weight of a "load" would determine, with the analysis, the economy of the purchase.

ANALYSES.

	25183	25184	25185	25186	25204	25205	25636
Lime	56.20	62.20	62.94	35.42	44.84	66.93	36.52
Magnesia	3.45	0.99	1.01	0.72	....	....	24.46
Insoluble in acid	....	....	....	....	....	....	3.17

PART VI.

FIFTEENTH REPORT ON FOOD PRODUCTS AND THIRD REPORT ON DRUG PRODUCTS, 1910.

(Examined during the year ending July 31, 1910.)

BY JOHN PHILLIPS STREET.*

This station is required by law to make examinations of food products and drugs, 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. Prosecution for infractions of the law rests with this official, the station's duty being to determine the facts and supply expert testimony in case of prosecution.

The dairy commissioner and his deputy have sent a large number of samples of vinegar, molasses and butter, the sale of which is regulated by special statutes, as well as a limited number, about one hundred, of samples of other foods and drugs. These are but briefly noticed here, being discussed in the commissioner's report, where account is also given of the results of prosecution under the law.

Lastly, a number of samples of food and drug products have been examined for individuals, which will likewise receive brief mention.

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

I. FOOD PRODUCTS.

CANNED PEAS.

The canning of peas is a very important branch of the canning industry, tomatoes and corn only exceeding it in total output, and peas ranking second in value. The production of canned peas in the United States for 1907 was estimated at 6,505,961 cases,* with a value of $14,650,000. Wisconsin and New York lead in output, with Indiana, Michigan and Maryland also producing large quantities.

The garden pea, *Pisum sativum,* belongs to the legume family, the vegetables of which are exceedingly rich in protein, and therefore of great importance in the human dietary. Dried peas contain about 24 per cent. of protein. The fresh peas, with about 75 per cent. of water, naturally contain much less protein, about 5.5 per cent., while the protein of canned peas falls to about 3.5 per cent., portions of the nitrogenous matter being leached out in the washing and blanching, and dissolved in the brine in which the peas are packed.

The method of growing peas for canning purposes, and the various processes employed at the factory in their preparation for human food are described fully by Bitting.†

The Grading of Peas.

Peas are graded at the factory both as to quality and size. The quality chiefly depends on their maturity or hardness. They are graded for quality by passing through tanks containing salt solutions of different densities, the young peas floating even in a rather dilute salt solution, and the very mature peas sinking in one much more concentrated. In practice three grades have been established as to quality:

1st. Float in salt solution, sp. gr. 1.040.

2d. Sink in salt solution, sp. gr. 1.040, float in solution, sp. gr. 1.070.

3d. Sink in salt solution, sp. gr. 1.070.

The lightest peas are of even quality, tender and succulent. The next class are of good quality but less uniform and of darker

* The Canner and Dried Fruit Packer, December 26, 1907.

† The Canning of Peas, U. S. Dept. Agr., Bur. of Chem., 1909, Bull. 125.

color, and the heaviest peas are uneven in quality, hard, and often of bad color. The mature peas would be the preferable purchase if their nutritive qualities were the only desideratum, for they contain more solid matter, and more protein and starch. But delicacy and flavor are important qualities, and these are found in the young and tender peas of the first grade.

Peas are also graded as to size by passing them over revolving cylinders containing perforations of different diameters. The sizes adopted by the trade are as follows:

No. 1. Petits Pois, less than $^{9}/_{32}$ in. diameter.
No. 2. Extra Sifted, or Extra Fins, $^{9}/_{32}$ to $^{10}/_{32}$ in. diameter.
No. 3. Sifted or Fins, $^{10}/_{32}$ to $^{11}/_{32}$ in. diameter.
No. 4. Early June, $^{11}/_{32}$ to $^{12}/_{32}$ in. diameter.
No. 5. Marrowfats, $^{12}/_{32}$ to $^{13}/_{32}$ in. diameter.
No. 6. Telephone, over $^{13}/_{32}$ in. diameter.

In some factories sizes 5 and 6 are combined under the general name "Marrowfats."

All of these size names have a definite meaning in the trade, but often convey a false impression to the purchaser. "Early June," for instance, is a size name, and does not refer to the season when the peas are picked. Our examinations also show that in all the grades the label does not always correctly indicate the size of the peas.

Details of Examination.

One hundred and eleven samples were analyzed, representing as many brands and the product of seventy-three manufacturers or jobbers. All the samples were subjected to a thorough physical and chemical examination.

Table I gives the brand names and manufacturers of the samples examined.

TABLE I.—BRANDS OF CANNED PEAS.

* Labeled "Colored with Sulphate of Copper." † Added Sugar indicated on label.

23834. Packed for Acker, Merrall & Condit Co., New York. Amcehat Brand Early June.
23756. Algoma Packing Co., Algoma, Wis. Sifted Wisconsin.
23833. Packed for Allen-Ditchett Co., New York. Our Initial Brand Sweet Wrinkled.
23958. Dist. by S. K. Ames, Boston. Ames' Quality Brand Selected.
*23927. A. and P. Brand, Wespelaer, Belgium. Medium.
*23931. Barton Brand, Imported. Fine.

23800. Batavia Preserving Co., Batavia, N. Y. Aetna Brand June.
†23820. " " " " " Royalton Brand.
23941. Dist. by A. T. Beckmann & Co., New York. Gold Rock Brand.
23815. Bonnie Meade Canning Co., Randolph, Wis. Bonnie Brand Petits Pois.
†23785. Burt Olney Canning Co., Oneida, N. Y. American Club Brand Sifted Sweet Wrinkled.
23947. Burt Olney Canning Co., Oneida, N. Y. Napoleon Brand French Petits Pois.
†23946. Burt Olney Canning Co., Oneida, N. Y. Napoleon Telephone Extra Tender Sugar.
†23765. Burt Olney Canning Co., Oneida, N. Y. Oneida Chief Brand Telephone.
23751. Burt Olney Canning Co., Oneida, N. Y. Rose of Sharon Brand Sifted Sweet.
†23786. Burt Olney Canning Co., Oneida, N. Y. St. Lawrence Brand Tender Sweet.
23780. Byron Brand Choice Telephone.
23945. H. P. Cannon, Bridgeville, Ind. Diamond State Brand Early June.
23760. Cheboygan Pea Canning Co., Cheboygan, Mich. Mackinac Brand Sifted.
†23811. Cherry Creek Canning Co., Cherry Creek, N. Y. Emerald Brand Sweet Sifted.
23943. Cherry Creek Canning Co., Cherry Creek, N. Y. Prize Winner Sifted Sweet.
23954. Cohocton Canning Co., Cohocton, N. Y. Three "C" Brand Early June.
†23939. Columbus Canning Co., Columbus, Wis. College Brand Wisconsin Sugar.
*23749. LaCorbeille Wespelaer Société Anonyme Petits Pois Fins.
*23807. Corbeille Brand Wespelaer Extra Fine.
*23949. G. Cremer, Malines, Belgium. Petits Pois Très Fins.
23752. Curtice Bros. Co., Rochester, N. Y. Blue Label Extra Fine.
23956. Packed for F. H. Davis & Co., New London. Davisco Brand Extra Sifted.
23930. Packed for Lewis DeGroff & Son, New York. Health Brand Sugar.
23821. Draper & Hirch, Milford, Del. Milford Brand Early June.
23803. Packed for R. N. Fitzgerald Co., Hartford. Bon Ton Brand Early June.
23950. Packed for R. N. Fitzgerald Co., Hartford. Mascot Brand Sweet Early June.
23796. Fort Stanwix Canning Co., Rome, N. Y. Flag Brand Early June.
†23802. Fort Stanwix Canning Co., Rome, N. Y. Fulton's Pride Brand Sifted Little Sweet Champion.
†23805. Fort Stanwix Canning Co., Rome, N. Y. Morning Dawn Brand Telephone Extra Tender Sugar.

†23955. Fox Lake Canning Co., Fox Lake, Wis. Square Deal Brand Wisconsin Early June.
*23791. François Brand Extra Fine French Peas, Bordeaux, France.
23774. Franklinville Canning Co., Franklinville, N. Y. Blue Bells Brand Sifted June.
23772. Fredonia Preserving Co., Fredonia, N. Y. Bridal Bell Early June Sifted.
23787. Fredonia Preserving Co., Fredonia, N. Y. Butter-Nut Brand Early June Sifted (packed for The F. C. Bushnell Co.).
23778. Fredonia Preserving Co., Fredonia, N. Y. Fedora Early June Sifted.
23735. Fredonia Preserving Co., Fredonia, N. Y. Magnes Brand Marrow Sifted.
23822. Fredonia Preserving Co., Fredonia, N. Y. Silver Edge Marrowfat Sifted.
23754. Genesee Valley Pres. Co., East Rock, N. Y. Valley Farm Standard.
23753. Geneseo Canning Co., Geneseo, N. Y. Blue Star Brand Marrow.
23830. Geneva Preserving Co., Geneva, N. Y. Lotus Brand Sweet Wrinkled.
23733. Put up for The Great Atl. and Pac. Tea Co., Jersey City, N. J. Iona Brand.
23953. Packed for The Great Atl. and Pac. Tea Co., Jersey City, N. J. Reliable Brand.
23748. The Great Atl. and Pac. Tea Co., Jersey City, N. J. Sultana Brand.
†23773. H. C. Hemingway & Co., Clyde, N. Y. Alpine Brand Early June Extra Sifted.
†23790. H. C. Hemingway & Co., Auburn, N. Y. Auburn Brand Early June Sifted.
†23776. H. C. Hemingway & Co., Syracuse, N. Y. Exposition Brand Sweet Wrinkled.
23932. Robert Hill, New York. Little Oliver Brand Extra Sifted Early June.
23928. Grafton Johnson, Greenwood, Ind. Fame Brand Telephone.
23759. Grafton Johnson, Tifton, Ind. Idyl Brand.
23736. Grafton Johnson, Whiteland, Ind. Our Favorite Brand Early June.
23944. Grafton Johnson, Whiteland, Ind. Our Favorite Brand Early June.
23824. Packed for The E. S. Kibbe Co., Hartford. Helmet Brand Sifted Sugar.
23747. Packed for The E. S. Kibbe Co., Hartford. Blue Petre Brand Sugar.
23832. J. Langrall & Bro., Baltimore, Md. Maryland Chief Early June.
23940. Dist. by Francis H. Leggett & Co., New York. Carleton Brand Sugar.
23793. Lemoine Petits Pois Fins, Bordeaux, France.

23737. Lenox Canning Co., Lenox, N. Y. Homes Sweetest Marrowfat Sifted.
*23816. Le Soleil Petits Pois Moyens No. 1, Malines, Belgium.
*23825. Le Soleil Petits Pois Moyens No. 2, Malines, Belgium.
23797. Lord-Mott Co., Baltimore, Md. Hunter Brand Early June.
23810. Wm. McKinley Canning Co., Lenox, N. Y. Gladstone Brand Marrowfat Sifted.
23809. Wm. McKinley Canning Co., Lenox, N. Y. Golden Brand French Petits Pois.
23784. Miller Bros. & Co., Baltimore, Md. Hawkins Point Brand Early June.
23738. Packed for Miner, Read & Garrette, New Haven. Sphinx Brand Sweet Wrinkled.
23799. Dist. by Chas. E. Moody & Co., Boston. Matchless Brand Champion Sugar.
*23812. Morel Brand, Belgium. Fine.
23766. Oconto Canning Co., Oconto, Wis. Mignonette Brand Extra Telephone.
23777. Oswego Preserving Co., Oswego, N. Y. Cameo Brand Sweet.
23788. Oswego Preserving Co., Oswego, N. Y. Golden Key Brand Sifted Sweet.
23764. Oswego Preserving Co., Oswego, N. Y. Huntress Brand Sweet Wrinkled.
23792. Oswego Preserving Co., Oswego, N. Y. Magnet Brand Early June.
23826. Oswego Preserving Co., Oswego, N. Y. Oswego Brand Petits Pois.
†23761. Oswego Preserving Co., Oswego, N. Y. Silver Key Brand Early June.
23798. Pennellville Canning Co., Camden, N. Y. National Park Brand Sugar Admiral.
23937. Phillips Packing Co., Cambridge, Md. Castle Haven Brand Early June.
23775. Potter & Wrightington, Boston. Azalea Brand Sugar.
23817. Potter & Wrightington, Boston. Brier Bush Brand.
23779. Potter & Wrightington, Boston (Northern Canning Co.). Golden Helmet.
23929. Dist. by Jas. G. Powers & Co., New York. Century Brand Sweet Wrinkle.
*23755. L. A. Price, Bordeaux, France. Fine.
23959. Randolph Canning Co., Randolph, Wis. Randolph Brand Sweet Sifted.
23808. Rodier Fils et Cie, Paris, France. Petits Pois Fins.
23819. Dist. by Seeman Bros., New York. Savoy Brand.
23831. Dist. by Seeman Bros., New York. Warfield Brand Sweet Wrinkled.
23813. Dist. by Seeman Bros., New York. Waverly Brand Delicious Sweet.

23814. Dist. by Seeman Bros., New York. White Rose Brand Petite Peas.
23804. Dist. by John S. Sills & Sons, New York. Epicure Brand Sugar.
23795. Silver Creek Pres. Co., Silver Creek, N. Y. Silver Dollar Brand Sifted Sweet Wrinkled.
23806. Dist. by Sprague, Warner & Co., Chicago. Richelieu Brand XXX Sifted Sweet Wrinkled.
23739. The Springville Canning Co., Springville, N. Y. Robin Brand Marrow.
23957. Sussex Packing Co., Seaford, Del. Fidelity Brand Early June.
23740. A. J. Tanner Co., Oakfield, N. Y. Golden Tip Brand Sweet Wrinkled.
23789. Tipton Canning Co., Tipton, Ind. Sweetstakes Early June.
23942. Tipton Canning Co., Tipton, Ind. Tip Top Brand June.
*23750. P. Tirot et Cie., Nantes, France. Petits Pois Extra Fins Des Marquises.
23745. Varick Brand, Standard Early June.
†23801. Waterloo Preserving Co., Waterloo, N. Y. Trophy Brand Sweet Wrinkle.
*23936. Petits Pois sur Extra Fine Fleur, A. and P., Wespelaer, Belgium.
†23744. Dist by R. C. Williams & Co., New York. Red Line Early June.
†23823. Dist. by R. C. Williams & Co., New York. Robin Hood Brand Crinkled Sweet.
†23938. Dist. by R. C. Williams & Co., New York. Royal Scarlet Small Tender.
23746. Wilson Canning Co., Mexico, N. Y. Lily Brand Fancy Sweet Wrinkled.
23828. Winters & Prophet, Mt. Morris, N. Y. Choicest Pickings Sweet Wrinkled.
23743. Winters & Prophet Canning Co., Mt. Morris, N. Y. Empire Brand Sweet Wrinkled.
23734. Winters & Prophet Canning Co., Mt. Morris, N. Y. Old Colony Brand Sweet Wrinkled.

Weight of Peas.

On opening the cans the contents were poured on a sieve and the peas allowed to drain for one minute. The following data as to the respective amounts of peas and liquor was thus obtained:

	Max.	*Min.*	*Ave.*
Weight of Can and Contents, gms.	723	380	672
" " Peas and Liquor, gms.	623	315	570
" " Drained Peas, gms.	455	211	364
" " Liquor, gms.	305	101	206
Per cent. of Liquor, by weight	49.7	27.0	36.1

TABLE II.—PHYSICAL EXAMINATION OF CANNED PEAS.

Station Number.	Sold as	Weight of Can and Contents.	Weight of Peas and Liquor.	Weight of Drained Peas.	Weight of Liquor.	Per cent. Liquor.	Cost per Can.	Cost of Drained Peas per Pound.	Discoloration of Interior of Can.	Appearance of Liquor.
		gms.	gms.	gms.	gms.		cts.	cts.		
	Petits Pois.									
23936	A. and P.	517	424	277	147	34.7	18	29.5	none	sl. cl.
23815	Bonnie Meade	701	600	370	230	38.3	18	22.1	sl.	cl.
23947	Burt Olney	391	322	211	111	34.5	18	38.7	cons.	sl. cl.
23949	Cremer	496	406	274	132	32.5	20	33.1	sl.	cl.
23816	Le Soleil, No. 1	530	437	287	150	34.3	15	23.7	none	cl., greenish
23825	" No. 2	517	419	293	126	30.1	15	23.2	"	" "
23809	McKinley	380	315	214	101	32.1	15	31.8	sl.	sl. cl.
23826	Oswego	701	591	362	229	38.7	25	31.3	cons.	cl.
23814	Seeman	704	603	380	230	37.0	25	29.8	"	"
	Petits Pois Extra Fins.									
23750	Tirot	513	434	311	123	28.3	25	36.5	very sl.	sl. cl.
	Petits Pois Fins.									
23749	La Corbeille	511	415	268	147	35.4	20	33.9	sl.	"
23793	Lemoine	519	428	274	154	36.0	15	24.8	none	cl., greenish
23808	Rodier	520	437	281	156	35.7	18	29.1	sl.	sl. cl., greenish
	Extra Fins or Extra Sifted.									
23807	Corbeille	505	410	261	149	36.3	20	34.8	none	" "
23752	Curtice	692	584	364	220	37.7	25	31.2	sl.	cl.
23956	Davis	700	591	398	193	32.7	13	14.8	cons.	rather thick
23791	François	542	450	313	137	30.4	20	29.0	none	sl. cl.
	Early June Extra Sifted.									
23773	Hemingway	676	575	366	209	36.3	15	18.6	much	cl.
23932	Hill	694	596	395	201	33.7	15	17.2	very sl.	"
	Sifted or Fins.									
23756	Algoma	705	598	411	187	31.3	9	9.9	sl.	thick
23931	Barton	491	393	243	150	38.2	12	22.3	cons.	sl. cl.
23785	Burt Olney (Amer. Club)	710	60[illegible]	423	182	30.1	15	16.1	sl.	cl.
23751	" (Rose of Sharon)	698	595	386	209	35.1	15	17.6	cons.	"
23760	Cheboygan	697	594	366	228	38.6	10	12.4	sl.	thick
23811	Cherry Creek (Emerald)	710	607	413	194	32.0	13	14.3	cons.	"
23943	" (Prize Winner)	704	599	384	215	35.9	12	14.2	"	cl.
23802	Fort Stanwix	697	590	376	214	36.3	20	24.1	"	"
23774	Franklinville	714	603	417	186	30.9	10	10.9	"	thick
23824	Kibbe	702	596	354	242	40.6	15	19.2	sl.	cl.
23812	Morel	533	434	281	153	35.3	18	29.1	none	"
23788	Oswego	699	591	370	221	37.4	12	14.7	very sl.	"
23755	Price	537	447	293	154	34.5	30	46.4	"	"
23959	Randolph	700	595	353	242	40.7	10	12.9	sl.	"
23795	Silver Creek	706	602	385	217	36.0	10	11.8	"	"
23806	Sprague, Warner & Co.	692	588	377	211	35.9	15	18.0	cons.	"
	Early June Sifted.									
23772	Fredonia (Bridal Bell)	716	609	404	205	33.7	15	16.8	"	"
23787	" (Butter-Nut)	721	609	401	208	34.2	15	17.0	sl.	"
23778	" (Fedora)	717	612	383	229	37.4	10	11.8	cons.	"
23790	Hemingway	681	575	347	228	40.0	13	17.0	"	"

Station Number.	Top of Can above level of Contents.	Depth of Liquor above Peas.	Color of Peas.	Consistency of Peas	Cotyledons Prominent.	Weight of 100 Peas.	Graded as to Size. Petits Pois (No. 1).	Extra Fins or Extra Sifted (No. 2).	Fins or Sifted (No. 3).	Early June (No. 4).	Marrowfat (No. 5).	Telephone (No. 6).	Graded as to specific gravity. Float in NaCl solution, sp. gr. 1.04.	Sink in NaCl solution, sp. gr. 1.04, but float in 1.07 solution.	Sink in NaCl solution, sp. gr. 1.07.
	in.	in.				gms	%	%	%	%	%	%		%	%
23936	0.1	0.2	yell. gr.	good	no	16	100	--	--	--	--	--	5	86	9
23815	0.4	0.4	"	soft	"	23	93	7	--	--	--	--	0	54	46
23947	0.4	0.1	"	good	"	23	60	40	--	--	--	--	7	82	11
23949	0.4	—0.1	br. gr.	sl. hard	"	24	24	76	--	--	--	--	2	25	73
23816	0.2	0.1	"	good	"	31	2	72	26	--	--	--	8	21	71
23825	0.5	0.0	"	sl. hard	"	37	---	20	80	--	--	--	1	8	91
23809	0.4	0.0	yell. gr.	good	"	22	79	21	--	--	--	--	8	37	55
23826	0.3	0.5	"	"	"	20	96	4	--	--	--	--	3	19	78
23814	0.4	0.3	"	"	"	21	89	11	--	--	--	--	2	48	50
23750	0.1	—0.2	gr. & yell. gr.	hard & soft	"	16	100	--	--	--	--	--	11	61	28
23749	0.4	0.1	light gr.	good	"	25	61	39	--	--	--	--	1	10	89
23793	0.1	0.2	br. gr.	rather hard	"	26	42	57	1	--	--	--	4	39	57
23808	0.2	0.3	light gr.	good	"	25	48	52	--	--	--	--	2	26	72
23807	0.1	0.1	light gr.	good	"	18	100	--	--	--	--	--	19	74	7
23752	0.5	0.2	yell. gr.	hard & soft	yes	21	98	2	--	--	--	--	1	25	74
23956	0.4	0.3	"	soft	in some	40	---	12	55	33	--	--	3	11	86
23791	0.1	0.0	light gr.	hard & soft	no	20	100	--	--	--	--	--	5	76	19
23773	0.5	0.3	yell. gr.	rather hard	"	32	---	39	61	--	--	--	1	1	98
23932	0.2	0.2	"	very soft	"	17	100	--	--	--	--	--	17	82	1
23756	0.5	0.1	yell. gr.	soft, mushy	"	39	---	31	53	16	--	--	2	1	97
23931	0.2	0.2	br. gr.	sl. hard	sl.	25	31	66	3	--	--	--	0	16	84
23785	0.4	—0.2	yell. gr.	good	no	34	---	47	53	--	--	--	0	0	100
23751	0.4	—0.2	"	hard & soft	yes	42	11	86	3	--	--	--	1	16	83
23760	0.4	0.3	"	hard	no	42	---	18	48	30	4	--	2	10	88
23811	0.3	0.1	"	sl. hard	yes	36	2	52	43	3	--	--	0	2	98
23943	0.4	0.4	"	sl. soft	in some	38	2	16	55	27	--	--	2	29	69
23802	0.4	0.2	"	rather soft	no	25	47	53	--	--	--	--	0	29	71
23774	0.3	0.1	"	rather hard	yes	37	---	31	52	17	--	--	0	2	98
23824	0.4	0.6	"	good	"	50	---	--	11	75	14	--	0	4	96
23812	0.2	0.3	light gr.	"	no	30	5	94	1	--	--	--	3	23	74
23788	0.4	0.4	yell. gr.	"	"	41	---	6	51	43	--	--	0	0	100
23755	0.1	0.1	light gr.	hard	"	22	100	--	--	--	--	--	3	26	71
23959	0.5	0.5	yell. gr.	soft	"	25	34	51	15	--	--	--	8	59	33
23795	0.4	0.3	"	hard	yes	51	---	2	15	72	11	--	0	19	81
23806	0.4	0.3	"	very soft	no	25	62	38	--	--	--	--	6	44	50
23772	0.4	0.3	light yell. gr.	rather hard	"	31	2	69	29	--	--	--	0	1	99
23787	0.4	0.3	" "	good	"	28	11	82	7	--	--	--	1	1	98
23778	0.4	0.5	yell. gr.	"	"	38	---	15	68	17	--	--	1	1	98
23790	0.6	0.4	light yell. gr.	rather hard	in some	41	---	2	73	25	--	--	0	2	98

TABLE II.—PHYSICAL EXAMINATION OF CANNED PEAS—*Continued.*

Station Number.	Sold as	Weight of: Can and Contents.	Weight of: Peas and Liquor.	Weight of: Drained Peas.	Weight of: Liquor.	Weight of: Per cent. Liquor.	Cost per Can.	Cost of Drained Peas per Pound.	Discoloration of Interior of Can.	Appearance of Liquor.
		gms.	gms.	gms.	gms.		cts.	cts.		
	Early June.									
23834	Acker, Merrall & Condit	711	609	390	219	36.0	12	14.0	very sl.	thick
23945	Cannon	699	595	374	221	37.1	10	12.1	cons.	"
23954	Cohocton	705	601	368	233	38.8	9	11.1	sl.	cl.
23821	Draper & Hirsch	694	593	370	223	37.6	10	12.3	"	thick
23803	Fitzgerald (Bon Ton)	700	593	379	214	36.1	12	14.4	cons.	cl.
23950	" (Mascot)	698	587	367	220	37.5	15	18.5	sl.	thick
23796	Fort Stanwix	701	606	358	248	40.9	12	15.2	cons.	cl.
23955	Fox Lake	712	606	380	226	37.3	10	11.9	much	thick
23736	Grafton Johnson	680	585	401	184	31.5	10	11.3	sl.	very thick
23944	"	695	587	412	175	29.8	10	11.0	cons.	thick
23832	Langrall	684	579	361	218	37.7	12	15.1	sl.	very thick
23797	Lord-Mott	710	614	309	305	49.7	10	14.7	cons.	cl.
23784	Miller	690	588	330	258	43.9	10	13.7	"	thick
23792	Oswego (Magnet)	695	586	369	217	37.0	10	12.3	"	"
23761	" (Silver Key)	696	593	378	215	36.3	9	10.8	sl.	"
23937	Phillips	689	585	383	202	34.5	10	11.8	cons.	"
23957	Sussex	713	605	385	220	36.4	10	11.8	"	"
23789	Tifton	712	607	392	215	35.4	10	11.6	"	"
23745	Varick	698	608	384	224	36.8	10	11.8	sl.	"
23744	Williams	697	598	366	232	38.8	13	16.1	none	cl.
	Marrow Sifted.									
23735	Fredonia (Magnes)	723	623	455	168	27.0	13	13.0	sl.	very thick
23822	" (Silver Edge)	693	589	380	209	35.5	10	11.9	cons.	cl.
23737	Lenox	675	589	371	218	37.0	12	14.7	sl.	thick
23810	McKinley	683	582	373	209	35.9	12	14.6	cons.	cl.
	Marrow.									
23753	Geneseo	715	612	421	191	31.2	12	12.9	sl.	very thick
23739	Springville	711	614	400	214	34.9	10	11.3	"	thick
	Telephone.									
23946	Burt Olney (Napoleon)	718	612	391	221	36.1	15	17.4	cons.	"
23765	" (Oneida Chief)	710	607	412	195	32.1	15	16.5	very sl.	cl.
23780	Byron	697	585	364	221	37.8	10	12.5	sl.	"
23805	Fort Stanwix	701	593	354	239	40.3	15	19.2	cons.	"
23928	Grafton Johnson	693	598	407	191	37.8	10	11.1	"	thick
23766	Oconto	706	604	372	232	38.4	8	9.8	"	cl.
	Sweet Wrinkled.									
23833	Allen-Ditchett	718	611	389	222	36.3	15	17.5	sl.	thick
23830	Geneva	691	590	379	211	35.6	13	15.6	"	cl.
23776	Hemingway	679	576	345	231	40.0	10	13.1	"	"
23738	Miner, Read & Garrette	678	581	363	218	37.5	13	16.2	none	"
23764	Oswego	706	603	365	238	39.5	15	18.6	very sl.	"
23929	Powers	697	592	349	243	41.0	13	17.0	cons.	"
23831	Seeman	697	596	399	197	33.1	15	17.0	"	thick

Station Number.	Top of Can above level of Contents.	Depth of Liquor above Peas.	Color of Peas.	Consistency of Peas.	Cotyledons Prominent.	Weight of 100 Peas.	Graded as to Size: Petits Pois (No. 1).	Graded as to Size: Extra Fins or Extra Sifted (No. 2).	Graded as to Size: Fins or Sifted (No. 3).	Graded as to Size: Early June (No. 4).	Graded as to Size: Marrowfat (No. 5).	Graded as to Size: Telephone (No. 6).	Graded as to specific gravity: Float in NaCl solution, sp. gr. 1.04.	Graded as to specific gravity: Sink in NaCl solution, sp. gr. 1.04, but float in 1.07 solution.	Graded as to specific gravity: Sink in NaCl solution, sp. gr. 1.07.
	in.	in.				gms.	%		%			%		%	%
23834	0.3	0.2	yell. gr.	good	yes	41	1	7	51	41	--	--	0	2	98
23945	0.4	0.5	"	very hard	"	46	---	--	17	74	9	--	0	0	100
23954	0.5	0.6	"	good	"	41	---	1	56	43	--	--	0	4	96
23821	0.5	0.5	"	sl. hard	"	42	---	14	44	41	1	--	0	0	100
23803	0.4	0.3	"	soft	"	52	---	--	15	64	21	--	3	19	78
23950	0.4	0.4	"	good	in some	39	---	4	43	53	--	--	1	68	31
23796	0.3	0.6	"	some soft	no	34	---	48	50	2	--	--	0	0	100
23955	0.5	0.5	"	hard	yes	48	---	--	12	88	--	--	0	0	100
23736	0.5	0.1	"	good	no	36	---	25	54	21	--	--	0	1	99
23944	0.5	0.1	"	sl. hard	yes	36	---	25	58	17	--	--	0	1	99
23832	0.5	0.8	"	rather hard	"	40	---	14	64	22	--	--	0	0	100
23797	0.3	1.3	yel. & yel. gr.	good	in some	43	---	8	54	38	--	--	0	0	100
23784	0.5	0.9	many yell., yell. gr.	old & hard	yes	45	---	2	35	63	--	--	0	0	100
23792	0.4	0.3	yell. & yell. gr.	" "	"	31	22	59	17	2	--	--	1	12	87
23761	0.5	0.2	yell. gr.	hard	"	40	---	12	50	38	--	--	0	1	99
23937	0.4	0.5	"	sl. soft	"	35	1	6	59	34	--	--	0	1	99
23957	0.4	0.4	"	very hard	"	46	---	5	29	53	13	--	0	0	100
23789	0.4	0.4	"	rather hard	"	46	---	--	37	58	5	--	0	3	97
23745	0.4	0.3	"	good	no	41	---	19	53	28	--	--	0	0	100
23744	0.5	0.3	"	"	"	41	---	16	54	30	--	--	0	1	99
23735	0.6	−0.2	yell. gr.	quite hard	yes	47	---	--	10	71	15	4	0	0	100
23822	0.4	0.1	"	good	"	49	---	2	17	64	17	--	0	12	88
23737	0.4	0.4	"	rather hard	"	45	---	--	25	72	3	--	0	7	93
23810	0.5	0.2	"	" "	"	51	1	1	17	48	32	1	2	14	84
23753	0.4	−0.2	yell. gr.	hard	"	44	---	6	65	29	--	--	0	1	99
23739	0.5	0.2	"	rather hard	"	41	---	1	38	51	10	--	0	0	100
23946	0.4	0.3	yell. gr.	good	in some	57	3	7	18	32	30	10	0	7	93
23765	0.4	0.0	"	many br'k'n	yes	49	1	8	29	37	17	8	2	3	95
23780	0.5	0.5	"	fair	"	63	---	--	6	37	46	11	0	4	96
23805	0.4	0.5	"	soft & hard	"	63	3	1	7	42	34	13	0	21	79
23928	0.4	0.3	"	hard	"	45	---	13	19	67	1	--	0	0	100
23766	0.3	0.3	"	"	"	61	---	--	--	43	39	18	0	0	100
23833	0.3	0.3	yell. gr.	good	"	51	---	2	8	77	13	--	0	5	95
23830	0.4	0.4	"	"	"	55	---	--	--	47	53	--	0	2	98
23776	0.5	0.3	"	hard, many broken	"	62	---	--	--	29	48	23	0	9	91
23738	0.5	0.3	"	poor, some mushy	"	65	--	--	--	7	66	27	0	11	89
23764	0.3	0.2	"	good	no	31	17	63	20	--	--	--	0	0	100
23929	0.3	0.5	"	"	yes	44	---	--	48	52	--	--	2	55	43
23831	0.2	0.3	"	very soft	no	32	13	39	41	7	--	--	2	39	59

TABLE II.—PHYSICAL EXAMINATION OF CANNED PEAS—*Concluded.*

Station Number.	Sold as	Weight of Can and Contents.	Weight of Peas and Liquor.	Weight of Drained Peas.	Weight of Liquor.	Per cent. Liquor.	Cost per Can.	Cost of Drained Peas per Pound.	Discoloration of Interior of Can.	Appearance of Liquor.
		gms.	gms.	gms.	gms.		cts.	cts.		
	Sweet Wrinkled.									
23740	Tanner	693	597	365	232	38.9	10	12.4	sl.	thick
23801	Waterloo	710	607	358	249	41.0	12	15.2	cons.	cl.
23823	Williams	712	604	379	225	37.3	15	18.0	"	"
23746	Wilson	680	585	361	224	38.3	13	16.3	sl.	"
23828	Winters & Prophet (Choicest Pickings)	714	606	406	200	33.0	15	16.8	"	thick
23743	Winters & Prophet (Empire)	692	601	394	207	34.4	13	15.0	"	cl.
23734	Winters & Prophet (Old Colony)	681	593	372	221	37.3	15	18.3	"	"
	Sweet or Sugar.									
23786	Burt Olney	714	611	398	213	34.9	10	11.4	cons.	thick
23939	Columbus	716	612	396	216	35.3	12	13.7	"	rather thick
23930	DeGraff	714	604	424	180	30.0	16	17.1	sl.	cl.
23747	Kibbe	694	588	394	194	33.0	15	17.3	cons.	"
23940	Leggett	683	579	354	225	38.8	13	16.7	sl.	thick
23799	Moody	707	605	404	201	33.2	18	20.2	cons.	cl.
23777	Oswego	710	607	393	214	35.3	10	11.5	sl.	"
23798	Pennellville	708	599	400	199	33.2	10	11.3	cons.	"
23775	Potter & Wrightington	695	598	378	220	36.8	12	14.4	"	"
23813	Seeman	713	608	391	217	35.7	16	18.6	sl.	"
23804	Sills	712	612	387	225	36.8	13	15.2	cons.	"
	Peas.									
23820	Batavia	715	604	385	219	36.3	9	10.6	"	"
23941	Beckmann	713	611	378	233	38.1	13	15.6	"	thick
23754	Genesee	715	609	366	243	40.0	10	12.4	much	"
23733	Gt. Atl. & Pac. Tea (Iona)	692	599	366	233	38.9	10	12.4	sl.	cl.
23953	" " (Reliable)	684	581	351	230	40.0	13	16.8	very sl.	thick
23748	" " (Sultana)	699	599	392	207	34.6	12	13.9	cons.	cl.
23759	Grafton Johnson	691	591	368	223	37.7	10	12.3	sl.	thick
23817	Potter & Wrightington (Brier Bush)	691	588	376	212	36.1	10	12.1	"	cl.
23779	Potter & Wrightington (Golden Helmet)	700	594	361	233	39.2	13	16.3	"	"
23819	Seeman	712	604	376	228	37.7	13	15.7	"	"
	Miscellaneous.									
23800	Batavia (June)	701	600	371	229	38.2	12	14.7	cons.	"
23942	Tipton (June)	661	557	397	160	28.7	10	11.4	"	very thick
23927	A. and P. (Medium)	515	419	270	149	35.6	13	21.8	none	sl. cl.
23958	Ames (Selected)	712	605	374	231	38.2	13	15.8	sl.	cl.
23938	Williams (Small Tender)	690	588	343	245	41.7	18	23.8	very sl.	"
	Maximum	*723*	*623*	*455*	*305*	*49.7*	*30*	*46.4*	----	------
	Minimum	*380*	*315*	*211*	*101*	*27.0*	*8*	*9.8*	----	------
	Average	*672*	*570*	*364*	*206*	*36.1*	*13.5*	*16.8*	----	------

Station Number.	Top of Can above level of Contents.	Depth of Liquor above Peas.	Color of Peas.	Consistency of Peas.	Cotyledons Prominent.	Weight of 100 Peas.	Graded as to Size: Petits Pois (No. 1).	Extra Fins or Extra Sifted (No. 2).	Fins or Sifted (No. 3).	Early June (No. 4).	Marrowfat (No. 5).	Telephone (No. 6).	Graded as to specific gravity: Float in NaCl solution, sp. gr. 1.04.	Sink in NaCl solution, sp. gr. 1.04, but float in 1.07 solution.	Sink in NaCl solution, sp. gr. 1.07.
	in.	in.				gms.	%	%	%	%	%			%	%
23740	0.5	0.3	yell. gr.	rather hard	yes	52	---	--	19	68	13	--	1	2	97
23801	0.4	0.5	"	" "	"	77	---	--	--	2	45	53	0	1	99
23823	0.3	0.4	"	fair	in some	40	---	18	54	28	--	--	0	12	88
23746	0.6	0.2	"	good	no	43	---	5	57	38	--	--	2	20	78
23828	0.4	0.2	"	"	in some	45	---	2	39	59	--	--	1	2	97
23743	0.3	0.2	"	"	no	30	---	17	50	33	--	--	0	16	84
23734	0.3	0.3	"	"	yes	39	---	8	69	23	--	--	1	1	98
23786	0.4	0.3	yell. gr.	rather hard	"	52	---	--	9	76	15	--	1	3	96
23939	0.3	0.2	"	good	"	32	---	70	30	--	--	--	3	52	45
23930	0.3	0.0	"	fair	"	47	1	8	26	46	19	--	1	20	79
23747	0.6	—0.2	"	hard & soft, s'me mushy	"	83	---	1	2	10	27	60	0	10	90
23940	0.5	0.5	"	hard	"	49	---	--	18	79	3	--	0	9	91
23799	0.3	0.1	"	rather soft	no	60	1	6	13	31	41	8	1	40	59
23777	0.3	0.2	"	good	in some	45	---	5	45	50	--	--	0	0	100
23798	0.4	0.1	"	rather hard	yes	51	---	--	14	76	10	--	1	8	91
23775	0.3	0.2	"	soft, some broken	"	39	---	24	38	37	1	--	2	47	51
23813	0.4	0.3		hard & soft	in some	54	7	11	12	31	26	13	3	13	84
23804	0.4	0.3	"	" "	yes	48	7	17	27	32	15	2	4	13	83
23820	0.5	0.4	yell. gr.	hard	"	43	---	4	50	46	--	--	0	3	97
23941	0.3	0.5	"	sl. hard	"	35	---	46	52	2	--	--	1	0	99
23754	0.4	0.2	yell. gr. & yell.	hard & old	"	45	3	13	22	47	15	--	1	7	92
23733	0.4	0.5	yell. gr.	rather soft	"	51	---	--	11	55	27	7	0	11	89
23953	0.5	0.5	"	good	no	33	---	43	56	1	--	--	2	72	26
23748	0.4	0.1	"	hard	"	33	---	79	21	--	--	--	5	5	90
23759	0.5	0.5	"	good	yes	35	2	52	45	1	--	--	0	1	99
23817	0.4	0.4	"	rather soft	"	45	---	8	43	48	1	--	2	31	67
23779	0.3	0.4	"	" "	no	37	---	25	75	--	--	--	0	44	56
23819	0.3	0.3	"	very soft	sl.	35	4	59	37	--	--	--	0	19	81
23800	0.4	0.4	yell. gr.	fair	yes	42	---	--	47	53	--	--	0	1	99
23942	0.7	0.0	"	sl. hard	"	46	---	--	35	59	6	--	0	0	100
23927	0.1	0.2	br. gr.	very hard	"	34	1	41	57	1	--	--	0	7	93
23958	0.5	0.4	yell. gr.	good	no	30	---	49	51	--	--	--	23	68	9
23938	0.4	0.7	"	"	in some	30	---	75	25	--	--	--	0	78	22
	0.7	*1.3*	----	----	----	*83*	*100*	*94*	*80*	*88*	*66*	*60*	*19*	*86*	*100*
	0.1	*—0.2*	----	----	----	*16*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*
	0.4	*0.3*	----	----		*40*	*14*	*20*	*29*	*28*	*7*	*2*	*2*	*18*	*80*

The liquor made up from about one-quarter to one-half of the total weight of the contents, on the average 36 per cent. This is important, in view of the fact that this liquor is almost always thrown away when preparing the peas for the table. The significance of this waste will be taken up in a later section.

