8	3.8	0	1.7	6.2
	" 3d treatment	"	2	267	82.4	0	3.0	0	10.5	4.1
	Totals, Blanchard L.-S.	"	11	2158	79.4	0.7	6.4	0.2	8.2	5.0
	Self-boiled Lime-Sulphur with Lead Arsenate........	"	13	3274	86.9	3.4	3.9	0	0.6	5.1
	Self-boiled Lime-Sulphur without Lead Arsenate.....	"	10	1845	88.2	2.2	4.6	0	0.7	4.4
	Atomic Sulphur	"	14	2883	86.4	6.0	3.4	0	0.1	4.1
	Total, Sprayed	"	48	10160	85.4	3.3	4.4	0.0	2.1	4.6
	Checks	"	12	2602	63.5	0.0	12.3	1.2	19.8	3.2

did not cause any very evident leaf injury, did cause more fruit scald than where it was left out. The sprays, particularly with the addition of lead arsenate, seemed to heighten the color of the fruit. This was especially true of the Atomic sulphur, where the added color almost partook of the nature of an injury, due to numerous small reddish spots that were produced. It would seem from the results in this orchard that the presence of lead arsenate was responsible for most of the injury that resulted on peaches in the various experiments this year.

The winter treatment with commercial lime-sulphur reduced the leaf curl to practically nothing, though this trouble was not prominent this year even on unsprayed trees. A count of the 73 trees receiving this treatment showed only 30 leaves with the curl, or less than ½ leaf to a tree. Twelve trees not sprayed showed from 3 to 70 leaves with the curl, or an average of 22½ per tree. Last year's difference was considerably greater, the sprayed trees showing 1½ leaves with the curl, and the unsprayed, 132 per tree.

The trees having the winter treatment and three summer treatments did not show any less scab or rot than the trees having only the three summer treatments. The winter treatment, therefore, seems of no special value as far as these two troubles are concerned. With the commercial lime-sulphur the trees were so sprayed that some received one, some two, and others all three treatments, as indicated in the table. While the experiment was on too small a scale to show positively, still it agrees with our experiments of last year, and indicates 1st, that three summer treatments give the best fungicidal results; 2d, that two treatments in a dry year may also give good results; 3d, that if one of the three treatments is omitted, it should be the first; 4th, that one treatment only, given at the time of either the first or the third, is likely to be of little value.

The three different sprays showed about the same value in preventing scab and rot when used in three applications. The total percentage of scab and rot on all the sprayed fruit was 6.5, as against 33.3 for all the checks. Rot would have been worse had the weather been a little more favorable for it earlier, but this trouble did not start to any extent on either the sprayed or the unsprayed trees until about half the fruit had been gathered.

The self-boiled lime-sulphur used without lead arsenate gave a lower percentage of insect injury than where it was added in the first two sprayings. On the whole, the checks also had a somewhat lower percentage than the sprayed trees. These results seem to indicate that an insecticide gives little protection to the fruit against insect injury.

PEARS AND QUINCES.

Our spraying experiments with pears and quinces were rather limited, being carried on with a few trees each at the Clark and Ives farms. No special data, as in the case of apples and peaches, were gathered, but the general benefits and injuries of the spraying were noted. Experiments by Thaxter long ago showed that scab of pear and leaf blight of quince could be readily controlled by the general Bordeaux treatments. Our experiments were largely to determine whether some of the other sprays had any advantage over the Bordeaux.

Fungi and Insects. The pear and quince have several fungous troubles in common, and the same as those of the apple, described in our previous report; namely, black rot, brown rot, more or less common to both, and sooty blotch on pear and fruit spot on quince, the two latter of comparatively little importance. The most serious diseases of the pear in this State, outside of the bacterial blight, are scab (*Fusicladium pyrinum,* see Plate XXI, a), leaf spot (*Septoria pyricola*) and leaf and fruit blight (*Entomosporium maculatum*). This latter is even a more serious trouble of the quince (see Plate XXI, b), while rust (*Roestelia aurantiaca*) is another common trouble in certain places.

The insects found on pear and quince are also very similar to those on the apple; namely, bud moth, codling moth, and fall webworm. Leaf blister mite, pear psylla, and San José scale are not affected by arsenical poisons, though the lime-sulphur should have a tendency to keep them down. Possibly the quince curculio may be repelled in a measure by lime-sulphur preparations, but arsenical poisons are not effective against it, and when it is particularly destructive the jarring method is usually employed.

Pears. At the Clark farm one tree each of eight different varieties of pears were sprayed on May 26 and and June 16, as follows: (1) Bordeaux, 2-4-50, with three pounds lead arsenate; (2) Grasselli's lime-sulphur, 1¼-50, with three pounds lead arsenate; (3) Swift's lead arsenate, 3-50. At the second spraying, it was seen that the lead arsenate alone had caused no injury to the foliage. The Bordeaux had caused a slight injury, while the lime-sulphur had caused a little more, some varieties suffering more than others. The trees did not fruit very heavily, and those that did showed no scab either on the sprayed or unsprayed trees. There was a little russeting on a few of the pears sprayed with the Bordeaux.

At Mr. Ives' the Flemish Beauty pear, by far the worst variety to scab, and often worthless because of it, was sprayed with 4-4-50 Bordeaux before blossoming, and twice afterwards with the 1-4-50, and a fourth treatment was given on July 16, with self-boiled lime-sulphur. None of these sprayings caused any noticeable injury. The fruit was slightly russeted, but this possibly may have been natural, as it did not mar the appearance of the fruit. Practically no scab showed on the sprayed fruit.

Quinces. Two bushes at the Clark farm were sprayed at the same time as the pears, one with Bordeaux and the other with Grasselli's lime-sulphur. No particular injury was noticed from either of these sprayings, and no fungi showed on either the sprayed bushes or the check, except a little black rot on the fruit at the end of the season.

At the Ives farm, six quince bushes just coming into bearing were sprayed with self-boiled lime-sulphur on May 26, June 14, and July 14, using lead arsenate in the first spraying. Mr. Ives also had sprayed these bushes earlier with Bordeaux. No injury was noticed from any of these sprayings. No fungi appeared on the sprayed or check bushes, except a little rust, which was almost as abundant on the sprayed as on the unsprayed bushes.

RECOMMENDATIONS. Since pears are not generally seriously injured by fungi or insects in this State, they frequently require no protection by spraying. Bordeaux has proved a very effective spray in the past, and as we saw no special advantage from the other sprays tried, we are still inclined to recommend it, especially when used

against pear scab. However, we believe that less leaf injury will result if the weaker solution, 1-4-50, is used after the first treatment. Therefore we recommend the same strengths, and number and times of treatment with Bordeaux, as for apples (see page 370).

We would also recommend the same treatment for the quince, since it is even less liable than the apple to suffer injury from Bordeaux on either leaves or fruit. In cases where the quinces tend to rot in the fall, starting at the blossom end through the evident opening in the calyx, it may be well to give a fourth spraying with weak Bordeaux about a month after the third, or about the middle of July. The bushes should also be kept pruned of all dead branches, as these carry over the black rot fungus. To protect the quinces from rust evidently requires that they be coated continually with a spray from the time the leaves unfold to the middle of July, taking special care to protect the young fruit and branches, where this trouble develops most frequently.

CHERRIES AND PLUMS.

While quite a number of cherry and plum trees were sprayed the past year, the experiments were more to test the general effects of the sprays on the foliage, etc., than to determine the exact numerical results in lessening fungous and insect troubles of the fruit. The experiments were thus somewhat preliminary in nature, but we give here such results as were obtained. The experiments were made in the orchards of the late F. W. Gray of Watertown; W. A. Henry & Son, Wallingford; and E. M. Ives, Meriden. Each of these orchards had been infested in the past by a different fungous trouble as mentioned later.

Fungi and Insects. The fungous and insect troubles of cherries and plums, because of their close botanical relationship, are practically the same. In this State, the most troublesome fungous pests are brown rot of the fruit, anthracnose of the leaves, and black knot of the stems. The brown rot is the same as that on peaches, which we described in our report last year. On cherries and plums it often starts from insect punctures, especially those made by the curculio, as shown in Plate XXIII, b. The sweet cherries, as Governor Wood, etc., are much more subject to rot than the sour cherries, as Early Richmond, etc. With the plums, the Japanese, as a rule, suffer most from rot, though some of the varieties of the American group also rot badly.

The anthracnose (*Cylindrosporium Padi*) forms small purplish spots on the upper sides of the leaves, while the mass of spores ooze out on the under surface, often showing as minute, slightly tinted, agglutinated globules. The infected tissues, especially in the plum, often fall out, giving a shot-hole appearance to the leaf. The leaves, if badly infected, turn yellow and drop prematurely, especially toward the end of the season. Certain varieties of cherries seem to be especially subject to this trouble.