The weight of the peas and liquor showed wide variations, but no more than would be expected in samples of varying size, quality and price. The following is a summary of the variation in weight of drained peas according to the sizes indicated on the label:

	Max.	*Min.*	*Ave.*
Petits Pois	380	211	292
Extra Sifted	398	261	350
Sifted	423	243	368
Early June	412	309	373
Marrowfat	455	371	400
Telephone	412	354	383
Miscellaneous	424	270	373

Quoting Bitting, "the average fill of a can (No. 2) is such that after processing there will be 14 ounces of peas (400 grams) and 7¼ ounces (200 grams) of liquor. . . . Any very marked deviation from these figures in the direction of reducing the proportion of peas would evidently be an adulteration with water, while any considerable increase in the proportion of peas would result in dryness. Cans containing only 11 or 12 ounces of peas are evidently short weight, though a customer can not reasonably demand more than 15 ounces as a maximum and expect a good appearance." The above remarks, of course, only apply to the No. 2 can most generally used. "Petits pois" and "extra sifted" are very frequently packed in much smaller cans, as is shown by the above summary. Of the ninety-two samples packed in No. 2 cans, fifty-six contained less than 385 grams of drained peas, thirty-one between 385 and 415 grams, and five over 415 grams. That is, 61 per cent. had a tendency toward short weight, 34 per cent. were normal and 5 per cent. contained too much peas for the liquor. The most prominent offenders in this respect were Nos. 23797, 23784 and 23938, where the drained peas weighed only 309, 330 and 343 grams, and the liquor made up 50, 44 and 42 per cent. of the total weight of the sample, respectively; and No. 23735, where the peas weighed 455 grams and the liquor made up only 27 per cent. of the weight and was very thick and generally unattractive.

Cost of Peas.

The cost per can ranged from 8 to 30 cents, with an average of 13.5. Here size of can and quality were also important factors, and a calculation based on the cost per pound of the drained peas in the different samples offers a more satisfactory basis of comparison. This ranged from 9.8 to 46.4 cents, with an average of 16.8. By consulting the tables it will be seen that the cost per pound on the average decreased quite regularly as the size increased, the "petits pois" averaging 29.8 cents, and the "marrowfats" and "telephones" averaging 13.1 and 14.4 cents, respectively. The young and tender peas, that is the peas of the finer quality, cost on the average about twice as much per pound as the larger and more mature peas.

Condition of the Peas on Opening.

Corrosion of Cans. In ten samples there was no discoloration or corrosion of the interior of the can, in fifty-two it was slight, in forty-six considerable, while in three, Nos. 23773, 23955 and 23754, it was very marked.

Clearness of Liquor. In no case was the liquor perfectly clear; it ranged from slightly cloudy to a very thick, pasty consistency. In ten samples the liquor was slightly cloudy, in sixty-three cloudy, in thirty-three thick and in five very thick and pasty.

Filling of the Can. According to Bitting, a can is well filled when the contents are within three-eighths of an inch of the cap, and the peas are just covered with liquor. In seven of the samples examined the contents were 0.1 in. from the cap, in six, 0.2 in., in twenty-one, 0.3 in., in forty-seven, 0.4 in., in twenty-five, 0.5 in., in four, 0.6 in., and in one, 0.7 in. Thirty samples, or 27 per cent., contained over 0.4 in. of empty can. The shortage was sometimes in the peas, sometimes in the liquor, and sometimes in both.

Too much liquor causes a deterioration of the peas, while insufficient liquor renders the peas less attractive and more likely to become pasty. In thirteen of the samples the liquor was insufficient to cover the peas, in thirty-one it was excessive, and in seven it was very excessive.

Color. In the great majority of the samples the color was satisfactory. The peas treated with copper had an unnatural bright green color, and some of the more mature peas were distinctly yellow.

Consistency of the Peas. The consistency of the peas ranged from soft and mushy to hard. In some samples many of the peas were broken, indicating the probable use of "soaked" peas.

The prominence of the cotyledons is somewhat indicative of the maturity of the peas. In forty-two samples the cotyledons were not prominent, in fifty-six they were prominent, and in eleven some of the peas showed prominent cotyledons and some did not.

Weight of Peas. One hundred drained peas from each can were weighed before grading as to size and specific gravity. This weight ranged from 16 to 83 grams, with an average of 40 grams. The average weight of one hundred "petits pois" was 24 grams, "extra fins," 25 grams, "sifted," 35 grams, "early June", 41 grams, "marrowfats," 46 grams, and "telephones," 56 grams.

Grading as to Size. Of course, during "processing," peas naturally increase somewhat in weight and size. It is not to be expected, therefore, that the canned peas will grade up as accurately as they would in their natural fresh condition. Nevertheless, it is believed that the figures reported in the table indicate with reasonable accuracy the percentage of peas of the different grades found in the samples. In seventy-two of the 111 samples the label indicated a standard size. Of these twenty-three were found true to size, thirty-four of smaller size and fifteen of larger size. The proper grading for the whole number of samples would be twelve "petits pois," twenty "extra sifted," thirty-six "sifted," thirty-six "early June," five "marrowfat" and two "telephone." The following tabulation summarizes our grading as to size:

Sold as	Total Number.	Correct Grade.						Per cent. of Grade Stated or Better.
		Petits Pois.	Extra Sifted.	Sifted.	Early June.	Marrowfat.	Telephone.	
Petits Pois	13	6	5	2	--	--	--	46
Extra Sifted, or Extra Fins	6	4	0	1	1	--	--	67
Sifted or Fins	23	1	8	8	6	--	--	74
Early June	22	--	1	12	9	--	--	100
Marrowfat	2	--	--	1	1	--	--	100
Telephone	6	--	--	--	5	1	--	100
Grade not indicated	39	1	6	12	14	4	2	--
Totals	111	12	20	36	36	5	2	--

All of the samples marked "early June," "marrowfat" or "telephone," were equal to or better than the grade claimed on the label. On the other hand, only 46 per cent. of the "petits pois," 67 per cent. of the "extra sifted" and 74 per cent. of the "sifted" were of as good grade as claimed on the label.

The weight of one hundred of the drained peas is a very satisfactory guide as to the size of the peas. The table giving the details of the physical examination of the peas shows that of the fourteen branded "petits pois," twelve ranged from 16 to 26 gms. weight per hundred peas, 23816 and 23825 showing 31 and 37 gms.; of the six "extra sifted," four showed from 17 to 21 gms., 23773 and 23956 showing 32 and 40 gms.; of the twenty "sifted," fourteen showed from 25 to 39 gms., 23790, 23788, 23751, 23760, 23824 and 23795 showing 41, 41, 42, 42, 50 and 51 gms. respectively; of the twenty "early June," nineteen showed from 31 to 48 gms., 23803 showing 52 gms.; the six "marrowfats" showed from 41 to 51 gms.; the six "telephones" from 45 to 63 gms. All of these eleven samples showed a large proportion of peas of greater size than indicated by the brand name, and are misbranded.

Specific Gravity. The figures obtained are very unsatisfactory and in most cases convey little useful information.

Chemical Examination.

Complete chemical analyses of the liquor and drained peas of all the samples are given in Table III; in Table IV the composition of the drained peas is given on the water-free basis.

The Pea Liquor.

This liquor generally consists of water, salt and sugar, the proportions of salt and sugar varying greatly at different factories. The use of sugar is frequently for the purpose of giving "a weak, insipid, sugarless pea some semblance of quality, also to make the smooth pea as sweet as the sweet wrinkled variety." * In eight of the samples in which sugar was declared on the label, glucose was present; in one of these cane sugar was specifically guaranteed, and this sample was clearly misbranded.

Some canners, recognizing the amount of extracted nutriment in the pea liquor, recommend its use in preparing peas for the

* Bitting, *loc. cit.*

TABLE III.—CHEMICAL ANALYSES OF CANNED PEAS.

Station Number.	Sold as	Liquor. Water.	Liquor. Ash.	Liquor. Protein (N x 6.25).	Liquor. Sucrose by Clerget.	Liquor. Undetermined, chiefly Starch.	Liquor. Sodium Chloride.	Liquor. Pea Ash.	Drained Peas. Water.	Drained Peas. Ether Extract.	Drained Peas. Fiber.	Drained Peas. Ash.	Drained Peas. Protein (N x 6.25).	Drained Peas. Nitrogen-free Extract.	Drained Peas. Sodium Chloride.	Drained Peas. Pea Ash.	Drained Peas. Reducing Sugars as Dextrose.	Drained Peas. Starch.	Drained Peas. Undetermined Carbohydrates.
23936	Petits Pois	94.78	0.60	1.38	2.34	0.90	0.34	0.26	87.30	0.26	1.36	0.67	3.27	7.14	0.27	0.40	1.93	3.88	1.33
23815	" "	93.00	1.32	1.44	3.08	1.16	1.03	0.29	86.66	0.26	1.27	1.24	2.88	7.69	0.89	0.35	2.78	4.14	0.77
23947	" "	94.33	0.87	1.44	3.15	0.21	0.64	0.23	86.26	0.49	1.52	0.89	3.27	7.57	0.51	0.38	2.96	3.44	1.17
23949	" "	94.40	0.94	1.07	2.36	1.23	0.66	0.28	83.31	0.31	1.90	0.96	3.75	9.77	0.47	0.49	2.09	6.55	1.13
23816	" "	95.31	1.26	1.42	0.75	1.26	0.90	0.36	81.70	0.22	2.01	1.15	4.38	10.54	0.68	0.47	0.83	8.54	1.17
23825	" "	94.47	1.35	1.69	1.04	1.45	0.99	0.36	81.72	0.21	1.88	1.20	4.07	10.92	0.72	0.48	0.80	8.63	1.49
23809	" "	94.85	1.12	1.49	1.74	0.80	0.81	0.31	86.10	0.33	1.42	1.04	3.00	8.11	0.65	0.39	1.90	5.23	0.98
23826	" "	94.06	1.23	1.10	2.53	1.08	0.98	0.25	84.99	0.27	1.51	1.17	3.17	8.89	0.77	0.40	2.63	5.56	0.70
23814	" "	93.44	1.17	1.31	3.00	1.08	0.92	0.25	86.16	0.29	1.35	1.10	3.22	7.88	0.76	0.34	1.96	4.77	1.15
23750	Petits Pois Extra Fins	94.15	0.96	1.56	1.47	1.86	0.63	0.33	85.30	0.29	1.68	0.95	4.11	7.67	0.52	0.43	1.82	4.63	1.22
23749	Petits Pois Fins	94.31	1.36	1.44	1.90	0.99	1.07	0.29	81.23	0.25	2.06	1.34	4.24	10.88	0.84	0.50	1.91	7.69	1.28
23793	" " "	95.84	0.95	0.96	1.53	0.72	0.76	0.19	83.55	0.21	1.96	0.94	3.67	9.67	0.55	0.39	1.42	6.79	1.46
23808	" " "	96.12	1.02	1.32	0.85	0.69	0.79	0.23	82.62	0.21	1.95	1.05	4.05	10.12	0.55	0.50	0.84	7.83	1.45
23807	Extra Fins or Extra Sifted	94.56	0.51	0.76	2.98	1.19	0.32	0.19	89.10	0.21	1.16	0.52	2.52	6.49	0.24	0.28	2.67	2.70	1.12
23752	" " " " "	94.71	1.16	1.41	1.74	0.98	0.90	0.26	85.21	0.49	1.78	1.12	4.04	7.36	0.71	0.41	1.99	4.18	1.19
23956	" " " " "	92.91	1.09	1.32	2.90	1.78	0.84	0.25	84.39	0.56	1.61	0.97	3.80	8.67	0.64	0.33	2.25	4.94	1.48
23791	" " " " "	95.31	0.73	1.09	2.22	0.65	0.54	0.19	87.62	0.15	1.29	0.76	3.08	7.10	0.41	0.35	2.07	3.92	1.11
23773	Early June Extra Sifted	93.63	1.24	1.65	2.06	1.42	0.85	0.39	78.39	0.37	1.82	1.16	4.81	13.45	0.64	0.52	2.09	10.37	0.99
23932	" " " "	94.08	0.77	1.48	2.77	0.90	0.54	0.23	90.46	0.30	0.94	0.71	2.84	4.75	0.41	0.30	1.46	2.04	1.25
23756	Sifted or Fins	91.05	1.51	2.26	2.73	2.45	1.05	0.46	75.94	0.39	1.78	1.28	5.19	15.42	0.76	0.52	2.61	11.74	1.07
23931	" " "	96.27	1.50	1.46	0.53	0.24	1.21	0.29	81.75	0.14	1.84	1.42	3.98	10.87	0.91	0.51	0.53	8.59	1.75
23785	" " "	92.21	1.09	1.66	3.13	1.91	0.75	0.34	78.12	0.40	1.69	1.03	4.36	14.40	0.52	0.51	3.39	8.84	2.17
23751	" " "	92.13	0.78	1.55	4.21	1.33	0.48	0.30	81.53	0.49	1.90	0.79	4.68	10.61	0.35	0.44	4.68	5.84	0.09
23760	" " "	92.84	1.51	1.45	2.93	1.27	1.18	0.23	79.79	0.54	2.03	1.45	5.55	10.64	0.98	0.47	3.01	6.19	1.44
23811	" " "	91.91	1.47	1.38	2.62	2.62	1.06	0.41	78.51	0.39	1.84	1.31	3.96	13.99	0.77	0.54	2.63	9.78	1.58
23943	" " "	91.70	1.00	1.13	4.91	1.26	0.70	0.30	84.49	0.59	1.53	0.87	3.51	9.01	0.47	0.40	3.69	4.26	1.06
23802	" " "	93.12	0.93	1.29	3.14	1.52	0.66	0.27	82.85	0.36	1.53	0.87	3.26	11.13	0.44	0.43	3.49	6.93	0.71
23774	" " "	91.96	1.37	1.99	1.13	3.55	0.85	0.52	75.21	0.40	1.89	1.21	5.57	15.72	0.56	0.65	1.93	12.50	1.29
23824	" " "	92.35	1.18	1.71	3.60	1.16	0.85	0.33	82.08	0.55	1.80	1.04	4.80	9.73	0.62	0.42	3.14	5.71	0.88

TABLE III.—CHEMICAL ANALYSES OF CANNED PEAS—*Continued.*

Station Number.	Sold as	Liquor. Water.	Liquor. Ash.	Liquor. Protein (N x 6.25).	Liquor. Sucrose by Clerget.	Liquor. Undetermined, chiefly Starch.	Liquor. Sodium Chloride.	Liquor. Pea Ash.	Drained Peas. Water.	Drained Peas. Ether Extract.	Drained Peas. Fiber.	Drained Peas. Ash.	Drained Peas. Protein (N x 6.25).	Drained Peas. Nitrogen-free Extract.	Drained Peas. Sodium Chloride.	Drained Peas. Pea Ash.	Drained Peas. Reducing Sugars as Dextrose.	Drained Peas. Starch.	Drained Peas. Undetermined Carbohydrates.
23812	Sifted or Fins	95.59	0.79	1.17	1.60	0.85	0.55	0.24	83.66	0.20	1.69	0.74	3.58	10.13	0.34	0.40	0.90	7.54	1.69
23788	" " "	92.20	0.87	1.20	4.30	1.43	0.61	0.26	80.74	0.71	1.92	0.97	4.49	11.17	0.55	0.42	4.06	5.98	1.13
23755	" " "	94.18	0.84	0.66	3.09	1.23	0.64	0.20	82.21	0.20	1.69	0.90	3.53	11.47	0.45	0.45	2.95	7.39	1.13
23959	" " "	92.54	0.92	1.98	2.38	2.18	0.56	0.36	86.25	0.37	1.35	0.90	3.92	7.21	0.47	0.43	2.79	3.32	1.10
23795	" " "	93.70	1.28	1.61	2.27	1.14	0.94	0.34	79.72	0.71	1.87	1.16	5.38	11.16	0.71	0.45	2.28	6.83	2.05
23806	" " "	93.77	0.85	1.63	3.07	0.68	0.54	0.31	84.25	0.47	1.63	0.77	4.86	8.02	0.29	0.48	2.66	4.40	0.96
23772	Early June Sifted	94.56	1.33	1.63	1.52	0.96	0.96	0.37	80.66	0.36	1.75	1.16	4.34	11.73	0.68	0.48	1.41	9.63	0.69
23787	" " "	93.51	1.06	2.16	1.95	1.32	0.72	0.34	80.77	0.37	1.66	0.98	4.73	11.49	0.51	0.47	2.01	8.43	1.05
23778	" " "	94.34	1.28	1.61	1.58	1.19	0.91	0.37	78.32	0.39	1.80	1.17	4.79	13.53	0.69	0.48	1.48	10.99	1.06
23790	" " "	93.59	1.05	1.74	2.50	1.12	0.68	0.37	75.68	0.40	1.88	0.91	5.24	15.89	0.48	0.43	2.06	12.28	1.55
23834	Early June	92.68	1.22	1.60	1.06	3.44	0.88	0.34	83.41	0.60	1.61	1.11	4.45	8.82	0.70	0.41	2.37	4.98	1.47
23945	" "	93.85	1.26	1.81	1.11	1.97	0.79	0.47	74.76	0.38	2.04	1.08	5.78	15.96	0.49	0.59	0.48	13.66	1.82
23954	" "	92.37	1.37	1.53	3.49	1.24	1.03	0.34	80.19	0.57	1.62	1.18	5.47	10.97	0.69	0.49	2.27	7.15	1.55
23821	" "	92.10	1.81	2.15	1.14	2.80	1.25	0.56	73.97	0.38	2.08	1.50	5.95	16.12	0.86	0.64	0.60	13.24	2.28
23803	" "	93.65	0.84	1.51	2.45	1.55	0.52	0.32	82.49	0.56	1.85	0.80	4.87	9.43	0.35	0.45	2.70	5.63	1.10
23950	" "	94.37	1.04	1.32	0.00	3.27	0.79	0.25	86.18	0.42	1.51	0.89	3.80	7.20	0.54	0.35	2.58	3.77	0.85
23796	" "	93.29	1.24	1.33	2.77	1.37	0.99	0.25	78.24	0.43	1.83	1.13	4.33	14.04	0.70	0.43	3.11	10.05	0.88
23955	" "	91.67	1.33	1.90	2.73	2.37	0.94	0.39	76.34	0.59	1.72	1.13	5.17	15.05	0.64	0.49	1.95	11.75	1.35
23736	" "	92.41	1.62	1.91	2.80	1.26	1.05	0.57	76.20	0.29	1.94	1.32	4.93	15.32	0.75	0.57	0.78	13.32	1.22
23944	" "	92.20	1.56	2.02	0.69	3.53	1.02	0.54	78.19	0.34	1.73	1.32	4.92	13.50	0.72	0.60	0.58	10.79	2.13
23832	" "	92.84	1.53	1.01	0.45	4.17	0.97	0.56	77.29	0.36	2.00	1.28	5.00	14.07	0.66	0.62	0.53	11.82	0.72
23797	" "	95.11	1.80	1.33	1.18	0.58	1.40	0.40	75.29	0.38	1.98	1.40	5.60	15.35	0.94	0.46	0.37	13.34	1.64
23784	" "	93.94	2.16	1.66	0.30	1.94	1.73	0.43	75.23	0.38	1.96	1.69	5.89	14.85	1.12	0.57	0.34	12.51	2.00
23792	" "	92.58	1.20	1.45	3.00	1.77	0.86	0.34	78.87	0.64	2.08	1.20	5.24	11.97	0.62	0.58	3.23	6.75	1.99
23761	" "	92.38	1.07	1.56	3.00	1.99	0.69	0.38	72.83	0.45	2.07	0.99	5.08	18.58	0.46	0.53	2.69	14.42	1.47
23937	" "	92.98	1.82	1.70	1.96	1.54	1.29	0.53	79.22	0.33	1.82	1.43	4.57	12.63	0.92	0.51	1.18	10.21	1.24
23957	" "	93.84	1.03	2.22	0.35	2.56	0.52	0.51	75.58	0.42	1.98	0.93	6.45	14.64	0.32	0.61	0.56	12.83	1.25
23789	" "	94.00	1.18	1.93	1.17	1.72	0.68	0.50	75.20	0.38	1.89	1.04	5.77	15.72	0.38	0.66	0.53	13.17	2.02
23745	" "	94.19	1.30	1.69	2.20	0.62	0.82	0.48	73.82	0.42	2.07	1.16	5.37	17.16	0.49	0.67	0.67	15.65	0.84

TABLE III.—CHEMICAL ANALYSES OF CANNED PEAS—*Continued.*

Station Number.	Sold as	Liquor. Water.	Liquor. Ash.	Liquor. Protein (N x 6.25).	Liquor. Sucrose by Clerget.	Liquor. Undetermined, chiefly Starch.	Liquor. Sodium Chloride.	Liquor. Pea Ash.	Drained Peas. Water.	Drained Peas. Ether Extract.	Drained Peas. Fiber.	Drained Peas. Ash.	Drained Peas. Protein (N x 6.25).	Drained Peas. Nitrogen-free Extract.	Drained Peas. Sodium Chloride.	Drained Peas. Pea Ash.	Drained Peas. Reducing Sugars as Dextrose.	Drained Peas. Starch.	Drained Peas. Undetermined Carbohydrates.
23744	Early June	93.25	1.46	1.48	2.50	1.31	1.04	0.42	76.86	0.71	2.07	1.32	6.16	12.88	0.75	0.57	2.52	9.14	1.22
23735	Marrow Sifted	92.17	1.82	2.13	2.13	1.75	1.18	0.64	74.31	0.31	1.83	1.42	5.71	16.42	0.80	0.62	0.91	14.43	1.08
23822	" "	94.87	1.11	1.45	1.42	1.15	0.78	0.33	81.27	0.54	2.02	1.11	4.91	10.15	0.57	0.54	1.51	6.82	1.82
23737	" "	94.95	1.08	1.45	1.83	0.69	0.66	0.42	79.23	0.70	2.05	1.01	5.69	11.32	0.48	0.53	1.29	8.81	1.22
23810	" "	95.08	1.12	1.42	1.26	1.12	0.79	0.33	80.84	0.56	2.03	1.05	4.03	11.49	0.54	0.51	1.11	6.96	3.42
23753	Marrow	90.13	1.15	2.38	4.84	1.50	0.65	0.50	74.32	0.38	1.96	1.14	5.80	16.40	0.36	0.78	3.15	12.46	0.79
23739	"	94.26	1.31	1.94	1.82	0.67	0.90	0.41	74.75	0.32	1.94	1.25	5.84	15.90	0.73	0.52	0.67	14.27	0.96
23946	Telephone	91.18	1.21	1.86	3.46	2.29	0.84	0.37	81.21	0.55	1.64	1.04	5.11	10.45	0.60	0.44	3.47	5.94	1.04
23765	"	91.08	1.12	1.84	4.63	1.33	0.79	0.33	82.83	0.52	1.69	1.12	4.23	9.61	0.70	0.42	4.93	3.72	0.96
23780	"	92.57	1.04	0.98	4.28	1.13	0.72	0.32	82.31	0.68	1.88	1.10	3.71	10.32	0.49	0.61	3.73	5.29	1.30
23805	"	93.58	1.49	1.20	2.84	0.89	1.24	0.25	84.33	0.48	1.70	1.33	4.05	8.11	0.95	0.38	2.87	4.28	0.96
23928	"	92.33	1.52	1.87	0.82	3.46	0.98	0.54	77.97	0.36	1.71	1.22	4.64	14.10	0.62	0.60	0.82	11.38	1.90
23766	"	93.29	1.16	2.01	1.66	1.88	0.82	0.34	76.22	0.69	2.04	1.08	6.32	13.65	0.60	0.48	1.76	9.73	2.16
23833	Sweet Wrinkled	91.76	0.95	1.31	3.48	2.50	0.63	0.32	84.08	0.45	1.52	0.93	3.91	9.11	0.51	0.42	4.19	4.09	0.83
23830	" "	92.15	1.19	1.80	3.82	1.04	0.81	0.38	81.02	0.58	1.67	1.05	5.24	10.44	0.54	0.51	3.17	6.03	1.24
23776	" "	94.63	0.68	1.48	1.92	1.29	0.36	0.32	79.44	0.62	2.03	0.73	5.67	11.51	0.21	0.52	1.90	7.82	1.79
23738	" "	93.47	1.03	1.48	2.88	1.14	0.71	0.32	80.42	0.58	1.91	1.00	5.10	10.99	0.48	0.52	2.80	6.69	1.50
23764	" "	91.23	1.22	1.51	5.21	0.83	0.93	0.29	82.17	0.62	1.90	1.17	4.16	9.98	0.76	0.41	5.18	4.06	0.74
23929	" "	93.52	0.94	1.29	3.31	0.94	0.61	0.33	83.08	0.64	1.58	0.89	4.57	9.24	0.46	0.43	2.99	5.32	0.93
23831	" "	92.92	1.02	1.01	1.78	3.27	0.75	0.27	87.21	0.40	1.43	0.89	3.10	6.97	0.59	0.30	2.81	3.34	0.82
23740	" "	94.47	1.19	1.49	1.52	1.33	0.82	0.37	76.52	0.69	2.04	1.11	6.08	13.56	0.58	0.53	1.57	9.92	2.07
23801	" "	92.75	1.57	1.77	2.00	1.91	1.16	0.41	77.11	0.58	2.16	1.44	5.96	12.75	0.86	0.58	1.75	8.76	2.24
23823	" "	92.28	1.22	1.43	3.93	1.14	0.93	0.29	83.30	0.53	1.72	1.08	3.89	9.48	0.71	0.37	3.40	4.67	1.41
23746	" "	94.70	0.87	1.17	2.19	1.07	0.66	0.21	80.71	0.68	2.08	0.95	4.86	10.72	0.52	0.43	1.30	6.73	2.69
23828	" "	92.73	1.08	1.68	1.52	2.99	0.70	0.38	80.50	0.58	1.88	0.99	5.30	10.75	0.43	0.56	2.65	6.48	1.62
23743	" "	92.29	0.97	1.18	4.62	0.94	0.70	0.27	81.69	0.60	1.50	0.89	4.11	11.21	0.41	0.48	4.37	5.49	1.35
23734	" "	92.29	0.92	1.33	4.31	1.15	0.62	0.30	83.03	0.62	1.75	0.88	4.13	9.59	0.50	0.38	4.43	4.18	0.98
23786	Sweet or Sugar	93.41	0.98	1.65	2.55	1.41	0.65	0.33	77.30	0.61	2.03	0.97	5.96	13.13	0.42	0.55	2.09	8.53	2.51

TABLE III.—CHEMICAL ANALYSES OF CANNED PEAS—*Continued.*

Station Number.	Sold as	Liquor. Water.	Liquor. Ash.	Liquor. Protein (N x 6.25).	Liquor. Sucrose by Clerget.	Liquor. Undetermined, chiefly Starch.	Liquor. Sodium Chloride.	Liquor. Pea Ash.	Drained Peas. Water.	Drained Peas. Ether Extract.	Drained Peas. Fiber.	Drained Peas. Ash.	Drained Peas. Protein (N x 6.25).	Drained Peas. Nitrogen-free Extract.	Drained Peas. Sodium Chloride.	Drained Peas. Pea Ash.	Drained Peas. Reducing Sugars as Dextrose.	Drained Peas. Starch.	Drained Peas. Undetermined Carbohydrates.
23939	Sweet or Sugar	93.13	1.00	1.63	2.91	1.33	0.66	0.34	83.03	0.49	1.76	0.92	4.69	9.11	0.49	0.43	2.61	5.28	1.22
23930	" " "	91.41	0.92	1.74	4.91	1.02	0.59	0.33	83.00	0.46	1.69	0.92	4.38	9.55	0.49	0.43	4.08	4.35	1.12
23747	" " "	91.46	1.18	1.66	3.04	2.66	0.79	0.39	80.42	0.83	1.84	1.03	5.08	10.80	0.60	0.43	3.57	6.24	0.99
23940	" " "	93.32	0.99	1.64	2.45	1.60	0.60	0.39	80.69	0.49	1.79	0.94	5.55	10.54	0.39	0.55	1.58	6.97	1.99
23799	" " "	92.74	1.02	1.76	3.07	1.41	0.72	0.30	82.14	0.52	1.80	0.97	4.97	9.60	0.57	0.40	3.13	5.54	0.93
23777	" " "	91.13	1.22	1.57	4.86	1.22	0.87	0.35	77.04	0.85	2.00	1.24	5.44	13.43	0.72	0.52	4.94	7.54	0.95
23798	" " "	93.27	1.11	1.67	2.25	1.70	0.75	0.36	78.82	0.63	2.05	1.07	5.84	11.59	0.56	0.51	2.40	7.68	1.51
23775	" " "	93.98	0.91	1.72	2.59	0.80	0.65	0.26	84.73	0.49	1.66	0.95	4.15	8.02	0.47	0.48	2.77	4.37	0.88
23813	" " "	92.11	1.19	1.81	3.51	1.38	0.84	0.35	82.33	0.51	1.78	1.09	4.72	9.57	0.66	0.43	2.74	5.16	1.67
23804	" " "	91.96	1.07	1.90	3.39	1.68	0.71	0.36	81.11	0.67	1.74	1.11	4.82	10.55	0.65	0.46	4.07	5.51	0.97
23820	Peas	93.05	1.14	1.79	2.84	1.18	0.77	0.37	76.52	0.40	1.80	1.01	5.52	14.75	0.50	0.51	2.31	11.45	0.99
23941	"	92.64	1.20	1.97	2.43	1.76	0.81	0.39	78.52	0.35	1.75	0.99	4.98	13.41	0.53	0.46	2.67	9.15	1.59
23754	"	93.72	1.16	1.51	2.48	1.13	0.76	0.40	76.90	0.76	2.02	1.12	6.32	12.88	0.46	0.66	2.00	8.39	2.49
23733	"	94.61	0.95	1.10	2.17	1.17	0.72	0.23	81.19	0.65	1.90	0.91	4.85	10.50	0.54	0.37	2.32	7.42	0.76
23953	"	94.34	1.05	1.12	1.98	1.51	0.82	0.23	86.06	0.43	1.64	1.00	3.72	7.15	0.62	0.38	2.74	3.29	1.12
23748	"	92.82	1.17	1.35	3.04	1.62	0.94	0.23	79.83	0.38	1.75	1.20	4.00	12.84	0.69	0.51	3.27	8.62	0.95
23759	"	93.84	1.46	1.51	1.22	1.97	0.95	0.51	76.63	0.38	1.93	1.26	4.92	14.88	0.66	0.60	0.93	12.41	1.54
23817	"	94.16	1.05	1.46	2.13	1.20	0.77	0.28	83.69	0.65	1.67	0.98	4.40	8.61	0.62	0.36	2.51	4.91	1.19
23779	"	93.70	0.93	1.48	2.73	1.16	0.69	0.24	85.16	0.62	1.51	1.01	4.01	7.69	0.57	0.44	3.14	3.92	0.63
23819	"	92.43	1.13	1.46	3.43	1.55	0.84	0.29	84.51	0.51	1.43	1.02	4.15	8.38	0.63	0.39	3.49	4.06	0.83
23800	June	95.12	0.76	1.74	1.51	0.87	0.48	0.28	80.24	0.38	1.50	0.59	4.67	12.62	0.20	0.39	0.89	10.95	0.78
23942	"	89.32	1.32	3.04	0.92	5.40	0.71	0.61	77.32	0.33	1.84	1.14	5.52	13.85	0.51	0.63	0.50	11.31	2.04
23927	Medium	96.23	0.49	1.12	1.51	0.65	0.23	0.26	80.49	0.36	2.02	0.57	4.54	12.02	0.09	0.48	1.28	9.79	0.95
23958	Selected	94.96	1.03	1.01	2.13	0.87	0.79	0.24	87.10	0.48	1.02	1.00	2.93	7.47	0.67	0.33	1.89	3.44	2.14
23938	Small Tender	92.80	1.23	1.90	3.20	0.87	0.92	0.31	86.65	0.32	1.36	1.05	3.68	6.94	0.67	0.38	2.66	3.45	0.83
	Maximum	*96.27*	*2.16*	*3.04*	*5.21*	*5.40*	*1.73*	*0.64*	*90.46*	*0.85*	*2.08*	*1.69*	*6.45*	*18.58*	*1.12*	*0.78*	*5.18*	*15.65*	*3.42*
	Minimum	*89.32*	*0.49*	*0.66*	*0.00*	*0.21*	*0.23*	*0.19*	*72.83*	*0.14*	*0.94*	*0.52*	*2.52*	*4.75*	*0.09*	*0.30*	*0.34*	*2.04*	*0.09*
	Average	*93.33*	*1.15*	*1.55*	*2.44*	*1.53*	*0.81*	*0.34*	*80.86*	*0.46*	*1.77*	*1.06*	*4.62*	*11.23*	*0.58*	*0.48*	*2.26*	*7.64*	*1.33*

TABLE IV.—CHEMICAL ANALYSES OF DRAINED PEAS (WATER-FREE BASIS).

Station No.	Sold as	Total Dry Matter per Can.	Ether Extract.	Fiber.	Ash.	Protein (N x 6.25).	Nitrogen-free Extract.	Sodium Chloride.	Pea Ash.	Reducing Sugars as Dextrose.	Starch.	Undetermined Carbohydrates.
		gms.	%	%	%	%	%	%	%	%	%	%
23936	Petits Pois	35	2.05	10.71	5.28	25.75	56.21	2.13	3.15	15.20	30.55	10.46
23815	" "	49	1.95	9.52	9.30	21.59	57.66	6.67	2.63	20.84	31.03	5.81
23947	" "	29	3.57	11.06	6.48	23.80	55.09	3.71	2.77	21.54	25.04	8.51
23949	" "	46	1.86	11.38	5.75	22.47	58.54	2.82	2.93	12.52	39.25	6.77
23816	" "	53	1.20	10.98	6.28	23.93	57.61	3.72	2.56	4.54	46.67	6.40
23825	" "	54	1.15	10.28	6.56	22.26	59.75	3.94	2.62	4.38	47.21	8.16
23809	" "	30	2.37	10.22	7.48	21.58	58.35	4.68	2.80	13.67	37.63	7.05
23826	" "	54	1.80	10.06	7.79	21.12	59.23	5.13	2.66	17.52	37.04	4.67
23814	" "	53	2.10	9.75	7.95	23.27	56.93	5.49	2.46	14.16	34.47	8.30
23750	Petits Pois Extra Fins	46	1.97	11.43	6.46	27.96	52.18	3.54	2.92	12.38	31.50	8.30
23749	Petits Pois Fins	50	1.33	10.97	7.14	22.59	57.97	4.48	2.66	10.18	40.97	6.82
23793	" " "	45	1.28	11.91	5.71	22.31	58.79	3.34	2.37	8.63	41.28	8.88
23808	" " "	49	1.21	11.22	6.04	23.30	58.23	3.16	2.88	4.83	45.05	8.35
23807	Extra Fins or Extra Sifted	27	1.93	10.64	4.77	23.12	59.54	2.20	2.57	24.49	24.77	10.28
23752	" " " "	54	3.32	12.04	7.57	27.32	49.75	4.80	2.77	13.46	28.26	8.03
23956	" " " "	62	3.59	10.31	6.21	24.34	55.55	4.10	2.11	14.41	31.65	9.49
23791	" " " "	39	1.21	10.42	6.14	24.88	57.35	3.31	2.83	16.72	31.66	8.97
23773	Early June Extra Sifted	79	1.71	8.42	5.37	22.26	62.24	2.96	2.41	9.67	47.99	4.58
23932	" " " "	38	3.14	9.85	7.44	29.77	49.80	4.30	3.14	15.30	21.38	13.12
23756	Sifted or Fins	99	1.62	7.40	5.32	21.57	64.09	3.16	2.16	10.85	48.79	4.45
23931	" " "	44	0.77	10.08	7.78	21.81	59.56	4.99	2.79	2.90	47.07	9.59
23785	" " "	93	1.83	7.72	4.71	19.93	65.81	2.38	2.33	15.49	40.40	9.92
23751	" " "	71	2.65	10.29	4.28	25.34	57.44	1.90	2.38	25.34	31.62	0.48
23760	" " "	74	2.67	10.04	7.17	27.46	52.66	4.85	2.32	14.49	30.63	7.54
23811	" " "	89	1.81	8.56	6.10	18.43	65.10	3.58	2.52	12.24	45.51	7.35
23943	" " "	60	3.80	9.86	5.61	22.63	58.10	3.03	2.58	23.79	27.47	6.84
23802	" " "	64	2.10	8.92	5.07	19.01	64.90	2.56	2.51	20.35	40.41	4.14
23774	" " "	103	1.61	7.62	4.88	22.47	63.42	2.26	2.62	7.79	50.42	5.21
23824	" " "	63	3.07	10.04	5.80	26.79	54.30	3.46	2.34	17.52	31.86	4.92
23812	" " "	46	1.22	10.34	4.53	21.91	62.00	2.08	2.45	5.51	46.14	10.35
23788	" " "	71	3.69	9.97	5.04	23.31	57.99	2.85	2.19	21.08	31.05	5.86
23755	" " "	52	1.12	9.50	5.06	19.84	64.48	2.53	2.53	16.58	41.54	6.36
23959	" " "	49	2.69	9.82	6.55	28.51	52.43	3.42	3.13	20.29	24.15	7.99
23795	" " "	78	3.50	9.22	5.72	26.53	55.03	3.50	2.22	11.24	33.68	10.11
23806	" " "	59	2.98	10.35	4.89	30.86	50.92	1.84	3.05	16.89	27.94	6.09
23772	Early June Sifted	78	1.86	9.05	6.00	22.44	60.65	3.52	2.48	7.29	49.79	3.57
23787	" " "	77	1.92	8.63	5.10	24.60	59.75	2.65	2.45	10.45	43.84	5.46
23778	" " "	83	1.80	8.30	5.40	22.09	62.41	3.18	2.22	6.83	50.69	4.89
23790	" " "	84	1.64	7.73	3.74	21.55	65.34	1.97	1.77	8.47	50.49	6.38
23834	Early June	65	3.62	9.70	6.69	26.82	53.17	4.22	2.47	14.29	30.02	8.86
23945	" "	94	1.51	8.08	4.28	22.90	63.23	1.94	2.34	1.90	54.12	7.21
23954	" "	73	2.88	8.18	5.96	27.61	55.32	3.48	2.48	11.46	36.09	7.77
23821	" "	96	1.46	7.99	5.76	22.86	61.93	3.30	2.46	2.31	50.86	8.76
23803	" "	66	3.20	10.57	4.57	27.81	53.85	2.00	2.57	15.42	32.15	6.28
23950	" "	51	3.04	10.93	6.44	27.50	52.09	3.91	2.53	18.67	27.28	6.14
23796	" "	78	1.98	8.41	5.19	19.90	64.52	3.22	1.97	14.29	46.18	4.05
23955	" "	90	2.49	7.27	4.78	21.85	63.61	2.70	2.08	8.24	49.66	5.71
23736	" "	95	1.22	8.15	5.55	20.71	64.37	3.15	2.40	3.28	55.97	5.12
23944	" "	90	1.56	7.93	6.05	22.56	61.90	3.30	2.75	2.66	49.47	9.77
23832	" "	82	1.59	8.81	5.64	22.02	61.94	2.91	2.73	2.33	52.05	7.56
23797	" "	76	1.54	8.01	5.67	22.66	62.12	3.80	1.87	1.50	53.99	6.63
23784	" "	82	1.53	7.91	6.82	23.78	59.96	4.52	2.30	1.37	50.50	8.09
23792	" "	78	3.03	9.84	5.68	24.80	56.65	2.93	2.75	15.29	31.94	9.42
23761	" "	103	1.66	7.62	3.64	18.70	68.38	1.69	1.95	9.90	53.07	5.41
23937	" "	80	1.59	8.76	6.88	21.99	60.78	4.43	2.45	5.68	49.13	5.97
23957	" "	94	1.72	8.11	3.81	26.41	59.95	1.31	2.50	2.29	52.54	5.12
23789	" "	97	1.53	7.62	4.19	23.27	63.39	1.53	2.66	2.14	53.10	8.15

TABLE IV.—CHEMICAL ANALYSES OF DRAINED PEAS (WATER-FREE BASIS) —*Continued.*

Station No.	Sold as	Total Dry Matter per Can.	Ether Extract.	Fiber.	Ash.	Protein (N x 6.25).	Nitrogen-free Extract	Sodium Chloride.	Pea Ash.	Reducing Sugars as Dextrose.	Starch.	Undetermined Carbohydrates.
		gms.	%	%	%	%	%	%	%	%	%	%
23745	Early June	101	1.60	7.91	4.43	20.51	65.55	1.87	2.56	2.56	59.78	3.21
23744	" "	85	3.07	8.95	5.70	26.62	55.66	3.24	2.46	10.89	39.07	5.70
23735	Marrow Sifted	117	1.21	7.12	5.53	22.23	63.91	3.11	2.42	3.54	56.17	4.20
23822	" "	71	2.88	10.78	5.93	26.21	54.20	3.04	2.89	8.06	36.41	9.73
23737	" "	77	3.37	9.87	4.86	27.40	54.50	2.31	2.55	6.21	42.42	5.87
23810	" "	71	2.92	10.60	5.48	21.03	59.97	2.82	2.66	5.79	36.33	17.85
23753	Marrow	108	1.48	7.63	4.44	22.59	63.86	1.40	3.04	12.27	48.52	3.07
23739	"	101	1.27	7.68	4.95	23.13	62.97	2.89	2.06	2.65	56.51	3.81
23946	Telephone	77	2.93	8.73	5.53	27.20	55.61	3.19	2.34	18.47	31.61	5.53
23765	"	71	3.03	9.84	6.52	24.64	55.97	4.08	2.44	28.71	21.67	5.59
23780	"	64	3.84	10.63	6.22	20.97	58.34	2.77	3.45	21.09	29.90	7.35
23805	"	55	3.06	10.85	8.49	25.85	51.75	6.06	2.43	18.32	27.31	6.12
23928	"	90	1.63	7.76	5.54	21.06	64.01	2.81	2.73	3.72	51.66	8.63
23766	"	88	2.90	8.58	4.54	26.59	57.39	2.52	2.02	7.40	40.92	9.07
23833	Sweet Wrinkled	62	2.83	9.55	5.84	24.56	57.22	3.20	2.64	26.32	25.69	5.21
23830	" "	72	3.06	8.80	5.53	27.61	55.00	2.85	2.68	16.70	31.77	6.53
23776	" "	71	3.02	9.87	3.55	27.58	55.98	1.02	2.53	9.24	38.04	8.70
23738	" "	71	2.96	9.75	5.11	26.05	56.13	2.45	2.66	14.30	34.17	7.66
23764	" "	65	3.48	10.66	6.56	23.33	55.97	4.26	2.30	29.05	22.77	4.15
23929	" "	59	3.78	9.34	5.26	27.01	54.61	2.72	2.54	17.67	31.44	5.50
23831	" "	51	3.13	11.18	6.96	24.24	54.49	4.61	2.35	21.97	26.11	6.41
23740	" "	86	2.94	8.69	4.73	25.89	57.76	2.47	2.26	6.69	42.25	8.82
23801	" "	82	2.53	9.44	6.29	26.04	55.70	3.76	2.53	7.65	38.27	9.78
23823	" "	63	3.17	10.30	6.47	23.29	56.77	4.25	2.22	20.36	27.96	8.45
23746	" "	70	3.53	10.78	4.92	25.19	55.58	2.70	2.22	6.74	34.89	13.92
23828	" "	79	2.97	9.64	5.08	27.18	55.13	2.21	2.87	13.56	33.23	8.34
23743	" "	72	3.28	8.19	4.86	22.45	61.22	2.24	2.62	23.87	30.00	7.35
23734	" "	63	3.65	10.31	5.18	24.34	56.52	2.95	2.23	26.10	24.63	5.79
23786	Sweet or Sugar	90	2.69	8.94	4.27	26.26	57.84	1.85	2.42	9.21	37.58	11.05
23939	" " "	67	2.89	10.37	5.42	27.64	53.68	2.89	2.53	15.38	31.11	7.19
23930	" " "	72	2.71	9.94	5.41	25.76	56.18	2.88	2.53	24.00	25.59	6.59
23747	" " "	77	4.24	9.40	5.26	25.95	55.15	3.06	2.20	18.23	31.87	5.05
23940	" " "	67	2.54	9.27	4.87	28.74	54.58	2.02	2.85	8.18	36.10	10.30
23799	" " "	72	2.91	10.08	5.43	27.83	53.75	3.19	2.24	17.53	31.02	5.20
23777	" " "	90	3.70	8.71	5.40	23.69	58.50	3.14	2.26	21.52	32.84	4.14
23798	" " "	85	2.97	9.68	5.05	27.57	54.73	2.64	2.41	11.33	36.26	7.14
23775	" " "	58	3.21	10.87	6.22	27.18	52.52	3.08	3.14	18.14	28.62	5.76
23813	" " "	69	2.89	10.07	6.17	26.71	54.16	3.74	2.43	15.51	29.20	9.45
23804	" " "	73	3.55	9.21	5.88	25.52	55.84	3.44	2.44	21.55	29.17	5.12
23820	Peas	90	1.70	7.67	4.30	23.51	62.82	2.13	2.17	9.84	48.76	4.22
23941	"	81	1.63	8.15	4.61	23.18	62.43	2.47	2.14	12.43	42.60	7.40
23754	"	84	3.29	8.74	4.85	27.36	55.76	1.99	2.86	8.66	36.32	10.78
23733	"	69	3.46	10.10	4.84	25.78	55.82	2.87	1.97	12.33	39.45	4.04
23953	"	49	3.08	11.76	7.17	26.69	51.30	4.45	2.72	19.66	23.60	8.04
23748	"	79	1.88	8.68	5.95	19.83	63.66	3.42	2.53	16.21	42.74	4.71
23759	"	86	1.63	8.26	5.39	21.05	63.67	2.82	2.57	3.98	53.10	6.59
23817	"	61	3.99	10.24	6.01	26.98	52.78	3.80	2.21	15.39	30.10	7.29
23779	"	54	4.18	10.18	6.81	27.02	51.81	3.84	2.97	21.16	26.42	4.23
23819	"	58	3.29	9.23	6.58	26.79	54.11	4.07	2.51	22.53	26.21	5.37
23800	June	73	1.92	7.59	2.99	23.63	63.87	1.01	1.98	4.50	55.41	3.96
23942	"	90	1.46	8.11	5.03	24.34	61.06	2.25	2.78	2.20	49.87	8.99
23927	Medium	53	1.84	10.35	2.92	23.27	61.62	0.46	2.46	6.56	50.18	4.88
23958	Selected	48	3.72	7.91	7.75	22.71	57.91	5.19	2.56	14.65	26.67	16.59
23938	Small Tender	46	2.40	10.19	7.87	27.57	51.97	5.02	2.85	19.93	25.84	6.20
	Maximum	*117*	*4.24*	*11.91*	*9.30*	*30.86*	*68.38*	*6.67*	*3.45*	*28.71*	*59.78*	*17.85*
	Minimum	*27*	*0.77*	*7.12*	*2.92*	*18.43*	*49.75*	*0.46*	*1.77*	*1.37*	*21.38*	*0.48*
	Average	*70*	*2.40*	*9.25*	*5.54*	*24.14*	*58.67*	*3.03*	*2.51*	*11.81*	*39.92*	*6.94*

table, but in the great majority of households this liquor is entirely wasted. In the samples examined the liquor made up from 27 to 49.7 per cent. of the total weight of the can contents, with an average of 36.1 per cent. It is, therefore, of importance to learn just how much nutriment this discarded liquor contains. In our examination water, ash, protein, sucrose, sodium chloride and glucose were determined directly, and starch by difference.

The analysis of the liquor may be summarized as follows:

	Max.	*Min.*	*Ave.*
Water	96.27	89.32	93.33
Ash	2.16	0.49	1.15
Protein	3.04	0.66	1.55
Sucrose	5.21	0.00	2.44
Undetermined, chiefly starch	5.40	0.21	1.53
Sodium chloride	1.73	0.23	0.81
Sodium chloride—free ash	0.64	0.19	0.34

In other words, the composition of the liquor is exceedingly variable. No striking differences in composition are shown between the liquors of the peas of different grades, although in the "petits pois" the percentages of ash, protein and starch are somewhat lower than in the liquor of the more matured peas.

The solid matter of the liquor ranges from 3.73 to 10.68 per cent. This is made up on the average of 23 per cent. protein, 37 per cent. sugar, 23 per cent. starch, 5 per cent. pea ash and 12 per cent. sodium chloride.

The following tabulation shows the average composition of the solids of the drained peas and the liquor of the 111 samples per can:

	206 grams of Liquor contain		364 grams of Drained Peas contain	
Ash	2.37 gms.	= 38% of total.	3.86 gms.	= 62% of total.
Protein	3.19 "	= 16% " "	16.82 "	= 84% " "
Carbohydrates	8.18 "	= 15% " "	47.32 "	= 85% " "
Fat	---	---	1.67 "	= 100% " "
Total Solids	13.74 "	= 16% " "	69.67 "	= 84% " "

That is, 16 per cent. of the total solids of the canned peas is represented in the discarded liquor. This quantity, however, does not necessarily mean that much loss of pea substance, for sugar is often added to sweeten otherwise insipid peas and salt is added for seasoning purposes. The 10 per cent. loss of starch and 16 per cent. loss of protein are, however, actual loss of pea substance, and represent a distinct waste of food. These losses

are due in part to methods of canning, too little liquor causing mushiness in the peas and consequently a thick, cloudy liquor. Even with the best methods of canning, however, the liquor must continue to represent considerable waste, unless the processes can be so improved as to eliminate or reduce the odor of the liquor, which is disagreeable to many, and ensure a nearly clear liquor free of excessive starch. The solubility of a portion of the pea protein in water and weak sodium chlorid solutions seems to present a chemical problem difficult to solve. If, however, the present objectionable features of the liquor can be removed and its use made admissible, this loss of protein becomes entirely a matter of household economics.

The liquor was not examined for metallic contamination, for while certain of the tin and copper salts may be present in the liquor, the fact that the liquor is rarely used as food makes their determination of relative unimportance. Tin, copper and lead were determined in the drained peas and will be discussed later in this report.

In eight of the samples in which sugar was declared on the label, glucose was present; in one of these cane sugar was specifically guaranteed, and this sample was clearly misbranded.

In fifty-six of the samples a plus reading was obtained after inversion, indicating the possible addition of glucose syrup. Calculated as glucose this ranged from 0.27 to 1.30 per cent., with an average of 0.47 per cent.

The Drained Peas.

Below will be found the average analysis of 20 samples of fresh peas by Dubois,* the average analysis of 81 samples of

	Fresh Peas. (Dubois.)		Canned Peas. (Peas and Liquor.) (McElroy and Bigelow.)		Canned Peas. (Peas and Liquor.) (Connecticut.)		Drained Peas. (Connecticut.)		Liquor. (Connecticut.
	Original.	Water-free.	Original.	Water-free.	Original.	Water-free.	Original.	Water-free.	Original
Water	74.97	----	85.48	----	85.37	---	80.86	----	93.33
Ether Extract	0.34	1.35	0.21	1.45	0.29	1.98	0.46	2.40	----
Fiber	2.26	8.96	1.18	8.13	1.13	7.72	1.77	9.25	----
Ash	0.91	3.61	1.11	7.64	1.09	7.45	1.06	5.54	1.15
Protein	6.88	28.13	3.56	24.52	3.51	24.00	4.62	24.14	1.55
Nitrogen-free Ex.	14.64	57.95	8.46	58.26	8.61	58.85	11.23	58.67	3.97
Nitrogen	1.10	4.50	0.57	3.93	0.56	3.83	0.74	3.86	0.25
Sodium Chloride	---	----	0.66	4.55	0.66	4.51	0.58	3.03	0.81
Pea Ash	0.91	3.61	0.45	3.09	0.43	2.94	0.48	2.51	0.34

* U. S. Dept. Agr., Bur. of Chem., Circ. 54.

canned peas (peas and liquor) by McElroy & Bigelow* and the average analysis of our 111 samples (peas, liquor and peas and liquor combined), both in the original material and on the water-free basis.

It appears from the above figures that during canning the peas take up on the average about 8 per cent. of water. The most important changes, however, are in the ash and protein. The ash has increased from 3.61 per cent. in the fresh peas to 5.54 per cent. in the drained peas, water-free basis, on account of the added sodium chloride, 3.03 per cent., the true pea ash showing a loss of 1.10 per cent. The protein has decreased from 28.13 to 24.14 per cent., the loss chiefly occurring during the washing and the blanching of the peas.

The close agreement of the analyses made seventeen years ago by the Bureau of Chemistry and by this laboratory in the present year is quite remarkable. The averages probably represent accurately the composition of canned peas sold in the American market. McElroy and Bigelow's samples represent forty-three of American and thirty-eight of foreign origin, while of our samples ninety-seven were packed in America and fourteen in foreign countries.

The samples showed wide variations in composition in all ingredients, both in the fresh and water-free condition. These variations are due to differences in the methods of canning, in maturity of the peas, in seasoning and sweetening used and in the amount of water added. Dubois† has shown that as the pea matures the ash and crude fiber decrease, and the starch increases, as a rule, while variety and locality appear to have more influence on the protein content. The crude fiber of immature peas, in which the meaty portion has just begun to develop, is usually higher than in the more mature.

In seventy-one of the samples examined the label indicated a distinct classification, based on size. The following table shows the amount of nutriment offered to the consumer under these different group names.

In the original substance it will be noted that the smaller peas have much more water than the larger sizes; for instance, the

* U. S. Dept. Agr., Bur. of Chem., Bull. 13, pt. 8, p. 1094.

† *Loc. cit.*

COMPOSITION OF DRAINED PEAS. (In Original Substance.)

	No.	Water.	Fat.	Fiber.	Ash.	Protein.	Extract.	NaCl.	Sugar.	Starch.	Undetermined Carbohydrates.
Petits Pois	9	84.91	.29	1.58	1.05	3.45	8.72	.64	1.99	5.64	1.09
Petits Pois Extra Fins	1	85.30	.29	1.68	0.95	4.11	7.67	.52	1.82	4.63	1.22
Petits Pois Fins	3	82.47	.22	1.99	1.11	3.98	10.23	.65	1.39	7.44	1.40
Extra Fins, or Extra Sifted	4	86.58	.35	1.46	0.84	3.36	7.41	.50	2.25	3.94	1.23
Early June Extra Sifted	2	84.41	.34	1.38	0.94	3.83	9.10	.53	1.77	6.21	1.12
Sifted or Fins	16	81.07	.43	1.75	1.04	4.42	11.29	.57	2.79	7.24	1.26
Early June Sifted	4	78.85	.38	1.77	1.06	4.78	13.16	.59	1.74	10.33	1.09
Early June	20	77.51	.45	1.89	1.20	5.24	13.71	.66	1.50	10.76	1.45
Marrow Sifted	4	78.91	.53	1.98	1.15	5.09	12.34	.60	1.20	9.26	1.88
Marrow	2	74.53	.35	1.95	1.20	5.82	16.15	.55	1.91	13.37	0.87
Telephone	6	80.81	.55	1.77	1.15	4.68	11.04	.66	2.93	6.72	1.39

COMPOSITION OF DRAINED PEAS. (Water-free Basis.)

	Dry Matter per Can. gms.	Fat.	Fiber.	Ash.	Protein.	Extract.	NaCl.	Sugar.	Starch.	Undetermined Carbohydrates.
Petits Pois	45	2.01	10.44	6.98	22.86	57.71	4.25	13.82	36.54	7.35
Petits Pois Extra Fins	46	1.97	11.43	6.46	27.96	52.18	3.54	12.38	31.50	8.30
Petits Pois Fins	48	1.27	11.37	6.30	22.73	58.33	3.66	7.88	42.43	8.02
Extra Fins, or Extra Sifted	45	2.51	10.85	6.17	24.92	55.55	3.60	17.27	29.09	9.19
Early June Extra Sifted	59	2.42	9.13	6.41	26.02	56.02	3.63	12.48	34.69	8.85
Sifted or Fins	70	2.32	9.36	5.53	23.53	59.26	3.02	15.15	37.41	6.70
Early June Sifted	86	1.80	8.43	5.06	22.67	62.04	2.83	8.26	48.70	5.08
Early June	84	2.09	8.54	5.39	23.56	60.42	2.97	7.32	46.35	6.75
Marrow Sifted	84	2.60	9.59	5.45	24.22	58.14	2.82	5.90	42.83	9.41
Marrow	105	1.38	7.65	4.70	22.86	63.41	2.15	7.46	52.51	3.44
Telephone	74	2.90	9.40	6.14	24.38	57.18	3.57	16.29	33.84	7.05

"extra fins" show 86.58 while the "marrow" contain only 74.53 per cent. The variations in the other ingredients appear more strikingly when studied on the water-free basis. The fiber shows a general decrease from 11.43 in "petits pois extra fins" to 7.65 in "marrow." The ash likewise decreases from 6.98 to 4.70. The variations in protein seem to be independent of the class of peas. The sugar shows wide variations, from 5.90 to 17.27, generally being higher in the smaller peas. The opposite is true with starch, "extra fins" containing 29.09 and "marrow" 52.51. The pea ash is very uniform in all classes, but the smaller varieties generally carry somewhat more sodium chloride.

Two common abuses exist in the pea-canning industry, the addition of sugar or glucose syrup to give character to otherwise insipid, sugarless peas, and the use of "soaked" peas. We have already referred to the former in our consideration of the composition of the pea liquor. The sugar in the liquor was found to range from none at all to 5.21 per cent., with an average of 2.44, equivalent to 37 per cent. of the liquor solids. In fifty-six samples the presence of glucose was also shown, ranging from 0.27 to 1.30 per cent. Total reducing sugars were also determined in the drained peas and are reported in the tables calculated as dextrose. These range from 0.34 to 5.18, average 2.26, per cent. in the original substance, or from 1.37 to 28.71, average 11.81, per cent. in the water-free material.

There is considerable difference of opinion as to the nature of the nitrogen-free extract of fresh peas. R. Sachse* found in 62.70 per cent. of the extract, 42.44 per cent. starch and 6.50 per cent. dextrin. E. Schulze* found in the dry matter 6.22 per cent. of saccharose and galactan, and 40.49 per cent. of starch. König† also gives an analysis with 64.77 per cent. of nitrogen-free extract, with 5.09 per cent. of dextrin and no sugar. As already stated, we did not determine the nature of the sugar present, but only the total reducing sugars calculated as dextrose. Probably the small percentages of undetermined carbohydrates, 0.09 to 3.42 per cent., reported in our tables, consist chiefly of galactan.

On the labels of eighteen samples added sugar is declared, on eight "sugar" is part of the brand name. On twenty-two "sweet" is similarly used, while on the other sixty-three no sugar is declared or any claim made as to superior sweetness. The sugar content of these four groups was as follows in the water-free material:

	Max.	*Min.*	*Ave.*
Added sugar declared	28.71	7.65	14.02
"Sugar" in brand name	24.00	8.18	17.06
"Sweet" in brand name	29.05	6.21	17.77
No reference to sugar on label	24.49	1.37	8.43

While the amount of reducing sugars natural to the pea is somewhat in doubt, it is worthy of note that the minimum percentage of sugar in the dry matter of those samples in which added sugar is declared is 7.65 per cent. It is not unreasonable, therefore, to suspect added sugar in samples showing more than this percentage. Of the sixty-three samples in which no reference to sugar or added sweetening is made on the label, twenty-seven show from 1.37 to 7.79, seven from 8.06 to 11.46, eighteen from 12.27 to 15.42, and eleven from 16.21 to 24.49 per cent. in

* König, Chem. der Mensch. Nahr. u. Genussm., 1904, *2*, 787.
† König, *1*, 636.

the dry matter. The last two classes, numbering twenty-nine samples, certainly contain sugars in amounts exceeding the quantities naturally found in peas. These samples also have excessive amounts of sugar in the pea liquor. Unless the addition of sugar is clearly stated on the label, its use is a deception. The natural sweetness of peas, as of other vegetables, decreases rapidly after picking and with maturity, and the addition of sugar as a rule indicates the use of peas either not freshly picked or over-mature.

Soaked Peas.

In addition to the canning of fresh peas, at certain canneries it is the practice to use dried green or Scotch peas, chiefly grown in Michigan and Wisconsin. These peas are received by the packers dry and after soaking for from twelve to thirty-six hours are blanched, canned and processed in the usual way. It is manifestly misbranding to sell these soaked peas as fresh peas.

The appearance of the peas is of some value in distinguishing soaked from fresh peas. The former are generally more or less broken, the cotyledons are generally more developed, especially in the mature peas, and the liquor is more liable to be thick and starchy. Maturity, however, is not a sure guide, because old and well-developed peas are frequently packed in the fresh condition; and mature fresh peas, over-processed or packed with too little liquor, will give a liquor very similar to that of soaked peas.

Dubois,* in his study of soaked peas, has shown that "it is not hard to distinguish the fresh and more succulent grades from the soaked material, the chief difficulty arising in differentiating between the soaked goods and the more matured peas put up in the usual way." He found the average water content of twenty-two samples of soaked peas to be 72.02, with a maximum of 74.92, and the average for twenty-one samples of mature fresh peas 76.54 per cent., with a minimum of 70.79. This overlapping of results renders impossible a definite conclusion from this determination. Likewise he found the crude starch† in the soaked peas to range from 18.19 to 11.08 per cent., with an average of 13.98, while the average crude starch content of fresh

* *Loc. cit.*
† Includes all carbohydrates hydrolyzed by dilute hydrochloric acid, which reduce copper.

matured peas was 11.05, again an overlapping of results. He found, however, that the average crude starch content of soaked peas was about "4 per cent. higher than that of Early Junes and peas of similar quality."

We found the starch,* in our analyses, to range from 2.04 to 15.65, with an average of 7.64 per cent., in the drained peas, and from 21.38 to 59.78, with an average of 39.92 per cent. in the water-free substance. In the following summary the samples are grouped according to starch content in the fresh material, showing the variations in water content of the drained peas, the solids of the liquor, and the starch of the drained peas in the water-free material.

Per Cent. of Starch.	No.	In Drained Peas. Original Substance. Starch Ave.	Water. Max.	Water. Min.	Water. Ave	Solids in Liquor. Original Substance. Max.	Min.	Ave.	Starch in Drained Peas. Water-free Basis. Max.	Min.	Ave.
Under 4	13	3.40	90.46	82.83	86.78	8.92	4.69	6.17	31.66	21.38	25.72
" 5	17	4.43	86.66	82.17	84.29	8.59	5.29	7.09	34.47	22.77	28.20
" 6	14	5.54	86.10	81.11	82.49	8.82	5.15	7.16	37.63	29.17	31.64
" 7	14	6.64	83.55	78.87	81.00	8.54	4.16	6.41	41.28	30.63	34.95
" 8	9	7.56	83.66	77.04	80.71	8.87	3.88	5.98	46.14	32.84	39.19
" 9	10	8.61	81.75	76.90	79.44	7.79	3.73	6.06	47.21	36.32	41.88
" 10	7	9.59	80.66	76.22	78.25	7.36	3.77	6.24	50.18	39.07	44.09
" 11	6	10.56	80.24	78.19	78.77	7.80	4.88	6.41	55.41	46.18	49.74
" 12	6	11.58	77.97	75.94	76.90	10.68	6.95	8.29	52.05	48.76	50.13
Over 12	15	13.37	76.63	73.82	74.92	8.04	4.89	6.81	59.78	48.52	53.31

The above table shows that on the average there is quite a close relation between the amount of water and starch in the drained peas and the amount of starch in the liquor. The average water steadily decreases as the starch increases. Unfortunately, confirming Dubois's experience, there is an overlapping of results in individual analyses, and the distinction of the soaked from the fresh peas is far from clear.

Considered from the standpoint of size, in our analyses the different grades showed the following variations in starch, dry basis:

Petits Pois	25.04	to 47.21,	average	37.51
Extra Sifted	21.38	" 47.99,	"	30.95
Sifted	24.15	" 50.69,	"	39.67
Early June	27.28	" 59.78,	"	46.35
Marrow	36.33	" 56.51,	"	46.06
Telephone	21.67	" 51.66,	"	33.85
Unclassified	22.77	" 55.41,	"	38.95

* All water-soluble carbohydrates removed before hydrolysis.

Grouping the samples according to starch content we have thirty containing from 21 to 30 per cent., thirty-eight from 31 to 40 per cent., thirty from 41 to 50 per cent., and thirteen over 50 per cent. Judging from our present information, a sample showing 45 per cent. or more of starch in the dry matter may be suspected to consist of either very mature or soaked peas. We find thirty-five such among our samples. The pea liquor of three of these was slightly cloudy, of eleven cloudy, of sixteen thick and of five very thick; in nine of them the consistency of the peas was good, in twenty-three they were hard, and in three were soft; the cotyledons were prominent in twenty-two, not prominent in eleven and of varying prominence in two. Accepting as characteristics of soaked peas a thick liquor, peas of hard consistency, cotyledons prominent, and a starch content of over 45 per cent. in the dry matter, we find sixteen samples which have all these characters. They are Nos. 23811, 23774, 23945, 23821, 23955, 23944, 23832, 23784, 23761, 23957, 23789, 23735, 23753, 23739, 23928, 23942. While we cannot say definitely that these samples are soaked peas, we can say that they are of inferior quality. These samples likewise show a low water content, ranging from 72.83 to 78.51, with an average of 75.74 per cent., as compared with the general average of 80.86 and the maximum of 90.46 per cent.

The Nutriment of Canned Peas.

The following tabulation shows the average weights, in grams, of the different ingredients contained in a can of dried peas of the class indicated by the label.

The larger peas contain the larger amount of nutriment and cost less. Thus a can of "marrow" peas supplies 385 Calories, and a can of "petits pois" only 157. Furthermore, the former show an average cost of 11 cents per can, the latter 19 cents per can, making the cost per 100 Calories in "marrow" peas 2.9 cents, while in "petits pois" it is 12.1 cents, or over four times as much. There can be no argument as to which is the more economical purchase, but as already stated, delicacy and flavor are also important, and these are found in higher degree in the smaller, higher-priced peas.

NUTRIENTS PER CAN OF DRAINED PEAS, IN GRAMS.

	Ether Extract.	Crude Fiber.	Ash.	Protein.	Carbohydrates.	Sodium Chloride.	Pea Ash.	Reducing Sugars.	Starch.	Undetermined Carbohydrates.	Calories per 100 gms. Drained Peas.	Calories per Can of Drained Peas.
Petits Pois	0.90	4.70	3.14	10.29	25.97	1.91	1.23	6.22	16.44	3.31	53	157
Petits Pois Extra Fins	0.91	5.26	2.97	12.86	24.00	1.63	1.34	5.69	14.49	3.82	51	160
Petits Pois Fins	0.61	5.46	3.02	10.91	28.00	1.76	1.26	3.78	20.37	3.85	60	165
Extra Fins or Extra Sifted	1.13	4.88	2.78	11.21	25.00	1.62	1.16	7.77	13.09	4.14	47	159
Early June Extra Sifted	1.43	5.39	3.78	15.35	33.05	2.14	1.64	7.36	20.47	5.22	56	211
Sifted or Fins	1.62	6.55	3.87	16.47	41.49	1.76	2.11	10.61	26.19	4.69	77	253
Early June Sifted	1.55	7.25	4.35	19.50	53.35	2.43	1.92	7.10	41.88	4.37	82	313
Early June	1.76	7.17	4.53	19.79	50.75	2.49	2.04	6.15	38.93	5.67	82	306
Marrow Sifted	2.18	8.06	4.58	20.34	48.84	2.37	2.21	4.96	35.98	7.90	76	304
Marrow	1.45	8.03	4.94	24.00	66.58	2.26	2.68	7.83	55.14	3.61	93	385
Telephone	2.15	6.96	4.54	18.04	42.31	2.64	1.90	12.05	25 04	5.22	70	267

Metallic Contaminations.

To give the peas what the consumer has come to regard as a more attractive appearance, salts of copper or zinc are frequently used, especially in peas imported from Europe. The quantity of these metals present is usually small, and its effect on the health of the consumer has been a subject of long and still unsettled controversy. It is generally conceded that the occasional ingestion of a small amount of a copper or zinc salt may result in no noticeable injury to health. But the continued and regular ingestion of even small quantities of these metallic salts must be considered as at least prejudicial to health. While the Federal Government has taken a wavering attitude on this subject, first prohibiting the importation of "greened" peas, then later removing this embargo, provided the peas did not "contain an excessive amount of copper," the present requirement is that where "greening" is practiced, the fact must be clearly stated on the label. In this way the choice is left to the consumer, whether or not he shall use the artificially colored product.

Another source of metallic contamination is the tin used in making the container. In this country there is no restriction as to the quality of the tin employed, and in consequence the tin of some cans has been found to contain as much as 12 per cent. of lead.* Lead as a constituent of food products has as yet found

* McElroy and Bigelow, *loc. cit.*

no champion. The continued ingestion of even small amounts of it is followed by most serious results. Tin salts themselves are much less poisonous than lead, and are quite commonly found in canned vegetables. The solder used is another source of contamination, especially when it is allowed to come into contact with the contents of the can. Occasionally, too, through carelessness, fragments of solder are found in the peas, but these offer little danger to the consumer, as they would as a rule be easily detected. In only three samples were solder fragments found in noticeable quantities, in Nos. 23743, 23775 and 23738. In the first two the amount was small, but in the last it amounted to 1.5 gms. These fragments were excluded from the samples taken for analysis.

Lead was not found with certainty in any sample, although in six its absence was questionable.

Copper was found in fourteen samples, in twelve of which its presence was stated on the label. The other two, Nos. 23793 and 23808, *Lemoine Petits Pois Fins*, and *Rodier's Petits Pois Fins*, must be considered adulterated, as they contained 27 and 14 mgms. of copper per kilo of drained peas, respectively. The copper content of the "greened" peas ranged from 8 to 67 mgms. per kilo. The amounts of copper found in 23825, 23749 and 23949, namely, 4 5 58 and 67 mgms. per kilo, are very excessive. In no case was copper found in peas packed in this country.

TABLE V.—COPPER IN DRAINED PEAS.

Station No.	Sold as	Copper Mgms. per kilo of peas.	Station No.	Sold as	Copper Mgms. per kilo of peas.
23936	*Petits Pois	8	23808	Petits Pois Fins	14
23949	* " "	67	23807	*Extra Fins	13
23816	* " "	15	23791	* " "	16
23825	* " "	45	23755	*Fins	25
23750	*Petits Pois Extra Fins	18	23812	* "	15
23749	*Petits Pois Fins	58	23931	* "	28
23793	" " "	27	23927	*Medium	9

* Labeled "colored with sulphate of copper."

Tin was found in weighable quantities in eighty-eight of the 111 samples. The quantity ranged from 2 to 395 mgms. per kilo of drained peas.

TABLE VI.—TIN IN DRAINED PEAS.

Station No.	Tin Mgms. per kilo of peas.	Station No.	Tin Mgms. per kilo of peas.	Station No.	Tin Mgms. per kilo of peas.	Station No.	Tin Mgms. per kilo of peas.
23936	115	23824	28	23744	109	23746	78
23815	13	23812	30	23735	30	23828	24
23947	11	23755	142	23822	33	23743	9
23949	38	23959	20	23737	71	23734	40
23816	31	23795	69	23810	31	23939	23
23825	65	23806	21	23753	13	23730	19
23809	45	23772	20	23739	104	23747	4
23814	4	23778	38	23946	21	23940	28
23750	168	23834	18	23765	50	23775	101
23749	121	23954	45	23805	5	23804	4
23793	184	23821	59	23928	53	23820	44
23808	215	23803	23	23766	44	23941	2
23807	21	23950	13	23833	11	23754	19
23752	30	23796	30	23830	23	23733	25
23956	55	23955	56	23776	35	23953	37
23932	22	23736	36	23738	111	23748	24
23756	54	23832	39	23764	20	23817	51
23931	395	23792	44	23929	33	23800	8
23751	10	23761	70	23831	25	23942	12
23760	112	23937	36	23740	100	23927	50
23943	19	23957	54	23801	9	23958	27
23802	2	23745	8	23823	39	23938	18

No attempt was made to determine how much of this tin existed in a soluble form; if it were all insoluble, the possibility of danger from its use would be much decreased. Thirteen of these samples also contained so much copper that the consumer would receive a more than liberal dosage of metals. In 23749, for instance, he would ingest in one kilo of drained peas 121 mgms. of tin and 58 mgms. of copper. As one can of this sample contained 268 gms. of drained peas, each can contained about one-fourth of the above amounts, or 30 mgms. of tin and 15 mgms. of copper. In 23931 each can of drained peas contained about 100 mgms. of tin and 7 mgms. of copper. The differences in tin content of the peas packed in this country and those packed abroad is very striking. The tin content of the fourteen foreign samples ranged from none (in one sample) to 395, with an average of 113 mgms. per kilo; in the ninety-seven domestic samples it ranged from none (in twenty-three samples) to 112, with an average of 28 mgms. per kilo. The following tabulation shows more clearly the variations in the two sets of samples.

Tin Content (mgms. per kilo of Drained Peas).

Mgms. of Tin.	Foreign Packed. No. of Samples.	Foreign Packed. Per Cent.	Domestic Packed. No. of Samples.	Domestic Packed. Per Cent.
None	1	7	23	24
1 to 20	0	0	26	27
21 to 50	5	36	31	32
51 to 100	1	7	11	11
Over 100	7	50	6	6
	14	100	97	100

The superiority of the domestic peas as regards metallic contamination is marked.

Summary.

One hundred and eleven samples were examined, fourteen of foreign and ninety-seven of domestic packing.

The drained peas ranged in weight from 211 to 455 gms., average, 364 gms.; the weight of the liquor ranged from 101 to 305 gms., average, 206 gms.; the liquor made up from 27 to 50 per cent., average, 36 per cent., of the total weight of the sample.

The drained peas showed normal weight in 34 per cent. of the ninety-two samples packed in No. 2 cans, excess weight in 5 per cent., and a tendency toward short weight in 61 per cent. Three samples showed a great deficiency in fill of peas.

The peas cost from 8 to 30 cents per can, average, 13.5 cents. The cost per pound of drained peas ranged from 9.8 to 46.4 cents, average, 16.8 cents.; the smallest peas, "petits pois," averaging 29.8 cents, the "marrowfats" and "telephones," 13.1 and 14.4 cents, respectively.

The liquor was perfectly clear in no case; in ten it was slightly cloudy, in sixty-three cloudy, in thirty-three thick and in five very thick and pasty.

Thirty samples, or 27 per cent., showed over 0.4 inch of empty can, indicating short fill. In thirteen samples there was too little liquor for the peas, in thirty-one it was excessive and in seven very excessive.

The weight of one hundred drained peas ranged from 16 to 83 gms., average, 40 gms.

Of the seventy-two samples indicating a standard size on the label, twenty-three were true to size, thirty-four were smaller and fifteen larger.

The solid matter of the pea liquor ranged from 3.73 to 10.68 per cent., average, 6.67 per cent. On the average it was composed of 23 per cent. protein, 37 per cent. sugar, 23 per cent. starch, 5 per cent. pea ash, and 12 per cent. sodium chloride.

In fifty-six samples the pea liquor indicated the presence of glucose, ranging from 0.27 to 1.30 per cent. In no case was glucose declared on the label.

The liquor contained on the average 16 per cent. of the total solids of the canned peas. Ten per cent. of the starch and 16 per cent. of the protein of the peas are lost in the discarded liquor.

In the drained peas the water ranged from 72.83 to 90.46, average, 80.86 per cent.; starch from 2.04 to 15.65, average, 7.64 per cent.; sodium chloride from 0.09 to 1.12, average, 0.58 per cent.

In the smaller, less mature peas the fiber, sugar and ash are generally higher, while the starch is higher in the more mature peas.

In forty-eight samples the use of sugar was either declared on the label, or indicated in the brand name; in twenty-nine of the other sixty-three samples the sugar ranged from 12.27 to 24.49 per cent. in the dry matter, indicating added sugar.

On the average there is quite a close relation between the amount of water and starch in the drained peas and the amount of starch in the liquor. The average water steadily decreases as the starch increases.

Thirty samples contained from 21 to 30 per cent. of starch thirty-eight from 31 to 40 per cent.; thirty from 41 to 50 per cent., and thirteen over 50 per cent., dry basis.

Thirty-five samples contained 45 per cent. or more of starch dry basis; sixteen of these by their high starch content, by their thick liquor, by the hardness of the peas and by the prominence of the cotyledons, and by their low water content, 72.83 to 78.51 per cent., are shown to be either "soaked peas" or over-mature peas of inferior quality.

The larger, more mature peas contain the most actual nutriment, a can of "marrowfats" supplying 385 Calories, a can of "petits pois" 157 Calories. The cost of 100 Calories in the "marrowfats" is 2.9 cents, in the "petits pois," 12.1 cents.

Lead was found with positive certainty in no sample.

Copper was found in fourteen samples, all of foreign pack, ranging from 8 to 67 mgms. per kilo of drained peas.

Tin was found in weighable quantities in eighty-eight samples, ranging from 2 to 395 mgms. per kilo of drained peas. Thirteen of these also contained copper. In the peas packed abroad the tin ranged from none (in one sample) to 395, average, 113 mgms. per kilo; in the domestic peas, from none (in twenty-three samples) to 112, average 28 mgms. per kilo.

METHODS OF ANALYSIS.

Physical.

Preliminary Examination. Weigh the full can unopened; open can carefully close to the edge, avoiding all loss, and pour off the liquor through a sieve, allowing the peas to drain for one minute; catch the liquor in a tared flask, and weigh; also weigh the empty can. From these weights the weights of the total contents of the can, of the solid contents, together with adhering moisture, and of the liquid contents are calculated.

On opening the can note whether there is an outflow of gas, any corrosion or discoloration of the can, and whether the contents of the can are covered with a mucilaginous film. Measure the distance between the surface of the liquor and the top of the can, and the depth of the liquor above the peas. Note also color and consistency of peas and whether they are smooth or wrinkled; note development, if any, of cotyledons.

After weighing the sample, count out one hundred peas, fairly representative of the whole sample, and weigh. Grade these peas by size by means of a series of sieves containing openings $\frac{9}{32}$, $\frac{10}{32}$, $\frac{11}{32}$, $\frac{12}{32}$ and $\frac{13}{32}$ of an inch in diameter. Record number of peas of each grade, and grade as Nos. 1, 2, 3, 4, 5 and 6 respectively. The separations must be done quickly to avoid excessive losses of moisture.

Prepare salt solutions of 1.04 and 1.07 sp. gr. Determine in a cylinder how many of the counted hundred peas float in the 1.04 solution, those which sink in the 1.04 and float in the 1.07 solution, and those which sink in the 1.07 solution. Grade these as quality 1, 2 and 3 respectively.

Dry the remainder of the solid contents of the can (total peas less one hundred) at not over 100° C. until sufficiently dry for grinding so as to pass a $\frac{1}{50}$ in. sieve. Pick out all globules of solder as far as possible before grinding, and also separate other particles which may appear during the sifting of the sample.

Bottle the ground sample and use for analysis.

Chemical.

Liquor. Determine water, ash and protein in 25 gm. portions in the usual way. Polarize before and after inversion.

Drained Peas. Determine water, ether extract, crude fiber, protein and ash in the usual way.

Determine *sodium chloride* by washing residue from ash determination into a 100 c.c. flask with water and enough dilute nitric acid to make Congo red blue. Add powdered calcium carbonate to distinct alkalinity and boil to expel carbonic acid. Cool, make up to the mark, filter and pipette 50 c.c. of the filtrate into a beaker, and titrate with tenth-normal silver nitrate solution, using potassium chromate as indicator.

Determine *crude starch* in 4 gms. of material by the diastase method.

Heavy Metals.

Char 25 grams of material in a porcelain dish. Moisten the charred mass with concentrated sulphuric acid and burn as completely as possible, adding nitric acid if necessary. Digest the ash on steam-bath for fifteen minutes with 15 c.c. of water and a few drops of 50 per cent. sulphuric acid. Filter and wash with hot water. The residue (I) may contain lead sulphate, insoluble tin and silica. The filtrate (II) will contain any copper, zinc and soluble tin.

Wash residue (I) into a beaker with 25 c.c. of 10 per cent. acid ammonium acetate, heat to boliing, filter and wash with hot water. This removes lead, which may be determined in the filtrate as lead sulphate by the alcohol method. The residue (III) contains insoluble tin and silica.

Acidify filtrate (II) with 2-3 c.c. of concentrated hydrochloric acid and pass hydrogen sulphide into the hot solution so long as a precipitate forms. Place upon a steam bath and allow the sulphides to settle. Filter and wash with hot water containing hydrogen sulphide. This removes zinc, which may be determined in the filtrate. The insol. residue (IV) contains the sulphides of copper and tin.

Unite residues (III) and (IV) and fuse for 20 minutes in a covered porcelain crucible with three times their weight of a mixture of equal parts of sodium carbonate and sulphur. Dissolve the fused mass in water, transfer to a beaker and boil for five minutes. Filter and wash with hot water. Acidify the filtrate with a few drops of concentrated hydrochloric acid and place upon a steam bath to facilitate the separation of tin sulphide. Filter, wash with water, ignite in a porcelain crucible with access of air and weigh as SnO_2.

Boil the residue, left after filtering the fused mass with dilute nitric acid for five minutes. Filter and wash with hot water. Neutralize the filtrate with ammonia and add a few drops of concentrated hydrochloric acid. Precipitate the copper by passing hydrogen sulphide into the solution, filter off the copper sulphide and wash with hot water. Ignite in hydrogen and weigh as the sulphide Cu_2S. For the small amount of copper obtained it is practicable to ignite in air and weigh as CuO.

CANNED SOUPS.

The meat of soup stock yields to water a large part of its so-called "extractives" and mineral matter. The small quantities of protein or flesh-forming material which are dissolved

in water are made insoluble again by cooking and are skimmed off with the fat. From the connective tissue of meat some gelatin is formed by cooking, which remains in the finished clear soup, and is what causes it to "set" to a jelly if quite concentrated, but this gelatin has not a high nutritive value.

It follows that a clear soup, like bouillon, contains but little nutriment. Nevertheless the salts and extractives in a soup, which are the flavoring constituents of the meat, have a dietetic value as "appetizers" and aids to digestion through the stimulation of the flow of gastric juice.

Soups thickened with cereals or to which prepared vegetables or meats are added contain of course much more nourishment than clear meat soups.

The serving of soup at the beginning of a meal is an entirely rational practice.

These two types of soup, namely clear meat soup and vegetable soup, are represented in the eighteen samples examined; six of bouillon and twelve of tomato soup. The analyses are given in Tables VII and VIII.

Bouillon.