Black knot (*Plowrightia morbosa,* see Plate XXII) shows in early spring as slight swellings on the smaller branches and twigs. These soon crack open, and rapidly enlarge, and by the first of June in this region they develop an olive-green surface growth of the summer spore stage. This is gradually superseded during July by the appearance of the winter spore receptacles. In the meantime, the knots have enlarged to several times the diameter of the twig for a length of from three to six inches. They usually encircle the stem nearly, but not entirely, and so do not completely cut off the food supply from the parts above. When fully enlarged, the winter stage completely coats the knots with a black layer of closely placed, minute papillæ. It is within these papillar receptacles that the winter spores are finally developed. Some of these spores are matured by the first of December, and by April or May they are ready for general reinfection of the young twigs.

Both plums and cherries are injured by the plum curculio, which has been mentioned under peaches. The cherry is also attacked by the cherry fruit fly (*Rhagoletis cingulata* Loew.), which, like its close relative, the apple maggot, lays an egg beneath the skin of the fruit. The larva hatching from it feeds inside on the pulp, entirely out of reach of sprays. Certain chewing insects, like canker worms and sawflies, may be controlled by the use of lead arsenate.

Gray Orchard. *Black Knot.* This was a small orchard of sour Montmorency cherries just coming into bearing. They had been badly infected for the last few years with black knot, and while this had all been cut out in 1910, there was still a good deal present in 1911, when our experiments began. The trees had received a winter treatment with lime-sulphur for the San José scale, but had received no previous summer treatments. The experiments here were largely for the prevention of black knot. Three sprayings were given, as follows: 1st, May 19; 2d, June 2; 3d, July 11. Two sprays only were used: (1) Atomic sulphur, 12-50, with lead arsenate in the first and second applications, and 10-50, without lead arsenate, in the third; (2) self-boiled lime-sulphur, 8-8-50, with lead arsenate in the first treatment only.

Twenty-six trees were included in each treatment, and others were reserved for checks. The fruit ripened, and was picked between the second and third sprayings. As it was a sour variety, and the season was quite dry, there was practically no rot, even on the check trees. The crop, however, was light, because late frost had injured the blossoms. No anthracnose showed on the leaves of the sprayed or unsprayed trees during the season. No injury showed on the leaves of any of the sprayed trees after any of the treatments.

The black knot was not cut out this year from any of the trees until after the third treatment in July. At this time all of the knots were removed from seven trees in each of the treated lots and the checks. These showed an average of sixty-two knots on each tree sprayed with self-boiled lime-sulphur, fifty-two on each sprayed with Atomic sulphur, and forty-five on each check tree. Of course the spraying would have no effect this year on the number of knots, as these came from infections before the treatment was begun, but these figures show that the sprayed trees were infected as badly, if not worse, than the check trees. The effect of the treatment, however, was decidedly manifested in preventing the fruiting stages from developing on the knots, as shown in Plate XXII. On June 2, the time of the second spraying, the olive-green summer spore stage was just beginning to develop prominently on the surface of the knots. On July 11, when the winter receptacles had begun to form quite generally, while the spray had not materially stopped the growth of the knots in size, it had very largely prevented the formation of either of the spore stages on the exterior of these knots (compare No. 1 with No. 2 in Plate XXII). The following table shows the condition of the knots on this date, as regards the development of the fruiting stages:

Treatment.	No Fruiting Stage.	Summer Stage.	Winter Stage.	Not Fruiting.
Atomic Sulphur	222	105	23	63%
Self-boiled Lime-Sulphur	153	118	75	44%
Checks—no treatment	0	24	230	0%

This table does not show the total effect of the sprays, since many of the knots were producing the fruiting stage only on a portion of the knot, evidently where the spray had not thoroughly protected it. This protection seems to have been permanent, since knots examined in August and again in December and in April of the next year still remained in about the same condition, while the unsprayed knots had continued to develop. While it may seem curious that the spray should prevent the development of the fruiting stages of the knot, especially the more protected winter stage, and still not prevent to a very great extent the enlargement of the knots, this appears to have been accomplished by the searing over of the surface of the knots by a sort of corky development of plant tissues, while the mycelium of the fungus within was protected from any injury. From what could be seen of the development, it appeared that the winter spore receptacles developed only on those sprayed knots, or on portions of them, where the summer spore stage had not been prevented in its development.

The table shows that the Atomic sulphur was more effective in preventing the fruiting of the knots than the self-boiled lime-sulphur. While the former appears to be a somewhat better fungicide, its more efficient results here were apparently in part due to the weak condition of the self-boiled lime-sulphur, as this was made up only in half-barrel lots, so that the heat from the slaking lime did not bring much sulphur into solution. If made up in two or three barrel lots at a time, we believe it would have shown equal fungicidal value.

To determine the real value of the experiments, they should be continued for another year, and will be if arrangements can be made with those who now have the orchard in charge. Present results, however, seem to show that thorough spraying with an efficient fungicide, combined with winter pruning of the knots, should keep this trouble under control.

Henry Orchard. *Anthracnose.* In this orchard, which included a variety of plums and sweet and sour cherries which were just coming into bearing, there had been some previous trouble from anthracnose, which caused premature defoliation. This year Mr. Henry had given the trees a winter treatment and one summer treatment, about May 26, with home-made lime-sulphur, testing about 25°, and then diluted to about 1-60. This strength caused a little shot-hole injury to the plum leaves, but apparently little injury to the cherries. On June 8, a few of the trees were sprayed with Atomic sulphur, 12-50, containing lead arsenate, and a larger number with self-boiled lime-sulphur without lead arsenate. During the first week in July, Mr. Henry also made a second spraying with self-boiled lime-sulphur on part of those that had received this spray previously, so that these received three summer treatments. No very evident injury resulted from the later sprayings made by us or Mr. Henry.

As the season was dry, there was practically no rot either on the sprayed or unsprayed trees. No black knot was seen on this orchard. We did not have a chance to examine the orchard after the middle of August, at which time apparently no anthracnose showed, though there was some shot-hole injury. Mr. Henry states that some anthracnose showed later on both the sprayed or unsprayed trees, but that he did not make any particular observations to determine the difference, if any, due to the spraying. While the experiments did not positively prove the value of spraying against anthracnose, they show that the self-boiled lime-sulphur is a fairly safe fungicide for such treatment so far as spray injury is concerned.

Ives Orchard. *Brown Rot.* These experiments were on a few cherry (Coe's Seedling, Bigarreau, and Oxheart) and plum trees (Satsuma and Abundance), which had been subject to rather serious rotting in previous years. The kind and strength of treatments and dates of spraying were exactly the same as those for the peaches at the same place (see page 393), except that only the first two sprayings were made on the cherries, as they ripened before the third was made. Sherwin-Williams lime-sulphur, self-boiled lime-sulphur, and Atomic sulphur were the sprays used.

No spray injury was noticed except a little shot-hole on the leaves of the Coe's Seedling, and apparently also on the plums, from the Sherwin-Williams lime-sulphur. The plums had been so severely winter-injured at the base of the trees several years previously that the severe dry weather caused all the fruit to drop before ripening. This dry weather also prevented any extensive rotting of the cherries, even on the check trees, such as ordinarily occurs. However, counts were made at the picking time, June 30, with the following results:

Treatment.	Variety.	Total No. Cherries.	Perfect.	Rot.	Insects.	Per cent. Perfect.
Sherwin-Williams L.-S.	Coe's Seedling	267	250	3	14	93.6%
Atomic Sulphur....	Coe's Seedling	394	380	8	6	96.4%
Self-boiled L.-S. ...	Coe's Seedling	351	333	9	9	94.9%
" "	Bigarreau	1176	1028	122	26	87.4%
" "	White Ox-heart ...	1097	1017	7	73	92.7%
Total Sprayed......		3285	3008	149	128	91.6%
Checks	Coe's Seedling	437	387	32	18	88.6%
"	Bigarreau	646	516	107	23	79.9%
"	White Ox-heart ...	541	448	34	59	82.8%
Total Checks......		1624	1351	173	100	83.2%

From the preceding table it will be seen that the sprayed cherries gave 91.6% perfect fruit, as against 83.2% on the unsprayed. This increase was partly due to decrease of rot, and to a less extent to a decrease of insect injury. With a wet season at harvest time, no doubt, the difference due to rot would have been considerably greater. When picked, the cherries sprayed with self-boiled lime-sulphur, and to a less degree with Atomic sulphur, showed more or less adhering sediment, as the last spraying had been made only a week before, with no intervening rains. The sediment largely wore off in handling, did not affect the taste, and was not especially objected to by the buyers.

The spraying helped to keep the fruit longer, as showed by tests made with a box each taken from sprayed and check trees of the Coe's Seedling. These boxes were examined every other day, and all rotten cherries removed. The keeping quality was unusually good for both the sprayed and the check fruit, because of the dry weather at this time. At the end of the sixth day after picking, the box from the tree sprayed with Atomic sulphur showed that only 26% had rotted, while the box from the check had 57% rotted. At the end of the sixteenth day, the former showed 45% rotted, and the latter 87%.

The Bigarreau cherries failed to set well, many dropping off before maturing, and the Oxheart showed a tendency to crack open. Neither of these troubles was lessened by the spraying. The former trouble was apparently due to imperfect pollenization, and the latter was evidently characteristic of the variety, aggravated by certain weather conditions. This cracking opens the way for rot, and so sprayed cherries, even if cracked as badly, should suffer less from rot.