The samples contained from 92.03 to 96.41 per cent. of water, or from 3.59 to 7.97 per cent. of solid matter. The ether extract

TABLE VII.—CANNED SOUP—BOUILLON.*

Station Number.	Brand.	Net weight of soup.	Price per can.	Cost per lb. of soup.	Water.	Ash.	Ether Extract.	Protein (N x 6.25).	Undetermined.	Chlorine calculated as salt.	Nitrogen.
		oz.	cts.	cts.							
23935	Amcehat. Acker, Merrall & Condit Co., N. Y.	11.2	9	12.9	92.03	1.65	0.08	2.03	4.21	1.41	.324
23952	Schimmel's. The American Preserve Co., Phila.	10.8	8	11.9	94.74	2.48	0.09	0.83	1.86	2.26	.133
23762	Campbell's. Joseph Campbell Co., Camden, N. J.	10.7	9	13.5	93.75	2.01	0.06	1.32	2.86	1.81	.211
23951	Blue Label. Curtice Bros. & Co., Rochester, N. Y.	33.7	30	14.2	95.67	1.23	0.15	2.09	0.86	0.93	.334
23763	The Franco-American Food Co.	32.6	28	13.7	95.05	1.10	0.06	1.56	2.23	0.89	.250
23757	Mohican. The Mohican Co., New York	11.2	9	12.9	96.41	2.68	0.09	0.49	0.33	2.48	.079
	Average				*94.61*	*1.86*	*0.09*	*1.39*	*2.05*	*1.63*	*.222*

*Contain no benzoic or salicylic acid.

was low in all samples, while the ash and protein showed considerable range. The range of percentage of ash was caused by the common salt, which made up from 18 to 69 per cent. of the total solid matter of the soup, and was excessive in Nos. 23952 and 23757. In these two samples the protein matter is also extremely low; namely, 0.83 and 0.49 per cent., respectively.

The analyses show that at most the amount of nutriment in bouillon is small, while in some samples there is almost no nutriment. In one case the purchaser pays nearly 13 cents per pound for a material, nearly 99 per cent. of which is water and salt.

None of the samples contained benzoic or salicylic acid.

The samples cost from 11.9 to 14.2 cents per pound of soup, with an average of 13.2 cents.

TABLE VIII.—CANNED SOUP—TOMATO.*

Station Number.	Brand.	Net weight of soup.	Price per can.	Cost per lb. of soup.	Water.	Ash.	Ether Extract.	Protein (N x 6.25).	Nitrogen-free Extract.	Chlorine calculated as salt.	Nitrogen.
		oz.	cts.	cts.							
23934	Amcehat. Acker, Merrall & Condit Co., N. Y.	11.7	9	12.3	84.01	3.68	0.69	1.41	10.21	2.96	.225
23741	Campbell's. Joseph Campbell Co., Camden, N. J.	11.7	10	13.7	85.06	2.48	0.80	1.18	10.48	1.96	.189
23781	Columbia Clear. Columbia Conserve Co., Ind'napolis	15.3	15	15.7	89.18	1.62	0.25	0.97	7.98	1.15	.155
23933	Blue Label. Curtice Bros. Co., Rochester, N. Y.	34.0	30	14.1	91.23	1.31	0.24	1.06	6.16	0.99	.170
23827	The Franco-American Food Co.	16.9	18	17.0	88.61	1.59	0.16	1.88	7.76	1.28	.300
23818	A. & P. The Great Atlantic & Pacific Tea Co., N. Y.	11.6	9	12.4	80.54	3.49	0.57	1.50	13.90	2.83	.240
23742	Heinz. H. J. Heinz Co., Pittsburg, Pa.	30.5	25	13.1	88.21	2.26	2.08	1.07	6.38	1.66	.171
23769	Mohican. The Mohican Co., New York	11.7	10	13.7	83.17	3.42	0.55	1.60	11.26	2.73	.256
23948	P. & W. Potter & Wrightington, Boston	11.6	8	11.0	83.29	2.77	0.70	1.44	11.80	2.02	.230
23794	Richardson & Robbins, Dover, Del.	32.1	25	12.5	89.74	1.25	1.13	2.38	5.50	0.66	.380
23829	Snider's. The T. A. Snider Preserve Co., Cin., O.	11.5	10	13.9	84.90	1.75	0.22	1.81	11.32	1.00	.290
23770	Van Camp's. The Van Camp Packing Co., Indianapolis	11.4	9	12.6	83.82	2.57	0.98	1.61	11.02	1.90	.258
	Average				*85.98*	*2.35*	*0.70*	*1.49*	*9.48*	*1.76*	*.239*

*Contain no benzoic or salicylic acid.

Tomato Soup.

The samples contained from 80.54 to 91.23 per cent. of water, or from 8.77 to 19.46 per cent. of solid matter. The range of percentages of all the ingredients was much greater than in the case of bouillon. The amount of salt added was much less than in the bouillons, 19 per cent. of the solids being the maximum. The wide differences in percentages of nitrogen-free extract are due in some cases, as in No. 23818, to the addition of starch and sugar. The differences in percentage of ether extract, from 0.16 to 2.08 per cent., are very striking. The highest fat is found in No. 23742, in which the label states that the manufacturer has used "pure sweet cream," a statement which is supported by the analysis.

These analyses show that tomato soup contains very much more actual nutriment than bouillon. The solids are about two and one-half times greater, and in addition to considerable quantities of fat, starch and sugar are present in considerable amounts.

None of the samples contained benzoic or salicylic acid or artificial color.

The cost per pound of soup ranged from 11 to 17 cents, the average cost, 13.5 cents, being only slightly higher than that of bouillon.

FLAVORING EXTRACTS.

Our examination this year includes fourteen samples of almond, two of banana, thirty-four of ginger, twenty of orange, thirteen of peppermint, thirteen of pineapple, seven of raspberry, fifteen of strawberry, and eleven of wintergreen extracts. In addition we have examined for the dairy commissioner two ginger, five lemon, two orange, five peppermint, three vanilla, and one wintergreen extract.

The law unfortunately permits, in the case of a drug of less than standard U. S. P. strength, a statement of its strength on the label. This provision does not apply to foods, under which head flavoring extracts are included. If, for instance, a lemon extract contains only 3 per cent. of lemon oil instead of the standard 5 per cent., it cannot legally be labeled "lemon extract, three-fifths standard strength," for the product is not entitled to the name "lemon extract" at all. It might be labeled "compound lemon extract and water," or "imitation lemon extract," as the case might be, but in all cases its compound nature should be stated clearly on the label. Many manufacturers still seem to be unable or unwilling to understand this point in the law.

Almond Extract.

Standard almond extract is "the flavoring extract prepared from oil of bitter almonds, free from hydrocyanic acid, and contains not less than one (1) per cent. by volume of oil of bitter almonds."

The unpurified oil of bitter almonds consists chiefly of benzaldehyde, with a small amount of hydrocyanic acid, which is extremely poisonous. Benzaldehyde is produced artificially, and this synthetic benzaldehyde has the same properties as pure oil of bitter almonds, and possesses the great advantage of freedom from hydrocyanic acid. For this reason it has largely taken the place of the natural oil in the market.

The chief adulterants of almond extract are hydrocyanic acid and nitrobenzol. Occasionally also there is a deficiency of almond oil and alcohol.

Of the fourteen samples examined, eight contained the standard amount of almond oil, and were free of hydrocyanic acid and nitrobenzol. Six samples were adulterated; five were below standard in almond oil, two contained hydrocyanic acid, and one nitrobenzol. Sample 23680, although containing only 0.84 per cent. of the oil, was misbranded "triple strength." Sample 23246 bore the indefinite and misleading formula "70 parts hydro-alcoholic sol. oil almond, 30 parts aqua." As the strength of the "hydro-alcoholic solution" is not specified, the label conveys no useful information.

The cost of the pure extracts ranged from 15 to 25 cents for from 1.8 to 3.2 fluidounces, with an average cost of 9.3 cents per fluidounce. In the adulterated extracts the cost ranged from 10 to 30 cents for from 1.1 to 2.2 fluidounces, with an average cost of 10 cents per fluidounce.

Four samples were guaranteed on the label as to quantity. These guarantees were met in all cases except in sample 23082, where there was a deficiency of 10 per cent.

For methods of analysis see page 515.

TABLE IX.—ALMOND EXTRACT UP TO STANDARD.

Station Number.	Brand.	Dealer.	Price per bottle, cts.	Capacity of bottle, fluid oz.	Almond oil by volume. Volumetric.	Almond oil by volume. Gravimetric.	Remarks.
23679	Burnett's Superior Extract of Almond. Joseph Burnett Co., Boston	*New Haven:* E. E. Hall	18	2.1	1.43	---	
23251	Capital House Pure Extract Almond	*Middletown:* Middletown Cash Groc.	20	2.0	---	1.32	
23017	A. & P. Almond. The Great Atlantic & Pacific Tea Co., New York	*Bridgeport:* Atlantic & Pacific Tea Co.	25	1.9	---	1.39	
23083	Howco Pure Flavoring Extracts, Almond	*Bridgeport:* Howland Dry Goods Co.	15	1.8	1.85	1.86	
23020	Monogram Brand Finest Extract Almond	*Bridgeport:* Bridgeport Public Market	20	2.1	1.42	1.46	
23082	Van Duzer's Fruit Extracts High. Conc. Almond. Van Duzer Extract Co., N. Y.	*Milford:* Perry & Perry	20	1.8	1.01	1.03	
23677	Van Dyk's Ambassador Brand Extract of Almond. James Van Dyk Co., N. Y.	*Bridgeport:* Van Dyk's Tea Store	19	3.2	1.10	---	
23072	Williams Pure Extract of Almond. The Williams & Carleton Co., Hartford	*West Haven:* R. G. Green	20	2.0	2.01	2.01	

TABLE X.—ALMOND EXTRACT BELOW STANDARD, OR ADULTERATED.

Station Number.	Brand.	Dealer.	Price per bottle, cts.	Capacity of bottle, fluid oz.	Almond oil by volume. Volumetric.	Almond oil by volume. Gravimetric.	Remarks.
23673	Monarch Flavoring Extr's Almond, High. Conc. Austin, Nichols & Co., N. Y.	*Bridgeport:* Bridgeport Public Market	18	2.2	1.06	---	Contains hydrocyanic acid.
23680	*Colton's Select Flavors Almond. J. W. Colton, Springfield, Mass.	*New Haven:* John R. Gilbert & Son	30	2.0	0.84	---	Label illegal.
23309	Harris' Pure Extract Almond. Frank E. Harris, Binghamton, N. Y.	*Hartford:* Brown, Thomson & Co.	15	1.1	0.93	0.93	
23037	Pansy Almond Flavoring Compound. Pansy Extract Co., (The A. Colburn Co., Phila.)	*Stamford:* New York Cash Grocery	10	1.4	---	---	Contains nitrobenzol.
23246	†St. John's Extract of Almond. St. John & Co., New York	*Middletown:* C. A. Allison	15	1.8	0.71	0.72	Label misleading.
23085	Van Dyk's Ambassador Brand Extract of Almond. James Van Dyk Co., N. Y.	*Bridgeport:* Van Dyk's Tea Store	10	1.3	0.82	0.85	Contains hydrocyanic acid.

* Labeled on bottle "Triple Strength."
† Formula given as "70 parts hydro-alcoholic sol. oil almond, 30 parts aqua," which is indefinite and misleading.

Banana Extract.

Both of the samples examined were synthetic, or artificial, flavors. Sample 23025 was correctly labeled "imitation," while sample 23229 was illegally labeled, one side of the carton reading "best banana" and the other side "best artificial banana flavoring." The average cost was 9.1 cents per fluidounce.

Ginger Extract.

Standard ginger extract is "flavoring extract prepared from ginger, and contains, in each one hundred (100) cubic centimeters, the alcohol-soluble matters from not less than twenty (20) grams of ginger."

The above standard is the same as required by the U. S. P. for medicinal Tincture of Ginger.

To compare the strength of a ginger extract with the standard, it is necessary to know how much alcohol-soluble matter powdered ginger root will yield. From an examination of the literature it is apparent that the kind of ginger used has an important bearing on the strength of the extract. The most complete examinations of authentic samples of ginger have been made by Winton, Ogden and Mitchell* and by Reich.† The average alcohol-soluble matter determined by them, using the same method, is shown below:

	Winton.	Reich.
Jamaica	4.97	....
Cochin	5.00	3.96
Japan	5.02	5.80
African	6.34	6.64
Calcutta	4.33	4.36
All samples	5.18	5.19

The individual samples showed considerable variation with both analysts, Winton's ranging from 3.63 to 6.58 per cent. and Reich's from 3.24 to 8.05 per cent., the maximum in both cases being secured from African ginger. These solubilities were obtained by using alcohol 95 per cent. by volume. While these variations are considerable, we are chiefly concerned with Jamaica and African ginger, the more commonly used varieties, and in these the variations are somewhat smaller, from 4.04 to 8.05.

* Conn. Agl. Expt. Station, Report, 1898, 203.
† Zeit. Unter. Nahr. u. Genuss., 1907, *14*, 549.

From these figures we would expect 100 cc. of standard extract of ginger to contain from 0.80 to 1.60 gm. alcohol-soluble solids, or based on a specific gravity of 0.820, 0.97 to 1.94 per cent.

Two samples of tincture of ginger were prepared in this laboratory, following the U. S. P. directions, which should give a preparation of the same strength as the standard extract. The analyses are given below:

U. S. P. Tincture of Ginger.

	Jamaica.	African.
Specific gravity, 15.6° C.	.8198	.8222
Alcohol by volume	94.63	93.21
Total solids	1.43	1.81
Solids soluble in 95 per cent. alcohol	1.42	1.81
" " " cold water	0.21	0.16

The most striking characteristic of these tinctures is the high alcohol-solubility of the solids; it is also striking that only a small proportion of the material soluble in 95 per cent. alcohol is likewise soluble in cold water. From these analyses and those of Winton and Reich it would seem that a properly prepared extract of ginger should show a specific gravity of about .820, and should contain at least 93 per cent. alcohol by volume, from one to two per cent. of solids, practically all of which should be soluble in 95 per cent. alcohol, and not over 15 per cent. of it soluble in cold water. Numerous authorities assert that a minimum of 1 per cent. of solids should be found in a pure ginger extract.

The most common form of adulteration of this extract is the use of alcohol of low strength. As ginger root contains much more (in Jamaica ginger three times as much) matter soluble in water than in alcohol, weak alcohol will dissolve more material from ginger root, than strong alcohol. This increased extractive, however, adds nothing to the value of the extract, while the valuable principles of the root, the essential oil and the oleoresins, are not completely dissolved by the weak spirits. A determination of solids alone then shows little as to the quality of the extract, not only because a weak alcohol may have been used, but also because sugar or glycerol or both are frequently used to fortify weak extracts.

The lead member, similar to that suggested by Winton for maple syrup and later for vanilla extract, was determined in a

Table XI.—Extract of Ginger up to Standard.

Station Number.	Brand.	Dealer.	Price per bottle, cents.	Capacity of bottle, fl. oz.	Specific gravity at 15.6°C.	Alcohol by volume.	Solid Matter: Total.	Solid Matter: Soluble in alcohol.	Solid Matter: Soluble in water.	Per cent. of total solids soluble: In alcohol.	Per cent. of total solids soluble: In water.	Lead number.	Remarks.
24936	Colburn's Ess. Jamaica Ginger. The A. Colburn Co., Phila.	*Bridgeport*: L. Kopp	10	1.0	.8347	92.41	0.94	0.94	0.36	100	38	----	Labeled 90% alcohol.
25033	Pure Flav. Extr. of Ginger. East India Tea Co.	*So. Norwalk*: East India Tea Co.	20	1.7	.8249	96.18	1.45	1.41	0.34	97	23	----	Labeled 95% alcohol, one-half standard strength.
25065	Littell's Conc. Ess. of Jamaica Ginger. C. S. Littell & Co., N. Y.	*Wilton*: R. W. Keeler	20	2.8	.8218	94.38	1.04	1.03	0.26	99	25	----	Labeled 93% alcohol.
24962	Jamaica Ginger. McMonagle & Rogers, Middletown, N. Y.	*New Haven*: Carlson Tea and Butter Co.	25	1.9	.8269	96.25	1.47	1.46	0.22	99	15	0.36	
24983	Conc. Extract Ginger. Nichols & Harris, New London	*New London*: F. H. Davis & Co.	20	2.0	.8246	90.59	1.37	1.31	0.08	96	6	----	Labeled "clear alcohol."
25032	Sovereign Essence Jamaica Ginger. Union Pac. Tea Co.	*So. Norwalk*: Union Pacific Tea Co.	25	2.9	.8339	93.30	1.52	1.45	0.29	95	19	0.24	
24960	Williams' Extr. of Jamaica Ginger. Williams & Carleton Co., Hartford	*New Haven*: D. M. Welch & Son	20	2.1	.8366	93.37	1.85	1.72	0.39	93	21	0.28	Labeled 94% alcohol.
----	Made in laboratory from Jamaica ginger	----	----	----	.8198	94.63	1.43	1.42	0.21	99	15	0.23	
----	Made in laboratory from African ginger	----	----	----	.8222	93.21	1.81	1.81	0.16	100	9	0.29	

Table XII.—Extract of Ginger Legally Labeled Compounds.

Station Number.	Brand.	Dealer.	Price per bottle, cents.	Capacity of bottle, fl. oz.	Specific gravity at 15.6°C.	Alcohol by volume.	Solid Matter: Total.	Solid Matter: Soluble in alcohol.	Solid Matter: Soluble in water.	Per cent. of total solids soluble: In alcohol.	Per cent. of total solids soluble: In water.	Lead number.	Remarks.
24939	Hudson Brand Imitation Extr. Jamaica Ginger. Austin, Nichols & Co., N.Y.	*Bridgeport*: Village Store Co.	10	2.9	.9584	48.55	6.45	1.20	6.08	19	94	0.19	Formula: 42% alcohol, Jamaica ginger, caramel, alcohol, sugar, water.
25077	A. & P. Jamaica Ginger. Great Atl. and Pac. Tea Co.	*New Haven*: Atl. & Pac. Tea Co.	25	2.0	.9242	56.07	0.87	0.87	0.22	100	25	----	Labeled 60% alcohol
24935	Sol. Extr. Jam. Ginger, Stuart Brand. The Hartford Extract Co., Hartford	*Bridgeport*: Public Market Co.	10	1.7	.9948	38.07	10.14	0.86	9.72	8	96	0.73	Labeled 40% alcohol. Contains ginger root, alcohol, molasses, water.
24963	Loveday's Ginger Compound. Loveday's Premium House, New Haven	*New Haven*: Loveday's Tea Store	20	2.7	.9588	37.28	0.49	0.42	0.41	86	84	----	Contains ginger, capsicum, alcohol and water.
25031	Ginger Extract Colton. St. John & Co., New York	*Norwalk*: G. T. Bruce.	10	2.2	.9765	36.70	4.89	0.43	4.26	9	87	0.24	Labeled $\frac{1}{3}$ standard strength. Contains 32% alcohol, glycerine, sugar & water.
23079	Ginger Extract Colton. St. John & Co., New York	*Bridgeport*: H. Isenberg & Co.	15	2.6	.9921	35.20	5.41	2.86	4.92	53	91	----	Labeled same as 25031.
23164	Compound Jam. Ginger. Yale Tea Co., Waterbury	*Waterbury*: Yale Tea Co.	10	1.8	.9557	39.35	1.18	0.54	1.01	46	86	----	Formula claims extr. Jam. ginger, oleo resin ginger, oleo resin capsicum, essence oil ginger, 20% alcohol and caramel.

number of the samples. In the samples made in the laboratory, lead numbers of 0.23 and 0.29 were obtained, while in the samples classed as pure 0.24, 0.28 and 0.36 were secured. On the other hand the compound and adulterated extracts showed similarly low numbers in the great majority of cases, although in two samples 0.70 and 0.73 were secured. In one of these molasses was declared on the label. It does not appear that this determination has much value in determining the purity of a

TABLE XIII.—EXTRACT OF GINGER BELOW STANDARD OR ADULTERATED.

Station Number.	Brand.	Dealer.	Price per bottle, cents.	Capacity of bottle, fl. oz.
25024	Monarch Conc. Ess. Jam. Ginger. Austin, Nichols & Co., N. Y.	*Stamford:* Brown & Webb	24	3.9
23043	Sunbeam Extr. Jam. Ginger. Austin, Nichols & Co., N. Y.	*Stamford:* W. W. Waterbury	15	1.9
23069	Pure Extract of Ginger. Clark Extract Co., West Haven	*West Haven:* C. S. Atzback	10	1.0
25066	Colton's Conc. Ess. or Extr. Jamaica Ginger. J. W. Colton	*Danbury:* Robertson & Menzies	25	2.2
24937	Essence Jamaica Ginger, Colton's	*Bridgeport:* Charles D. Richards	10	2.5
25011	Benefit Brand Pure Jam. Ginger. Direct Imp. Co., Boston	*Willimantic:* Direct Importing Co.	13	1.9
24938	Pure Jamaica Ginger. Donzales & Co.. Kingston, Jam.	*Bridgeport:* P. D. Lyon	20	2.6
23107	Goodhonest Brand Essence Ginger	*Wilton:* R. W. Keeler	20	3.1
23078	Extract Jamaica Ginger. Grand Union Tea Co.	*Bridgeport:* Grand Union Tea Co.	20	2.0
23123	A. & P. Jamaica Ginger Extr. Great Atl. & Pac. Tea Co.	*Danbury:* Atlantic & Pacific Tea Co.	20	1.8
23019	Imperial Pure Extr. of Jamaica Ginger. Springfield, Mass.	*Bridgeport:* D. E. McNamara	10	1.1
23253	Dr. McKee's Conc. Extr. Jam. Ginger. McKee Medicine Co., Middletown.	*Middletown:* The Village Grocery	20	2.0
24959	Mohican Pure Extr. of Ginger. The Mohican Co., N. Y.	*New Haven:* The Mohican Co.	21	2.0
23664	Mohican Pure Extr. of Ginger. The Mohican Co., N. Y.	*New Haven:* The Mohican Co.	20	2.0
23080	Mohican Pure Extr. of Ginger. The Mohican Co., N. Y.	*Bridgeport:* The Mohican Co.	21	1.9
25010	Supreme Conc. Extract Ginger. The T. R. Sadd Co.	*Willimantic:* The T. R. Sadd Co.	20	1.4
24982	*Extract Jamaica Ginger. Seeman Bros. New York	*New London:* James Kiehy	10	2.9
24961	Pure Extract of Jam. Ginger. Shartenberg & Robinson	*New Haven:* Shartenberg & Robinson	19	2.5
24997	Aromatic Extract Jam. Ginger. J. E. Thompson	*Norwich:* Disco Bros.	25	3.2
23666	Ambassador Brand Extr. or Ess. Jam. Ginger. James Van Dyk Co., N. Y.	*New Haven:* Van Dyk Co.	10	1.2

Station Number.	Specific gravity at 15.6° C.	Alcohol by volume.	Solid Matter. Total.	Solid Matter. Soluble in alcohol.	Solid Matter. Soluble in water.	Per cent. of total solids soluble. In alcohol.	Per cent. of total solids soluble. In water.	Lead number.	Remarks.
25024	.9184	59.88	2.17	1.12	1.51	52	70	0.25	Low alcohol; high water-soluble solids.
23043	.9128	62.50	1.30	0.94	0.70	72	54	0.23	Labeled 57% alcohol; high water-soluble solids.
23069	.8903	69.00	0.80	0.80	----	100	--	----	Low alcohol.
25066	.8904	75.87	2.42	1.54	1.27	64	52	- --	Low alcohol; high water-soluble solids.
24937	.9900	21.35	4.29	0.63	3.57	15	83	0.50	Low alcohol; high water-soluble solids.
25011	.9325	46.96	0.36	0.36	0.14	100	39	---	Low alcohol; low solids.
24938	.9567	54.28	9.90	1.39	9.12	14	92	----	Low alcohol; high water-soluble solids.
23107	.9734	24.15	0.59	0.43	0.52	73	88	0.18	Low alcohol & solids; high water-soluble solids.
23078	.9031	67.60	2.05	1.21	1.29	59	63	0.42	Low alcohol; high water-soluble solids.
23123	.9232	49.90	0.70	0.68	0.16	97	23	----	Low alcohol and solids.
23019	.8602	80.75	1.62	1.38	0.81	85	50	0.26	Low alcohol; high water-soluble solids.
23253	.8284	95.00	0.52	0.52	0.07	100	13	----	Low solids; not "concentrated."
24959	.9617	34.90	0.59	0.56	0.58	95	98	---	Low alcohol & solids; high water-soluble solids.
23664	.9608	33.35	0.58	0.58	0.40	100	69	0.24	Low alcohol & solids; high water-soluble solids.
23080	.9718	25.90	0.63	0.42	0.56	67	89	----	Low alcohol & solids; high water-soluble solids.
25010	.9133	62.15	0.96	0.41	0.82	43	85	----	Low alcohol; high water-soluble solids.
24982	.9657	35.93	2.17	0.21	1.97	10	91	0.70	Low alcohol; high water-soluble solids.
24961	.8997	69.32	2.85	1.55	1.80	54	63	0.39	Low alcohol; high water-soluble solids.
24997	.9260	50.61	1.91	1.20	1.53	63	80	0.32	Low alcohol; high water-soluble solids.
23666	.9175	66.70	6.46	4.50	4.48	70	70	0.50	Low alcohol; high water-soluble solids.

* Labeled "Contains the alcoholic soluble matter from 6.5 gms. Jamaica Ginger and 41% ethylic alcohol."

ginger extract, although a high number is a reasonably certain indication of the presence of molasses.

Of the thirty-four samples examined, seven show standard composition, seven are legally labeled compounds, and twenty are

below standard or adulterated. The analyses are given in Tables XI to XIII.

The standard samples ranged in specific gravity from .8218 to .8366, average, .8291; alcohol from 90.59 to 96.18, average, 93.78; total solids from 0.94 to 1.85, average, 1.38; solids soluble in alcohol from 0.94 to 1.72, and solids soluble in water from 0.08 to 0.39. From 93 to 100 per cent. of the solids was soluble in alcohol, and from 6 to 38 per cent. in water.

The compound extracts were made with dilute alcohol and contained sugar, molasses, glycerol, caramel or capsicum, alone or in mixture. Their specific gravities ranged from .9242 to .9948, alcohol from 35.20 to 56.07, total solids from 0.49 to 10.14, solids soluble in alcohol from 0.42 to 2.86, and solids soluble in water from 0.22 to 9.72. From 8 to 100 per cent. of the solids was soluble in alcohol, and from 25 to 96 per cent. in water.

The extracts below standard or adulterated were so classed either because of low alcohol percentages or because of an excess of water-soluble solids. In some cases these solids were derived only from the ginger root itself, while in others they were due, at least in part, to added glycerol, sugar or molasses. Some of the weakest extracts were illegally labeled "concentrated." The samples ranged in specific gravity from .8284 to .9900, alcohol from 21.35 to 95.00, total solids from 0.52 to 9.90, solids soluble in alcohol from 0.21 to 4.50, and solids soluble in water from 0.07 to 9.12. From 10 to 100 per cent. of the solids were soluble in alcohol, and from 13 to 92 per cent. in water.

For methods of analysis see page 515.

Eight of the samples were sold in flat flasks, which seemed more suitable for hip-pocket use than for use in the kitchen. As most of these samples were relatively low in ginger extractive and alcohol, their use as a beverage is by no means impossible or improbable.

The Extractives of Ginger Root.

Attention has already been called to the amount of extractives obtained by Winton, Reich and this laboratory in samples of ginger root of known purity, using 95 per cent. alcohol as the solvent. It occurred to us that perhaps the high solids found in some samples, and the abnormally high proportion of these soluble in water, might in certain cases have been due quite as much, if not entirely, to the weak alcohol employed as to added sugar or glycerol. To test this point a series of extracts was made in the laboratory with alcohols of different strength, and the solids determined in them with the following results:

	95 Per Cent. Alcohol.	60 Per Cent. Alcohol.	20 Per Cent. Alcohol.
Total solids	1.43	1.91	2.59
Solids soluble in alcohol	1.42	1.16	0.30
" " " cold water	0.21	1.23	2.09

These results are what would be expected. As the alcoholic strength decreases the amount of solids increases, and a greater proportion is soluble in water and less in alcohol.

Orange Extract.

Standard orange extract is "the flavoring extract prepared from oil of orange, or from orange peel, or both, and contains not less than five (5) per cent. by volume of oil of orange."

The usual adulterations of orange extract are a deficiency in oil or use of artificial color. The so-called "terpeneless" orange extracts are sometimes sold as the genuine extract; in these all or nearly all of the terpenes, which make up about 90 per cent. of orange oil, have been removed.

Twenty samples were examined. Thirteen of these were of standard strength or above it and of natural color. These contained from 5.11 to 9.32 per cent. of oil, with an average of 6.65. The precipitation method in all cases gave somewhat higher results, averaging 0.22 per cent.

Seven samples were adulterated or illegally labeled. Four were deficient in oil, two were colored with turmeric, and four with coal-tar dyes. Sample 23692, although labeled "concentrated," contained no orange oil whatever and was artificially colored. Sample 23252, although containing a high percentage of oil, was artificially colored. Sample 23182 contained only a trace of oil, was artificially colored, and showed only about 46 per cent. of alcohol, indicating adulteration with water. Sample 23041, labeled "concentrated," likewise contained only a trace of oil, was artificially colored, and contained only about 54 per cent. of alcohol, also indicating adulteration with water.

The average cost of the pure extracts was 10.3 cents per fluid-ounce. That of the adulterated extracts was 8 cents per fluid-ounce.

Five samples were guaranteed as to quantity, three of which satisfied the guaranty. Samples 23162 and 23081 each showed a deficiency of 5 per cent.

For methods of analysis see page 516.

TABLE XIV.—ORANGE EXTRACT UP TO STANDARD.

Station No.	Brand.	Dealer.	Price per bottle, cts.	Capacity of bottle, fl. oz.	Orange Oil by Volume. Polariscope Method.	Orange Oil by Volume. Precipitation Method.	Refraction of Oil at 30° C.	Color.
					%	%		
23042	Republic Extract Orange. Austin, Nichols & Co., New York	*Stamford:* W. W. Waterbury	15	2.2	5.11	5.20	1.4672	Natural
23162	Extract Orange. Grand Union Tea Co., Brooklyn, N. Y.	*Waterbury:* Grand Union Tea Co.	25	1.9	5.82	6.10	1.4678	"
23308	Pure Extract Orange. Frank E. Harris, Binghamton, N. Y.	*Hartford:* Brown, Thomson & Co.	15	1.0	7.47	7.60	1.4665	"
23245	Extract Orange. J. G. Hedges, Middletown	*Middletown:* Thos. Walsh	25	1.8	6.20	6 40	1.4675	"
23283	Imperial Pure Flavoring Extracts, Orange. Prep. at Springfield, Mass.	*Meriden:* Eastern Tea Importing Co.	8	1.0	9.32	9.90	1.4668	"
23661	Imperial Pure Flavoring Extracts, Orange. Prep. at Springfield, Mass.	*New Haven:* F. J. Markle Co.	10	0.9	7.51	7.70	1.4672	"
23160	Orange for Flavoring. McMonagle & Rogers, Middletown, N. Y.	*Waterbury:* Model Market Co.	25	2.0	6.38	6.60	1.4672	"
23081	Mohican Pure Extract of Orange. The Mohican Co., New York	*Bridgeport:* The Mohican Co.	21	1.9	5.86	6.00	1.4672	"
23068	Sauer's Pure Extract Orange. The C. F. Sauer Co., Richmond, Va.	*New Haven:* J. N. Waterbury & Co.	9	0.9	5.24	5.40	1.4678	"
23044	Sauer's Pure Extract Orange. The C. F. Sauer Co., Richmond, Va.	*Stamford:* South End Cash Grocery	10	1.0	7 05	7 20	1.4678	"
23015	Foss' Pure Extract Orange. Schlotterbeck & Foss Co., Portland, Me.	*Bridgeport:* Village Store Co.	15	1 8	7.80	8.00	1.4675	"
23665	Ambassador Brand Pure Extract of Orange. James Van Dyk Co., New York	*New Haven:* Van Dyk Co.	19	3.1	6.04	6.40	1.4672	"
22309	Williams' Pure Extract of Orange. The Williams & Carleton Co., Hartford	*Hartford:* T. H. Bride	25	2.1	6.64	6.80	1.4681	"

TABLE XV.—ORANGE EXTRACT BELOW STANDARD OR ILLEGALLY LABELED.

Station No.	Brand.	Dealer.	Price per bottle, cts.	Capacity of bottle, fl. oz.	Orange Oil by Volume. Polariscope Method.	Orange Oil by Volume. Precipitation Method.	Refraction of Oil at 30° C.	Color.
23250	Capitol House Pure Extract Orange	*Middletown:* Middletown Cash Grocery	20	2.6	5.16	5.40	1.4672	Turmeric
23691	Carolan's Pure Extract Orange. J. M. Carolan & Co., New York	*Stamford:* N. Y. Cash Grocery	18	2.1	5.35	5.70	1.4675	"
23692	Concentrated Compound Extract of Orange. Columbia Tea Co., Stamford	*Stamford:* Columbia Tea Co.	10	1.8	0.00	0.00	....	Artificial
23084	Howco Pure Flavoring Extracts, Orange	*Bridgeport:* The Howland Dry Goods Co.	15	2.2	4.55	4 70	1.4675	Natural
23252	Dr. McKee's Concentrated Fruit Extract, Orange. The McKee Medicine Co., Middletown	*Middletown:* The Village Grocery	20	1.9	9.30	9.80	1.4668	Artificial
23182	Essence Orange	*Mystic:* Mutual Tea Co.	15	1.7	*0.30	tr.	....	"
23041	Tropic Brand Concentrated Extract, Orange. The Tropic Co., New York	*Stamford:* Hepton Tea Co.	10	1.2	†0.28	0.00	....	"

* Specific gravity @ 15.6°C., 0.9411; alcohol by volume about 46%. † Specific gravity @ 15.6°C., 0.9266; alcohol by volume about 54%.

Peppermint Extract.

Standard peppermint extract is "the flavoring extract prepared from oil of peppermint, or from peppermint, or both, and contains not less than three (3) per cent. by volume of oil of peppermint."

The usual adulterations of this extract are deficiency of oil and the use of artificial color.

Thirteen samples were examined. Four were up to standard and of natural color. Sample 23061 was of the full strength of the U. S. P. preparation. The use of the words "highly concentrated" with sample 23075 is not strictly correct.

Six samples were below standard or illegally labeled. Four contained only traces of the oil and three were artificially colored; in only one case was this stated on the label. Sample 23659 was labeled "one-fourth standard strength, oil peppermint, 2.34%," which statement was untrue. The standard strength referred to was evidently that of the U. S. P. The formula given with sample 23247 was meaningless and misleading. Samples 23693 and 23163 bore the word "concentrated" on the label, although they only contained traces of the oil.

Three samples were legally labeled compounds. Sample 23124 was labeled "10% U. S. standard." As the U. S. P. standard for spirit of peppermint is 10 per cent. oil, and as under the Food and Drug law the U. S. P. is a U. S. standard, the use of the phrase given on the label is misleading, although in this particular case the extract is 10 per cent. of the U. S. standard, 3 per cent.

The average cost of the extracts was 8.3 cents per fluidounce.

The quantity of extract was guaranteed in three samples and these guaranties were satisfied.

Peppermint oil itself varies greatly in rotatory power and in menthol content. The polariscope and the determination of menthol, therefore, give only an approximate idea of the amount of oil present in the extract. In the Mitchell precipitation method the results tend to be low because of the imperfect separation of the oil. Howard's modification of the latter method gives much more satisfactory results, but with this method we have found it difficult to evaporate all of the chloroform and ether without losing some of the volatile oil. The results by this

TABLE XVI.—PEPPERMINT EXTRACT UP TO STANDARD.

Station Number.	Brand	Dealer.	Price per bottle, cts.	Capacity of bottle, fl. oz.	Peppermint Oil by Volume. Polariscope Method.	Mitchell's Precipitation Method.	Howard's Method.	Refractive Index of Oil at 30° C.	Color.
23061	Essence Peppermint. Austin, Nichols & Co., New York	*Norwalk*: F. D. Lawton	10	1.2	9.57	11.2	11.4	1.4603	Natural
23071	Pure Extract of Peppermint. Clark Extract Co., West Haven	*West Haven*: D. M. Welch & Son	10	2.0	4.90	4.0	4.4	1.4586	"
22311	Pure Extract Peppermint. Frank E. Harris, Binghamton, N. Y.	*Hartford*: Hartford Public Market	10	1.0	*	6.2	6.8	1.4600	"
23075	†Perfectly Pure Highly Concentrated Flav. Extr. Peppermint	*Bridgeport*: East India Tea Co.	20	2.0	3.14	3.0	2.8	1.4600	"

* Could not read. † Not a "highly concentrated" extract.

TABLE XVII.—PEPPERMINT EXTRACT BELOW STANDARD OR ILLEGALLY LABELED.

Station Number.	Brand	Dealer.	Price per bottle, cts.	Capacity of bottle, fl. oz.	Polariscope Method.	Mitchell's Precipitation Method.	Howard's Method.	Refractive Index of Oil at 30° C.	Color.
23028	Finest Extr. of Peppermint. Acker, Merrall & Condit Co., New York	*Greenwich*: Acker, Merrall & Condit Co.	20	2.1	*	2.2	†	1.4586	Natural
23693	Concentrated Extract of Peppermint. Columbia Tea Co., Stamford	*Stamford*: Columbia Tea Co.	10	1.6	0.0	0.0	0.2	....	Artificial
23183	Essence Peppermint	*Mystic*: Mutual Tea Co.	15	1.7	*	‡1.2	†	....	Natural
23659	Premium Brand Peppermint	*New Haven*: Carlson Tea & Butter Co.	13	1.7	0.50	§0.4	0.2	....	§Artificial
23247	St. John's Extract Peppermint. St. John & Co., New York	*Middletown*: C. A. Allison	15	1.8	0.43	‖0.4	0.8	....	Natural
23163	Gilt Edge Brand Concentrated Extract of Peppermint	*Waterbury*: Yale Tea Co.	10	1.7	0.57	¶0.2	0.4	....	¶Artificial

* Could not read. † Could not effect separation of the oil. ‡ Labeled "3% oil peppermint." § Labeled indistinctly "one-fourth Standard Strength." Formula, 2.34% oil peppermint, artificially colored. ‖ Meaningless formula on back of carton, "70 pts. hydro-alcoholic sol. oil peppermint, 30 pts. aqua." ¶ Formula, essential oil, 1.56%, artificial color, a trace.

TABLE XVIII.—COMPOUND PEPPERMINT EXTRACT LEGALLY LABELED.

Station Number.	Brand	Dealer.	Price per bottle, cts.	Capacity of bottle, fl. oz.	Polariscope Method.	Mitchell's Precipitation Method.	Howard's Method.	Refractive Index of Oil at 30° C.	Color.
23035	A. & P. Peppermint. The Great Atl. & Pac. Tea Co., New York	*Stamford*: Atlantic & Pacific Tea Co.	25	1.9	2.86	3.0	3.8	1.4579	*Artificial
23124	Superior Brand Extract Peppermint. Made at Hartford	*Danbury*: Danbury Grocery Co.	10	1.7	0.29	†tr.	0.4	....	Natural
23122	Sovereign Peppermint Flavoring. The Union Pacific Tea Co., New York	*Danbury*: Union Pacific Tea Co.	20	2.2	0.71	‡1.0	1.2	...	"

* Handstamped "color, trace." † Labeled "10% U. S. Standard." ‡ "Oil of peppermint, 0.75%" *on bottle, but not on carton.*

method, therefore, may be a trifle high. In judging of the purity of the extracts examined we have accepted the figures by the Howard method, thus giving the manufacturer the benefit of every doubt.

For details of the method see page 516.

Pineapple Extract.

It is not possible to prepare from the pineapple, raspberry, strawberry and certain other fruits extracts concentrated enough to give the distinctive fruity flavor. Artificial fruit essences composed of compound ethers in varying proportions and combinations are used instead to imitate these fruit flavors. At best they are poor imitations and are apt to produce indigestion and diarrhœa if consumed in quantity. The requirement of the law is clear that these artificial flavors should be sold as such and should not be represented to be "pure fruit flavors."

The thirteen pineapple extracts examined were, with one exception, synthetic or artificial. Sample 23039 showed a faint resemblance to the flavor of the natural fruit; in no sense, however, should it be labeled "highly concentrated." Ten of the samples are passed as legally labeled either as "imitation," "artificial" or "ethereal." There is some question, however, as to compatibility of the words "pure" and "artificial," or "highly concentrated" and "artificial" on the same label. Four of the legally labeled extracts contained artificial color, which was declared in two cases.

Three samples were illegally labeled. Sample 23694, labeled "concentrated compound extract," was a synthetic flavor, artificially colored; sample 23249, labeled "pure concentrated extract," was a synthetic flavor; sample 23228, a synthetic flavor, was labelled "best pineapple" on one side of the carton and "best artificial pineapple flavoring" on the other.

The average cost of these extracts was 8.9 cents per fluidounce.

Six samples were guaranteed as to quantity of extract; sample 23039 showed a slight shortage.

Raspberry Extract.

Six of the seven samples tested were synthetic flavors, three of which were legally labeled. Sample 22314 had the genuine fruit flavor and appears to be a concentrated fruit juice rather than an

TABLE XIX.—BANANA, PINEAPPLE, RASPBERRY AND STRAWBERRY EXTRACTS LEGALLY LABELED.

Station No.	Brand.	Dealer.	Price per bottle	Capacity of bottle.	Remarks.
	Banana.		cts.	fl. oz.	
23025	Burnett's Imitation Banana. Joseph Burnett Co., Boston	*Greenwich:* T. F. Carey	20	2.1	Synthetic flavor, natural color.
	Pineapple.				
23029	Finest Pineapple Flavor, Artificial. Acker, Merrall & Condit Co., New York	*Greenwich:* Acker, Merrall & Condit Co.	20	2.2	" "
23186	Imitation Pineapple. Grand Union Tea Co., Brooklyn, N. Y.	*New London:* Grand Union Tea Co.	20	2.1	" "
23159	Imitation Pineapple Flavoring. McMonagle & Rogers, Middletown, N. Y.	*Waterbury:* Model Market Co.	25	2.0	" "
23662	Pure Extract of Finest Pineapple Flavor Artificial. The Mohican Co., N. Y.	*New Haven:* The Mohican Co.	20	2.0	Synthetic flavor, artificial color.
22312	The Stuart Brand Imitation Flavor of Pineapple. Made at Hartford	*Hartford:* B. A. Bartlett	15	1.8	" " *
23021	Sovereign Imitation Pineapple Flavoring. The Union Pacific Tea Co., New York	*Bridgeport:* Union Pacific Tea Co.	20	2.1	"
23039	Highly Concentrated Pineapple. Van Duzer Extract Co., New York	*Stamford:* Stamford Grocery	10	1.9	Natural flavor (?), natural color.
23105	Artificial Extracts, Highly Concentrated Pineapple. Van Duzer Extract Co., New York	*Ridgefield:* S. D. Keeler	25	2.1	Synthetic flavor, natural color.
23678	Extract of Pineapple (Ethereal). Wightman's, New York	*Bridgeport:* Village Store Co.	15	1.9	Synthetic flavor, artificial color.
23211	High Grade Brand Imitation of Pineapple. Made at Hartford	*Norwich:* The Mohican Co.	17	2.0	" " *

* Artificial color declared on label.

TABLE XIX.—BANANA, PINEAPPLE, RASPBERRY AND STRAWBERRY EXTRACTS LEGALLY LABELED—*Concluded.*

Station No.	Brand.	Dealer.	Price per bottle.	Capacity of bottle.	Remarks.
	Raspberry.		cts.	fl. oz.	
23284	Baker's Imitation Raspberry Flavor. Baker Extract Co., Springfield and Portland	*Meriden:* Booth's Grocery	20	1.8	Synthetic flavor.
22314	Raspberry Extract. Beach & Clarridge, Boston	*Hartford:* C. H. Strong	25	2.2	Probably natural flavor & color.
23663	Pure Extract of Finest Raspberry Flavor, Artificial. The Mohican Co., N. Y.	*New Haven:* The Mohican Co.	20	1.9	Synthetic flavor, artificial color.
23038	Foss' Imitation Extract Raspberry. Schlotterbeck & Foss Co., Portland, Me.	*Stamford:* J. M. Wassing	25	2.0	"
	Strawberry.				
23030	Finest Strawberry Flavor, Artificial. Acker, Merrall & Condit Co., New York	*Greenwich:* Acker, Merrall & Condit Co.	20	2.1	Synthetic flavor, artificial color.
23285	Baker's Imitation Strawberry Flavor. Baker Extract Co., Springfield and Portland	*Meriden:* Booth's Grocery	20	1.6	" "
23026	English Fruit Extracts, Strawberry, Artificial. Joseph Burnett Co., Boston	*Greenwich:* Knapp & Studwell	25	2.1	" " *
23016	High Grade Brand Imitation Strawberry Flavor. The Carleton Extract Co., Hartford	*Bridgeport:* Batchelder Bros.	20	1.9	" " *
23077	Imitation Strawberry. Grand Union Tea Co., Brooklyn, N. Y.	*Bridgeport:* Grand Union Tea Co.	20	1.9	" " *
23054	Mayflower Extract of Artificial Strawberry. The A. Colburn Co., Philadelphia	*So. Norwalk:* A. F. Beckman	10	0.9	" "
23254	Dr. McKee's Fruit Extract Artificial Strawberry. The McKee Medicine Co., Middletown	*Middletown:* The Village Grocery	20	2.0	" "
23053	Sovereign Artificial Strawberry Flavoring. The Union Pacific Tea Co., New York	*So. Norwalk:* Union Pacific Tea Co.	20	2.2	" "
22313	Artificial Extracts Highly Concentrated Strawberry. Van Duzer & Co., New York	*Hartford:* C. H. Strong	25	2.1	"

* Artificial color declared on label.

TABLE XX.—BANANA, PINEAPPLE, RASPBERRY AND STRAWBERRY EXTRACTS ILLEGALLY LABELED.

Station No.	Brand.	Dealer.	Price per bottle.	Capacity of bottle.	Remarks.
	Banana.		cts.	fl. oz	
23229	*Best Banana. Stickney & Poor Spice Co., Boston	*Putnam:* Edward Mullan	10	1.2	Synthetic flavor, natural color.
	Pineapple.				
23694	Concentrated Compound Extract of Pineapple. Columbia Tea Co., Stamford	*Stamford:* Columbia Tea Co.	10	2.0	Synthetic flavor, artificial color.
23249	Pure Concentrated Extract Pineapple. The John T. Doyle Co., New Haven	*Middletown:* O. Thompson & Co.	18	1.9	Synthetic flavor.
23228	†Best Pineapple. Stickney & Poor Spice Co., Boston	*Putnam:* Edward Mullan	10	1.2	"
	Raspberry.				
23060	Bastine's Pure Extracts, Raspberry. Bastine & Co., New York	*So Norwalk:* Raymond & Co	25	1.9	Synthetic flavor, artificial color.
23248	Pure Concentrated Extract Raspberry. The John T. Doyle Co., New Haven	*Middletown:* O. Thompson & Co.	18	1.0	" "
23036	‡Hill's Raspberry, Highly Concentrated. Robert Hill, New York	*Stamford:* Empire State Tea Co.	15	1.9	" "
	Strawberry.				
23070	Clark's Compound Strawberry. Clark Extract Co., West Haven	*West Haven:* D. M. Welch & Son	10	2.0	" "
23188	Clover Brand Pure Flavoring Extracts, Strawberry, Highly Concentrated	*New London:* Jas. P. Kiely	20	1.7	
23018	A. & P. Strawberry Flavor (color trace). The Great Atl. & Pac. Tea Co., New York	*Bridgeport:* Atlantic & Pacific Tea Co.	25	2.0	" "
23185	Extract of Strawberry. Nichols & Harris, New London	*New London:* F. H. Davis & Co.	15	2.0	" "
23210	Fruit Extracts, Highly Concentrated Strawberry. Van Duzer Extract Co., New York	*Norwich:* The Mohican Co.	17	1.9	" natural color.
23106	Williams' Choice Extract of Strawberry. The Williams & Carleton Co., Hartford	*Ridgefield:* S. D. Keeler	20	2.1	" artificial color.

* Labeled "Best Banana" on one side of carton, "Best Artificial Banana Flavoring" on the other side.
† Labeled "Best Pineapple" on one side of carton, "Best Artificial Pineapple Flavoring" on the other side.
‡ Labeled as above on carton, "Artificial Extract of Raspberry" on the bottle.

extract. The use of the words "pure" and "artificial" on the same label in sample 23663 is objectionable. Samples 23060, 23248 and 23036 were sold as pure or concentrated extracts; they were in all cases synthetic flavors artificially colored.

The average cost of these extracts was 11.7 cents per fluidounce. Sample 23663 contained slightly less extract than guaranteed.

Strawberry Extract.

All of the fifteen samples tested, with possibly the exception of sample 23210, were synthetic flavors, artificially colored. Nine were legally labeled "artificial" or "imitation." The other six were illegally labeled either as pure extracts or not clearly designated as compounds.

The average cost was 10.1 cents per fluidounce.

Four samples were guaranteed as to quantity; of these samples 23077 and 23210 showed slight deficiencies.

Wintergreen Extract.

Standard wintergreen extract is "the flavoring extract prepared from oil of wintergreen, and contains not less than three (3) per cent. by volume of oil of wintergreen."

Oil of wintergreen consists almost entirely of methyl salicylate. This is also true of oil of betula or sweet birch, which is frequently substituted for the true oil of wintergreen. The two differ somewhat in odor and taste. Synthetic methyl salicylate is very commonly used instead of either of the above-named oils. It is a matter of extreme difficulty to distinguish these three substances from each other by chemical means. The results reported herewith were obtained by determining the methyl salicylate present and calculating the same in terms of oil of wintergreen, no attempt being made to establish the source of the flavor.

Eleven samples were examined, six of which contained a practical equivalent of 3 per cent. oil of wintergreen and were of natural color. Five samples were below standard or illegally labeled.

Sample 23277 was artificially colored. Sample 23184, which was of U. S. P. strength, was artificially colored. Sample 23660 was labeled on the carton to contain 1.5 per cent. oil, but it contained only 0.89 per cent. and was artificially colored. Sample

TABLE XXI.—WINTERGREEN EXTRACT UP TO STANDARD.

Station Number.	Brand.	Dealer.	Price per bottle, cts.	Capacity of bottle, fl. oz.	Oil of Wintergreen.	Color.
					%	
22310	Baker's Pure Essence Wintergreen. Baker Extract Co., Springfield and Portland	*Hartford:* Boston Branch Grocery	25	2.1	2.91	Natural.
23187	Clover Brand Pure Flavoring Extracts Wintergreen, Highly Concentrated	*New London:* Jas. P. Kiely	20	2.0	3.39	"
23062	Pure Concentrated Essence Wintergreen. Colonial Perfume & Toilet Co., Detroit	*Norwalk:* F. D. Lawton	10	1.9	3.19	"
23161	Essence Wintergreen. Grand Union Tea Co., Brooklyn, N. Y.	*Waterbury:* Grand Union Tea Co.	20	1.9	3.13	"
23212	A. & P. Flavoring Extracts, Wintergreen. The Great Atlantic & Pacific Tea Co., N. Y.	*Norwich:* Atlantic & Pacific Tea Co.	25	2.0	3.24	"
23076	Perfectly Pure Highly Concentrated Flavoring Extract, Wintergreen	*Bridgeport:* East India Tea Co.	20	2.0	3.20	"

TABLE XXII.—WINTERGREEN EXTRACT BELOW STANDARD OR ILLEGALLY LABELED.

Station Number.	Brand.	Dealer.	Price per bottle, cts.	Capacity of bottle, fl. oz.	Oil of Wintergreen.	Color.
23277	Baker's Pure Essence Checkerberry. Baker Extract Co., Springfield and Portland	*Meriden:* H. E. Bushnell	20	2.0	2.82	Artificial.
23184	Essence Wintergreen. Nichols & Harris, New London	*New London:* F. H. Davis & Co.	15	1.8	5.36	"
23660	*Premium Brand Wintergreen	*New Haven:* Carlson Tea & Butter Co.	13	1.4	0.89	"
23660a	†Premium Brand Wintergreen	*New Haven:* Carlson Tea & Butter Co.	13	1.7	1.59	"
23125	‡Superior Brand Extract Wintergreen. Distributed by Hooker & Co., Hartford	*Danbury:* Danbury Grocery Co.	10	1.8	0.34	Natural.

*Formula on carton, but not on bottle, calls for "Oil Wintergreen, 1.5; . . Coloring, 1."
†Formula calls for "Oil Wintergreen, 2.34; . . . Artificially colored." Also labeled indistinctly "one-fourth Standard Strength."
‡The use of the word "Superior" with an extract of this quality is objectionable. The words "10 % U. S. Standard" are also misleading as to its strength.

23660a, a duplicate sample from the same dealer, was labeled to contain 2.34 per cent, but contained only 1.59 per cent. Sample 23125 claimed to be "10 % U. S. standard," which would be 0.30 per cent. It actually contained 0.34 per cent. The sample is wintergreen extract diluted with water and should be so stated on the label.

The average cost was 9.3 cents per fluidounce.

Four samples were guaranteed as to quantity; of these sample 23161 showed a slight deficiency.

For methods of analysis see page 517.

Methods of Analysis.

The details of only those methods which require special comment, or which were modified by us in some particular, are included here.

Alcohol. The volatile oil was found to interfere seriously in the determination of the high percentages of alcohol in ginger extracts. The method adopted was to dilute 15 gms. of the extract with water to 100 c.c. in a 200 c.c. Erlenmeyer flask, add 2.5 gms. of magnesium carbonate and shake thoroughly. Filter through small plaited filter and distil the alcohol from 75 c.c of the filtrate.

Almond Oil. Hortvet's method was used.* Both the gravimetric and volumetric methods were used, and the results differed by only a few hundredths of 1 per cent. The method was very satisfactory and gave concordant results irrespective of the amounts of alcohol and oil which the extracts contained. The presence of hydrocyanic acid, glycerol or sugar did not vitiate the results. If nitrobenzol is present it may be removed by Leach's method before attempting the determination of the benzaldehyde.

Hydrocyanic Acid in Almond Extract.† To a few cubic centimeters of the extract in a test tube add a few drops of a mixture of solutions of ferrous sulphate and ferric chloride, the ferrous salt being in excess. Make alkaline with sodium hydroxide, and add enough dilute hydrochloric acid to dissolve the precipitate formed by the alkali. Presence of a blue coloration or precipitate, due to the formation of Prussian blue, indicates hydrocyanic acid.

Total Solids in Ginger Extract. Weigh from 5 to 10 grms. of extract into a tared flat-bottomed dish and evaporate to apparent dryness at a moderate temperature (there is danger of loss by spurting in samples

* Journ. Ind. and Eng. Chem., 1909, *1*, 87.
† Leach's Food Inspection and Analysis, 1909, 877.

containing high percentages of alcohol). Dry to constant weight in drying oven at the temperature of boiling water.

Solids of Ginger Extract Soluble in Alcohol. Add 15 c.c. of 95 per cent. alcohol to the dried residue obtained as above. Stir thoroughly with a glass rod and allow to stand for one hour. Wash into a 50 c.c. flash with 95 per cent. alcohol and make up to the mark. Filter the solution through a dry plaited filter, and evaporate an aliquot of 25 c.c. and weigh as for total solids, taking the same precautions to insure a slow evaporation of the alcohol.

Solids of Ginger Extract Soluble in Water. Add 15 to 20 c.c. of water at room temperature to the residue obtained in total solids determination. Stir with glass rod at frequent intervals during three hours. Because of the gummy character of many residues it is sometimes difficult to secure proper contact with the solvent. Wash in a 50 c.c. flask with water and make up to the mark. Filter the solution through a dry plaited filter, and evaporate an aliquot of 25 c.c. and dry to constant weight in a water oven.

Orange Oil. The usual polariscope method was used, dividing the V° by 5.2 to secure per cent. of oil by volume. According to Allen* a correction must be made in the polariscope reading when any other than the standard temperature has been used. At temperatures below 20° C., 0.24° must be subtracted for each degree below 20°, whilst for temperatures above 20° C., 0.22° must be added for each degree to obtain the angular rotation for the standard temperature. One degree of angular rotation equals 2.8835° V., and we have made this correction in each case.

Orange oil was also determined by Mitchell's precipitation method.

Peppermint Oil. The extreme variability in rotatory power of peppermint oil itself makes the use of the polariscope of relatively small value in determining this oil. Mitchell's precipitation method has also been found to be quite uncertain in its results because of the imperfect separation of the oil. We found by a series of experiments that no constant factor for this solubility could be applied, especially in extracts containing less than 5 per cent. of oils. In spirits of peppermint where the content of oil should be 10 per cent., the Mitchell method gave much more satisfactory results.

Howard's modification† was also used and with more satisfactory results, but there is a tendency toward high results because of the difficulty in removing all the ether and chloroform without losing some of the volatile oil. In three prepared solutions containing 1, 2 and 3 per cent. of peppermint oil, by the Howard modification we secured 1.00, 2.40 and 3.40 per cent. respectively.

* Organic Analysis, *2*, pt. 3, 438.

† Leach's Food Inspection and Analysis, 1909, 865.

Oil of Wintergreen. Hortvet's method* of determining methyl salicylate was used. Attempts were made to modify the Mitchell precipitation method by using salt solutions of varying densities, but the heaviness of the oil prevented a satisfactory separation in the Babcock bottles used in the centrifuge method.

ICE CREAM CONES.

During the last year or two the method of serving ice cream in small quantities in cake-like cones has become very popular and the consumption of these cones has become enormous. One firm is reported to put out over a million cones a day during the heated term. Inasmuch as the cones are eaten very largely by children, it is important to determine their composition and whether they contain harmful ingredients.

Twenty-seven samples were examined. These ranged from the small cones, in which a cent's worth of ice cream was sold, to the larger ones, costing five cents when filled with cream. This way of buying ice cream is of course expensive, but is convenient, and if the cones, which are generally eaten, contain no harmful ingredients, their use is not open to serious criticism.

The weight of the cones ranged from 1.1 to 16.9 grams. They cost on the average about five cents per dozen for the small cones to about 17 cents for the largest size.

The cones were submitted to the usual food analysis and were examined also for benzoic, salicylic and boric acids, saccharine and artificial color.

In twenty-two samples no adulteration was detected, although in two of these there was some question as to the addition of coloring matter. One of the adulterated samples contained a coal-tar dye and four boric acid. There is no necessity for using any chemical preservative in the manufacture of the cones, and the presence of the boric acid is probably traceable to the eggs used in making the cones. Whatever the source, its presence in the cones is highly objectionable and is clearly contrary to the law. It is interesting to note that a duplicate purchase of one brand of the cones, containing boric acid, from the same dealer a month later, showed no boric acid. The publicity given to the Federal seizure of cones in New York probably has had its effect.

In composition the cones are quite similar to that of biscuits, as the following averages will show:

* Journ. Ind. and Eng. Chem., 1909, *1*, 90.

TABLE XXIII.—ICE CREAM CONES NOT FOUND ADULTERATED.

Station Number.	Manufacturer.	Dealer.	Average weight of cone, gms	Price per dozen, cts	Water.	Ash.	Protein (N x 6.25).	Crude Fiber	Nitrogen-free Extract.	Ether Extract.	Refractive Index of Fat at 40° C.
24928	Augur Baking Co., New York	*Middletown:* Bergquist Bros.	3.2	12	8.35	1.29	12.13	0.25	74.23	3.75	1.4778
25074	" " " " "	*Mount Carmel:* Thomas O'Neil	3.4	10	11.59	1.15	12.25	0.16	70.49	4.36	1.4756
25115	F. Atwood & Co.	*New Haven:* E. N. Sperry	16.9	12	8.17	1.00	8.50	0.16	80.20	1.97	1.4512
24896	J. A. Beany, New Haven	*New Haven:* H. L. Laviettes	11.5	14	8.03	0.53	8.38	0.28	80.19	2.59	1.4687
24977	Corey & Co., West Haven	*West Haven:* Corey & Co.	13.5	20	5.10	0.39	8.88	0.11	82.06	3.46	1.4720
24976	" " " " "	*West Haven:* Kimberly's News Store	11.6	20	7.29	0.41	8.69	0.09	78.49	5.03	1.4629
24906	Eagle Mfg. Co., Baltimore, Md.	*Hartford:* East Side Lunch	6.7	20	8.19	1.15	7.69	0.24	79.71	3.02	1.4523
25082	Howe & Marks, Highwood	*New Haven:* J. M. Roseff	14.8	12	13.19	0.50	7.58	0.08	77.85	0.80	....
24897	Jaconelli Mfg. Co , Philadelphia, Pa.	*New Haven:* Confectionery, 1271 State St.	1.3	7	9.52	0.64	10.50	0.18	76.77	2.39	1.4759
24929	Kibbie & Co., Springfield, Mass.	*Middletown:* Boston Candy Kitchen	4.8	10	9.45	0.50	11.31	0.23	74.43	4.08	1.4732
25054	J. Marchiony, Hoboken, N. J.	*South Norwalk:* F. W. Woolworth & Co.	3.8	10	9.32	1.07	11.00	0.20	75.95	2.46	1.4663
24980	H. A. Nahass, New London	*New London:* H. A. Nahass	14.7	20	9.31	0.42	9.81	0.16	79.79	0.51	....
25114	New Haven Dairy Co., New Haven	*New Haven:* David Ring	14.6	12	9.40	0.48	7.88	0.18	80.52	1.54	1.4629
25055	Popcorn & Cone Works, Akron, O.	*South Norwalk:* Candy Kitchen	13.8	20	8.93	0.37	6.25	tr.	84.09	0.36	....
24904	Not given	*Hartford:* Holdstock Confectionery	5.1	24	9.27	0.51	12.19	0.10	74.94	2.99	1.4759
24905	" "	*Hartford:* S. Weiner	1.1	5	9.47	1.54	11.13	0.17	76.07	1.62	1.4748
24907	Made in Hartford	*Hartford:* S. Lipman	1.3	12	8.69	1.76	13.00	0.28	74.59	1.68	1.4746
24927	Not given	*Middletown:* Candy Kitchen	4.4	10	9.31	0.96	12.50	0.24	73.92	3.07	1.4735
24894	Made in Hartford	*New Haven:* Rubins, 31 Washington Ave.	1.3	5	9.14	0.87	12.56	0.18	70.38	6.87	1.4685
24981	Not given	*New London:* H. Millson	11.3	20	7.95	0.50	10.00	0.09	79.49	1.97	1.4684
24996	" "	*Norwich:* Olympia Candy Kitchen	4.9	8	10.77	0.50	11.44	0.21	75.63	1.45	1.4752
24978	" "	*West Haven:* Nouget de Montilimar	11.6	20	8.82	0.35	8.38	0.13	81.89	0.43	1.4740

TABLE XXIV.—ICE CREAM CONES ADULTERATED.

Station Number.	Manufacturer.	Dealer.	Average weight of cone, gms	Price per dozen, cts	Water.	Ash.	Protein (N x 6.25).	Crude Fiber	Nitrogen-free Extract.	Ether Extract.	Refractive Index of Fat at 40° C.
24893	*Delzarino, Hartford	*New Haven:* Rubins, 31 Washington Ave.	1.3	5	8.95	1.12	13.44	0.17	70.39	5.93	1.4682
24895	†Not given	*New Haven:* D. Markowitz, 63 Washington Ave.	1.2	10	9.86	0.99	13.19	0.18	74.16	1.62	1.4759
24903	†Brooklyn Cone Co., Brooklyn, N. Y.	*Hartford:* Joe Rates, 135 Albany Ave.	2.9	10	10.63	0.99	12.88	0.18	73.11	2.21	1.4550
24955	†Made in Brooklyn, N. Y.	*Bridgeport:* J. Delbarbieri, 692 Fairfield Ave.	1.1	5	10.00	0.74	13.00	0.19	74.71	1.36	....
25023	†‡Consolidated Water Co. Cones, N. Y.	*Stamford:* Max Myers, 110 Pacific St.	1.2	5	12.21	1.03	12.25	0.26	72.59	1.66	1.4734

* Contains artificial color. † Contains boric acid. ‡ Second sample taken from same dealer one month later contained no boric acid.

	Cones. Average Conn. Samples.	Biscuits. Ave. Wiley's Analyses.
Water	9.29	7.13
Ash	0.81	1.57
Protein	10.62	9.43
Crude Fiber	0.17	0.47
Nitrogen-free Extract	76.55	73.77
Ether Extract	2.56	8.67

There is nothing in the analyses to indicate the use of any ingredient not usually employed in the making of biscuits or similar material. The low percentages of crude fiber show that the popular idea that paper enters into the make-up of the cones is without foundation.

Tests for benzoic and salicylic acids and for saccharine were negative in all cases.

The refractive index of the fat was determined with the idea that it might give some indication as to whether oleomargarine had been used. The refractive index of pure butter at 40° C. ranges from 1.4535 to 1.4565, oleomargarine from 1.4595 to 1.4645, and that of the oil from wheat flour is 1.4796. The indices of the fat of the cones ranged from 1.4512 to 1.4778, and no conclusions can be drawn from this determination.

MINCE MEAT.

The standard for mince meat is as follows:

"Mince, mince meat, is a mixture of not less than ten (10) per cent. of cooked, comminuted meat, with chopped suet, apple and other fruit, salt and spices, and with sugar, sirup, or molasses, and with or without vinegar, fresh, concentrated, or fermented fruit juices or spirituous liquors."

The standard permits wide variations in the composition of this material, and a chemical analysis alone is of little value in establishing its purity. The examination was therefore concerned chiefly in determining the nature of the preservative used, if any.

Of the nineteen samples examined, eight were of a semisolid consistence and in general were of the nature required by the standard. The other eleven were compressed into the form of a cake, the binding material generally being flour or starch. Four of these samples, **24029**, **23962**, **24095** and **23960**, gave no indication on the label as to the added cereal, and under a strict interpretation of the standard would be considered adulterated.

TABLE XXV.—MINCE MEAT NOT FOUND ADULTERATED.*

Station Number.	Brand.	Price per package.	Net weight per package.	Cost per lb.
	Semi-solid.	cts.	oz.	cts.
24030	†Acker, Merrall & Condit Co., N. Y. Amcehat Brand	30	22.4	21.4
24066	†Atmore & Son, Philadelphia. Atmore's	20	24.4	13.1
24084	†Boston Grocery, Meriden. (In bulk)	13	21.8	9.5
24034	†H. J. Heinz Co., Pittsburgh, Pa. Heinz	20	14.7	21.8
24106	Oneida Community Limited, Oneida, N. Y. Home Grown and Home Preserved	60	38.1	25.2
24108	Whipple Coöperative Co., Natick, Mass. Grandmother's	35	43.7	12.8
	In compressed cake.			
24029	Armour & Co., Chicago. Veribest	10	11.8	13.6
24049	Atmore & Son, Philadelphia. Atmore's Condensed	9	11.6	12.4
24059	Brownell & Field Co., Providence, R. I. Autocrat Brand	10	11.2	14.3
24085	Lewis DeGroff & Son, New York. Health Brand	10	11.4	14.0
23962	Great Atlantic & Pacific Tea Co., New York. A. & P. Brand	9	11.0	13.1
24094	H. C. Gutchess, Port Byron, N. Y. Gutchess' Imperial Condensed	10	11.0	14.5
24058	The Humphrey Cornell Co., New London. Laurel Brand	10	10.8	14.8
24095	Libby, McNeill & Libby, Chicago. Libby's Cond.	10	11.8	13.6
23961	The Mohican Co., N. Y. Mohican Brand Condensed	9	11.1	12.0
24033	Merrell-Soule Co., Syracuse, N. Y. None Such	10	11.6	13.8
23960	Whipple Coöperative Co., Natick, Mass. Grandmother's	9	11.7	12.3

* Contained no benzoic, salicylic or boric acid. See page 521.
† Considerable fat present indicating use of suet.

TABLE XXVa.—MINCE MEAT COMPOUND OR ADULTERATED.

	Semi-solid.			
24069	‡The Acme Mince Co., Bristol, Conn. Acme High Grade Pie Fillings	16	16.7	15.3
24107	§George Chitty, New Haven. (In bulk)	9	17.7	8.1

‡ Labeled to contain 0.10 % sodium benzoate and colored with caramel; 0.10 % benzoate found.
§ Adulterated; contained 0.12 % sodium benzoate, not stated on label.

All the samples were tested for benzoic, sulphurous, salicylic and boric acid. The two latter were found in no case. Two samples contained sodium benzoate. In **24069** 0.10 per cent. was guaranteed on the label, and exactly that amount was found on analysis. In **24107**, which was sold in bulk and unlabeled, 0.12 per cent. was found, and the sample is, therefore, adulterated.

Sulphurous acid ranged from 1.43 to 8.12 mgms. per 100 gms. of material. It is recognized that traces of sulphurous acid in meat products should be ignored, as unpreserved meats may give slight reactions for this acid, probably due to a partial decomposition of proteins. Mentzel* asserts that 4 mgms. per 100 gms. may be due to this cause. Only two of the samples examined materially exceed this limit, **24066** and **24084**, which contain 7.35 and 8.12 mgms., respectively. These quantities would seem to be excessive, although we have not classed the samples as adulterated.

Only four of the samples, **24030**, **24066**, **24084** and **24034**, contained any considerable amount of fat, indicating that most of the samples contained little, if any, suet. In certain samples the amount of meat present was a vanishing quantity, the samples consisting chiefly of raisins or currants, and in one case largely of a puffed cereal.

The cost per pound of the semisolid mince meat ranged from 8.1 to 25.2 cents, but in the compressed form it was much more uniform, ranging from 12.0 to 14.8 cents. Quality is an important factor in a material like mince meat, and in many of the samples the better quality is reflected by the higher price asked, although this does not follow in every case.

KETCHUP.

The standard for this material is as follows:

"*Catchup* (*ketchup, catsup*) is the clean sound product made from the properly prepared pulp of clean, sound, fresh, ripe tomatoes, with spices and with or without sugar and vinegar; *mushroom catchup, walnut catchup, et cetera,* are catchups made as above described, and conform in name to the substances used in their preparation."

This standard gives no analytical maxima or minima, and the main purpose of the present examination was to fix, if possible, certain analytical standards whereby the purity of the ketchup in question might be established. The standard permits the use of no chemical preservative, no substitute for sugar, such as glucose, nor any foreign coloring matter. Furthermore, accord-

* Zeit. Unter. Nahr. Genuss., *11*, 320.

ing to the standard, the use of the word "ketchup" without any qualifying term means that made from tomatoes.

Seventy-four samples, representing fifty-six manufacturers, or jobbers, were analyzed. The following table gives the names of the manufacturers and the brands, together with the exact phraseology of the label:

TABLE XXVI.—LIST OF BRANDS AND MANUFACTURERS.

23719. American Pickling Co., Providence, R. I. *American Brand Ketchup.* Preserved with one-tenth of one per cent. Benzoate of Soda.

23724. American Pickling Co., Providence, R. I. (Manufactured for). *Standard Ketchup.* Ninety per cent. Fruit Pulp, two and one-half per cent. Pure Spices, two per cent. Sugar, two and one-half per cent. Wheat Flour, two and four-tenths per cent. Vinegar, one-tenth of one per cent. Benzoate of Soda, Trace of Vegetable Color. (Blown in bottle, "H. J. Heinz Co.")

23707. Anderson Preserving Co., Camden, N. J. *Tomato Ketchup.* The contents of this package are preserved with three-hundredths per centum of Sodium Benzoate and are warranted not injurious to health.

23690. C. Andresen & Co. *Home Made Long Island Tomato Catsup.* Made from Red Ripe Tomatoes, pure Spices, and granulated Sugar. Preserved with Benzoate of Soda with a trace of artificial coloring. (Blown in bottle, "Pride of the Farm Tomato Catsup.")

23758. Austin, Nichols & Co., New York (Distributors). *Lion Brand Ketchup.* Benzoate of Soda one-tenth of one per cent, Compound of Tomatoes, Tomato Trimmings, Salt, Sugar, Vinegar, Onions and Spices.

23717. Austin, Nichols & Co., New York. *Sunbeam Brand Tomato Catsup.* Preserved with one-tenth of one per cent. of Sodium Benzoate.

23696. Beech-Nut Packing Co., Canajoharie, N. Y. *Beech-Nut Brand Tomato Catsup.* Made from whole, red, ripe tomatoes, vinegar, sugar, spices, salt and onions.

23723. Bishop & Co., Los Angeles, San Francisco, New York. *Bishop's California Tomato Catsup.* Contains one-tenth of one per cent. Benzoate of Soda.

23631. P. F. Bowe, Waterbury, Conn. *Bowe Brand Tomato Catsup.* This Catsup is made from tomatoes and is free from coloring. Flavored with pure spices, salt, sugar and distilled vinegar; preserved with one-tenth of one per cent. of benzoate of soda. (Descriptive matter in fine type.)

23639. P. F. Bowe, Waterbury, Conn. *Eagle Brand Catsup.* None Better for Quality. (Same descriptive matter as on 23631 in fine type.) (Blown in bottle, "Homer's California Ginger Brandy.")

23633. P. F. Bowe, Waterbury, Conn. *Perfection Tomato Catsup.* This catsup is made from tomatoes, is free from coloring and preserved with one-tenth of one per cent. of Benzoate of Soda. (Descriptive matter in fine type.)

23647. Joseph Campbell Co., Camden, N. J. *Campbell's Tomato Ketchup.* Seven and one-half ounces net weight.

23710. R. H. Chance's Sons, Philadelphia. *Home Brand Tomato Ketchup.* Free from all artificial coloring and preserved with one-tenth of one per cent. Benzoate of Soda. Made from tomatoes, pure spices, vinegar and sugar.

23706. R. H. Chance's Sons, Philadelphia. *Table Talk Tomato Ketchup.* (Same descriptive matter as on 23710.)

23646. Columbia Conserve Co., Indianapolis, Ind. *Columbia Tomato Catsup.* Made from fresh, ripe, whole tomatoes (from which the skins, cores and seeds have been removed), granulated sugar, salt, distilled vinegar, spices and onions.

23718. H. P. Cornell Co., Providence, R. I. (Packed for). *Shiloh Tomato Ketchup.* Free from all artificial coloring and preserved with one-tenth of one per cent. Benzoate of Sodium. This ketchup is made from tomatoes, pure spices, vinegar and sugar.

23682. Cruikshank Bros. Co., Pittsburg, Pa. *Cruikshank's Tomato Ketchup.* One-tenth of one per cent. Benzoate of Soda. Made from fresh ripe tomatoes, pure spices, granulated sugar, vinegar and salt.

23722. Cruikshank Bros. Co., Pittsburg, Pa. *Home Made Tomato Ketchup.* Made from red ripe tomatoes, pure spices, granulated sugar and salt. Contains one-tenth of one per cent. Benzoate of Soda.

23653. Curtice Brothers Co., Rochester, N. Y. *Blue Label Tomato Ketchup.* Guaranteed free from artificial coloring or any injurious substances. Contains one-tenth of one per cent. Benzoate Soda.

23632. Lewis De Groff & Son, New York (Packed for). *Red Jacket Catsup.* Made from Tomatoes, Pure Spices, Salt, Sugar, Vinegar and Vegetables. Preserved with one-tenth of one per cent. Benzoate of Soda.

23699. The John T. Doyle Co., New Haven, Conn. *Blue Bell Brand Catsup.* Made from portions of Tomato and Apple. Contains one-tenth of one per cent. of benzoate of soda, one one-hundredth per cent. of color, one one-hundredth per cent. of saccharine.

23655. The John T. Doyle Co., New Haven, Conn. *Doyle's Country Club Tomato Catsup.* Made with care from the best material. Benzoate of Soda one-tenth of one per cent.

23656. The John T. Doyle Co., New Haven, Conn. *East Rock Brand Catsup.* (Same descriptive matter as on 23699.)

23702. The R. N. Fitzgerald Co., Hartford, Conn. (Packed for). *Bon Ton Tomato Catsup.* Contains one-tenth of one per cent. benzoate of soda.

23641. The R. N. Fitzgerald Co., Hartford, Conn. (Packed for). *Mascot Brand Tomato Catsup.* Contains one-tenth of one per cent. Benzoate of Soda. Not Artificially Colored.

23713. The E. C. Flaccus Co., Wheeling, W. Va. *Ohio Valley Preserving Co.* (picture of tomato) *Ketchup.* Natural color. Made from choice, ripe tomatoes and pure spices. Preserved with one-tenth of one per cent. Benzoate Soda.

23726. The L. A. Gallup Co., Norwich, Conn. (Put up expressly for). *Jack Dalton, Jr. Catsup.* Preserved with one-tenth of one per cent. Benz. of Soda. (Blown in bottle, "Pride of the Farm Tomato Catsup.")

23687. The Great Atlantic and Pacific Tea Co. (Packed for). *Tomato Ketchup.* Prepared from tomatoes, distilled vinegar, granulated sugar, salt, onions and spices. Prepared with one-tenth of one per cent. Benzoate of Soda, not artificially colored.

23686. E. C. Hazard & Co., New York. *Hazard's Shrewsbury Tomato Ketchup.* Made from ripe tomatoes without fermentation. $1000 will be paid to any one who shows that it contains artificial coloring, chemical preservatives or other impurities.

23695. H. J. Heinz Co., Pittsburg, Pa. *Heinz Tomato Ketchup.* Contains no artificial preservative or coloring matter.

23728. Chas. L. Hirsh & Co., New York (Prepared for). *Crescent Brand Catsup.* Uncolored. Tomatoes seventy-eight, Cereals eighteen, Spices three and nine-tenths, Benzoate one-tenth. (Blown in bottle, "Deep Spring Tennessee Whiskey.")

23640. The Horton-Cato Mfg. Co., Detroit, Mich. *Royal Tomato Catsup.* Made from selected whole fresh tomatoes and finest spices. Contains one-tenth of one per cent. Benzoate Soda.

23721. The Humphrey Cornell Co., New London, Conn. (Packed for). *Best Yet Brand Catsup.* (Same descriptive matter as on 23699.)

23771. The Jersey Packing Co., Cincinnati, Ohio. *Manhattan Club Tomato Ketchup.* Not artificially colored. Contains tomatoes, pieces of tomatoes, sugar, salt, vinegar, corn syrup, onions, garlic and spices.

23644. The Jersey Packing Co., Cincinnati, Ohio (Manufactured for). *Sunny Side Tomato Ketchup.* (Same descriptive matter as on 23771.)

23714. Keystone Pickle Works, Philadelphia. *Stohrer's Keystone* (picture of tomato) *Catsup.* Contains one-tenth of one per cent. Benzoate of Soda.

23705. The E. S. Kibbe Co., Hartford, Conn. (Packed for). *Winner Brand Tomato Catsup.* Contains one-tenth of one per cent. Benzoate of Soda.

23712. Francis H. Leggett & Co., New York (Distributed by). *Windsor Brand Tomato Catsup.* Prepared from tomatoes, spice, sugar, salt, vinegar and garlic. Preserved with one-tenth of one per cent. Benzoate of Soda.

23698. LeRoy Packing Co., Boston, Mass. *Red Berry Tomato Catsup.*

23648. Jas. J. Longhery & Co., Boston, Mass. *LeRoy Extra Quality Tomato Catsup.* One-tenth of one per cent. benzoate of soda.

23704. Libby, McNeill & Libby, Chicago. *Libby's Tomato Catsup.* Contains one-tenth of one per cent. Benzoate of Soda.

23727. W. H. Mansfield & Co., Putnam, Conn. (Prepared for). *Tomato Catsup, Monogram Brand.* Preserved with one-tenth of one per cent. Benzoate of Soda. This catsup is made from fresh ripe tomatoes, salt, granulated sugar, onions, distilled vinegar and spices.

23703. Mansfield, Witham & Co., Lowell, Mass. *Spindle City Ketchup.* Preserved with one-tenth of one per cent. of benzoate of soda.

23654. McMechen Preserving Co., Wheeling, W. Va. *Nail City Brand* (picture of tomato) *Catsup.* Contains one-tenth of one per cent. of Benzoate of Soda.

23684. McMechen Preserving Co., Wheeling, W. Va. *Old Virginia Catsup.* Made from selected ripe tomatoes, granulated sugar, salt, pure spices, grain vinegar. Preserved with one-tenth of one per cent. Benzoate of Soda. Not artificially colored.

23649. McMechen Preserving Co., Wheeling, W. Va. *Parker House Brand Catsup.* (Same descriptive matter as on 23684.)

23651. Miner, Read & Garrette, New Haven, Conn. (Manufactured for). *None Such Brand Tomato Ketchup.* Made from tomatoes, gran. sugar, onions, pure spices, salt and vinegar. Preserved with one-tenth of one per cent. benzoate of soda.

23657. The Mohican Co., New York. *Mohican Brand Tomato Catsup.* This condiment is prepared from selected ripe tomatoes, flavored with distilled vinegar, sugar and choice spices, and contains one one-thousandth benzoate of soda. No artificial coloring used.

23688. Fred C. Orrell, Stamford, Conn. *The Celebrated White Label Catsup.* Made from Tomato Pulp, Salt, Vegetables, Sugar, Spices, Vinegar and Preserved with Benzoate of Soda. Free from artificial coloring.

23711. Jas. G. Powers & Co., New York. *20th Century Tomato Catsup.* Prepared from Tomatoes, Sugar, Corn Syrup, Distilled Vinegar, Onions, Salt and Spices and Preserved with one-tenth of one per cent. Soda Benzoate.

23782. The Pressing & Orr Co., Norwalk, Ohio. *Omega Brand Tomato Catsup.* Made from Tomatoes and Parts of Tomatoes, Vinegar, Sugar, Salt and Spices. One-tenth of one per cent. Benzoate of Soda.

23716. The Pressing & Orr Co., Norwalk, Ohio. *Winorr Tomato Catsup.* Made from fresh ripe tomatoes, vinegar, sugar, salt and pure spices; to prevent fermentation one-tenth of one per cent. Benzoate of Soda is used.