RECOMMENDATIONS. From these experiments, we make the following suggestions for spraying cherries and plums in this State, until further knowledge is gained.

(1) If the trees suffer from black knot, the knots should be cut off thoroughly by the first of April and destroyed. If the trees need spraying for San José scale, the treatment should be made with commercial lime-sulphur 1-8, in April, just before the buds begin to swell, as this may help to kill the spores of the black knot, and also will take care of any leaf curl or plum pocket that may appear.

(2) As certain varieties of cherries and plums, especially the latter, are as sensitive to spray injury as the peach, it is best to use only self-boiled lime-sulphur, 8-8-50, for summer spraying. If commercial lime-sulphur is used, it should not be stronger than 1-150, and without poison.

(3) As a rule, three summer treatments are desirable, and these may be given somewhat according to the fungous troubles to be combatted, and the time of ripening of the fruit. As a rule, the first treatment should be given on the leaves as soon as they reach maturity, somewhere near the middle of May (the earlier the better, for black knot and anthracnose). The second should be made on the young fruit from the first to the middle of June, according to its size and the time of its ripening. The third should be made usually a week or ten days before the fruit ripens. This will vary from the latter part of June, for cherries, to about the middle of July, for most of the plums. With early ripening fruit, the second and third sprayings thus come close together, before picking, when used against brown rot. If anthracnose or black knot are the chief troubles, it may be well to defer the third treatment until just after the cherry harvest. As the cherries and plums are smooth fruits, the spraying may be made within a week or ten days of picking time, especially if rainy, since the sediment does not adhere to these so readily as to the hairy peaches.

(4) If it is desired to protect the foliage and fruit against insects, lead arsenate, 3-50, may be added to self-boiled lime-sulphur in the first, and also in the second spraying, if the latter is made at least three weeks before the fruit ripens. It is still a question just how much this will do toward lessening wormy fruit.

CURRANTS.

The chief fungous trouble of currants in this State is anthracnose of the leaves (*Gloeosporium Ribis*), which produces small purplish spots on the upper surface, and causes premature defoliation (see Plate XXIV, a). The powdery mildew also attacks the foliage and young branches of certain varieties. Both these troubles yield to treatment with fungicides, when properly applied.

Of the insect troubles, the imported currant worm (*Pteronus ribesi* Scop.) is the most common and wide-spread. The adult is a four-winged fly, which lays its eggs on the under side of the lower leaves of the gooseberry and currant during April and May. The eggs hatch in a week or ten days, and the larvæ usually begin to feed by the second week in May, becoming full-grown about June 1. They then pupate, in earthen cells in the ground, the adults emerging before July, when the females lay eggs for a second brood. A spray of lead arsenate, or dusting with fresh hellebore, will easily control this insect, which is shown on Plate XXIV, b.

Our experiments with currants were not extensive enough to make any very general recommendations. They were carried on at the Gray place in connection with the experiments with cherries merely to test the effect on the currant leaves of the sprays used there. The sprays and times of treatment were the same as those given for the cherries; namely, three sprayings, made May 19, June 2, and July 11, with (1) self-boiled lime-sulphur, 8-8-50, with lead arsenate, 3-50 in the first spraying only; (2) Atomic sulphur, first and second treatment, 12-50, with lead arsenate; third treatment, 10-50, with no lead arsenate.

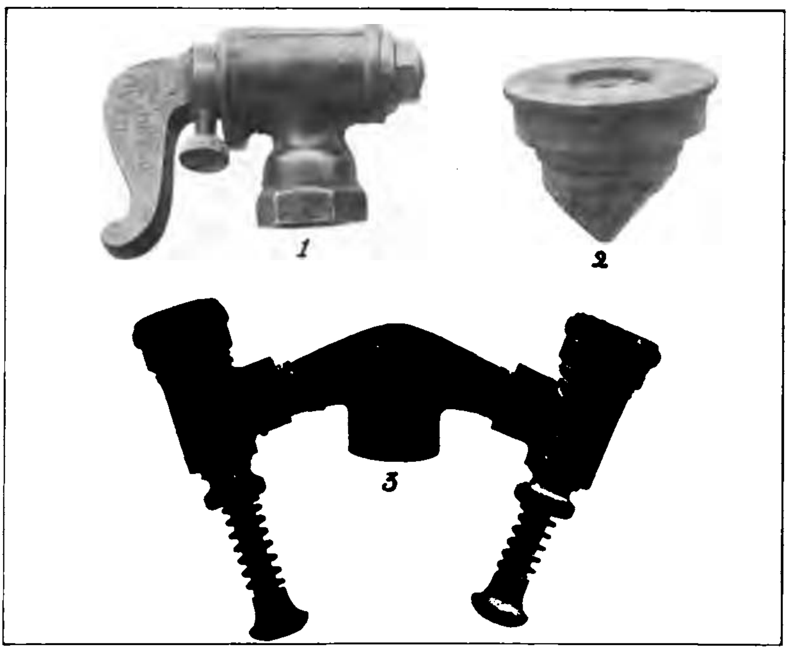
The only injury that resulted was an evident scorch on scattered clusters of leaves on the row of currants sprayed with Atomic sulphur, appearing some time after the second treatment. A similar scorch, but much less abundant, showed on the row sprayed with self-boiled lime-sulphur. Appearances seemed to indicate that the hot, dry weather at that time was at least partially responsible for the trouble. Gooseberries throughout the State baked on the bushes because of this hot period.

No anthracnose or insect injury appeared on the sprayed bushes. However, only a little anthracnose and a few leaves eaten by the imported currant worm were seen on the unsprayed rows. It is doubtful if either of the sprays used there have any advantage over Bordeaux. It might, however, be desirable to use the weak Bordeaux, 1-4-50, for the second and third treatments where leaf injury is likely to occur if the full strength is used.

a Gasoline engine sprayer used in Henry orchard.

b. Horizontal pump sprayer used in Ives orchard.

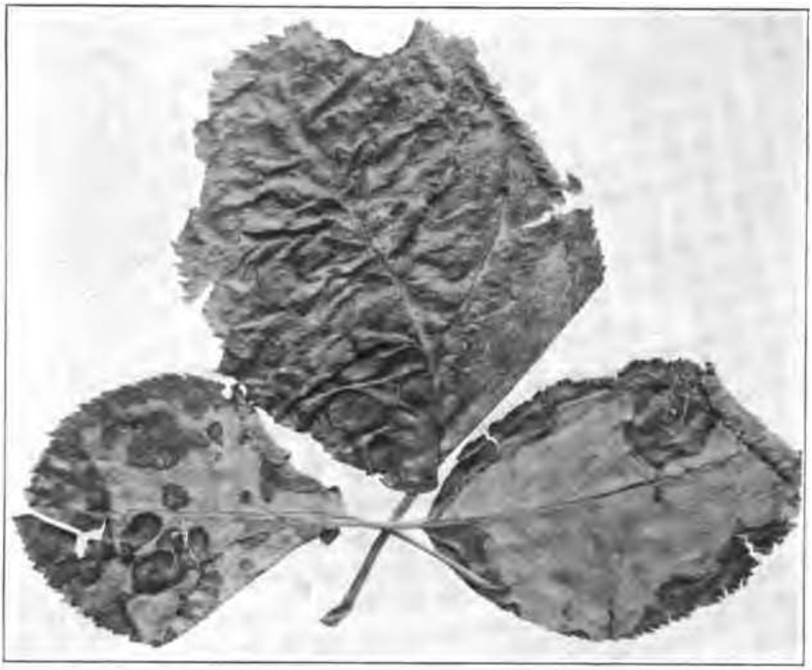
a. Mounted half barrel sprayer used in Jones orchard.



b. Types of nozzles: 1. Bordeaux; 2. Disc; 3. Double Vermorel.

a. Apple showing hail injury.

b. Apples showing scald injury.

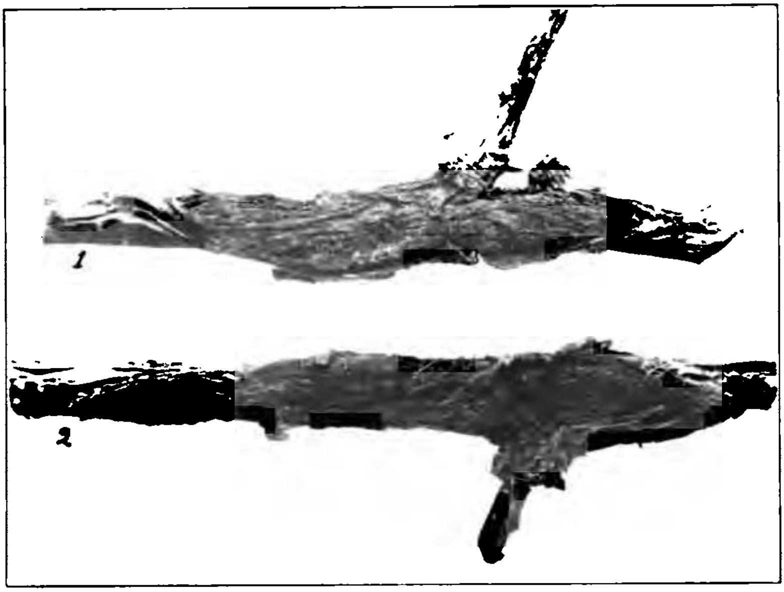


a. Ortho-arsenite of zinc injury on apple leaves.

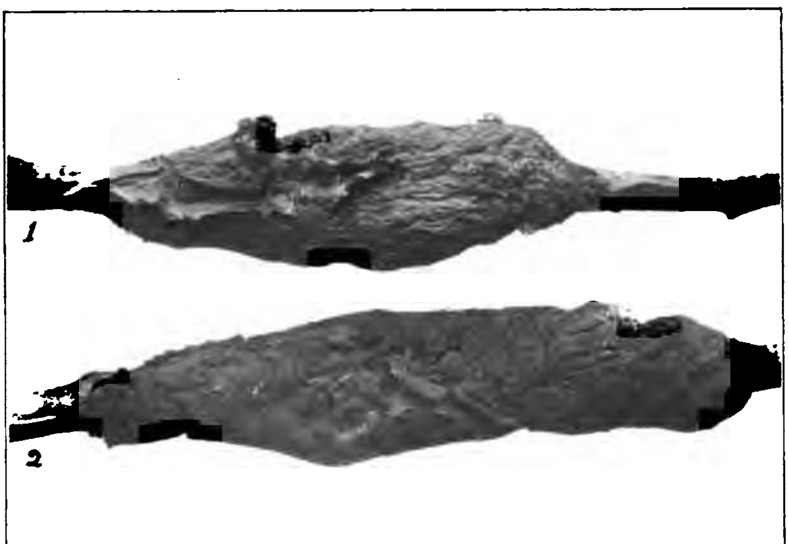
b. Lime and sulphur (Thomsen) injury on apple leaves.

a. Pear scab on leaf and fruit.

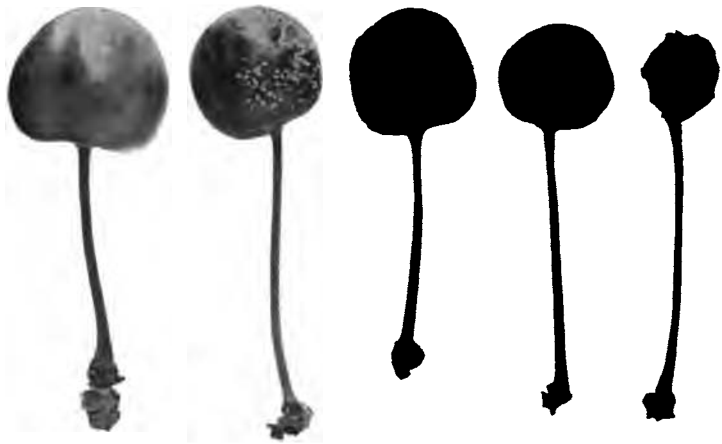
b. Quince fruit blight.



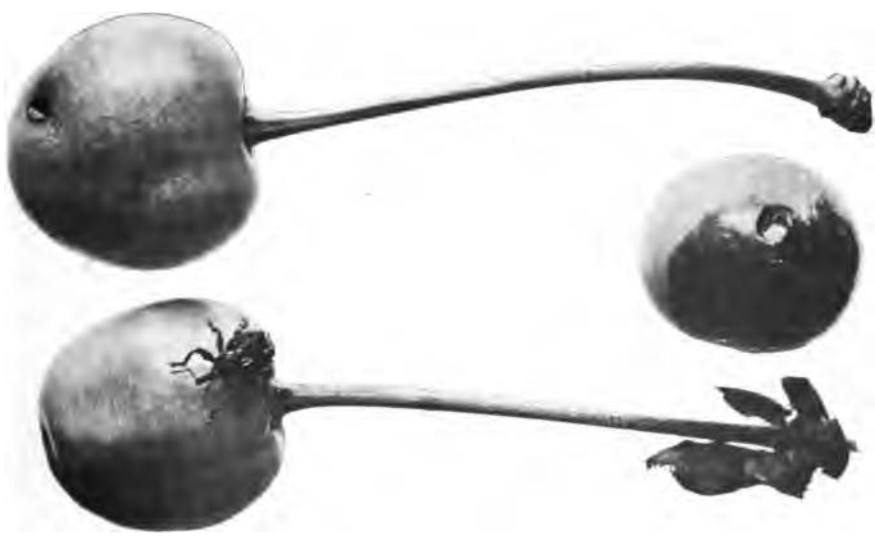
a. Development of Black Knot on sprayed (1) and unsprayed (2) branches, June 2. (2) shows summer stage.



b. Development of Black Knot on sprayed (1) and unsprayed (2) branches, Dec. 4. (2) shows winter stage.

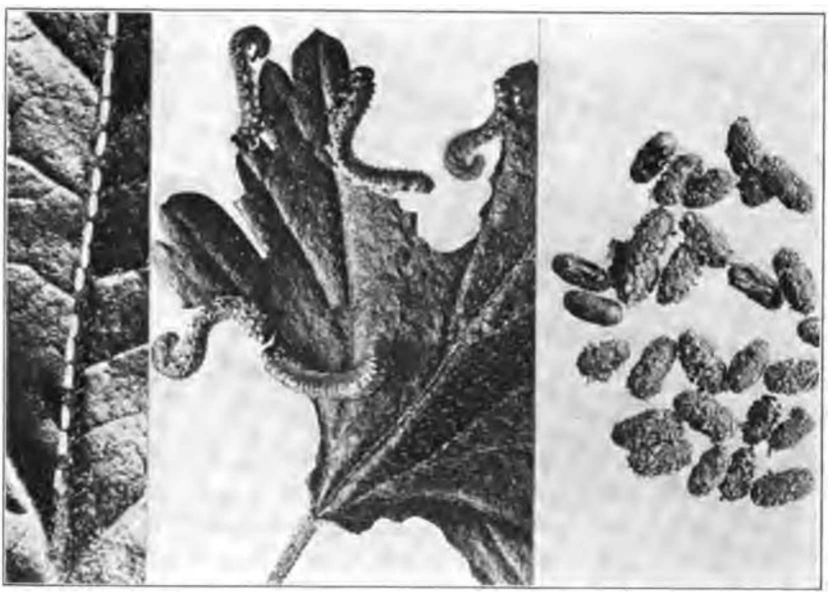


a. Brown rot of cherries.



b. Curculio, its injury and resulting brown rot.

a. Anthracnose of currant.



b. Imported currant-worm, eggs, larvæ, cocoons.

PART VI.

INHERITANCE IN CORN.

By H. K. HAYES.

Introduction

For the last six years this Station has been studying the inheritance of corn characters, and in 1911 a technical bulletin was published on the subject. The purpose of this paper is to state as clearly as possible some of our results which have practical value to corn growers and breeders in two different particulars.

First, a large number of corn varieties are grown in Connecticut and often several of them on the same farm. In spite of usual precautions, slight accidental crossings between varieties take place which cause serious embarrassment to growers of seed corn and plague everyone who wants to raise corn which is uniform in appearance. In the following pages is stated what can be done to detect and cull out the accidental hybrid seed.

Second, many more or less successful attempts have been and are being made to develop new hybrid varieties which shall combine desirable qualities from both parents. Accurate knowledge of the way in which these desirable qualities are inherited will simplify operations and prevent disappointment.

The Formation of the Seed

Following the general rule, seed corn can only be produced by a union of male and female elements. The tassels and silks of corn, which are the male and female reproductive organs, are borne on widely separated parts of the plant. Eaeh thread of silk grows from a spot on the cob where the kernel is to be and where the female cells are produced. The office of the silk is to collect the pollen grains which are formed in the tassel. A mature pollen grain falling on a mature silk germinates and sends out a tube which, guided by the silk, reaches the ovary. Through this tube two male cells pass, and on reaching the female cells, unite with them. One unites with the egg cell to form the embryo or undeveloped plant and the other fuses with a second female cell to form the endosperm of the seed. This endosperm is the surrounding tissue in which the food material is stored. The embryo of the corn seed is the germ or chit, the rest of the seed within the outer covering is the endosperm.

The fusion of the cells just described, called fertilization, is at once followed by rapid growth and the production of a seed. When the pollen comes from the same plant which bears the silk, there is "self-fertilization;" when it comes from another plant of the same variety there is "cross-fertilization;" when from another variety there results "hybridization." As a commercial variety of corn is generally composed of many types in a complex hybrid condition, due to constant inter-crossing, there is no exact distinction between "cross-fertilization" and "hybridization" as applied to corn.

The Law of Heredity

The transmission from one generation to another of the prominent features, such as sweet, dent and flint characters, color of seeds, etc., which distinguish varieties of corn, follows what is known as Mendel's Law of Heredity, which may be illustrated from his own work with peas. For this discussion Darbishire's book, "Breeding and the Mendelian Discovery," has been freely used.

The edible pea may be divided into two classes, the tall and the dwarf. One difference between them is in the length of the internodes, i. e., the sections of the stem between two nodes or joints where the leaves are attached. This causes the tallness or the shortness of the whole plant.