23681. E. Pritchard, New York and Bridgeton, N. J. *Pride of the Farm Brand Tomato Catsup.* Prepared with one-tenth of one per cent. Benzoate of Soda. Free from artificial color. Is made of choice tomatoes, the finest spices, onions, distilled vinegar, granulated sugar and salt.

23768. The Pyle & Tomlinson Co., Bridgeport, Conn. (Packed expressly for). *American Brand* (picture of tomato) *Catsup.* Prepared with one-tenth of one per cent. Benzoate of Soda.

23683. Rafferty & Hosier, New York. *Club House Brand Catsup.* Prepared from Tomato Pulp, Sugar, Dist. Vinegar, Onions, Salt and Spice and preserved with one-tenth of one per cent. Soda Benzoate.

23767. M. Schoenberg & Co., New York. *The Celebrated White Label Tomato Catsup.* (Same descriptive matter as on 23688.)

23658. M. Schoenberg & Co., New York. *Long Island Delight Brand* (picture of tomatoes) *Catsup.* Free from artificial coloring, made from tomatoes, salt, spices, vegetables, and preserved with one-tenth of one per cent. benzoate of soda. (Blown in bottle, "Cruikshank Bros., Allegheny, Pa.")

23689. John S. Sills & Sons, New York (Packed for). *Imperial Home Made Tomato Catsup.* Prepared from Tomatoes, Distilled Vinegar, Gran. Sugar, Onions and Pure Spices. Prepared with one-tenth of one per cent. Benzoate of Soda.

23685. The T. A. Snider Preserve Co., Cincinnati, Ohio. *Snider's Home Made Catsup.* Prepared from fresh, ripe tomatoes without fermentation. Not artificially colored. Contains one-tenth of one per cent. benzoate of soda.

23636. Sprague, Warner & Co., Chicago (Distributers). *Richelieu Brand Tomato Catsup.* Prepared with one-tenth of one per cent. Benzoate Soda. Not Artificially Colored.

23635. Squire Dingee Co., Chicago. *Squire Tomato Catsup.* Prepared with one-tenth of one per cent. Benzoate of Soda. Not Artificially Colored.

23643. The Standard Co., Hartford, Conn. (Distributed by). *Gold Leaf Tomato Ketchup.* Capitol City Pickle House. Preserved with one-tenth of one per cent. of Soda Benzoate. (Blown in bottle, "H. J. Heinz Co.")

23628. The Standard Co., Hartford, Conn. (Distributed by). *Tomato Catsup.* Preserved with one-tenth of one per cent. of Soda Benzoate.

23637. Stoddard, Gilbert & Co., New Haven (Put up expressly for). *High Grade Brand Catsup.* (Same descriptive matter as on 23699.)

23629. David Trubee Co., Bridgeport, Conn. (Packed for). *"Our Own" Ketchup.* Prepared with one-tenth of one per cent. Benzoate of Soda. (Blown in bottle, "Pride of the Farm Tomato Catsup.")

23634. David Trubee Co., Bridgeport, Conn. (Packed for). *"Seaside" Catsup.* Preserved with one-tenth of one per cent. Benzoate of Soda.

23652. The Van Camp Packing Co., Indianapolis, Ind. *Van Camp's Tomato Catsup.* Ingredients:—Tomatoes, Sugar, Vinegar, Salt, Cloves, Allspice, Cayenne Pepper, Onions, and one-tenth of one per cent. of Benzoate of Soda. Net weight about 16 oz.

23638. Waterbury Pickling Co., Waterbury, Conn. *Pride of Connecticut Tomato Ketchup.* Made from tomatoes, pure spices and vinegar, preserved with one-tenth of one per cent. of Benzoate of Sodium.

23630. The J. Weller Co., Cincinnati, Ohio. *Hoffman House Ketchup* (picture of tomato). Ingredients:—Tomatoes, Sugar, Vinegar, Salt, Cloves, Allspice, Cayenne Pepper, Onions and one-tenth of one per cent. of Benzoate of Soda.

23783. Geo. Wienhusen, New Haven, Conn. (Put up expressly for). *Pure Food Brand Catsup.* (Same descriptive matter as on 23699.)

23650. R. C. Williams & Co., New York. *New England Brand Tomato Catsup.* Prepared from Tomatoes, Spice, Sugar, Onions, Salt, and Vinegar. Preserved with one-tenth of one per cent. Benzoate of Soda.

23709. The Williams Bros. Co., Detroit, Mich. *Waldorf Brand Tomato Catsup.* Prepared with one-tenth of one per cent. Benzoate of Soda. Contains tomatoes, sugar, salt, vinegar and spices.

23642. (No manufacturer given.) *Yellow Label Tomato Ketchup.* Contains one-tenth of one per cent. Benzoate Soda, Garlic, Vinegar, Tomatoes, Salt, Spices and Granulated Sugar. (This sample had no cork in the bottle; the catsup was in direct contact with the metal cap.)

23645. (No manufacturer given.) *Ketchup* (picture of tomato). Tomato Pulp, Vinegar, Pure Spices, Sugar. Free from Artificial Color. Preserved with one-tenth of one per cent. Benzoate of Soda.

The Manufacture of Ketchup.

Bitting* has made an exhaustive study of the methods of manufacture used in this country. The process consists "essentially in reducing tomatoes to pulp, removing the skins, seeds, hard parts and stems, adding salt, sugar, condiments and vinegar to suit the taste and cooking to a proper consistency." The selection and preparation of stock, pulping, cooking and seasoning, evaporating and finishing, bottling and processing are all discussed in detail in the bulletin referred to in footnote. The following extract is of interest in connection with much of the present-day discussion as to the relative merits of benzoated, and non-benzoated, ketchups:

"Whole or ground spices, or acetic acid or oil extracts of the spices may be added to the pulp in such proportion as the particular brand demands. The spices most used are cloves, cinnamon, mace, and cayenne pepper; but paprika, pepper, mustard, cardamon, coriander, ginger, celery and allspice are used by some manufacturers. When whole spices are used, it is the practice to suspend them in a cloth bag or wire basket, and to take them out after boiling. They tend to darken the color of the ketchup, a result considered undesirable by some. The ground spices are used sparingly, with the exception of cayenne pepper. The acetic acid extracts of spices are used because they are economical and give a brighter red color than is obtained by the whole spice. The oil extracts produce no discoloration, but they are the most expensive and give an objectionable flavor. Hungarian sweet paprika is now quite largely used and adds to the color as well as to the flavor. Sugar, salt and vinegar are added in such proportion as may be desired, and in some brands onions and garlic are used."

The conditions under which ketchup is made at some of the better factories leave little to be desired. High-grade materials are used, the utmost cleanliness is practiced at all stages of manufacture, and the containers are thoroughly sterilized. The other extreme, representing the great bulk of the ketchup found on the market, is thus described by Bitting:

"The material is not whole ripe tomatoes, but consists of the waste of the canning factory, commonly designated as 'trimming stock,' including

* U. S. Department of Agriculture, Bur. of Chem., Bull. 119.

the green, moldy, broken, rotten and generally unsalable tomatoes, the skins, cores and stems from the peeling tables, and the surplus juice from the filling machine, all of which may be allowed to stand during the day and be run through the cyclone in the evening. At the end of the season, the frosted and half-ripe fruits may be used. . . . The pulp is put up in barrels, preserved, and allowed to stand, possibly in the sun, until a sufficient quantity has accumulated for shipment. . . . The sanitary condition of the factory may be poor, the handling of the goods be unclean, the spices be the refuse from the spice houses, the sugar be of the cheapest grade, and the bottles be only rinsed or be used without even that precaution. The ketchup is a concoction so heavily spiced with hot spices that the tomato flavor is lost and might as well be anything else. The color is normally dirty brown."

Labeling of Ketchup.

Since the passage of the Federal Pure Food law much improvement has been noted in the labeling. While deceptive practices are still sometimes employed in failing to make clear the presence of chemical preservatives, on the whole the labels give a fairly accurate idea as to the quality of the material. This statement does not apply to the amounts of sodium benzoate guaranteed, on the label, which are notoriously misleading, the usual formula "one-tenth of one per cent." generally being meaningless and apparently intended to be so.

The brand itself is the best guaranty of good quality. Price alone is not invariably a safe factor, nor is the absence of benzoate in all cases evidence of superior quality.

The Use of Chemical Preservatives.

It has been conclusively demonstrated by the Bureau of Chemistry and by several of the leading manufacturers, that the use of chemical preservatives in ketchup is totally unnecessary, provided good, ripe stock is used, clean methods of manufacture are followed and the material is thoroughly sterilized at the time of bottling. Notwithstanding these facts, however, the great majority of manufacturers continue to use a chemical preservative, generally benzoate of soda, in their products. In spite of the judgment of the Referee Board that the use of benzoate of soda in food products is not attended by injurious effects on the consumer, there is evidence to the contrary, and it would seem that where there is some doubt, as there undoubtedly is in this instance, as to the injurious effect of the preservative, it should be interdicted, especially when its use has been proved to be unnecessary. Unfortunately the Connecticut law is so closely modeled after the Federal law, that any interpretation or ruling that affects the one affects the other. Accordingly, under the present regulations the use of benzoate of soda in food products is permitted in this state, but its presence must be clearly stated on the label, together with its amount. As already stated, the usual quantity guaranteed is one-tenth of one per cent., but from the experience of this and other states it is evident either that the manufacturers do not know the quantity they are using or deliberately intend to deceive the consumer. Of the sixty-seven benzoated ketchups reported in this examination, fifty-two contained an excess of benzoate over what was claimed on the label, in some cases over three times as much.

Chemical Composition of Ketchup.

Few complete analyses of ketchup have been published, most analysts usually being content with a determination of the preservative present. The rather elaborate system of analysis used in this examination was adopted chiefly with the hope that chemical data might afford a means of determining purity. Hortvet* has suggested that determinations of salt-free ash, crude fiber and insoluble solids might be of value for this purpose.

In a material of such complex and variable nature as ketchup, wide variations in composition are to be expected. It would seem, however, that certain of the chemical characteristics of the tomato should still be found in the manufactured product. As a natural starting point a number of fresh tomatoes were separated as completely as possible into pulp, skin and seeds, and the separate portions analyzed. The variety of tomato used would naturally affect to some extent the relative proportions of these ingredients, and the figures obtained must not be considered as conclusive for all tomatoes. It is believed, however, that they fairly represent average ripe tomatoes of medium size. The following proportions were obtained:

* Pure Products, 5, 529.

	Original Substance. gms.	Air-dry Substance. gms.	Per Cent. of Tomato.
Whole tomatoes	1455	70.75	.....
Pulp and juice	1237	51.00	85.02
Seeds	75	9.75	5.15
Skins	143	10.00	9.83

That is, the pulp and juice make up about 85 per cent. by weight of the whole tomato.

Below are given the complete analyses of the pulp, seeds and skins and the whole tomato.

	In Original Fruit.				Water-free Basis.			
	Whole Fruit.	Pulp.	Seeds.	Skin.	Whole Fruit	Pulp.	Seeds.	Skin.
Water	95.63	96.38	87.45	93.54	----	----	----	----
Ether Extract	0.27	0.09	3.38	0.11	6.18	2.49	26.93	1.70
Crude Fiber	0.46	0.22	1.93	1.75	10.53	6.08	15.38	27.09
Protein	0.85	0.65	3.89	0.97	19.45	17.96	31.00	15.02
Ash	0.42	0.41	0.44	0.48	9.61	11.33	3.51	7.43
Nitrogen-free Extract	2.37	2.25	2.91	3.15	54.23	62.14	23.18	48.76
Water-Soluble Solids	2.93	2.98	2.25	2.84	67.05	82.32	17.93	43.96
Ratios 1:								
Insoluble Solids to Total Solids	3.0	5.7	1.2	1.8	----	----	----	----
Nitrogen to Fiber	3.4	2.1	3.1	11.3	----	----	----	----
Nitrogen to Ash	3.1	4.0	0.7	3.1	----	----	----	----
Nitrogen to Insoluble Solids	10.6	6.2	16.5	23.4	----	----	----	----
Nitrogen to Total Solids	32.2	34.8	20.2	41.7	----	----	----	----
Fiber to Ash	0.9	1.9	0.23	0.27	----	----	----	----
Fiber to Insoluble Solids	3.1	2.9	5.3	2.1	----	----	----	----
Fiber to Total Solids	9.5	16.4	6.5	3.7	----	----	----	----
Ash to Insoluble Solids	3.4	1.6	23.4	7.5	----	----	----	----
Ash to Total Solids	10.6	8.8	28.5	13.5	----	----	----	----

In studying the above analyses we find that each of the various parts of the tomato possesses some striking characteristics of composition. In the pulp the insoluble solids are low, ash high, fiber low, and protein medium. In the seeds the fiber is medium, the protein high, the ash low, and the insoluble solids very high. In the skin the insoluble solids are high, the fiber high, the protein low, and the ash medium. The application of these ratios in judging the quality of a ketchup will be considered in a later section.

Inasmuch as there are no fixed standards of composition at present for this material, the samples have been grouped in our

TABLE XXVII.—KETCHUPS NOT CONTAINING SODIUM BENZOATE.

Station No.	Brand.	Price per bottle, cents.	Net weight of contents, grams.	Cost of Ketchup per lb.	Analysis of Original Material. Total Solids.	Insoluble Solids.	Ash.	Sodium Chloride, calculated from chlorine.	Sodium Chloride-free Ash.	Fiber.	Protein, (N×6.25).	Acetic Acid.	Polariscope. Direct.	Polariscope. After Inversion.	Polariscope. Temperature.	Sucrose.	Invert Sugar or Glucose (*).	Undetermined.	Remarks.
				cts.															
23696	Beech-Nut	25	480	23.6	18.51	1.65	2.40	1.57	0.83	0.39	1.56	1.20	0.40	−4.40	21	3.63	10.57	†0.04	
23647	Campbell's	10	237	19.6	15.16	2.06	3.26	2.47	0.79	0.48	1.69	0.85	−2.60	−2.62	21	0.00	8.51	1.22	
23646	Columbia	25	481	23.6	23.21	1.79	4.02	2.85	1.17	0.41	2.44	1.83	....	....	....	....	....	....	
23686	Hazard's	10	440	10.3	15.95	1.63	3.77	3.00	0.77	0.35	1.44	1.20	−1.80	−3.08	21	0.97	9.07	0.35	
23695	Heinz	30	529	25.7	32.49	2.09	3.98	3.05	0.93	0.42	2.13	1.98	2.00	−7.70	21	7.34	17.48	1.14	
23771	Manhattan Club	10	437	10.4	28.23	2.19	3.59	2.54	1.05	0.41	1.38	1.14	27.20	23.10	23	3.13	*13.75	5.97	† Contains glucose.
23644	Sunny Side	10	453	10.0	28.10	2.56	3.37	2.33	1.04	0.48	1.69	1.26	25.00	22.88	23	1.62	*13.36	7.58	† Contains glucose.

* Glucose. † Stated on the label.

Table XXVIII.—Ketchups containing Sodium Benzoate not in excess of Amount Claimed.

Station No.	Brand.	Price per bottle, cents.	Net weight of contents, grams.	Cost of Ketchup per lb.	Analysis of Original Material.								Sodium Benzoate.		Polariscope.						Remarks.
					Total Solids.	Insoluble Solids.	Ash.	Sodium Chloride, calculated from chlorine.	Sodium Chloride-free Ash.	Fiber.	Protein (Nx6.25).	Acetic Acid.	Claimed.	Found.	Direct.	After Inversion.	Temperature.	Sucrose.	Invert Sugar or Glucose (*).	Undetermined.	
				cts.																	
23631	Bowe	10	499	9.1	11.32	2.58	1.69	0.71	0.98	0.63	1.25	0.84	0.10	0.08	−0.80	−1.98	21	0.90	5.56	1.29	Small amount of cereal starch
23710	Home	10	424	10.7	15.35	2.77	3.00	2.37	0.63	0.51	1.38	1.14	0.10	0.04	−0.80	−2.42	22	1.23	6.75	2.48	
23718	Shiloh	10	408	11.1	14.50	2.50	2.69	2.12	0.57	0.57	1.25	0.93	0.10	0.04	2.00	0.66	22	1.02	*0.56	8.41	Contains glucose; no place of manufacture
23682	Cruikshank's	10	241	18.8	19.21	2.47	2.97	2.11	0.86	0.50	1.50	1.62	0.10	0.10	−1.20	−4.18	21	2.25	11.29	0.70	
23632	Red Jacket	10	426	10.6	17.88	2.08	3.13	2.06	1.07	0.47	1.25	0.60	0.10	0.07	1.00	−3.52	21	3.42	7.92	1.69	No place of manufacture
23702	Bon Ton	10	452	10.0	17.33	2.15	1.61	0.85	0.76	0.57	1.63	0.96	0.10	0.09	1.20	−4.84	21	4.57	11.03	+2.08	No place of manufacture
23713	Ohio Valley Pres. Co.	15	467	14.6	18.65	2.95	4.31	2.71	1.60	0.69	1.63	1.68	0.10	0.05	3.00	−3.08	22	4.62	5.35	2.05	Benzoate not stated on main label
23714	Stohrer's	5	227	10.0	15.74	2.46	2.98	2.25	0.73	0.56	1.38	1.44	0.10	0.07	4.40	3.53	22	0.66	*2.14	8.02	Contains glucose
23705	Winner	10	443	10.2	17.53	1.59	3.12	2.25	0.87	0.40	1.63	0.72	0.10	0.10	1.40	−3.73	21	3.88	8.12	0.38	No place of manufacture
23681	Pride of the Farm	10	335	13.5	12.76	2.86	2.36	1.67	0.69	0.54	1.75	1.29	0.10	0.05	−1.80	−1.76	21	0.03	5.99	2.09	
23768	American Beauty	10	446	10.2	14.17	1.99	2.75	1.82	0.93	0.36	1.31	0.66	0.10	0.08	1.40	−2.86	22	3.24	6.12	0.39	No place of manufacture
23685	Snider's	18	470	17.4	18.78	2.10	4.22	3.39	0.83	0.35	1.56	0.90	0.10	0.07	−0.20	−3.30	21	2.35	8.35	1.95	
23628	Tomato Catsup (Standard)	10	738	6.1	11.02	1.90	3.26	2.52	0.74	0.50	1.44	1.26	0.10	0.10	0.60	−0.88	21	1.12	1.70	3.00	Excess of salt; no place of mnf.
23638	Pride of Conn.	10	422	10.8	20.67	3.01	1.70	0.97	0.73	0.77	1.31	1.32	0.10	0.07	10.80	4.84	21	4.51	*3.60	8.78	Glucose; cereal starch
23630	Hoffman House	10	453	10.0	19.20	3.24	2.93	1.99	0.94	0.47	1.88	1.50	0.10	0.09	−1.60	−2.86	21	0.95	8.35	4.62	

* Glucose.

Table XXIX.—Ketchups containing Sodium Benzoate in excess of Amount Claimed, or otherwise Illegal.

Station No.	Brand.	Price per bottle, cents.	Net weight of contents, grams.	Cost of Ketchup per lb.	Analysis of Original Material.								Sodium Benzoate.		Polarization.			Sucrose.	Invert Sugar or Glucose (*).	Undetermined.	Remarks.
					Total Solids.	Insoluble Solids.	Ash.	Sodium Chloride, calculated from chlorine.	Sodium Chloride-free Ash.	Fiber.	Protein (Nx6.25).	Acetic Acid.	Claimed.	Found.	Direct.	After Inversion.	Temperature.				
				cts.																	
23719	American	10	405	11.2	11.64	2.94	2.67	1.78	0.89	0.52	0.81	0.78	0.10	0.15	4.40	4.40	22	0.00	*2.51	5.13	Excess of benzoate; glucose and artificial color.
23724	Standard	5	289	7.8	18.39	6.07	2.40	1.43	0.97	0.33	1.00	0.96	0.10	0.25	4.80	—0.66	20	4.12	*0.39	10.15	Excess of benzoate; †artificial color; no place of manufacture; †much starch.
23707	Anderson	10	462	9.8	7.27	2.05	2.65	2.10	0.55	0.44	0.94	0.84	0.03	0.10	1.40	—1.32	21	2.06	2.16	+0.98	Excess of benzoate and salt; artificial color.
23690	Home Made Long Id.	10	426	10.6	16.40	2.88	4.89	4.04	0.85	0.46	1.56	1.38	?	0.13	----	----	--	---		----	†Artificial color; excess of salt; amount of benzoate not stated on label.
23758	Lion	10	447	10.1	18.00	2.90	4.60	3.37	1.23	0.70	1.56	1.20	0.10	0.15	1.00	—2.42	22	2.60	5.32	3.22	Excess of benzoate; no place of manufacture.
23717	Sunbeam	20	524	17.3	22.18	2.36	4.20	2.42	1.78	0.36	2.44	1.05	0.10	0.15	1.20	—4.40	22	4.26	10.17	0.75	Excess of benzoate.
23723	Bishop's	27	476	25.7	14.13	2.19	2.36	1.30	1.06	0.34	1.00	1.02	0.10	0.14	—1.20	—2.64	22	1.09	7.61	1.73	Excess of benzoate.
23639	Eagle	10	746	6.1	10.40	2.42	3.41	2.53	0.88	0.62	1.13	1.20	0.10	0.07	3.00	3.08	21	0.00	*1.71	3.53	Glucose; cereal starch; excess of salt.
23633	Perfection	10	428	10.6	17.17	2.21	4.28	3.01	1.27	0.52	1.31	1.14	0.10	0.16	—0.80	—2.64	21	1.39	7.17	2.50	Excess of benzoate; small amount of starch.
23706	Table Talk	10	440	10.3	15.20	2.04	3.92	2.95	0.97	0.49	1.50	0.90	0.10	0.35	0.40	—1.91	21	1.75	4.39	3.15	Excess of benzoate.
23722	Home Made	10	421	10.8	23.43	2.69	6.89	5.17	1.72	0.45	1.38	1.08	0.10	0.14	4.00	—4.18	22	6.21	7.35	1.15	Excess of benzoate and salt.
23653	Blue Label	20	478	19.0	16.49	1.23	3.91	3.12	0.79	0.35	1.50	0.84	0.10	0.15	5.20	—1.10	21	4.44	*0.66	5.63	Excess of benzoate.
23699	Blue Bell	7	419	7.6	8.41	2.03	2.77	1.96	0.81	0.57	1.19	1.44	0.10	0.20	0.00	0.00	23	0.00	0.00	3.88	Excess of benzoate and salt; †artificial color and †saccharin.

* Glucose. † Stated on the label.

TABLE XXIX.—KETCHUPS CONTAINING SODIUM BENZOATE IN EXCESS OF AMOUNT CLAIMED, OR OTHERWISE ILLEGAL—*Continued.*

Station No.	Brand.	Price per bottle, cents.	Net weight of contents, grams.	Cost of Ketchup per lb.	Analysis of Original Material: Total Solids.	Insoluble Solids.	Ash.	Sodium Chloride, calculated from chlorine.	Sodium Chloride-free Ash.	Fiber.	Protein (Nx6.25).	Acetic Acid.	Sodium Benzoate: Claimed.	Sodium Benzoate: Found.	Polarization: Direct.	Polarization: After Inversion.	Polarization: Temperature.	Sucrose.	Invert Sugar or Glucose (*).	Undetermined.	Remarks.
				cts.																	
23655	Country Club	10	297	15.3	18.47	2.21	3.91	2.95	0.96	0.39	1.63	1.14	0.10	0.14	0.40	—3.52	21	2.97	8.41	1.16	Excess of benzoate.
23656	East Rock	10	806	5.6	8.47	2.43	3.01	2.29	0.72	0.66	1.25	1.50	0.10	0.25	—0.20	—0.44	21	0.18	1.24	2.13	Excess of benzoate and salt; † artificial color and † saccharin.
23641	Mascot	20	504	18.0	19.83	2.63	3.33	2.07	1.26	0.53	2.50	1.20	0.10	0.12	1.00	—3.73	21	3.58	8.44	1.45	Excess of benzoate; no place of manufacture.
23726	Jack Dalton, Jr.	10	313	14.5	12.97	2.45	1.77	0.95	0.82	0.43	1.00	0.93	0.10	0.22	2.00	—2.64	22	3.52	5.05	1.20	Excess of benzoate; no place of manufacture.
23687	Gt. Atl. & Pac. Tea Co.	18	497	16.4	23.56	2.48	4.24	3.01	1.23	0.50	2.94	1.38	0.10	0.18	0.40	—4.40	21	3.63	10.57	1.68	Excess of benzoate; no place of manufacture.
23728	Crescent	12	721	7.5	7.45	2.47	2.87	1.99	0.88	0.33	0.94	0.54	0.10	0.23	0.00	0.00	23	0.00	0.00	3.31	Excess of benzoate and salt; † starch, saccharin (?), no place of manufacture.
23640	Royal	25	493	23.0	22.37	2.73	3.24	2.10	1.14	0.46	1.88	1.02	0.10	0.16	6.00	—4.40	21	7.87	6.12	2.80	Excess of benzoate; cereal starch.
23721	Best Yet	10	481	9.4	7.56	1.62	3.03	1.84	1.19	0.49	0.94	1.02	0.10	0.21	0.00	0 00	22	0.00	0.00	3.10	Excess of benzoate and salt; † artificial color; † saccharin; no place of manufacture.
23712	Windsor	10	433	10.5	15.43	2.15	2.25	1.37	0.88	0.48	1.38	0.72	0.10	0.15	2.60	—2.42	22	3.81	4.02	3.49	Excess of benzoate; no place of manufacture.
23698	Red Berry	25	509	22.3	24.82	2.74	3.77	2.87	0.90	0.54	1.19	1.08	0.00	0.25	10.00	8.36	21	1.24	*5.01	13.07	Contains glucose and starch; benzoate not stated on label.
23648	LeRoy	10	379	12.0	16.57	1.71	4.48	3.73	0.75	0.48	1.63	1.14	0.10	0.13	----	----	--	---	----	----	Excess of benzoate and salt.

* Glucose. † Stated on the label.

TABLE XXIX.—KETCHUPS CONTAINING SODIUM BENZOATE IN EXCESS OF AMOUNT CLAIMED, OR OTHERWISE ILLEGAL—*Continued.*

Station No.	Brand.	Price per bottle, cents.	Net weight of contents, grams.	Cost of Ketchup per lb.	Analysis of Original Material: Total Solids.	Insoluble Solids.	Ash.	Sodium Chloride, calculated from chlorine.	Sodium Chloride-free Ash.	Fiber.	Protein (Nx6.25).	Acetic Acid.	Sodium Benzoate: Claimed.	Sodium Benzoate: Found.	Polarization: Direct.	Polarization: After Inversion.	Polarization: Temperature.	Sucrose.	Invert Sugar or Glucose (*).	Undetermined.	Remarks.
				cts.																	
23704	Libby's	10	194	23.4	28.26	4.08	4.70	3.26	1.44	0.58	3.06	1.68	0.10	0.11	6.00	—2.64	21	6.53	6.52	6.87	Excess of benzoate.
23727	Monogram	25	491	23.1	18.56	2.28	3.62	2.15	1.47	0.39	2.13	1.14	0.10	0.16	1.40	—3.96	22	4.07	9.16	+0.84	Excess of benzoate; no place of manufacture.
23703	Spindle City	10	456	9.9	14.66	1.96	2.54	1.86	0.68	0.48	1.13	0.72	0.10	0.38	2.40	—3.30	21	4.31	6.25	+0.05	Excess of benzoate.
23654	Nail City	10	347	13.1	11.83	2.13	2.88	1.85	1.03	0.57	1.75	1.26	0.10	0.18	0.20	—0.88	21	0.82	2.03	3.78	Excess of benzoate.
23684	Old Virginia	25	483	23.5	17.21	1.77	3.69	2.60	1.09	0.38	2.38	0.93	0.10	0.17	1.80	—3.08	21	3.69	6.19	0.88	Excess of benzoate.
23649	Parker House	9	347	11.8	15.43	1.35	4.69	3.92	0.77	0.58	1.56	1.41	0.10	0.14	3.40	—0.88	23	3.28	0.00	5.32	Excess of benzoate and salt.
23651	None Such	10	449	10.1	13.92	1.82	2.58	1.63	0.95	0.48	1.75	0.84	0.10	0.12	3.60	—0.44	21	3.05	*0.54	5.52	Excess of benzoate; no place of manufacture.
23657	Mohican	11	369	13.5	12.99	2.60	3.12	2.44	0.68	0.55	1.25	1.11	0.10	0.14	3.40	1.10	23	1.75	*0.94	5.38	Excess of benzoate; glucose; no place of manufacture.
23688	Celebrated White Label (Orrell)	10	345	13.4	12.65	2.45	1.94	1.35	0.59	0.48	1.25	1.14	?	0.21	0.00	—2.20	21	1.66	5.43	1.89	Amount of benzoate not stated.
23711	20th Century	10	428	10.6	14.52	1.90	4.40	3.34	1.06	0.47	1.06	0.78	0.10	0.33	1.00	—1.51	22	1.91	3.03	3.65	Excess of benzoate and salt.
23782	Omega	10	386	11.8	24.74	2.28	4.59	3.00	1.59	0.32	2.38	1.14	0.10	0.14	2.40	—5.72	22	6.17	12.53	+1.25	Excess of benzoate.
23716	Winorr	20	466	19.5	21.02	2.12	3.73	2.33	1.40	0.42	1.44	1.14	0.10	0.13	0.00	—4.40	22	3.34	11.10	0.99	Excess of benzoate.
23683	Club House	10	454	10.0	19.28	2.38	5.09	3.98	1.11	0.63	1.56	1.29	0.10	0.32	0.60	—3.08	21	2.78	7.14	2.08	Excess of benzoate and salt.
23767	Celebrated White Label (Schoenberg)	10	350	13.0	13.40	2.46	2.42	1.72	0.70	0.55	1.13	0.72	?	0.23	0.80	—2.20	22	2.28	4.92	2.10	Amount of benzoate not stated.
23658	Long Is. Delight	5	223	10.2	8.33	1.89	2.92	1.99	0.93	0.46	1.56	1.41	0.10	0.19	0.00	0.00	21	0.00	0.00	3.39	Excess of benzoate and salt.
23689	Imperial Home Made	10	443	10.2	18.64	2.40	5.51	4.04	1.47	0.50	2.06	1.14	0.10	0.26	1.80	—2.20	21	3.03	4.03	3.51	Excess of benzoate and salt: no place of manufacture.

* Glucose.

TABLE XXIX.—KETCHUPS CONTAINING SODIUM BENZOATE IN EXCESS OF AMOUNT CLAIMED, OR OTHERWISE ILLEGAL—*Concluded.*

Station No.	Brand.	Price per bottle, cents.	Net weight of contents, grams.	Cost of Ketchup per lb.	Analysis of Original Material. Total Solids.	Insoluble Solids.	Ash.	Sodium Chloride, calculated from chlorine.	Sodium Chloride-free Ash.	Fiber.	Protein (Nx6.25).	Acetic Acid.	Sodium Benzoate. Claimed.	Sodium Benzoate. Found.	Polarization. Direct.	Polarization. After Inversion	Polarization. Temperature.	Sucrose.	Invert Sugar or Glucose (*).	Undetermined.	Remarks.
				cts																	
23636	Richelieu	25	483	23.5	15.57	1.95	2.83	1.63	1.20	0.44	1.50	0.78	0.10	0.14	2.00	—3.52	21	4.18	7.14	+0.52	Excess of benzoate; no place of manufacture.
23635	Squire	10	429	10.6	12.82	2.14	2.46	1.48	0.98	0.47	1.38	1.02	0.10	0.13	2.00	—1.76	21	2.84	2.75	2.92	Excess of benzoate.
23643	Gold Leaf	25	599	18.9	14.49	1.79	3.66	2.59	1.07	0.48	0.94	1.02	0.10	0.30	0.40	—2.20	21	1.97	5.14	2.30	Excess of benzoate; starch; no place of manufacture; benzoate not stated on main label.
23637	High Grade	10	409	11.1	7.51	1.33	2.71	1.81	0.90	0.62	1.13	1.38	0.10	0.20	0.00	0.00	21	0.00	0.00	3.05	Excess of benzoate and salt; † artificial color; † saccharin; no place of manufacture.
23629	Our Own	10	429	10.6	10.97	2.41	2.39	1.66	0.73	0.51	1.00	0.90	0.10	0.32	0.00	—1.32	21	1.00	3.27	2.80	Excess of benzoate; no place of manufacture.
23634	Seaside	10	419	10.8	14.22	1.38	2.47	1.59	0.88	0.47	0.88	0.60	0.10	0.20	5.00	0.22	21	3.06	*1.68	5.66	Excess of benzoate; glucose; no place of manufacture.
23652	Van Camp's	15	510	13.3	20.10	3.32	3.78	2.56	1.22	0.51	2.50	1.44	0.10	0.24	—1.80	—3.74	21	1.48	10.73	1.10	Excess of benzoate.
23783	Pure Food	10	442	10.3	8.14	1.84	3.17	2.21	0.96	0.55	1.06	1.02	0.10	0.21	0.00	0.00	22	0.00	0.00	3.36	Excess of benzoate and salt; † artificial color; † saccharin; no place of manufacture.
23650	New England	10	413	11.0	16.42	2.96	3.97	2.92	1.05	0.66	1.63	1.08	0.10	0.30	1.40	—1.98	21	2.56	3.17	4.43	Excess of benzoate.
23709	Waldorf	10	336	13.5	23.48	2.22	4.43	3.37	1.06	0.50	1.75	1.08	0.10	0.13	3.00	—4.40	21	5.60	8.51	2.69	Excess of benzoate.
23642	Yellow Label	10	445	10.2	15.99	1.85	3.34	2.57	0.77	0.55	1.13	0.96	0.10	0.08	3.80	1.10	21	2.04	*1.01	7.92	No manufacturer given; no cork; ketchup in contact with metal top.
23645	No brand or manufacturer	10	414	11.0	15.63	2.21	4.64	3.88	0.76	0.41	1.44	0.96	0.10	0.25	0.00	—1.76	21	1.33	4.35	3.46	Excess of benzoate and salt; no place of manufacture.

* Glucose. † Stated on the label.

TABLE XXX.—KETCHUPS NOT CONTAINING SODIUM BENZOATE.

Station No.	Brand.	Water-free Basis. Insoluble Solids.	Ash.	Sodium Chloride-free Ash.	Fiber.	Protein (N x 6.25).	Water-Sodium Chloride-free Basis. Insoluble Solids.	Ash.	Fiber.	Proteini (N x 6.25).
23696	Beech-Nut	8.91	12.97	4.48	2.11	8.44	9.74	4.90	2.30	9.25
23647	Campbell's	13.46	21.50	5.21	3.17	11.13	16.23	6.21	3.79	13.31
23646	Columbia	7.71	17.32	5.04	1.77	10.50	8.79	5.75	2.02	12.00
23686	Hazard's	10.22	23.64	4.83	2.19	9.00	12.59	5.95	2.70	11.06
23695	Heinz	6.43	12.25	2.86	1.29	6.56	7.10	3.16	1.42	7.25
23771	Manhattan Club	7.76	12.72	3.72	1.45	4.88	8.52	4.09	1.60	5.38
23644	Sunny Side	9.11	11.99	3.70	1.71	6.00	9.93	4.04	1.86	6.56

TABLE XXXI.—KETCHUPS CONTAINING SODIUM BENZOATE NOT IN EXCESS OF AMOUNT CLAIMED.

Station No.	Brand.	Water-free Basis. Insoluble Solids.	Ash.	Sodium Chloride-free Ash.	Fiber.	Protein (N x 6.25).	Water-Sodium Chloride-free Basis. Insoluble Solids.	Ash.	Fiber.	Protein (N x 6.25).
23631	Bowe	22.79	14.93	8.66	5.57	11.06	24.31	9.24	5.94	11.81
23710	Home	18.05	19.54	4.10	3.32	8.94	21.34	4.85	3.93	10.63
23718	Shiloh	17.24	18.55	3.93	3.93	8.63	20.19	4.60	4.60	10.13
23682	Cruikshank's	12.86	15.46	4.48	2.60	7.81	14.44	5.03	2.92	8.75
23632	Red Jacket	11.63	17.51	6.00	2.63	7.00	13.15	6.76	2.97	7.88
23702	Bon Ton	12.41	9.29	4.39	3.29	9.38	13.05	4.61	3.46	9.88
23713	Ohio Valley Pres. Co.	15.82	23.11	8.58	3.70	8.69	18.51	10.04	4.33	10.19
23714	Stohrer's	15.63	18.93	4.64	3.56	8.75	18.24	5.41	4.15	10.19
23705	Winner	9.07	17.81	5.00	2.28	9.25	10.41	5.69	2.62	10.63
23681	Pride of the Farm	22.41	18.49	5.41	4.23	13.63	25.78	6.22	4.87	15.69
23768	American Beauty	14.04	19.41	6.56	2.54	9.25	16.11	7.53	2.91	10.63
23685	Snider's	11.18	22.47	4.42	1.86	8.31	13.65	5.39	2.27	10.13
23628	Tomato Catsup (Standard)	17.24	29.58	6.72	4.54	13.06	22.35	8.71	5.88	16.94
23638	Pride of Connecticut	14.56	8.22	3.53	3.73	6.38	15.28	3.71	3.91	6.69
23630	Hoffman House	16.88	15.26	4.90	2.45	9.75	18.83	5.46	2.73	10.88

tables of analysis on the basis which most directly affects the legality of their sale in this state, that is, as to whether preservatives are present, and if so, whether the amount found corresponds to that stated on the label. Accordingly, three groups have been formed, those which contained no sodium benzoate, those which contained benzoate not in excess of the amount

TABLE XXXII.—KETCHUPS CONTAINING SODIUM BENZOATE IN EXCESS OF AMOUNT CLAIMED, OR OTHERWISE ILLEGAL.

Station No.	Brand.	Water-free Basis.					Water-Sodium Chloride-free Basis.			
		Insoluble Solids.	Ash.	Sodium Chloride-free Ash.	Fiber.	Protein (N x 6.25).	Insoluble Solids.	Ash.	Fiber.	Protein (N x 6.25).
23719	American	25.26	22.94	7.65	4.47	7.00	29.82	9.03	5.29	8.25
23724	Standard	33.01	13.05	5.27	1.79	5.44	35.79	5.72	1.95	5.88
23707	Anderson	28.20	36.45	7.57	6.05	12.88	39.65	10.64	8.51	18.13
23690	Home Made Long Island	17.56	29.82	5.18	2.80	9.50	23.30	6.87	3.72	12.63
23758	Lion	16.11	25.56	6.83	3.89	8.69	19.82	8.41	4.78	10.69
23717	Sunbeam	10.64	18.94	7.94	1.62	11.00	11.94	9.01	1.82	12.31
23723	Bishop's	15.50	16.70	7.50	2.41	7.06	17.07	8.26	2.65	7.81
23639	Eagle	23.27	32.79	8.46	5.96	10.81	30.75	11.18	7.88	14.31
23633	Perfection	12.87	24.93	7.40	3.03	7.63	15.61	8.97	3.67	9.25
23706	Table Talk	13.42	25.79	6.38	3.22	9.88	16.65	7.92	4.00	12.25
23722	Home Made	11.48	29.41	7.34	1.92	5.88	14.73	9.42	2.46	7.50
23653	Blue Label	7.46	23.71	4.79	2.12	9.13	9.20	5.91	2.61	11.25
23699	Blue Bell	24.14	32.94	9.63	6.78	14.13	31.47	12.56	8.84	18.44
23655	Country Club	11.97	21.17	5.20	2.11	8.81	14.24	6.19	2.51	10.50
23656	East Rock	28.69	35.54	8.50	7.79	14.75	39.32	11.65	10.68	20.19
23641	Mascot	13.26	16.79	6.35	2.67	12.63	14.81	7.09	2.98	14.06
23726	Jack Dalton, Jr.	18.89	13.65	6.32	3.32	7.69	20.38	6.82	3.58	8.31
23687	Gt. Atl. & Pac. Tea Co.	10.53	18.00	5.22	2.12	12.50	12.07	5.99	2.43	14.31
23728	Crescent	33.15	38.52	11.81	4.43	12.56	45.24	16.12	6.04	17.19
23640	Royal	12.20	14.48	5.09	2.06	8.38	13.47	5.62	2.27	9.25
23721	Best Yet	21.43	40.08	15.74	6.48	12.38	28.32	20.80	8.57	16.38
23712	Windsor	13.93	14.58	5.70	3.11	8.94	15.29	6.26	3.41	9.75
23698	Red Berry	11.04	15.19	3.63	2.17	4.81	12.48	4.10	2.46	5.44
23648	LeRoy	10.32	27.04	4.53	2.90	9.81	13.32	5.85	3.74	12.69
23704	Libby's	14.44	16.63	5.10	2.05	10.81	16.32	5.76	2.32	12.25
23727	Monogram	12.28	19.50	7.92	2.10	11.44	13.89	8.96	2.38	12.94
23703	Spindle City	13.37	17.33	4.64	3.27	7.69	15.31	5.31	3.75	8.81
23654	Nail City	18.00	24.34	8.71	4.82	14.81	21.34	10.32	5.71	17.56
23684	Old Virginia	10.28	21.44	6.33	2.21	13.81	12.11	7.46	2.60	16.25
23649	Parker House	8.75	30.40	4.99	3.76	10.06	11.73	6.69	5.04	13.50
23651	None Such	13.07	18.53	6.82	3.45	12.50	14.81	7.72	3.91	14.19
23657	Mohican	20.00	24.02	5.23	4.23	9.63	24.64	6.44	5.21	11.88
23688	Cel. White Label (Orrell)	19.37	15.34	4.66	3.79	9.88	21.68	5.22	4.24	11.06
23711	20th Century	13.09	30.30	7.34	3.24	7.31	16.99	9.48	4.20	9.50
23782	Omega	9.22	18.55	6.43	1.29	9.63	10.49	7.31	1.47	10.94
23716	Winorr	10.09	17.75	6.66	2.00	6.81	11.34	7.49	2.25	7.69
23683	Club House	12.34	26.40	5.76	3.22	8.13	15.56	6.49	3.63	9.19
23767	Cel. White Label (Schoenberg)	18.36	18.06	5.22	4.10	8.38	21.06	5.99	4.71	9.63
23658	Long Island Delight	22.69	35.05	11.16	5.52	18.75	29.81	14.66	7.25	24.63
23689	Imperial Home Made	12.88	29.56	7.89	2.68	11.06	16.44	10.07	3.42	14.13
23636	Richelieu	12.52	18.18	7.71	2.83	9.63	13.99	8.61	3.16	10.75
23635	Squire	16.69	19.19	7.64	3.67	10.75	18.87	8.64	4.14	12.13
23643	Gold Leaf	12.41	25.26	7.38	3.31	6.44	15.04	9.00	4.03	7.88
23637	High Grade	17.71	36.09	11.98	8.26	15.00	23.33	15.79	10.88	19.75
23629	Our Own	21.97	21.79	6.65	4.65	9.13	25.89	7.84	5.48	10.75
23634	Seaside	9.70	17.37	6.19	3.30	6.13	10.93	6.97	3.72	6.94
23652	Van Camp's	16.52	18.81	6.07	2.54	12.44	18.93	6.95	2.91	14.25
23783	Pure Food	22.61	38.94	11.79	6.76	13.06	32.72	16.19	9.27	17.94
23650	New England	18.03	24.18	6.40	4.02	9.88	21.93	7.78	4.89	12.00
23709	Waldorf	9.45	18.87	4.51	2.13	7.44	11.04	5.27	2.49	8.69
23642	Yellow Label	11.57	20.89	4.82	3.44	7.06	13.79	5.74	4.10	8.38
23645	No Brand or Mfr.	14.14	29.69	4.86	2.62	9.19	18.81	6.47	3.49	12.25

claimed, and those which contained benzoate in excess of the claimed amount or were otherwise illegal. In our first consideration of the results, the amount of preservative found is the basis of our judgment. It must be understood, however, that this classification is an arbitrary one and only in a general way reflects quality. Good ketchups, aside from the matter of preservative, are found in all three classes, and some of the ketchups included in the first class, from the standpoint of quality, are no better than some classed in the other two groups.