Moreover, the pea is a normally self-fertilized plant, i. e., seed is formed by the union of male and female cells of *the same plant*.

This seed, if from a tall race, will produce nothing but tall plants, and if from a dwarf plant will yield dwarfs only.

Now, if a cross is made between a tall and a dwarf race by applying the pollen of one variety to the stigma or female receptive organ of another variety, and the seeds produced by this "cross" are sown, nothing but tall plants will appear. These are no shorter than the pure tall plants and in many cases they are somewhat taller because of the increased vigor due to crossing two pure races.

When we sow the seed from the above hybrid generation we obtain tall and dwarf plants in the ratio of about three tall to one dwarf in every four. These dwarfs, if self-fertilized, will all breed true as to height in later generations, but while some of the tall plants will breed true others will again give tall and dwarf plants in the ratio of three to one.

These facts are easily explained by the present Mendelian theory, which is not essentially different from Mendel's interpretation. A plant or animal does not transmit its characters in a bunch as it were, as if the entire organism were the unit, but its various characters are inherited separately.

Each reproductive cell, whether in pollen or ovule of the tall pea, contains a factor, structure or unit quality of tallness which we may represent by T. A union of male and female cells of tall peas will be a union of reproductive cells, all of which contain T, and a tall race will result. Each such reproductive cell of the dwarf pea lacks the structure or factor which produces the tall race. This lack may be represented by t, and from their fusion only dwarfs result.

But when the tall and dwarf races are crossed, each seed is the result of a union of reproductive cells, the one from the tall race containing T and the one from the dwarf race containing t. But the tall character in this generation is "dominant;" i. e., it conceals or masks the other. Such characters as tallness and dwarfness are said to be contrasted or allelomorphic pairs, and as only tall plants are produced when tall and dwarf are crossed, the tall character is said to be a *dominant* one and the dwarf character a *recessive* condition.

Now, if all the seeds of this hybrid are planted and their blossoms self-fertilized, we may explain the conditions as follows: Half of the male cells are supposed to contain only T, the factor for tallness, and half only t, the factor for dwarfness. The same is true of the female cells. We may represent the situation and the resulting progeny thus:

	T	⟶	T	
Male cells	T	╳	T	Female cells
	t		t	
	t	⟶	t	

From the diagram it appears that one-quarter of the resulting seeds have received T from both pollen and ovule, or (T + T). They can produce only tall progeny. One-quarter have received t from both, or (t + t) and can produce only dwarf progeny. The remaining half of the seeds are like those from which they themselves were grown, i. e., they are formed by a union of cells, one of which contains T and the other t, or (T + t). But when the dominant factor T is received from only one reproductive cell the plant when grown is a tall one and can not be distinguished from the pure tall race.

The only method of distinguishing between the pure tall and hybrid tall plants is by breeding from them. The pure tall plants will, of course, give only tall progeny, while the hybrid tall plants will again give both tall and dwarf plants.

The first important fact which this illustrates is that the external appearance of a plant is not a correct criterion of its breeding qualities, but that the contents of the reproductive cells are the important feature, and that in most cases the only way of determining these contents is to breed from them.

We should also note that only one of the factors of a contrasted pair is found in a single reproductive cell. Thus, in the case above described no reproductive cell consisted of a mixture of the factors for both tall and dwarf plants but contained either the one or the other.

The fact that there is often a dominance of one condition over another in the first hybrid generation of a cross is of especial importance to the corn growers of Connecticut. A partial report of this matter was given in 1907 by East.

Dominance of Characters in Corn Breeding

After crossing, the characters here given behave in the following manner:

Flint or Dent	is	dominant	to	Sweet.
Yellow	"	"	"	No Yellow or White.
Purple	"	"	"	No Purple or White.
Red Pericarp	"	"	"	No Red or White.
Red Cob	"	"	"	No Red or White.

Flint or Dent—Sweet Crosses

If a sweet corn is used as the female parent and is crossed with a starchy corn, either a flint or a dent, there result hybrid seeds which cannot be distinguished from seeds of the starchy parent. This result is due to the fact that the endosperm of corn is hybridized as well as the embryo. (See The Formation of the Seed.)

A microscopic study of the starch grains of sweet corn shows them to be small, angular and abortive, while those of a flint or dent are much larger and are circular in outline. Something is evidently introduced by the pollen of the starchy corn which enables the sweet variety to proceed in its starch development and form seeds which are not visibly different from the starchy parent.

If, on the other hand, starchy corn, flint or dent, is used as the female parent and is pollinated with sweet corn pollen, no immediate effect is apparent. The starchy corn already contains the dominant factor and masks or hides the presence of the sweet character which is recessive.

The practical use of these facts is as follows:

No extreme care need be used in isolating sweet corn plots from field corn, as any crossing on the sweet corn shows in the first year, and at harvest the hard starchy kernels can be discarded. The sweet kernels, those with a wrinkled appearance, when grown will always produce sweet corn.

But, on the other hand, as there is no immediate visible change when field corn is pollinated with sweet corn pollen, there is no method of detecting and rejecting the hybrid kernels. The field corn seed should always therefore be saved from that part of the field which is farthest from the sweet corn plot.

Sometimes seeds of a semi-starchy nature appear in sweet corn varieties. In a study of the inheritance of starchy-sweet crosses a few ears of this nature were met with. Semi-starchy seeds have also been mentioned as occurring in a number of pure sweet races by Halsted of New Jersey. To determine the inheritance of this peculiarity, the most starchy and most sweet kernels were selected from a self-fertilized semi-starchy ear. The result of two years' selection of the most wrinkled kernels for planting produced ears nearly all of which were of a pure sweet nature. No ears have as yet been produced of a pure starchy nature.

Such semi-starchy ears are often encountered by sweet corn canning factories and give much trouble. Selection of the most wrinkled seeds for planting will assist in eliminating the semi-starchy types.

Yellow—White Crosses

Our results indicate that in many cases there are two separately inherited characters for yellow color in corn, either of which can produce this color. This fact, although of great scientific importance, does not materially change the methods of producing pure seed of either the yellow or white variety. The color which produces the yellow varieties of corn is an endosperm character. When white corn is crossed with pollen from a yellow variety the resulting progeny always has a yellow color, although it is sometimes lighter than the pure yellow. If the white corn plot is not completely isolated from the yellow variety some hybrid seeds will be produced. On saving the white corn seed, those seeds which are hybrid can be detected by their yellow color and removed, with the assurance that when nothing but white seed is planted the seed is pure for this character.

When yellow is the female parent and is crossed with white corn the resulting seed is yellow. In some crosses the hybrid seeds are light yellow, but, on the other hand, some hybrid yellow-white seeds are dark yellow, so it is impossible to separate the pure yellow from the hybrid yellow seed except by breeding. Therefore, yellow corn, when intended for seed, must be grown at a considerable distance from white varieties.

Intentional crossing of two varieties is usually done with the idea of obtaining an improved variety by combining the desirable qualities of both parents. Suppose a white corn with a large stalk has been crossed with a yellow variety with a good ear and that a type has been produced with both these characters (large stalk and good ears), but the ears are composed of such a heterogeneous mixture of yellow and white seeds that they have no value as seed corn. The problem is to obtain ears which will produce either all white or all yellow seeds. The easiest method is to select only pure white seeds for planting, which in turn will produce only white corn. If a yellow variety is desired it can be most easily produced by planting all yellow seeds and self-fertilizing a number of ears, i. e., the pollination of the silks of a plant by its own pollen grains. This is most easily performed as follows:

Just before the silk appears a bag should be placed over the ear and another over the tassel. About five days later, when the silk is well showing, the stalk should be bent over and the tassel bag carefully removed. This will contain a certain amount of yellow dust or pollen which should be carefully dusted over the silks, and the ear again covered. After maturity, these hand-fertilized ears should be harvested and examined. All ears which contain only yellow seeds will produce only yellow progeny. It is necessary to self-fertilize a large number of ears so that several pure ears may be allowed to cross naturally the following season in order not to obtain evil effects from inbreeding.

Purple—White Crosses

Only a few races of purple corn are grown in Connecticut, of which Black Mexican sweet is the best known example, although a purple pop variety is sometimes seen in the market. This purple color is due to a dye which is present in a single row of cells, known as the aleurone layer, which is found just underneath the pericarp or outer hull of the seed. As this layer is a part of the endosperm, there is an immediate effect when non-purple races are crossed with purple varieties. The conditions, however, are different than in the crosses previously mentioned.

From an analysis of crosses between Black Mexican sweet and several non-purple races the following facts have been established. The purple color is due to at least two separately inherited factors found in the reproductive cells, both of which must be present in order to produce a purple condition. By crossing a white race which we found to contain one of these factors with another white race which contained the other factor, purple seeds were obtained. In one cross there was no visible effect in some kernels when a non-purple race was crossed with pollen from a purple variety. This we explain by the presence of something in this race which inhibited the production of purple. These facts, however, will not be further discussed here.

When pure seed of a purple race is desired, it is necessary that it be isolated from other corn plots. Of course, when Black

Mexican sweet is fertilized with pollen from starchy races, either dent, flint, or pop, those seeds which are of a hybrid nature will be of a hard starchy condition and can therefore be rejected.

Non-purple races, of either flint, dent, pop, or sweet, from which seed is saved, should not be grown near a purple variety, as there is no surety that hybrid seeds can be rejected. All kernels showing any purple color will be found to be hybrids and by rejecting these the greater part of the hybrid seeds can be removed.

Red Pericarp—White Pericarp Crosses

The pericarp of corn is the outer hull. It is in this portion of the seed that the red color of the common red races of corn is found. If a paper bag be placed upon an ear before silking time and be removed after the silks have fully developed, thus leaving it unfertilized, the places on the ear where the seeds would have been formed, had pollination taken place, will be found to consist almost entirely of this outer hull or pericarp. This portion of the seed is therefore just as much a part of the mother plant as its tassels or silks and is not immediately affected by pollination. For this reason an ear has either a red pericarp color on all of its seeds or on none of them.

If a seed is soaked for a short time in water this outer hull may be easily removed. This red color conceals all other colors which may be present in the seed. Thus, an ear of corn may contain both yellow and white, or purple seeds, or any of these colors in a pure condition, yet if the red pericarp is present these facts are obscured. Thus we are further impressed with the fact that all of the characters so far discussed are separately inherited.

If a red pericarp corn is crossed with a non-colored race, no matter which is the female parent, there will be no immediate visible effect. If these hybrid seeds are planted, the crop for the following season will consist of all red pericarp ears. If these ears are self-fertilized and grown, red and non-red pericarp ears will be received in the ratio of three to one.

Besides this solid red pericarp there are mosaic red, commonly called "Bloody Butcher," varieties. This mosaic red is inherited as a pattern color. In common with many variegated races of plants this condition does not breed true but always gives some non-colored and, in some cases, some deep red progeny. There is also a pericarp color which varies in intensity due to light conditions. If the ear is stripped of its husks before maturity all seeds are partially covered with red, in other cases the red color is only seen as a slight blush on some seeds near the tip of the ear. This color is inherited in the same manner as the deep red pericarp color.

As there is no method of detecting a cross between red and non-red races, seed of either sort should only be grown in isolated plots at some distance from the other variety.

Red Cob—White Cob Crosses

The directions for selecting exhibition corn, issued by the extension department of the Massachusetts Agricultural College, state that white corn usually has white cobs, that red cobs in yellow corn are preferred, while a variation in cob color shows a mixture and poor breeding.

It is not believed that the color of the cob is of any practical importance, although for the sake of a uniform appearance a "mixture" is not advisable. In a study of a cross between a red pericarp, red cobbed variety, and a race which lacked these colors, the pericarp and cob colors were coupled in inheritance, i. e., when separation took place all red cobs had red pericarps and all white cobs had white pericarps. In other cases no coupling has been observed and each character is separately inherited.

The cob color behaves exactly similar to the pericarp color in crosses. Red is dominant to white and in the second generation there are, on the average, three red cobs to one white.

In case of a mixture of red and white cobs, or pericarp colors, pure races for either the one or the other can be most quickly got by self-fertilizing a number of ears, as explained under the heading Yellow-White Crosses. All non-colored self-fertilized ears for either cob or pericarp will give non-colored progeny. Of the self fertilized red ears, one-third will breed true and two-thirds will again give a mixture. The breeding nature of these can be tested by growing about ten hills of each and noting results. The remainder of the seeds from each ear should be reserved and all ears which, by test, give only red-eared progeny can be used to multiply the variety the following year.

Summary of Crosses Showing Dominance

In the preceding discussion we have considered the appearance of crosses, the production of seed of pure varieties, and the inheritance of characters.

Summing up these results, we find that when a white corn is crossed with a yellow variety the resulting seeds are always yellow. Likewise when sweet corn is pollinated with starchy races (dent, flint, or pop) the resulting seeds are always of a starchy appearance. Pure seeds for the characters, sweetness, or white color can therefore be told by inspection. When ears show a mixture of yellow and white or starchy and sweet seeds we may be sure that the white seeds and the sweet seeds are pure for these respective characters. Thus no extreme isolation from other varieties of either sweet or white corn seed plots need be practiced, as the crossed seeds can be detected and eliminated. Seed plots in all other cases must be isolated from other varieties.

In case a mixture has been received of yellow and white seeds and a yellow race is desired, this can be obtained by planting yellow seeds and self-fertilizing a number of ears, as we know that all self-fertilized ears which contain only yellow seeds will thereafter give yellow progeny.

When a variety produces some colored and some non-colored ears for either cob or pericarp colors, there is no surety that either selected color will breed true. As a larger part of the seeds of an ear is normally "cross-fertilized" there is a small chance of receiving either a red or white ear in which some seeds will not be fertilized with pollen from a plant bearing an opposite color and, when planted, give a mixture. Pure varieties can be most quickly obtained by self-fertilizing a number of ears as previously explained under the heading "Red Cob-White Cob Crosses."

It is always necessary to self-fertilize a number of ears so that several pure ears may be allowed to cross naturally the following season.

When attempting to produce an improved variety by crossing two types, each of which contains a desirable character, the aim of the breeder is to combine both desirable characters in one variety. As we have learned, each character is generally separately inherited, although some cases of coupling have been reported in which two or more characters are inherited together. The method of inheritance of any character can be determined by crossing a variety which contains this character with another in which it is either absent or is present in a modified condition and by studying the appearance of this character in later generations. The knowledge of the manner in which each character is inherited enables the breeder to combine desirable features of one variety with those of another.

When the parents differ by two separately inherited characters we may illustrate the results as follows:

Suppose one parent is a yellow sweet corn in which there is only one inherited factor for the yellow color and the other parent is a white flint corn. As we have seen, yellow is dominant to white, and flint or starchiness is dominant to sweetness. Since these are endosperm characters, the immediate cross of the above parents will be a yellow flint corn. But the following generation, if self-fertilized, will consist of ears containing four sorts of seeds in the ratio of nine yellow starchy, three white starchy, three yellow sweet and one white sweet. The yellow starchy corn is produced when the factors for yellow and starchiness are both present. As both are dominant factors, only a part of the nine yellow starchy seeds will breed true. Theoretically, one out of every nine will give ears containing only yellow starchy seeds, two will breed true for the yellow color but will be hybrid for the starchy character, two others will breed true for the starchy condition but will give both yellow and white seeds, and four will again produce ears containing all four sorts of seeds.

Of the three white starchy seeds, all will breed true to the white color, but only one of every three will give pure starchy ears. Likewise, of the three yellow sweet seeds, all will give sweet progeny, but only one out of every three will give pure yellow ears. The white sweet seeds will all breed true, giving only white sweet progeny.

Our parent varieties were yellow sweet and white flint. From crossing these varieties two new sorts have therefore been produced, namely, white sweet and yellow flint. This cross illustrates what we mean by a recombination of characters.

Inheritance of Characters Which do not Show Dominance

From the viewpoint of the improvement of corn by a cross between two varieties, each of which contains some desirable character, the phenomenon of dominance is of little importance. The result desired is to obtain a race which contains both beneficial characters.

The following crosses conform to the essential feature of Mendel's law, i. e., the separation of characters in the reproductive cells of hybrids and their chance recombination—although the conditions are of a complex nature.

After crossing, the characters given below do not show dominance. The first hybrid generation is intermediate in appearance and the second hybrid generation gives both intermediate and parent types.

Crosses between Flint and Dent races.

Crosses between races which differ in row numbers.
Crosses between races which differ in height of plants.
Crosses between races which differ in length of ears.
Crosses between races which differ in size of seeds.

Crosses between Flint and Dent

Flint corn has hard, smooth and oval grains generally nearly as broad as long, while dent corn is indented on the top and the length of the seeds is much greater than their breadth. The characteristic difference between flint and dent is due to the amount and position of horny starch in the endosperm. Flint seeds have the embryo and soft starch surrounded by the horny starch. In dent races the soft starch extends from the center to the cap, the sides of the seed being composed of horny starch.

There is no immediate visible effect when dent and flint races are crossed, the character being inherited as a plant character. For this reason seed of either sort must be produced in isolated plots. Frequently an ear from a flint-dent cross contains both indented and flinty seeds, yet selection of either kind for planting gives like results. An ear which contains both flint and dent seeds is generally a hybrid.

The first generation of a cross between a flint and dent is of a uniform nature and intermediate in appearance. Sometimes this generation is more like the flint parent, sometimes more like dent in appearance and in other cases strictly intermediate. Self-fertilized ears of this generation produce a wide range of variation the following season, a few ears resembling flint, others resembling dent, and the greater part again of an intermediate nature. Self-fertilized ears either of the pure dent or pure flint type produce pure races when grown, but the intermediates again show wide variabilities. In this cross there is often difficulty in separating pure dent or pure flint from intermediates, by inspection. As in some previous cases, the only sure method of determining the breeding nature of an ear is by growing it and examining its progeny.

Crosses between Races which Differ in Row Numbers

There is a wide range of row classes in corn. The most common flint races are eight-rowed sorts and some dent races produce as high as thirty-six rows. This character is quite markedly affected by conditions; thus, an eight-rowed flint frequently produces some twelve-rowed ears. A sixteen-rowed selection which has been inbred for a number of years has a normal fluctuation of from twelve to twenty rows with a mean value of sixteen rows. In pure races these fluctuations, due to environmental or physiological conditions, are non-inherited.