Tables XXVII to XXIX give the analysis of the original material, together with data as to price and amount sold; tables XXX to XXXII give the results calculated to the water-free, and water-sodium-chloride-free bases.

Guarantees as to Benzoate.

Eight samples were sold as containing no benzoate, one was claimed to contain 0.03 per cent., sixty-two 0.10 per cent., and three indicated benzoate on the label without stating the quantity.

Only one sample whose label was silent on the subject was found to contain benzoate; sample **23698**, *LeRoy Packing Co.'s Red Berry Brand,* contained 0.25 per cent.

The sample claimed to contain 0.03 actually contained 0.10 per cent.

Of the sixty-two samples claiming 0.10 per cent., forty-five exceeded that amount, ranging from 0.11 to 0.38 per cent.

In the three samples in which the quantity was not stated on the label, 0.13, 0.21 and 0.23 per cent. was found.

Our findings as to benzoate may be summarized as follows:

Contained no Benzoate	7 brands
" from .04 to .10 Benzoate	18 "
" " .11 to .20 "	30 "
" " .21 to .30 "	14 "
" over .30 Benzoate	5 "

It is clear from the above that the catch-phrase "Preserved with one-tenth of one per cent. of sodium benzoate" has little real significance as to the actual amount of preservative present. Of sixty-three samples claiming a definite amount of benzoate, forty-six, or 73 per cent., exceeded that amount, five samples containing over three times the amount claimed.

It is of interest to note the relative composition of the benzoated and nonbenzoated samples. This is shown in Table XXXIII.

TABLE XXXIII.—AVERAGE ANALYSES.

	Containing no benzoate.	Containing benzoate.	All Samples.
In original material:			
Water	76.91	84.20	83.78
Insoluble solids	2.00	2.25	2.32
Ash	3.48	3.38	3.39
Ash-NaCl	0.94	0.98	0.98
Fiber	0.42	0.50	0.49
Protein	1.76	1.50	1.53
Acetic acid	1.35	1.08	1.11
Water-free basis:			
Insoluble solids	9.09	15.90	15.26
Ash	16.06	22.53	21.91
Ash-NaCl	4.26	6.60	6.38
Fiber	1.96	3.49	3.35
Protein	8.07	9.69	9.53
Water-NaCl-free basis:			
Insoluble solids	10.41	19.24	18.40
Ash	4.87	7.97	7.68
Fiber	2.24	4.25	4.06
Protein	9.26	11.63	11.41

While in the original substance there are no striking differences in the averages, except the amount of water found, too much dependence must not be placed on these averages, for in the benzoated samples in particular they represent the means of widely divergent extremes. For instance, in these samples the water ranges from 71.74 to 92.73 per cent., insoluble solids from 1.23 to 6.07, ash from 1.61 to 6.89, sodium chloride from 0.71 to 5.17, fiber from 0.32 to 0.77, protein from 0.81 to 3.06, and acidity from 0.54 to 1.68. The nonbenzoated samples show much more uniform composition, but even here there are wide variations in water and acidity.

The following summary shows the extremes found in the various ingredients of the whole seventy-four samples, original material.

Total solids	7.27	to	32.49
Insoluble solids	1.23	to	6.07
Ash	1.61	to	6.89
Sodium chloride	0.71	to	5.17
Fiber	0.32	to	0.77
Protein	0.81	to	3.06
Acetic Acid	0.54	to	1.98
Sodium Benzoate	0.00	to	0.38

Acidity.

This determination can be best considered on the basis of original substance. It ranges from 0.54 to 1.98 per cent. acetic acid. The non-benzoated samples ranged from 0.85 to 1.98, the benzoated from 0.54 to 1.68 per cent. It has been urged by those who favor the use of benzoate in ketchup that the non-users secure their preservative effect by excessive amounts of acid, either in the form of vinegar or acetic acid extracts of the spices. At first glance our analyses would seem to lend some support to this contention, for two of the non-benzoated samples contain the high acidities of 1.83 and 1.98, 0.15 and 0.30 per cent. higher than the highest benzoated ketchups. It seems unfair, however, to consider acidity independent of the other ingredients of the ketchup. For instance, a ketchup might show a low acidity and yet be so low in solids that a very large quantity would have to be used to secure the desired condimental effect, while, on the other hand, a ketchup high in acidity might be so high in solids that only a small quantity would be needed to secure the same effect, and the acidity of the actual amount of ketchup used would be lower than in the low-solids ketchup. An examination of our tables shows that this statement is supported by the facts. The ratio of acidity to solids ranges from 12.7 to 24.8 in the non-benzoated samples with an average of 17.1, and in the benzoated samples from 5.4 to 29.8 with an average of 14.7. The two non-benzoated samples with high acidities show ratios of 12.7 and 16.4. The following table shows the variations in these ratios in the two classes of samples:

Acidity to Solids. 1 :	Non-benzoated.	Benzoated.
Over 25	–	1
19–25	2	18
12–19	5	28
9–12	–	14
5– 8	–	6
	7	67

In other words, twenty of the benzoated samples show a lower ratio of acidity to solids than the lowest of the non-benzoated samples.

Total Solids.

The solids range from 7.27 to 32.49, with an average of 16.22 per cent., illustrating the great variability of this material. Six samples contain over 24 per cent., nine from 20 to 24 per cent., thirty-one from 15 to 20 per cent., twenty from 10 to 15 per cent., and eight under 10 per cent. As will be shown later, the amount of solids considered by itself is not a safe criterion in judging the quality of a ketchup, for the solids may consist largely of added salt, sugar, glucose or cereal, and may be in very small part only true tomato solids. The eight samples showing the lowest solids were sold at what would appear to be a low price, from 5 to 12 cents for from 223 to 806 grams of ketchup. The average cost of the ketchup in these samples was 9.1 cents per lb., while in the six samples showing the highest solids the average cost was 17.3 cents per lb., that is, over three times the condiment (for water has no condimental value) was obtained in these for not quite double the price. These low-priced ketchups were, therefore, far from an economical purchase, leaving aside entirely the questions of quality and the presence of a chemical preservative.

The ratio of insoluble to total solids is of considerable value in judging a ketchup from chemical analysis, and will be discussed in a later section.

Salt.

Great variations in the content of salt are observed. The amounts of salt found in the ketchups ranged from 0.71 to 5.17 per cent., or from 4.69 to 28.88 per cent., water-free basis. The following tabulation shows the variations in salt content:

Per Cent. Salt in Solids.	No. of Samples.
Under 5	2
5–10	11
10–15	26
15–20	17
20–25	13
Over 25	5

The five samples showing over 25 per cent. of salt in the dry matter are interesting. Four of these are among the lowest in solids of all the samples examined, yet over one-fourth of this low solids consists of salt.

Brand.	Total Solids	Per Cent. of Salt in Solids.
Parker House	15.43	25.41
Crescent	7.45	26.71
East Rock	8.47	27.04
Pure Food	8.14	27.15
Anderson	7.27	28.88

Water-Sodium-Chloride-Free Basis.

A consideration of the samples on a water-free basis affords a more satisfactory basis of comparison, but even here the variable quantities of common salt used introduce a disturbing factor. For this reason all of the results have been further calculated to a water-sodium-chloride-free basis. Inasmuch as the quantity of spice used in the ketchup is relatively small to that of the tomatoes, the solids obtained by this method of calculation in a pure tomato ketchup should consist almost entirely of tomato solids and sugar. As the sugar contains no ash, fiber, protein or insoluble solids, the figures obtained for these ingredients by this calculation can be fairly attributed to the tomatoes, provided of course we are dealing with a pure tomato ketchup.

Insoluble Solids.

The insoluble solids in the original material range from 1.23 to 6.07; average, 2.32 per cent. They make up from 6.43 to 33.15 per cent. of the dry matter, and from 7.10 to 45.24 per cent. of the salt-free solids. It has already been shown that a very large proportion of the tomato pulp solids is soluble in water, while the solids of tomato skins and seeds have a much lower solubility. A high proportion of insoluble matter in a ketchup, therefore, should suggest the use of skins or seeds, or the addition of some insoluble matter like starch. In one of the samples, 23724, the use of wheat flour was declared on the label, and here we find 6.07 per cent. of insoluble solids, making up 36 per cent. of the salt-free solids. Likewise in No. 23728, where cereals were declared on the label, we find over 45 per cent. of insoluble solids. In six samples the ratio of insoluble to total solids was over 10, in nineteen from 7 to 10, in thirty-seven from 4 to 7 and in twelve less than 4. This low ratio shown by these twelve samples would seem to indicate that tomato pulp was not the only source of their solids. In eight samples we have a declaration on the label of the use of material other than tomato pulp; in one tomato trimmings were used, in two cereals and in five apples. The ratio and actual percentage of insoluble solids in these samples is as follows:

Foreign substance declared.	Per Cent. Salt-free Solids Insoluble.	Ratio of Insoluble to Total—Salt-free Solids.
Tomato Trimmings	19.82	1: 5.0
Cereal	35.79	1: 2.8
"	45.24	1: 2.2
Apples	23.33	1: 4.3
"	28.32	1: 3.5
"	31.47	1: 3.2
"	32.72	1: 3.2
"	39.32	1: 2.5
Average 6 high-grade ketchups	8.88	1: 11.4

Ash.

The ash ranges from 1.61 to 6.89; average, 3.39 per cent. in the original substance, or from 8.22 to 40.08 per cent. on the water-free basis. The amount of ash is affected, of course, by the varying content of sodium chloride, but the variations are by no means solely due to the salt present. In the original substance the salt-free ash ranges from 0.55 to 1.78 per cent., in the water-free substance from 2.86 to 15.74, and in the water-salt-free material from 3.16 to 20.80.

In our analysis of pure tomato pulp we found that the ash made up about 11 per cent. of the water-free substance. Because of the use of sugar, which contains no ash, and other materials which are relatively low in ash compared with tomato pulp, the salt-free ash of ketchup should be much lower than that of the original pulp. While it is difficult to set a maximum limit for salt-free ash in ketchup, the ketchups themselves show in our tables of analysis what should be expected in a high-grade ketchup. For instance, we find that the salt-free ash in the water-salt-free material is under 5 per cent. in nine samples, from 5 to 8 in forty, from 8 to 10 in thirteen, and over 10 in twelve samples. We find that the twenty-seven samples containing about 6 per cent. or less of salt-free ash include what are recognized as the highest grade brands on the market, that is, high grade from the standpoint of the quality of materials used, and entirely independent of whether or not benzoate is present. It is a striking fact, however, that the non-benzoated samples contain only from 3.16 to 6.21 per cent., while the benzoated ketchups contain from 3.71 to 20.80, only twenty-one of sixty-seven samples of the latter class containing less than 6 per cent. It would seem, therefore, adopting the best trade practice as a basis of judgment, that samples containing much over 6 per cent. of salt-free ash in the dry salt-free material must be considered with suspicion, and that those containing over 10 per cent. are not pure ketchups. That is, from this standpoint alone, twelve of our samples must be considered as more than suspicious. These twelve samples in the dry salt-free material contain from 10.04 to 20.80 per cent. salt-free ash, from 16.44 to 45.24 per cent. insoluble solids, from 4.33 to 10.88 per cent. crude fiber, and from 14.13 to 24.63 per cent. protein, all of which data indicates their inferiority.

Crude Fiber.

The crude fiber ranges from 0.32 to 0.77 per cent. in the original substance; average, 0.49 per cent.; and from 1.29 to 8.26 in the dry matter, and from 1.42 to 10.88 per cent. in the water-salt-free material. A high fiber content is characteristic of tomato seeds and skins, especially the latter. In the dry salt-free material seventeen of the samples contain less than 2.50 per cent. of fiber, twenty-nine from 2.50 to 4 per cent., sixteen from 4 to 5.50 per cent., and twelve over 5.50 per cent. The high percentages of fiber are as a rule associated with high insoluble solids and high salt-free ash.

Protein.

The protein ranges from 0.81 to 3.06 per cent., average, 1.53, in the original substance, and from 4.88 to 18.75 per cent. in the dry matter, and from 5.38 to 24.63 in the water-salt-free material. The most marked characteristic of tomato seeds is their high protein content, about 31 per cent. An abnormally high protein in ketchup would suggest, therefore, an imperfect separation or the direct addition of tomato seeds. In the dry salf-free matter eighteen samples contain less than 9 per cent. of protein, twenty-seven from 9 to 12 per cent., nineteen from 12 to 15 per cent. and ten over 15 per cent. The samples containing the greatest amount of protein also as a rule are high in salt-free ash, insoluble solids and crude fiber.

Sugar, Glucose and Starch.

All the samples were polarized before and after inversion. The presence of acetic acid renders the exact determination of sucrose and invert sugar somewhat difficult, and the percentages given in the tables are not claimed to be absolute. The amounts found were very variable, ranging from none at all to as much as 24 per cent. total sugars. It must be remembered, however, that the tomato itself contains much sugar, according to König over 50 per cent. of the dry matter, and the presence of sugar in ketchup is, therefore, to be expected, and its absence would indicate that little if any of the tomato juice and pulp had been used. It is the common practice to employ sugar in the manufacture of ketchup, the amount used resting solely with the manufacturer and the taste of the consumer. The standard definition permits the use of sugar, but if glucose is used as the sweetening agent, its presence should be stated on the label. Only two brands declared glucose on the label and these, the product of the same manufacturer, contained 13.75 and 13.36 per cent., making up nearly 50 per cent. of the solids of the ketchup. Twelve other samples contained from 0.39 to 5.01 per cent. None of the glucose-containing samples has been classed as illegal for that reason alone, although glucose must be considered as a substitute for sugar, and its presence should be declared on the label.

Starch was not determined quantitatively, but all the samples were examined under the microscope for starch. Pepper or paprika starch was observed in many of the samples, and their presence is entirely proper. The use of cereals, however, is contrary to the standard for pure ketchup; they add nothing to the

condimental value and serve simply as make-weight or as a means of giving body to an otherwise thin ketchup. Nine samples contained cereal starch, and in only two of these was it declared on the label. The column marked "undetermined" in our tables chiefly represents starch, and in certain samples this is shown to be inordinately high. For instance, No. 23724 shows 10.15 and No. 23698, 13.07 per cent.

The general use of sugar, and the frequent addition of glucose or starch, prevents the percentage of total solids, taken by itself, from being a safe guide as to the quality of a ketchup.

Saccharin.

Saccharin has no place in ketchup, or in any food product intended for normal consumers. The purpose of its use is solely to lower the cost of manufacture. In five samples its presence was declared on the label, and these brands are among the lowest grades of ketchup included in our examination. Two other samples gave zero polariscope reading both before and after inversion, and this would suggest the presence of saccharin, although the pungency of the spices used prevented its certain identification.

Artificial Color.

Nine samples contained artificial color, in seven of which color was declared on the label. Nos. 23719 and 23707 contained color without any declaration to that effect.

Suggested Limits of Composition.

It was hoped when this investigation was begun that there would be found certain definite ratios between the various ingredients of the ketchups that would possess diagnostic value. A very careful study of our tables of analysis has shown that no safe conclusion as to quality can be drawn from these particular ratios, except that of insoluble to total salt-free solids. Calculating the results to the water-salt-free basis, it is seen that there are very striking differences in this ratio between high- and low-grade ketchups. It ranges from 2.2 to 14.1 in the seventy-four samples, or expressing the same fact in another way, the insoluble solids make up from 7.10 to 45.24 per cent. of the salt-free solids. We have formed two groups of samples, the first consisting of sixteen brands of generally recognized high-grade ketchups, the second consisting of thirteen brands, which either condemn themselves by the information given on their labels, or are shown to be of low grade by our analysis. The following table shows the maxima, minima and averages of the various ingredients found in the two groups:

	High-Grade (16 Samples).			Low-Grade (13 Samples).		
	Max.	Min.	Ave.	Max.	Min.	Ave.
In Original Substance:						
Total solids	32.49	14.22	20.56	16.42	7.27	9.55
Sodium benzoate	0.20	0.00	0.08	0.30	0.07	0.18
NaCl in total solids	18.92	4.90	12.46	28.88	15.63	23.84
In Salt-free Dry Substance:						
Insoluble solids	14.24	7.10	11.22	45.24	21.34	30.04
Ash	6.97	3.16	5.38	16.19	7.78	12.73
Fiber	4.10	1.42	2.56	10.88	4.89	7.72
Protein	12.00	5.38	9.06	24.63	12.00	17.33
Ratio insol. to total solids (1:–)	14.1	7.0	8.9	4.7	2.2	3.3

In the samples which we have classed as high grade the maximum insoluble solids is 14.24, ash 6.97, fiber 4.10, protein 12.00, and the lowest ratio of insoluble to total solids is 1:7; in the samples classed as low grade these maxima are exceeded in every case, and the highest ratio of insoluble to total solids is 1:4.7. It is interesting to note also that all but one of the seven samples found to contain no benzoate are included in the high-grade class; the low-grade brands on the average contained more than twice as much benzoate as the high-grade. Likewise the proportion of salt to total solids is on the average nearly twice as high in the low-grade brands. By examining the tables it will be found that the forty-five other brands not included in the above groups all possess some of the characteristics of one or the other groups, but that none shows all the characteristics of either.

We would suggest as a tentative standard that pure tomato ketchup should contain in the salt-free dry substance not more than 15 per cent. insoluble solids, not more than 7 per cent. ash, not more than 4 per cent. fiber and not more than 12 per cent. protein; the ratio of insoluble to total salt-free solids should not be less than 1 to 7.

The Cost of Ketchup.

The contents of all the bottles were weighed, and from this data the cost per pound of ketchup calculated, which ranged from 5.6 to 25.7 cents. When the content of total solids is considered, it is evident that the cheapness of most of the low-priced ketchups is more apparent than real.

Methods of Analysis.

The methods employed were the usual ones for this class of materials. Benzoic acid was determined by the method suggested by P. B. Dunbar, associate referee on preservatives of the A. O. A. C. in 1909, as follows:

Weigh 150 gms. of ketchup in a 500 c.c. flask, add 15 gms. pulverized sodium chloride and shake thoroughly. Make slightly alkaline with 10 per cent. sodium hydroxide solution, and fill to the mark with saturated sodium chloride solution. Shake several times and allow to stand over night. Filter through a folded filter and transfer 150 c.c. to a separatory funnel. Neutralize the filtrate to litmus paper with sulphuric acid (1 to 5), about 1 c.c., and add 5 c.c. excess of this acid. Extract with 50, 30, 25 and 25 c.c. portions of chloroform, breaking up any emulsion by twirling the separator and breaking up the bubbles with a glass rod. Evaporate the combined chloroform extracts to dryness at room temperature, using reduced pressure. Dissolve the residue in 25 c.c. neutral alcohol, dilute with 10 c.c. water and titrate with tenth-normal sodium hydroxide, using 4 drops of strong phenolphthalein as indicator. One c.c. of tenth-normal alkali equals 0.0144 gms. sodium benzoate.

This method gave excellent results. In a non-benzoated ketchup, to which a known quantity of sodium benzoate was added, the theoretical amount was recovered. Duplicate determinations of sodium benzoate were made in every sample by two different analysts. In the seventy-four samples only six of the duplicate determinations varied over 0.01 per cent. with 0.032 as the maximum variation, notwithstanding the fact that, because of the limited amount of material, many of the duplicates were made in different amounts of material, 150 and 75 gms. A blank determination in a pure ketchup gave 0.01 per cent., which has been deducted in every case.

MISCELLANEOUS FOODS.

Gluten Preparations.

Six gluten preparations were analyzed. The first five were from the stock of John Gilbert & Son, New Haven; the last, a local product sent in by Dr. W. R. Miller, Southington.

24109. Pates aux Oeufs Macaroni. Brusson Jeune. Price, 45 cents for 220 gms.

24110. Vermicelle au Gluten Extrait des meilleurs blés de Russie. Brusson Jeune, Villemur. Price, 45 cents for 449 gms.

24111. Pates aux Oeufs Nouillettes. Brusson Jeune. Price, 30 cents for 231 gms.

24112. Gluten Semolina. Semoule du Gluten. Brusson Jeune, Villemur. "Indispensable to diabetic constitutions and to delicate persons affected by illeness (sic) or excess." Price, 30 cents for 209 gms.

24113. Gluten Bread. Brusson Jeune (in bulk). Price, 10 cents per loaf of 30 gms.

23398. Diabetic Bread.

	24109	24110	24111	24112	24113	23398
Water	8.57	7.96	8.67	9.65	7.47	29.60
Ash	0.68	0.80	0.65	0.70	1.08	1.45
Protein (N × 6.25)	13.94	18.44	14.38	17.19	32.06	21.24
Fiber	tr.	tr.	tr.	0.28	0.23	.....
Extract	76.38	72.37	75.77	71.72	57.07	*45.11
Fat	0.43	0.43	0.53	0.46	1.79	2.60
Starch	69.21	65.79	68.90	64.89	49.77	33.66

None of these samples is particularly to be recommended to diabetics or to those requiring a diet low in starch. The gluten bread and diabetic bread are by far the most satisfactory preparations, but even in these the starch is much too high. No. 24112, which is especially recommended for diabetics, contains nearly 65 per cent. of starch. When the true nature of the first five samples was reported to Messrs. John Gilbert & Son, they immediately reshipped all of their remaining stock back to the New York importers.

Cerena.

22300. Cerena Cereal Fruit and Vegetable Food. The Cerena Milling Co., Chicago. "A Food Remedy for Constipation and Stomach Disorders." Price, 25 cents for 431 gms. It contained:

Water	7.19
Ash	4.88
Protein (N × 6.25)	27.81
Fiber	2.40
Extract	46.35
Ether Extract	11.37
Starch	25.14
Soluble in Water	25.40
Water-soluble Protein	5.63
Total Phosphoric Acid	2.32
Phytin Phosphoric Acid	0.67
Refractive Index of Ether Extract @ 26°	1.4750

* Includes fiber.

According to the claims of the manufacturer, the "cereal, fruit and vegetable" nature of the food rests on the use of wheat, olive oil and cottonseed meal, a rather loose interpretation. The special claim for this remedy for constipation is based on the presence of phytin. We find 0.67 per cent. of phosphoric acid in this form. No mineral laxatives were detected, nor was there any evidence of the use of vegetable purgatives, like senna, cascara, etc.

Olive Oil.

One sample taken from the stock of a grocer was found not to be adulterated.

24114. Olive Tree Blossom Authentical Olive Oil, bottled at Nice. Benoit Mayrargue Fils et Cie. Sold by Conrad Weiss, New Haven. Price, 45 cents per bottle.

It showed a specific gravity at 15.5° C. of 0.916, an index of refraction at the same temperature of 1.4706, and contained no cottonseed, sesame or peanut oils.

II. DRUG PRODUCTS.

ALCOHOL.

"A liquid composed of about 92.3 per cent. by weight, or about 94.9 per cent. by volume, of absolute ethyl alcohol." *U. S. P.*

In addition to the U. S. P. tests, the following methods were used:

Methods of Analysis.

Acidity was determined by titrating 10 c.c. of alcohol with fiftieth-normal potassium hydroxide solution, using phenolphthalein as the indicator.

To 10 c.c. of alcohol, ten drops of aniline oil and two or three drops of hydrochloric acid were added; in the presence of furfurol a more or less pinkish-red color is produced.*

* Krauch: Testing of Chemical Reagents for Purity, p. 14.

Windisch's test for aldehyde, etc.,* was used as follows:—10 c.c. of alcohol are put into a small test tube, and 0.5 c.c. of water and 1 c.c of a freshly prepared 10 per cent. aqueous solution of meta-phenylene-diamine hydrochloride are added. After one hour's standing there should be scarcely any coloration. In the presence of aldehydes a yellow to yellowish-red color immediately appears, followed by a fine greenish fluorescence which slowly darkens. In our experience with tests of absolute alcohol to which small quantities of formaldehyde had been added, the color of the solution was less indicative of the presence of aldehyde than the fluorescence.

The Swiss test for fusel oil† was used as follows:—10 c.c. alcohol were mixed with 30 c.c. of water and the odor and color at once noted.

The U. S. P. standard for alcohol may be stated briefly as follows:—A liquid containing about 94.9 per cent. by volume of absolute ethyl alcohol, of specific gravity 0.816 at 15.6° C., colorless, neutral to litmus, leaving no color or weighable residue on evaporation, free of more than traces of fusel oil, furfurol, aldehyde and oak tannin and other organic impurities. In other words, it requires alcohol to be practically a mixture of chemically pure absolute alcohol and distilled water. The experience gained from our examination of the seventy-one samples here reported leads us to conclude that this standard of excellence is almost unattainable. In fact, not one of our samples satisfies this standard *exactly in every particular*. It is well known that on long standing even pure absolute alcohol shows a yellow color, due to the formation of aldehyde by oxidation with the air. A slight color is often imparted to alcohol by the barrels in which it is stored, and such an alcohol would show a color when tested with caustic potash. It does not seem fair, therefore, to condemn an alcohol as impure which contains only traces of aldehydes and other impurities. It has been stated that chemically pure absolute alcohol is an impossible product, and we are strongly inclined to agree with this statement.

The details of our seventy-one analyses are given in Table XXXIV.

Specific Gravity and Alcohol. The specific gravity ranged from 0.8166 to 0.8486, with an average of 0.8221, naturally reflecting quite accurately the percentage of alcohol, which with the exception of one sample, ranged from 94.87 to 91.81 per cent.

* Krauch, p 12.

† Krauch, p. 11.

TABLE XXXIV.—ALCOHOL.

Station Number.	Price per 8 ounces.	Spec. gravity at 15.6° C.	Alcohol by volume.	Solids in 50 cc. of alcohol, and color of solids.	Acidity of 50 cc. (cc. N-50 KOH)	Furfurol. (aniline HCl test) Color.	Fusel oil. Krauch test for odor.	Tests for Aldehyde, etc. Caustic potash. Color.	Silver nitrate. Color.	Meta-phenylene-diamine hydrochloride. Color.	‡ Remarks.
	cts.			mgms.							
23241	25	.8166	94.87	1.7 v. s. b	1.35	none	none	none	f. brown	none	Passed
23292	30	.8169	94.79	1.6 v. s. b.	1.00	tr. pink	slight	none	none	f. brown, f. fluor.	Slight fusel oil
23269	30	.8170	94.76	2.0 s. b.	0.85	none	none	faint	f. brown	f. brown, no fluor.	Passed
23049	30	.8174	94.66	1.8 v. s. b.	1.60	none	none	faint	very faint	f. brown, f. fluor.	"
23098	25	.8178	94.56	2.7 b.	1.90	pink	none	faint	pr. brown	pr. brown, no fluor.	Excess solids, acid, aldehyde
23057	25	.8184	94.41	1.8 s. b.	0.90	none	slight	none	f. brown	pr. yellow, pr. fluor.	Excess fusel oil, aldehyde
23131	30	.8186	94.36	2.0 s. b.	2.50	orange	none	very pr.	f. brown	dark orange, no fluor.	Excess acid, aldehyde
23156	25	.8186	94.36	2.2 v. s. b.	4.15	tr. pink	none	none	none	pr. orange, no fluor.	Excess solids, acid, aldehyde
23109	30	.8187	94.33	1 3 v. s. b.	1.00	tr. pink	slight	none	f. brown	f. yellow, f. fluor.	Slight fusel oil
23097	50	.8187	94.33	1.7 s. o. r.	2.45	pink	slight	faint	pr. brown	pr. yellow, pr. fluor.	Excess acid, fusel oil, aldehyde
23007	30	.8187	94.33	3.8 b.	0.75	pink	none	faint	pr. brown	none	Excess solids, aldehyde
22301	25	.8188	94.31	0.7 s. y.	1.50	pink	strong	faint	none	pr. yellow, fluor.	Excess fusel oil, aldehyde
23178	30	.8188	94.31	2.4 v. s.	0.85	none	slight	none	pr. brown	none	Excess solids, fusel oil, aldehyde
23058	25	.8189	94.28	1.6 v. s. y.	1.40	tr. pink	none	faint	f. brown	none	Passed
23010	30	.8189	94.28	3.2 y.	3.50	orange	none	very pr.	pr. brown	v. pr. brown, no fluor.	Excess solids, acid, aldehyde
23325	25	.8190	94.26	6.0 s. y.	2.15	pink	none	pr.	v. pr. brown	v. pr. brown, no fluor.	" " " "
23195	30	.8191	94.23	3.2 s. y.	1.75	pink	slight	faint	pr. brown	pr. brown, f. fluor.	Excess solids, acid, fusel oil, aldehyde
23096	30	.8193	94.18	2.7 s. y.	2.10	pink	none	faint	v. pr. brown	pr. brown, no fluor.	Excess solids, acid, aldehyde
23050	30	.8195	94.13	2.0 v. s. b.	1.70	tr. pink	none	faint	f. opal	f. brown, f. fluor.	Passed
23279	25	.8195	94.13	1.6 v. s. o. r.	1.90	tr. pink	none	v. faint	f. brown	f. brown, no fluor.	Excess acid
23056	25	.8197	94.08	1.9 s. b.	1.10	none	slight	none	f. brown	pr. yellow, pr. fluor.	Excess fusel oil, aldehyde
23120	30	.8199	94.03	1.8 s. b.	1.50	tr. pink	none	faint	pr. brown	pr. brown, no fluor.	Excess aldehyde
23197	25	.8200	94.00	2.5 s. o. r.	1.10	pink	slight	v. faint	pr. brown	pr. yellow, pr. fluor.	Excess solids, fusel oil, aldehyde
23242	25	.8200	94.00	2.5 s. b.	2.00	tr. pink	none	none	f. brown	f. brown, no fluor.	Excess solids, acid
23055	25	.8202	93.95	9.0 s. b.	10.85	none	slight, opal.	faint	pr. brown	v. pr. brown, v. pr. fluor.	Excess solids, acid, fusel oil, aldehyde
22304*a*	30	.8205	93.87	1.1 n.	0.75	none	slight, opal.	none	f. brown	pr. yellow, pr. fluor.	Excess fusel oil, aldehyde
23221	30	.8209	93.77	4.1 s. y.	3.00	pink	none	pr.	pr. brown	pr. brown, no fluor.	Excess solids, acid, aldehyde
23154	25	.8209	93.77	2.2 v. s. y.	2.00	tr. pink	slight	none	f. brown	none	Excess solids, acid, fusel oil
23067	30	.8209	93.77	1.2 v. s. y.	1.20	pink	none	none	f. brown	none	Excess furfurol
23118	30	.8211	93.72	5.2 v. y. b.	3.25	brown	none	very pr.	very pr.	v. pr. brown, no fluor.	Excess solids, acid, aldehyde
23215	30	.8211	93.72	3.5 s. y.	3.00	pink	slight	pr.	pr. brown	pr. yellow, f. fluor	Excess solids, acid, fusel oil, aldehyde
23066	30	.8215	93.62	3.5 s. b.	1.25	pink	none	faint	pr. brown	none	Excess solids, aldehyde
23263	30	.8216	93.59	2.5 v. s. b.	1.25	tr. pink	slight	none	f. brown	f. yellow, f. fluor.	Excess solids, fusel oil
23011	25	.8217	93.57	1.6 r. o.	2.35	pink	slight	pr.	pr. brown	pr. yellow, pr. fluor.	Excess acid, fusel oil, aldehyde
23158	25	.8217	93.57	3.4 v. s. y.	0.90	none	none	none	f. brown	f. brown, no fluor.	Excess solids
23052	25	.8218	93.54	4.2 v. y.	1.15	brown	none	pr.	v. pr. brown	pr. brown, no fluor.	Excess solids, aldehyde
23031	25	.8218	93.54	1.4 s. b.	1.85	tr. pink	slight	none	pr. brown	pr. yellow, pr. fluor.	Excess acid, fusel oil, aldehyde
23262	30	.8218	93.54	2.3 s. o. r.	1.50	pink	none	v. faint	pr. brown	f. yellow, f. fluor.	Excess solids, aldehyde

TABLE XXXIV.—ALCOHOL—*Continued.*

Station Number.	Price per 8 ounces.	Spec. gravity at 15.6° C.	Alcohol by volume.	Solids in 50 cc. of alcohol, and color of solids.	Acidity of 50 cc. (cc. N-50 KOH)	Furfurol. (Aniline HCl test). Color.	Fusel oil. Krauch test for odor.	Tests for Aldehyde, etc. Caustic potash. Color.	Silver nitrate. Color.	Meta-phenylene-diamine hydrochloride. Color.	‡ Remarks.
	cts.			mgms.							
23008	30	.8219	93.52	4.6 y.	1.90	orange	none	pr.	v. pr. brown	v. pr. brown, no fluor.	Excess solids, acid, aldehyde
23119	30	.8220	93.49	2.4 s. o. r.	1.50	tr. pink	slight	v. faint	pr. brown	pr. yellow, pr. fluor.	Excess solids, fusel oil, aldehyde
23208	30	.8220	93.49	4.7 s. y.	2.50	pink	slight	v. faint	pr. brown	f. brown, no fluor.	Excess solids, acid, fusel oil, aldehyde
22304	30	.8221	93.47	4.0 f. b.	4.50	orange	slight	pr.	v. pr. brown	v. pr. brown, f. fluor.	" " " "
23231	30	.8225	93.36	3.1 s. b.	1.65	pink	slight	pr.	pr. brown	pr. brown, v. f. fluor.	Excess solids, fusel oil, aldehyde
23051	25	.8228	93.29	2.6 y.	1.70	tr. pink	slight	none	pr. brown	f. yellow, pr. fluor.	Excess solids, acid, fusel oil, aldehyde
23157	25	.8229	93.26	3.4 v. s. b.	1.70	tr. pink	none	none	f. brown	pr. brown, f. fluor.	Excess solids, aldehyde, odor wnt'green
23290	30	.8229	93.26	2.3 v. s. y.	1.85	pink	none	faint	f. cloud	pr. brown, no fluor.	Excess solids, acid, aldehyde
23155	25	.8230	93.23	2.5 v. s.	3.75	none	none	none	f. brown	none	Excess solids, acid
22302	*15	.8231	93.20	2.6 s. b.	1.35	pink	slight	none	f. opal	f. brown, no fluor.	Excess solids, fusel oil, aldehyde
23278	25	.8233	93.14	2.0 s. y.	2.25	pink	slight	faint	pr. brown	pr. brown, f. fluor.	Excess acid, fusel oil, aldehyde
23140	25	.8236	93.06	2.4 v. s. b.	3.45	tr. pink	slight	v. faint	pr. brown	pr. brown, no fluor.	Excess solids, acid, fusel oil, aldehyde
23012	25	.8239	92.97	56.2 y. b.	1.60	pink	slight	faint	pr. brown	pr. brown, no fluor.	Excess solids, fusel oil, aldehyde
23165	25	.8239	92.97	3.5 s. y. b.	1.00	none	slight	v. faint	f. brown	pr. yellow, pr. fluor.	" " " "
23135	30	.8240	92.94	2.5 s. b.	1.95	tr. pink	none	pr.	pr. brown	v. pr. brown, no fluor.	Excess solids, acid, aldehyde
23009	30	.8240	92.94	0.9 s. b.	1.40	pink	slight	none	pr. brown	none, v. f. fluor.	Excess fusel oil, aldehyde.
23214	30	.8244	92.83	4.1 y.	8.00	orange	slight	v. pr.	v. pr. brown	v. pr. brown, no fluor.	Excess solids, acid, fusel oil, aldehyde
23330	25	.8244	92.83	2.7 v. s. y.	2.35	pink	none	v. faint	f. brown	f. brown, no fluor.	Excess solids, acid, furfurol
23129	30	.8246	92.77	4.1 s. o. b.	2.00	none	none	faint	pr. brown	pr. brown, no fluor.	Excess solids, acid, aldehyde
23166	25	.8249	92.68	2.8 v. s. y.	2.40	tr. pink	none	v. faint	f. brown	f. brown, no fluor.	Excess solids, acid
23027	25	.8249	92.68	3.1 s. b.	2 00	tr. pink	slight	pr.	f. brown	f. brown, f. fluor.	Excess solids, acid, fusel oil, aldehyde
23128	30	.8250	92.66	1.8 v. s. y.	1.70	none	none	none	pr. brown	f. brown, no fluor.	Excess aldehyde
23196	30	.8251	92.63	1.9 s. y.	0.90	pink	none	v. faint	f. brown	f. brown, no fluor.	Excess furfurol
23327	25	.8252	92.60	3.3 s. o. r.	2.90	pink	none	pr.	pr. brown	v. pr. brown, no fluor.	Excess solids, acid, aldehyde
23222	25	.8253	92.57	3.9 o. b.	2.25	pink	slight	pr.	pr. brown	pr. brown, no fluor.	Excess solids, acid, fusel oil, aldehyde
23102	30	.8256	92.48	2.5 s. o. b.	2.20	pink	none	faint	pr. brown	f. brown, no fluor.	Excess solids, acid, aldehyde
23230	25	.8260	92.36	4 8 v. s. y.	4.50	pink	slight	faint	pr. brown	f. brown, no fluor.	Excess solids, acid, fusel oil, aldehyde
23065	25	.8261	92.33	3.4 s. b.	1.65	pink	none	faint	pr. brown	none	Excess solids, aldehyde
23267	25	.8265	92.21	3.9 v. s. y.	3.10	pink	slight	faint	pr. brown	pr. brown, no fluor.	Excess solids, acid, fusel oil, aldehyde
23153	†25	.8269	92.08	3.8 s. y. b.	2.00	tr. pink	none	v. faint	pr. brown	pr. brown, no fluor.	Excess solids, acid, aldehyde
23326	25	.8278	91.81	5.3 v. o.	4.50	orange	none	v. pr.	v. pr. brown	v. pr. brown, no fluor.	" "
23095	25	.8486	85.39	3.1 v. s. y.	1.35	none	none	none	f. brown	none	Excess solids, low alcohol
DILUTED ALCOHOL (*Alcohol Dilutum*).											
22303	15	.9367	48.91	3.3 s. y.	0.55	none	none	none	f. brown	f. yellow, pr. fluor.	Excess solids

* 3 oz. † 7 oz. ‡ See text for limits allowed. Abbreviations used in table: tr., trace; f., faint; pr., pronounced; v., very; opal., opalescence; fluor., fluorescence; sl., slight; y., yellow; b., brown; o., orange; r., red; n., none.

by volume, with an average of 93.47. The deficient sample contained only 85.39 per cent. Another sample, sold as "Diluted Alcohol," contained 48.91 per cent. of alcohol by volume, corresponding exactly with the U. S. P. standard for that material.