Crosses between races which differ in row numbers are of an intermediate nature in the first generation, the range of classes being somewhat larger in the second generation than in the first. Some of these second generation plants breed comparatively true, although the greater part again break up the following year.

There must be several inherited factors for row classes in corn, as different varieties breed true to different row classes. The row classes of most commercial varieties of corn can be changed by selection and either increased or decreased. This is due to the fact that corn is naturally cross pollinated, and a commercial variety really consists of a complex hybrid condition.

Crosses Between Races which Differ in Height of Plants

Plant height is a complex character and, without doubt, due to many inherited factors. Our reasons for this belief are the large number of known varieties which differ from each other in plant height. In common with other size characters, environmental conditions have the power to greatly modify the height of plants. The fluctuations within a pure race are very large and make the analysis of the inheritance of such characters almost impossible. Some of our experimental races have been constantly inbred for a period of six years and are very uniform in appearance. Under ordinary field conditions, the difference in height of different plants of such pure races is often as great as two and a half feet.

Two crosses have been studied between races which differ in plant height, both giving similar results. One was a dent-flint cross and the other a cross between Tom Thumb pop and Black Mexican sweet. The results were as follows: The first generation of the cross proved to be as uniform as either parent and was somewhat larger than the average of the parents. This increased height over the average of the parents is due to increased vigor and not to dominance.

Self-fertilized ears of this first generation, when grown, produced a wide range of variability for plant height, embracing the range of both parent forms. Of course, it is not to be expected that many of these forms will breed true the following year, yet selection of forms like either parent will doubtless give an approach toward the parental condition.

Length of Ears and Size of Seeds

Only one cross between races which differ in ear length has been carefully studied. This was between Tom Thumb pop, with an ear length of from five to eight centimeters, and Black Mexican sweet, with an ear length of from thirteen to twenty-one centimeters. The first generation of this cross had a range of variation of nine to fifteen centimeters. This generation was no more variable than the parent races, and was of an intermediate ear length, although somewhat larger than the average of the parents. The second generation was very variable and produced some ears which closely approached the parental forms in length.

The above cross was also used to study the inheritance of weight of seeds. The size of the seeds is determined in a large measure by the pericarp, which is a mother plant character. For this study, twenty-five seeds were weighed from each ear. The first generation was intermediate in weight of seeds and no more variable than the parent forms. The second generation presented a wide range of variation. Some short ears produced large seeds, while some long ears produced small seeds.

Summary of Crosses not Showing Dominance

The preceding crosses do not show the phenomenon of dominance, yet all behave in a similar manner. The first generation of these crosses is of an intermediate appearance and the second generation has a range of variation from one parent form to the other. Some of these second generation forms will breed true, but it is impossible to determine, by inspection, which these are. The only method of determining the breeding nature of these second generation forms is by row tests.

Abnormalities

There are a number of abnormalities of corn which are often found in commercial races. These appear to be of two sorts; first, those which are produced by some unusual environmental condition and are non-inherited, and second, inherited abnormalities. Of these two classes the heritable one is of interest to the commercial grower or seedsman because it is important to know the quickest method of getting rid of these abnormalities if they appear.

The following abnormalities have been found to be inherited:

Dwarf forms.
Divided ears.
Irregularity of rows of seeds.

Dwarf Forms

Dwarfs have appeared several times in our cultures, and in all cases but one in strains which have been inbred for one or more seasons. Inbreeding, as used here, means the pollinating of the silks of a plant by its own pollen grains.

In one instance, some dwarf plants appeared in a commercial culture of Stowell's Evergreen Sweet. A normal plant from this culture was inbred and gave both dwarf and normal plants the following season. A cross was made between a normal plant and a race in which dwarfs had never appeared, which, when grown, gave only normal plants, two of which were self-fertilized. One of these ears produced only normal plants, and the other gave both normal and dwarf forms.

Several attempts to self-fertilize such dwarfs have proved unsuccessful and in one case when a few mature seeds were produced they failed to germinate. Emerson of Nebraska succeeded in self-fertilizing some similar dwarfs which appeared in his cultures and when grown only dwarfs were produced.

It seems very probable that we are dealing with a condition in which normal plants are dominant to dwarfs, as is the case of the tall and dwarf peas. The dwarfs which have appeared in our corn cultures, unlike dwarf peas, are absolutely valueless. The low per cent. of seeds which germinate from strains which produce some dwarfs points to the fact that in some cases such abnormalities have not been able to develop.

If dwarfs appear in an otherwise valuable strain they can be most quickly eliminated as follows: By hand pollinating a large number of ears we may expect to receive one out of every three which will give only normal plants. The hand pollinated ears should be tested by planting a part of each and reserving the remainder of the seeds. The seed from all ears which in this test gives only normal plants may be used to develop the strain the following season. Such a method should not be used unless the strain is a valuable one.

Divided Ears

A desirable ear of corn should be cylindrical in form and should not have too large a cob, i. e., the proportion of shelled corn to cob should be large.

There are several classes of abnormalities which show different degrees of division of the cob. A form with a monstrous, flattened, and in extreme cases a divided tip, is frequently seen in races which have a large number of rows, such as dents and pops. At our State Fair this year, one entry for the best six-ear lot of yellow dent corn contained one such ear. Such an ear produces a large proportion of cob which is valueless and also an ear which is hard to shell.

The above abnormality belongs to the inherited class, although environment has the effect of retarding or accelerating its manifestation. One of our inbred races of dent produces, on the average, about two-thirds of its progeny with a flattened ear and one-third with both a flattened ear and a divided tip. A cross between this strain and a strain with a flattened cob gave, in the first generation, about the same per cent. of divided tip ears as is produced by the divided tip parent.

Divided tip is dominant in crosses to normal tip, but the dominance is not complete. In such cases there is the added difficulty of not being able to tell the recessive form from the dominant by inspection. Flattened cobs have proved dominant in crosses over cylindrical cobs.

There are different degrees of cob division and in the extreme case the cob is grooved and only four rows are produced. Although we have not found this four-rowed condition to be inherited, there is no doubt of the fact that the tendency to division is sometimes inherited. We have often found the same plant producing one ear which is four-rowed and another with eight rows. When the tendency to division is an inherited character an inspection of the eight-rowed ear showed a tendency towards row splitting at the butt of the cob. In some cases we found this character to be non-inherited. Any row culture producing over five per cent. of such ears should probably be discarded.

Irregularity of Rows of Seeds

The greater part of the ears of our commercial varieties of corn have regular rows. Sometimes, as we have noted, two or more rows are dropped from a part of the ear, but even then the rows of seeds are regular and straight.

Nearly all varieties produce some ears which show irregular rows, the kernels being packed closely together on the ear, making it almost impossible to count the row number. Such irregular ears are undesirable, the seeds presenting differences of size and shape which are not conducive to even dropping by cornplanters. Regular-rowed ears also present a more attractive appearance.

Country Gentleman sweet corn is an irregular-rowed variety which proves that in some cases irregularity of rows is an inherited character. Irregular-rowed ears have often appeared in our cultures and proved to be non-inherited, in all but one case. A self-fertilized, irregular-rowed ear of a white flint strain produced thirty-three normal and fifteen irregular ears, while a normal self-fertilized ear produced one hundred and twenty-five normal and five irregular ears. One of these five irregular ears was self-fertilized, and the following year produced fifty-six regular ears and one irregular ear. A regular-rowed ear from the irregular-rowed strain produced seventy-nine regular and twenty-nine irregular-rowed.

The manner of the inheritance of this character cannot be definitely stated, yet the character is an inherited one. Any commercial row culture which contains much over five per cent. of irregular ears should be discarded to eliminate the undesirable character.

Summary of Results

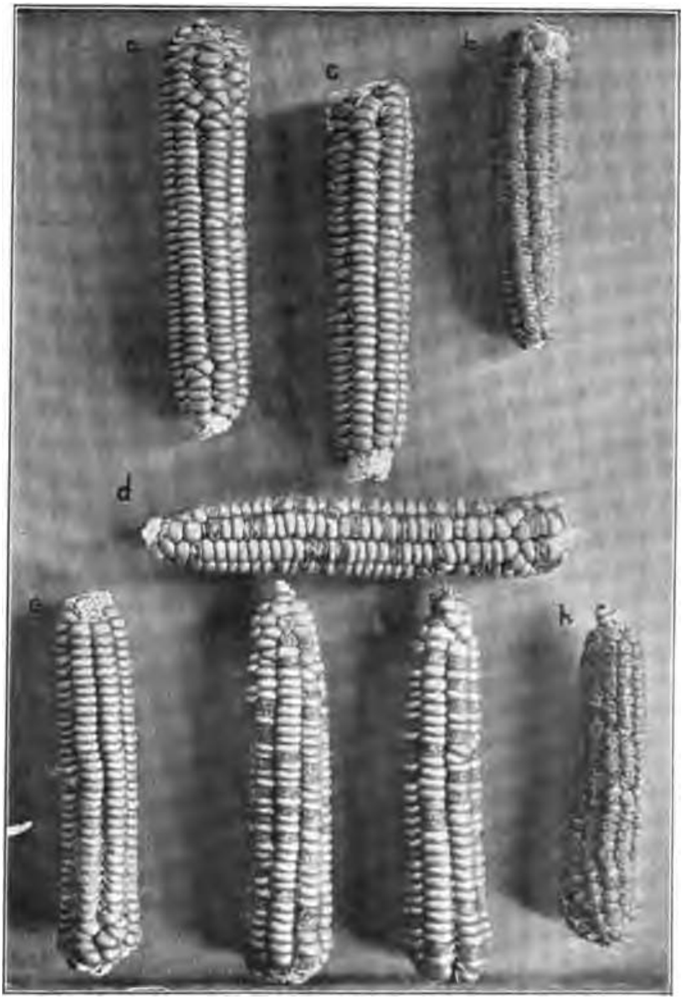
Corn is a normally cross-fertilized plant, and for this reason a commercial variety is composed of many types. Any variety can be made more uniform by selection. The benefit of selection seems chiefly due to the elimination of the poorer types, leaving only the better sorts.

The improvement of corn by selection has been thoroughly discussed in previous bulletins and will be only briefly mentioned here. Bulletin 152 gives directions for producing a breeding plot in which each row is grown from a single ear. Each row is then harvested separately, the yield and appearance determining the value of the selection. Such commercial row cultures have been and will continue to be of great value. We should not, however, expect too much from such a method. The increased yields which have been received by such methods are believed to be due to the elimination of undesirable types of which the preceding abnormalities are examples. Row cultures are of inestimable value in such work.

In Bulletin 168 we discussed corn breeding methods and came to the conclusion that the growing of first generation hybrids would prove beneficial and materially increase corn yields. Some varieties will doubtless prove more beneficial for this work than others; however, all investigators agree that crosses between highly selected sorts will prove most valuable.

It is hoped that the corn growers of Connecticut will not discard this article because of its technical nature and the difficulty of understanding this class of results. The subject of the inheritance of plant characters is a complex one, yet the seedsman or farmer who applies the known principles of inheritance and breeding to his own work will certainly receive a benefit thereby.

PLATE XXV.



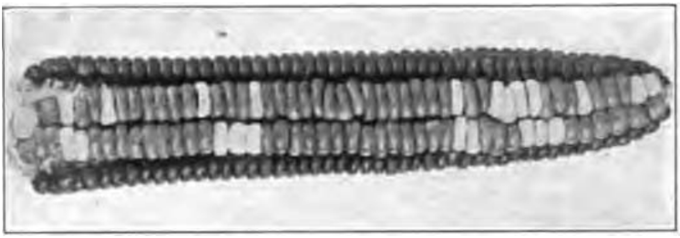
a, Rhode Island white flint (starchy parent); *b*, Early Crosby (sweet parent); *c*, result of immediate cross of *a* and *b*, showing dominance of the flint type; *d*, result of planting seeds of *c*. The result of planting starchy seeds of *d* is shown by *e*, *f*, *g*. The result of planting sweet seeds is shown by *h*.

a, At left, upper ear, Illinois low protein dent. Middle ear, immediate result of cross between low protein dent and Stowell's Evergreen sweet, and lower ear, Stowell's Evergreen sweet. At right, result of planting seeds of the hybrid ear.

b, At left, Rhode Island white flint; at right, Longfellow yellow flint; in center, immediate result of cross between yellow and white flint, showing dominance of the yellow color. Lower ear is a self-fertilized ear grown from hybrid seeds of central ear.

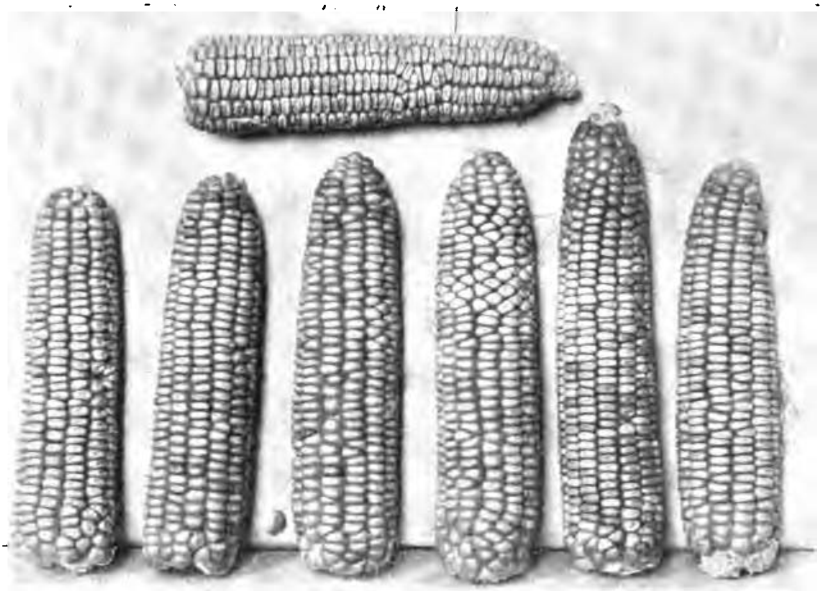
a, At left, the color which develops in sunlight; in center, variegated color which does not breed true; at right, common red pericarp.

b, The second generation of a cross between the pericarp color which develops in the light and a white pericarp variety, giving, on the average, 3 colored ears to 1 white. The non-colored ear, if self-fertilized, will breed true. One out of every three, on the average, of self-fertilized colored ears will breed true.



a, The first generation of a cross between a red and white pericarp, showing dominance of the red pericarp. The pericarp has been removed from two rows of seeds, showing a mixture of yellow and white endosperm colors.

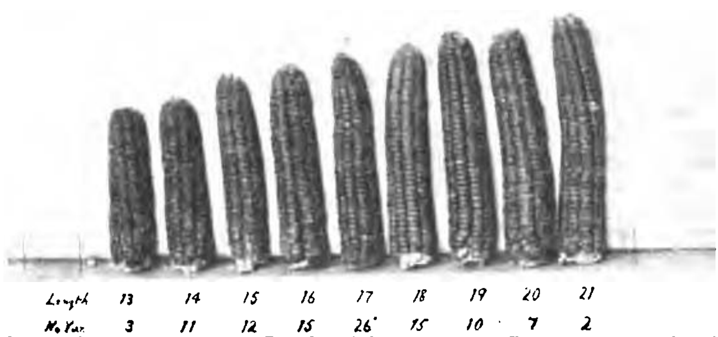
b, At left, Longfellow flint; at right, Illinois high-protein dent; in center, result of growing a cross between them.



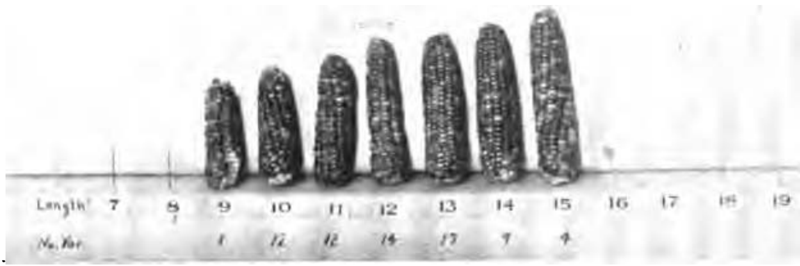
a, The ear above is a self-fertilized dent ear, received from growing the hybrid shown in Plate IV, *b* (frequency about 1 in 10). Random sample of its progeny below.

b, The ear above is a self-fertilized flint ear, received from growing the hybrid shown in Plate IV, *b* (frequency about 1 in 16). Random sample of its progeny below.

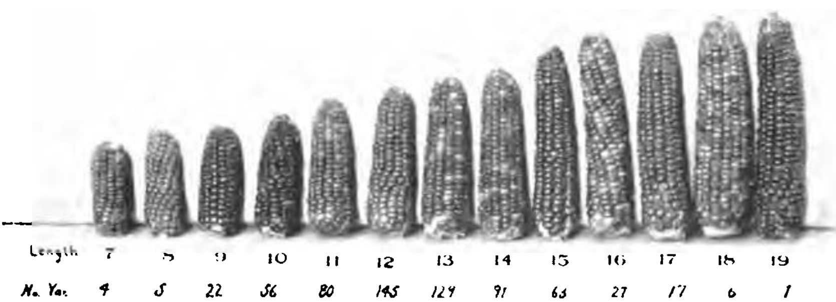
a, Tom Thumb pop, showing variation in length of ear. Length is given in even centimeters and the number of individuals in each class is given below (one-sixth of natural size).



b, Black Mexican sweet, showing variation in length of ear (one-sixth of natural size).



a, Variation in length of ear of the first generation of a cross between Tom Thumb and Black Mexican (one-sixth of natural size).



b, Variation in length of ear of second generation of cross between Tom Thumb and Black Mexican (one-sixth natural size).

A dwarf, appearing in a commercial culture of Stowell's Evergreen sweet, compared with a normal ear of the latter.

INDEX.