24 samples ranged from	....	94.87 to 94.00	per cent.
26 " " "	....	93.95 to 93.00	"
19 " " "	....	92.97 to 91.81	"
1 sample was below 90.00 per cent.			

Solids on Evaporation. On evaporating 50 cc. of alcohol a residue was obtained in every case, ranging from 0.7 to 56.2 mgms., with an average of 3.6 mgms. The extremes are equivalent to .0017 and .1364 per cent., respectively.

In 22 samples solids were under	....	2.0	mgms.
" 38 " " " from	....	2.1–4.0	"
" 10 " " " "	....	4.1–9.0	"
" 1 " " "	....	56.2	"

The solids in **23012**, 56.2 mgms., are very excessive.

The color of the solids showed a wide range from none at all in one sample to various shades of brown, yellow and orange red in the others. The color was absent or very slight in twenty-four samples, slight in thirty-five, pronounced in nine and very intense in three. The samples showing more than slight color were as follows:

23098 brown.	23011 orange red.
23007 "	23012 yellow brown.
23010 yellow.	23222 orange brown.
23008 "	23052 very yellow.
23051 "	23326 very orange.
23214 "	23118 very yellow brown.

Acidity. The results for acidity are expressed in cubic centimeters of fiftieth-normal potash necessary to neutralize 50 cc. of alcohol, using phenolphthalein as the indicator. The U. S. P. gives no quantitative method for acidity, but simply requires that 50 cc. shall not affect the color of either blue or red litmus paper moistened with water. It is true, of course, that traces of free acid exist in alcohol* insufficient to affect litmus paper. The indicator used by us, phenolphthalein, would detect much

* Schweissinger, Repert. Chem. Zeit., 1887, p. 174.

smaller quantities of acid than litmus and the test we used is admitted to be unnecessarily severe. It was conducted simply for the purpose of studying the acidity conditions of the alcohol on the market. The Swiss Excise Department* found that in 1070 samples of alcohol a maximum of 3.2 cc. and a minimum of 0.5 cc. of twentieth-normal soda were necessary to neutralize the acidity of 100 cc. of alcohol, using phenolphthalein as indicator. These quantities would be equivalent to 4.0 cc. and 0.6 cc. respectively of fiftieth-normal alkali for 50 cc. of alcohol. Schweissinger† found that 0.4 cc. of $\frac{N}{10}$ soda was required to neutralize the free acid in 100 cc. of a good alcohol; this is equivalent to 1.0 cc. of fiftieth normal alkali for 50 cc.

Our samples range from 0.75 cc. to 10.85 cc. of alkali for 50 cc., showing much greater variations than found by the Swiss Excise Department, and equivalent to .0022 to .0317 per cent. of acetic acid. Only eleven samples fall below the limit set by Schweissinger. In two samples, **23214** and **23055**, the acidities, 8.00 and 10.85 cc. respectively, were very excessive.

11 samples	required	less than	1 c.c.	$\frac{N}{50}$ alkali.
33 "	"	from	1.10 to 2.00 c.c.	"
21 "	"	"	2.10 to 4.00 c.c.	"
4 "	"	"	4.10 to 6.00 c.c.	"
2 "	"	over	6.00 c.c.	"
		Average,	**2.17 c.c.**	

Furfurol. The U. S. P. gives no specific test for this aldehyde, and we have used the method given by Krauch and referred to on a previous page. Absolute alcohol subjected to this test gave a completely negative result. 0.1 cc. of furfurol was added to 10 cc. of absolute alcohol and 0.05 cc. of this mixture added to another 10 cc. portion of absolute alcohol. The addition of ten drops of aniline and three drops of hydrochloric acid gave a faint but distinct pink color; the dilution was equivalent to about one part in 20,000.

15 samples gave no reaction for furfurol.
19 " " slight reaction for furfurol.
37 " " strong reaction for furfurol.

* Chem. Ztg., 1893, No. 84.
† *Loc. cit.*

Fusel Oil. The U. S. P. method did not give satisfactory results in our hands, so that used by the Swiss Excise Department was employed. In some cases a foreign odor was apparent, which did not resemble fusel oil.

39 samples gave no odor of fusel oil.
31 " " slight odor of fusel oil.
1 " " strong odor of fusel oil.

Aldehydes, Oak Tannin and Other Organic Impurities. Three tests were used for the detection of aldehydes. The meta-phenylene-diamine hydrochloride test of Windisch is an important one for impurities peculiar to the first runnings of the distillation, and especially for acetaldehyde. In applying this test we found that many samples gave a brownish color without fluorescence, while others gave a strong fluorescence. As a result of our experiments it would seem that the fluorescence is the characteristic part of the test, and that too much stress must not be placed on the simple appearance of a yellow or brownish color. An effort to make approximately quantitative determination of aldehyde by this method, using solutions of known aldehyde content for comparison, was unsuccessful, chiefly due to color present apparently not entirely due to aldehydes.

The silver nitrate test shows the presence not only of aldehyde but of other organic impurities as well. The caustic potash test likewise does not reveal aldehyde alone, for if the alcohol has been stored in casks made of wood, containing tannin, it will show a color with this test.

The following tabulation shows the results secured by the different tests singly, by any two or by all three, the figures representing the number of samples giving the test. These are classed as negative, faint or pronounced.

	Negative.	*Faint.*	*Pronounced.*
Potash	22	31	18
Silver nitrate	3	27	41
Windisch	11	20	40
Potash and silver nitrate	2	12	16
Potash and Windisch	6	12	16
Silver nitrate and Windisch ..	0	14	27
All	0	7	16

In other words, twenty-two samples gave negative results with potash, thereby satisfying the U. S. P. requirement. Thirty-one gave a faint test, while eighteen gave a pronounced test. With silver nitrate, thirty samples gave negative or faint tests, the U. S. P. limit, while forty-one gave a pronounced discoloration. With the unofficial Windisch test, thirty-one gave negative or faint reactions, while forty gave a pronounced color with fluorescence. The silver and Windisch tests, therefore, appear to be more delicate than the potash test. These two tests likewise agreed very closely in the total number of samples giving a pronounced test, although in only twenty-seven of the forty-one samples were the tests pronounced by both methods in the same samples. The same number of samples, sixteen, gave pronounced tests with potash and silver nitrate, and with potash and the Windisch test, but not always on the same samples. None of the seventy-one samples gave negative reactions with all three tests, while seven gave faint and sixteen pronounced colors.

The following tabulation summarizes our examination, in which the samples passed contained not less than 92 per cent. of alcohol, not over 2.0 mgms. solids, not over 1.7 cc. acidity, no fusel oil, and gave only slight reactions for aldehydes and furfurol.

5 passed.
2 contain fusel oil.
2 " excess solids.
1 " " acid.
4 " " aldehyde.
1 " " solids, low alcohol
3 " " solids, acid.
1 " " solids, fusel oil.
7 " " solids, aldehyde.
1 " " acid, aldehyde.
5 " " fusel oil, aldehyde.
1 " " solids, fusel oil, acid.
7 " " solids, fusel oil, aldehyde.
15 " " solids, acid, aldehyde.
4 " " acid, fusel oil, aldehyde.
12 " " solids, acid, fusel oil, aldehyde.

BISMUTH SUBNITRATE.

(Bismuthi Subnitras.)

"Bismuth subnitrate should yield not less than 80 per cent. of pure bismuth oxide." *U. S. P.*

The twenty-five samples examined were pure, none of them containing either arsenic, lead, copper, ammonia, chlorides, carbonates or sulphates.

Bismuth oxide, determined by the U. S. P. method, ranged from 82.36 to 80.01 per cent., with an average of 80.77 per cent.

The moisture limit of the U. S. P. is 3 per cent. The samples ranged from 2.98 to 4.18, with an average of 3.52 per cent.

Table XXXV.—Bismuth Subnitrate.

Station number.	Price of material. cts.	Weight.		Water.	Bismuth Oxide (Bi_2O_3).
		Claimed. oz.	Found. oz.		
23088	25	1	0.84	3.29	82.36
23152	40	2	1.80	3.49	82.30
23146	30	2	1.84	3.71	82.01
23175	25	1	0.94	3.58	82.01
23239	25	1	0.87	4.06	81.32
23204	25	1	0.94	3.91	81.18
23234	25	1	0.81	3.19	81.14
23301	20	1	1.13	3.16	81.10
23033	40	2	2.00	3.47	80.79
23199	25	1	1.03	3.39	80.72
23282	25	1	0.94	3.16	80.70
23238	20	1	0.97	2.98	80.64
22308	40	2	*	4.13	80.60
23198	25	1	1.10	3.43	80.54
23257	25	1	0.97	3.67	80.31
23169	50	2	1.90	3.62	80.31
23276	30	1	0.94	3.58	80.27
23258	25	1	1.32	3.44	80.16
23329	25	1	0.94	4.18	80.15
23181	25	1	0.90	3.67	80.08
23113	25	1	0.90	3.01	80.08
23217	25	1	1.00	3.90	80.07
23227	35	1	1.07	3.46	80.07
23259	25	1	0.90	3.65	80.04
23023	45	2	1.87	3.47	80.01

* Sample not weighed through oversight.

There was no serious excess of moisture in any case, yet only one sample fell within the U. S. P. limits.

The price of the material ranged from 20 to 35 cents for one ounce, and from 30 to 50 cents for two ounces, the usual wide variations noticed in nearly all drug products we have examined. There was a general tendency toward short weight, only seven samples equalling or exceeding the weight asked for. The greatest deficiency in weight amounted to 19 per cent.

SPIRIT OF CAMPHOR.

(*Spiritus Camphoræ.*)

According to the U. S. P., spirit of camphor should be made by dissolving 100 grams of camphor in 800 cc. of alcohol, filtering through paper, and passing sufficient alcohol through the filter to make a volume of 1,000 cc.

Spirit of camphor made according to the above directions in this laboratory contained 10 per cent. of camphor and 86.31 per cent. of alcohol by volume, and showed a specific gravity of 0.8223 at 25° C.

Of the sixty-nine samples examined, twenty-three contained 10 per cent. or more of camphor, with satisfactory percentages of alcohol; thirty-one samples, containing between 9 and 10 per cent. of camphor, were passed; while fifteen samples were decidedly below standard, twelve in camphor, two in alcohol, and one in both camphor and alcohol. (See Tables XXXVI to XXXVIII.)

The following tabulation shows the range in composition of all the samples:

	Max.	Min.	Ave.
Specific gravity	0.8842	0.8150	0.8296
Alcohol by volume	88.66	67.00	84.44
Camphor	13.6	5.4	9.6

No synthetic camphor or wood alcohol was detected in any of the samples. Careless labeling was observed in two samples, one being marked "Sweet Spts. Nitre," the other "Cholera Drops."

TABLE XXXVI.—SPIRIT OF CAMPHOR UP TO STANDARD.

Station No.	Cost per 4 oz.	Specific gravity at 25° C.	Alcohol by volume.	Camphor.	Station No.	Cost per 4 oz.	Specific gravity at 25° C.	Alcohol by volume.	Camphor.
	cts.					cts.			
24047	20	.8312	82.19	13.6	24092	35	.8279	84.72	10.2
24089	30	.8392	80.33	12.9	23966	30	.8293	84.34	10.2
24055	25	.8317	82.88	11.8	24052	25	.8294	84.31	10.2
24074	25	.8292	83.75	11.5	24075	25	.8273	84.95	10.1
24077	20	.8294	83.69	11.5	*24096	35	.8338	83.17	10.1
23971	15	.8281	84.34	10.9	24104	30	.8250	85.62	10.0
23967	20	.8258	85.07	10.7	24045	15	.8253	85.55	10.0
24082	25	.8332	83.05	10.7	24037	30	.8261	85.32	10.0
24044	25	.8289	84.24	10.6	23970	20	.8266	85.17	10.0
24078	15	.8261	85.10	10.5	24053	35	.8279	84.81	10.0
24076	20	.8309	83.75	10.5	24043	20	.8290	84.51	10.0
24061	25	.8236	85.83	10.3					

* Labeled "Sweet Spts. Nitre."

TABLE XXXVII.—SPIRIT OF CAMPHOR PASSED.

Station No.	Cost per 4 oz.	Specific gravity at 25° C.	Alcohol by volume.	Camphor.	Station No.	Cost per 4 oz.	Specific gravity at 25° C.	Alcohol by volume.	Camphor.
	cts.					cts.			
24101	35	.8264	85.29	9.9	24083	25	.8287	84.84	9.5
24091	35	.8255	85.59	9.8	24038	30	.8273	85.25	9.4
24072	25	.8274	85.05	9.8	24035	25	.8275	85.22	9.4
24068	25	.8275	85.02	9.8	23964	20	.8235	86.37	9.3
24067	25	.8280	84.87	9.8	23969	15	.8262	85.59	9.3
24063	25	.8313	84.00	9.8	24090	35	.8307	84.40	9.3
24046	20	.8258	85.55	9.7	24087	20	.8313	84.22	9.3
24025	25	.8269	85.24	9.7	24041	20	.8150	88.52	9.2
24051	20	.8276	85.04	9.7	24036	35	.8237	86.38	9.2
24056	15	.8280	84.94	9.7	24073	25	.8276	85.28	9.2
24081	35	.8303	84.31	9.7	24054	25	.8237	86.43	9.1
24062	25	.8245	85.95	9.6	24026	30	.8249	86.07	9.1
24079	20	.8253	85.85	9.6	*24042	35	.8298	84.76	9.1
24057	20	.8278	85.06	9.6	23968	25	.8271	85.49	9.0
24027	25	.8241	86.12	9.5	†24088	20	.8273	85.44	9.0
24065	25	.8259	85.61	9.5					

* Labeled "Alcohol 94%." † Labeled "Cholera Drops."

TABLE XXXVIII.—SPIRIT OF CAMPHOR BELOW STANDARD.

Station No.	Cost per 4 oz.	Specific gravity at 25° C.	Alcohol by volume.	Camphor.	Station No.	Cost per 4 oz.	Specific gravity at 25° C.	Alcohol by volume.	Camphor.
	cts.					cts.			
24048	20	.8743	69.55	10.9	24080	30	.8285	85.59	8.1
24102	30	.8687	72.11	9.0	24099	25	.8280	85.75	8.0
24071	25	.8251	86.15	8.8	24103	20	.8290	85.55	7.9
24098	25	.8309	84.58	8.8	24093	20	.8276	86.02	7.7
24097	25	.8257	86.09	8.7	24064	20	.8842	67.00	7.2
24100	25	.8290	85.15	8.7	23963	20	.8210	88.25	6.8
24086	15	.8327	84.17	8.6	24028	15	.8219	88.66	5.4
23965	20	.8227	86.97	8.5					

Another sample bore the impossible guarantee of 94 per cent. alcohol.

The cost of the spirit ranged from 15 to 35 cents for four ounces, with an average of 24.4 cents.

Methods of Analysis.

Camphor. Ordinary camphor is dextro-rotary, the apparent rotation varying with the nature of the solvent and the concentration of the solution. When the proportion of camphor in an alcoholic solution is roughly known, therefore, the optical activity of the liquid indicates the amount of camphor present only approximately, unless the strength of the alcohol is also known. In the ordinary samples of spirit of camphor the variations in alcohol content are relatively small, in sixty-six of our sixty-nine samples from 80 to 88 per cent., and the amount of camphor present may be determined with reasonable accuracy by the use of tables based on a 10 per cent. solution of camphor in 86 per cent. alcohol.

In the effort to ensure greater accuracy the method of O. Schmatolla, as given in Squire's Companion to the British Pharmacopœia, 1908, p. 309, was tried.

In our trials with the method a Gottlieb fat tube was used, graduated in one-fifth c.c. While with our standard spirit of camphor we secured satisfactory results, the use of a burette where each c.c. was equivalent to about 10 per cent. of camphor seemed to offer too large an opportunity for error to warrant the use of the method. Accordingly a series of observations was made in a 200 mm. polariscope tube at 25° C., using solutions of varying strength of camphor in 86 per cent. alcohol. A color screen, consisting of a 50 mm. tube filled with 10 per cent. potassium bichromate was used to correct for the dispersion of the camphor. The following tabulation based on these observations was employed in calculating the results given in the tables. It was shown that every 1.2 divisions on the scale was approximately equal to 0.5 per cent. of camphor.

POLARIZATION OF CAMPHOR IN 200 MM. TUBE AT 25° C., ALCOHOL 86 PER CENT.

Reading 200 mm. 25° C.	Camphor Per cent.	Reading 200 mm. 25° C.	Camphor Per cent.	Reading 200 mm. 25° C.	Camphor Per cent.	Reading 200 mm. 25° C.	Camphor Per cent.
1.2	0.5	7.1	3.0	13.0	5.5	19.1	8.0
2.5	1.0	8.2	3.5	14.2	6.0	20.3	8.5
3.8	1.5	9.3	4.0	15.4	6.5	21.5	9.0
5.1	2.0	10.6	4.5	16.7	7.0	22.7	9.5
6.1	2.5	11.8	5.0	17.9	7.5	24.0	10.0

Alcohol. The volatility of camphor renders difficult the determination of alcohol by distillation, even after the camphor has been partially separated by the addition of water. Furthermore, this separation is rarely complete and sometimes impossible.* We therefore employed for the determination of alcohol the formula given by Hortvet and West,† where the determination of the camphor and the specific gravity of the spirit affords sufficient data to calculate exactly the percentage of alcohol present.

SOLUTION OF FORMALDEHYDE.

(*Liquor Formaldehydi.*)

The U. S. P. defines this as "an aqueous solution, containing not less than 37 per cent., by weight, of absolute formaldehyde."

* Allen's Comm. Organic Anal., 1907, *2*, pt. 3, p. 370.

† Jour. Ind. and Eng. Chem., 1909, *1*, p. 94.

Methods of Analysis.

Specific Gravity. Determined by pycnometer at 25° C.

Formaldehyde. The U. S. P. and the A. O. A. C. methods for the assay of formaldehyde are both based on the Blank and Finkenbeiner hydrogen peroxide method. The two modifications differ considerably in details, and either in the form written may lead to erroneous results in careless hands. Haywood and Smith* have shown the advisability of adding the formaldehyde to the soda and peroxide instead of *vice versa.* Measuring 3 c.c. of the formaldehyde from a small pipette also certainly offers less chance of error than weighing 3 c.c. in a 500 c.c. Erlenmeyer flask. The U. S. P. method takes cognizance of the fact, apparently overlooked in the A. O. A. C. method, that hydrogen peroxide is generally decidedly acid in its reaction, and that correction should be made for the same. In our examination of hydrogen peroxide last year we found the acidity of 50 c.c. to range from 0.19 to 1.85 c.c. of normal alkali, which would cause a plus error in the formaldehyde determination of from 0.18 to 2.03 per cent. depending upon the brand of peroxide used. As all our determinations were made at the same time, the peroxide was neutralized before using instead of making a correction in each individual determination.

The method we used was exactly that given in Bull. 107 (revised), Bur. of Chem., U. S. Dept. of Agr., p. 33; except that the peroxide was neutralized with soda before using. In those samples not up to the U. S. P. standard of 37 per cent., a test was also made by the U. S. P. method. The differences in the results by the two methods were trifling.

Acidity. 20 c.c. of the solution, to which two drops of phenolphthalein had been added, were titrated with normal soda.

Fixed Impurities. 20 c.c. of the solution were evaporated to dryness on a water bath, and the residue ignited.

Eleven samples of formaldehyde were examined; the results are given in Table XXXIX.

The samples range from 37.59 to 34.25 per cent. of formaldehyde, only one sample, **24022**, being much below standard strength. The specific gravity ranged from 1.0615 to 1.0815, somewhat wider than the limits set by the U. S. P., 1.075 to 1.078. The acidity ranged from 0.25 to 1.33 cc. normal alkali per 20 cc. of solution, two samples, **24039** and **24105**, exceeding the 0.5 cc. limit of the U. S. P. The residues from ignition after the evaporation of 20 cc. ranged from none at all to 9.8 mgms. The highest residue amounted to only 0.04 per cent., and did not warrant a further examination as to the nature of this slight impurity.

* Jour. Amer. Chem. Soc., 1905, *27*, 1183.

TABLE XXXIX.—SOLUTION OF FORMALDEHYDE.

Station number.	Brand.	Specific gravity at 25° C.	Formaldehyde: A. O. A. C. Method.	Formaldehyde: U. S. P. Method.	Acidity of 20 cc. equal to cc. N. alkali.	Residue from evaporation and ignition of 20 cc.	Remarks.
			%	%	cc.	mgms	
24070	Prepared for The Lee & Osgood Co., Norwich	1.0748	37.59	----	0.37	4.7	
24032	*Lehn & Fink, N. Y.	1.0725	37.44	----	0.40	5.8	
24039	" " " "	1.0667	37.15	----	1.12	0.6	High acidity
24023	Not given	1.0724	37.13	----	0.38	9.8	
24024	*Merck	1.0765	37.06	---	0.25	1.8	
24060	* "	1.0687	37.00	----	0.27	0.0	
24050	"	1.0783	36.93	36.89	0.25	0.9	
24040	Lehn & Fink, N. Y.	1.0615	36.88	36.79	0.30	0.9	
24105	Powers-Weightman-Rosengarten Co.	1.0815	36.44	36.38	1.33	0.6	High acidity
24031	*Westport Chem. Co.	1.0705	36.38	36.31	0.50	5.2	
24022	*Merck	1.0605	34.25	34.40	0.50	2.4	Below standard

* Statement of dealer.

FOWLER'S SOLUTION (SOLUTION OF POTASSIUM ARSENITE).

(Liquor Potassii Arsenitis.)

This is defined by the U. S. P. as "an aqueous solution, which should contain potassium arsenite corresponding in amount to 1 per cent. of arsenic trioxide."

This preparation has a wide use as a medicine and is generally employed when arsenic is given internally. Inasmuch as it contains an active poison, it should conform very closely in composition with the U. S. P. standard. An excess of arsenic trioxide is quite as objectionable as a deficiency. In our tabulation we have arbitrarily classed as up to standard those samples containing over 0.90 per cent. arsenic trioxide. This allowance of 10 per cent. is an exceedingly generous one and it is questionable whether a more rigid adherence to the standard should not be required. McGill* suggests 0.020 per cent. of arsenic as the maximum limit of variability. The color of the solution has not been used in our classification of standard and below standard

* Lab. Int. Rev. Dept., Ottawa, Bull. 175.

solutions, although the data are given in the table. The color, however, is important, as it prevents the mixture being mistaken for water. The reddish-brown color, which standard Fowler's Solution should possess, is due to the red saunders of the compound tincture of lavender which the formula requires. Absence of color or a yellowish color indicates that the formula has not been strictly followed in this respect, and suggests the probable use of spirit of lavender, instead of the compound tincture, a practice permitted by the German Pharmacopœia.

Solutions of alkaline arsenites slowly absorb oxygen from the air, and are in part converted into arsenates. Hence it is advisable that the solution should be kept in small bottles well filled. It has been shown, however, that the alkaline reaction of the official solution somewhat retards this change. The loss of arsenite reduces the therapeutic value of the solution, and to determine the amount of this loss both arsenious and arsenic oxide were determined in all the samples under examination.

The fact that Fowler's Solution contains arsenic brings it under § 4733 of the General Statutes, which requires that the seller "shall affix to the package sold by him a label plainly marked with his name, date of sale, and the word 'poison,' and shall enter on a book kept by him for that purpose the name of the purchaser, date of sale, and the quantity sold." From the experience of the station's agent it is obvious that there is quite a general disregard of this statute on the part of druggists when selling Fowler's Solution. Of the fifty-five druggists selling this arsenical poison, only sixteen required the agent to give his name when purchasing it. One druggist did not even take the precaution of using a poison label.

Fifty-five samples were examined (see Tables XL and XLI). These ranged in total arsenic, calculated as arsenious oxide, from 1.331 to 0.109 per cent. The arsenious oxide ranged from 1.287 to 0.079, and the arsenic oxide from 0.126 to 0.006 per cent.

The following summary of the amounts of the two arsenic oxides found shows the variable composition of the solution as sold in this state:

Arsenious Oxide.		Arsenic Oxide.	
From 0.950 to 1.287	12	From 0.006 to 0.020	9
" 0.907 to 0.946	13	" 0.021 to 0.030	7
" 0.800 to 0.891	19	" 0.031 to 0.040	10

Arsenious Oxide.		Arsenic Oxide.	
From 0.713 to 0.788	5	From 0.041 to 0.050	9
" 0.638 to 0.668	4	" 0.051 to 0.060	12
" 0.079 to 0.252	2	" 0.061 to 0.126	8
	55		55
Average, 0.856		**Average, 0.044**	

Twenty-five samples contained over 0.900 per cent. of arsenious oxide; one of these contained the excessive amount of 1.287 per cent.; twenty-four samples ranged from 0.700 to 0.890 per cent.; while six were less than 70 per cent. U. S. P. strength, two of these, Nos. **23338** and **23319**, showing the very low percentages of 0.252 and 0.079.

The arsenic oxide ranged from 0.006 to 0.126 per cent. In most of the samples the amounts were very small, but in eight cases the arsenic oxide ranged from 0.061 to 0.126 per cent., three samples containing 0.111, 0.126 and 0.115 per cent. respectively. In one sample, No. **23338**, not only was the total arsenic very low, but nearly one-third of it was in the form of arsenate.

TABLE XL.—FOWLER'S SOLUTION UP TO STANDARD.*

Station No.	Price per bottle, cents.	Amount of Material, fl. oz.	Total Arsenic, calculated as As_2O_3.	Arsenious Oxide (As_2O_3).	Arsenic Oxide (As_2O_5).	Color.
			%	%	%	
23331	25	4	1.331	1.287	0.051	Red brown.
23045	45	4	1.040	1.035	0.006	"
23243	25	4	1.025	1.011	0.016	"
23288	35	4	1.040	0.998	0.049	"
23101	20	4	1.015	0.995	0.023	Yellowish.
23317	25	4	1.005	0.974	0.036	Red brown.
23294	30	4	1.005	0.969	0.042	"
23171	25	4	0.985	0.958	0.031	"
23190	35	4	0.965	0.954	0.013	Colorless.
23170	40	4	0.985	0.952	0.038	Red brown.
23108	15	4	0.955	0.950	0.006	"
23090	25	4	0.985	0.950	0.041	Yellowish.
23073	35	4	0.985	0.946	0.045	Red brown.
23064	30	4	0.970	0.946	0.028	"
23303	25	4	0.990	0.945	0.052	"
23116	25	4	0.990	0.942	0.056	"
23177	25	4	0.970	0.940	0.035	"
23335	50	4	0.980	0.939	0.048	"
23189	40	4	0.970	0.938	0.037	"
23271	20	4	0.975	0.934	0.048	"
23224	35	4	0.965	0.926	0.045	"
23091	35	4	0.950	0.922	0.032	"
23141	25	4	0.921	0.916	0.006	"
23013	35	4	0.941	0.911	0.035	"
23235	30	4	0.965	0.907	0.068	"

* Not more than 10 per cent. below standard strength; color disregarded.

TABLE XLI.—FOWLER'S SOLUTION BELOW STANDARD.*

Station No.	Price per bottle, cents.	Amount of Material, fl. oz.	Total Arsenic, calculated as As_2O_3.	Arsenious Oxide (As_2O_3).	Arsenic Oxide (As_2O_5).	Color.
			%	%	%	
23132	25	4	0.916	0.891	0.029	Red brown.
23089	35	4	0.936	0.889	0.055	"
23207	30	4	0.901	0.889	0.014	"
23167	15	4	0.901	0.880	0.024	Light yellow.
23332	35	4	0.926	0.879	0.055	Red brown.
23318	25	4	0.975	0.879	0.111	"
23320	35	4	0.921	0.875	0.054	"
23287	25	4	0.901	0.873	0.033	Yellow.
23280	35	4	0.921	0.871	0.059	Red brown.
23225	25	4	0.926	0.867	0.069	"
23270	25	4	0.881	0.852	0.034	"
23336	40	4	0.901	0.850	0.059	Dark yellow.
23334	40	4	0.921	0.848	0.085	Red brown.
23130	30	4	0.871	0.847	0.028	"
23117	30	4	0.886	0.845	0.048	"
23286	15	3	0.881	0.824	0.066	Yellow.
23337	40	4	0.931	0.822	0.126	Dark yellow.
23150	35	4	0.832	0.812	0.023	Red brown.
23216	35	4	0.812	0.800	0.014	"
23149	25	3	0.832	0.788	0.051	Yellowish.
23305	25	4	0.777	0.733	0.051	Red brown.
23134	35	4	0.743	0.727	0.019	Yellowish.
23260	15	4	0.767	0.723	0.051	Red brown.
23333	45	4	0.762	0.713	0.057	Yellow.
23304	35	4	0.688	0.668	0.023	"
23289	20	4	0.678	0.668	0.012	Red brown.
23261	20	4	0.708	0.652	0.065	Yellow.
23151	60	4	0.673	0.638	0.041	Yellowish.
23338	30	4	0.351	0.252	0.115	Dark yellow.
23319	25	4	0.109	0.079	0.037	Red brown.

* Over 10 per cent. below standard strength.

The solutions showed wide differences of color. Forty had the proper red-brown shade, fourteen varied from yellowish to dark yellow and one was colorless.

All the samples showed an alkaline reaction and had an aromatic odor.

The cost ranged from 15 to 60 cents per four ounces, with an average of 30.3 cents. The highest price was charged for one of the samples of lowest grade.

Methods of Analysis.

Arsenious Oxide. The U. S. P. method was followed using 25 gms. of solution instead of 24.6 gms.

Arsenic Oxide. The qualitative method of Lyons* was used as a preliminary test. The method follows: Shake 5 c.c. of the solution with

* Chem. Zentrabl., 1909, *80*, p. 54.

0.5 c.c. of magnesia mixture, allow to settle, pour off solution, and wash precipitate with 5 c.c. of water. Decant again and add to the residue a few drops of silver nitrate and a drop of acetic acid. If more than a trace of arsenate be present a chocolate-colored precipitate of silver arsenate will be formed.

In the effort to secure a definite means of comparison the precipitates were whirled for one minute in the centrifuge in tubes of small bore. The results, however, were not entirely satisfactory. The following quantitive method was then used: Weigh 10 gms. of solution into a 150 c.c. flask, transferring with water and boil until volume is about 10 c.c. Cool to about 80° C. and add an equal volume of concentrated hydrochloric acid and one gram of potassium iodide, mix and allow to stand for ten minutes to reduce arsenic to arsenious oxide. Transfer to a 500 c.c. Erlenmeyer flask and dilute with cold water, and add carefully tenth-normal sodium thiosulphate solution until the solution is exactly colorless. Make solution slightly alkaline with sodium carbonate, then make slightly acid with hydrochloric acid. Add sodium bicarbonate in excess and titrate with tenth-normal iodine solution, using starch as indicator.* From the total arsenious oxide thus found and the arsenious oxide found originally the amount of arsenic present as arsenate may be easily calculated.

TINCTURE OF GINGER.

(*Tinctura zingiberis.*)

The U. S. P. requires that tincture of ginger should be made by macerating 200 grams of ginger root, No. 50 powder, with strong alcohol by the usual process, with subsequent percolation, and adding sufficient alcohol to the percolate to obtain 1,000 cc.

We have already shown under Ginger Extract on page 499, that such a preparation should have a specific gravity of about 0.820 at 15.6° C., and should contain at least 93 per cent. alcohol by volume, and from 0.97 to 1.94 per cent. of solids, which should be almost completely soluble in 95 per cent. alcohol and only slightly soluble in cold water.

Fourteen samples were bought from druggists. Twelve of these proved to be tinctures of full standard quality. Two were below standard, one because of a deficiency in alcohol, and both showing solids of low alcohol- and high water-solubility. Although tincture of ginger and standard ginger flavoring extract are identical in strength, it is noticeable that the purity of the tincture as dispensed by druggists is very much higher

* U. S. Dept. Agl., Bur. of Chem., Bull. 107 (revised), p. 25.

than that of the extract. While 86 per cent. of the tinctures were pure, of the flavoring extracts only 21 per cent. were pure.

The following table shows the average composition of the laboratory samples, the standard tinctures, and the two samples below standard:

	Laboratory Samples.	Standard Tinctures.	Tinctures Below Standard.
Specific gravity @ 15.6° C.	.8220	.8271	.8473
Alcohol by volume	93.92	93.33	89.62
Total solids	1.62	1.36	2.41
Solids soluble in alcohol	1.62	1.30	1.54
Solids soluble in water	0.19	0.23	0.90
Per cent. of solids sol. in alcohol	100	96	64
Per cent. of solids sol. in water.	12	17	37

The sampling agent was instructed in every case to ask for tincture of ginger, and it is a striking fact that in only two of the fourteen samples was the preparation labeled "tincture." Six samples were labeled "extract," five "essence," and one very carelessly "Jamaica Rum." There should be no such confusion in nomenclature and when dispensing an official preparation the druggist should certainly give it its official name, espec-

TABLE XLII.—TINCTURE OF GINGER.

Station No.	Label.	Price per 4 oz., cents.	Specific gravity at 15.6° C.	Alcohol by volume.	Solid matter.			Per cent. of total solids soluble	
					Total.	Soluble in alcohol.	Soluble in water.	In alcohol.	In water.
24965	Ext. Jamaica Ginger	20	.8265	95.07	1.51	1.51	0.16	100	11
25060	Jamaica Rum	35	.8249	94.85	1.43	1.33	0.33	93	23
25030	Extract Jamaica Ginger	25	.8247	94.56	1.10	1.10	0.16	100	15
24940	Ext. Jamaica Ginger	*15	.8255	94.12	1.00	1.00	0.14	100	14
24984	Extract of Jamaica Ginger	25	.8359	93.89	2.23	1.23	0.68	†55	30
25017	Ext. Jamaica Ginger	20	.8332	93.78	1.68	1.49	0.47	89	28
24964	Ess. Jam. Ginger	35	.8295	93.49	1.34	1.31	0.18	98	13
24941	Ess. Jamaica Ginger	*15	.8310	93.33	1.34	1.16	0.31	87	23
24985	Ext. Jamaica Ginger	25	.8294	93.16	1.20	1.16	0.20	97	17
25035	Ess. Jamaica Ginger	30	.8254	93.13	1.31	1.30	0.12	99	9
25058	Tr. Ginger	35	.8224	92.26	1.19	1.14	0.23	96	19
25034	Essence of Jamaica Ginger	30	.8258	91.65	1.61	1.55	0.16	96	10
25075	Essence of Jamaica Ginger	25	.8274	90.52	1.59	1.58	0.29	99	18
24998	Tinct. Ginger	25	.8587	85.34	2.59	1.84	1.12	†71	43
----	Made in laboratory (Jamaica Ginger)	----	.8198	94.63	1.43	1.42	0.21	99	15
----	Made in laboratory (African Ginger)	----	.8222	93.21	1.81	1.81	0.16	100	9

* 2 oz. † Solubility too low for a standard tincture.

ially when the purchaser asks for it under that name. The name "essence" is usually associated with a preparation of low alcoholic strength, and the druggists themselves do their own preparations an injustice, in the five cases cited, by using this name instead of "tincture."

The cost of the tinctures was fifteen cents for two ounces, and from fifteen to thirty-five cents for four ounces, showing the usual wide variations in price of drug preparations sold in this state.

OLIVE OIL.

(*Oleum Olivae.*)

Seventy-three samples were bought from druggists, all but four being sold under the druggist's label. Sixty-three samples were not found adulterated, while ten were adulterated, three with cottonseed oil, three with peanut oil and four with sesame oil. The analyses are given in Tables XLIII and XLIV.

The range in the various determinations was as follows:

	Pure Samples.	Samples containing. Cottonseed Oil.	Peanut Oil.	Sesame Oil.
Specific Gravity..	0.915-0.917	0.916-0.923	0.915-0.916	0.915-0.916
Index of refraction	1.4699-1.4708	1.4712-1.4743	1.4702-1.4705	1.4699-1.4707

From the above figures it is seen that olive oil may be adulterated with peanut or sesame oil without materially affecting the specific gravity. Cottonseed oil, on the other hand, causes a decided increase in gravity. The same remarks apply to the index of refraction, cottonseed oil alone of the three oils causing a wide variation from the normal. The importance of applying the specific tests for foreign oils is therefore apparent.

Samples **24916** and **24138** consist almost, if not entirely, of cottonseed oil. Sample **24138** was labeled "sweet oil," which according to the U. S. Dispensatory is a synonym for olive oil.

In applying the Renard test for peanut oil the melting point of the resultant arachidic acid was determined in each case, and found to correspond with the accepted value for that fatty acid.

The price of the oil ranged from ten to twenty-five cents for four ounces.

The olive oil sold by druggists in this state has been inspected six times, and, while a slight improvement in purity has been

TABLE XLIII.—OLIVE OIL NOT FOUND ADULTERATED.

Station No.	Brand.	Place of Sampling.	Price of 4 oz., cents.	Specific gravity at 15.5° C.	Index of Refraction at 15.5° C.
25059	Druggist's label	Bethel	15	0.916	1.4703
24944	" "	Bridgeport	20	0.916	1.4707
24945	" "	"	15	0.916	1.4702
24946	" "	"	20	0.915	1.4704
24947	" "	"	15	0.916	1.4703
24948	" "	"	25	0.916	1.4702
24949	" "	"	15	0.915	1.4702
24950	" "	"	15	0.916	1.4702
24951	" "	"	20	0.916	1.4703
25056	McKesson & Robbins, N. Y. Excelsior Brand	Danbury	25	0.915	1.4702
25057	Druggist's label	"	20	0.916	1.4703
25062	" "	"	25	0.916	1.4708
25063	" "	"	25	0.916	1.4705
24912	" "	Hartford	20	0.916	1.4703
24913	" "	"	20	0.915	1.4704
24914	" "	"	15	0.915	1.4701
24915	" "	"	20	0.915	1.4707
24917	" "	"	10	0.915	1.4707
24922	" "	"	15	0.916	1.4700
24923	" "	"	15	0.915	1.4703
24924	" "	"	15	0.916	1.4702
24142	" "	Meriden	15	0.916	1.4705
24143	" "	"	15	0.915	1.4705
24144	" "	"	15	0.915	1.4706
24931	" "	Middletown	15	0.916	1.4703
24933	" "	"	15	0.915	1.4703
24151	" "	New Britain	15	0.915	1.4699
24152	" "	" "	15	0.915	1.4701
24153	" "	" "	15	0.915	1.4704
24155	" "	" "	20	0.916	1.4702
24898	" "	New Haven	20	0.916	1.4704
24899	" "	" "	20	0.916	1.4700
24900	" "	" "	20	0.916	1.4702
24160	" "	" "	15	0.915	1.4703
24162	" "	" "	20	0.915	1.4705
24966	" "	" "	10	0.915	1.4703
24967	" "	" "	20	0.915	1.4702
24968	" "	" "	15	0.915	1.4702
24970	" "	" "	10	0.916	1.4705
24986	" "	" "	20	0.915	1.4702
24987	" "	New London	15	0.915	1.4703
25002	" "	" "	25	0.915	1.4703
25003	" "	Norwich	20	0.915	1.4702
25004	" "	"	15	0.917	1.4703
25006	" "	"	20	0.915	1.4702
25007	" "	"	15	0.916	1.4701
25037	Lehn & Fink, N. Y., Lucca Cream Virgin Olive Oil	So. Norwalk	*35	0.916	1.4702
25026	A. Gaillard & Fils, Marseille, Olive Oil Sublime Extra	Stamford	*25	0.916	1.4705

* Price per bottle.

TABLE XLIII.—OLIVE OIL NOT FOUND ADULTERATED.—*Con't.*

Station No.	Brand.	Place of Sampling.	Price of 4 oz., cents.	Specific gravity at 15.5° C.	Index of Refraction at 15.5° C.
25027	Druggist's label	Stamford	20	0.917	1.4704
25028	" "	"	15	0.917	1.4704
24115	" "	Waterbury	15	0.916	1.4703
24116	" "	"	15	0.916	1.4706
24117	" "	"	15	0.915	1.4702
24118	" "	"	25	0.915	1.4705
24119	" "	"	15	0.915	1.4705
24120	" "	"	25	0.914	1.4705
24121	" "	"	15	0.915	1.4704
24122	" "	"	18	0.915	1.4705
24969	" "	West Haven	25	0.915	1.4702
24979	" "	" "	20	0.916	1.4702
25012	Benefit Brand Finest Olive Oil	Willimantic	17	0.916	1.4703
25013	Druggist's label	"	15	0.915	1.4703
25014	" "	"	20	0.916	1.4701

TABLE XLIV.—ADULTERATED OLIVE OIL.

	Contains Cotton Seed Oil.				
24916	Druggist's label	Hartford	15	0.921	1.4734
24988	" "	New London	15	0.916	1.4712
24138	" " (Sweet Oil)	Waterbury	15	0.923	1.4743
	Contains Peanut Oil.				
24932	Druggist's label	Middletown	15	0.915	1.4702
24154	" "	New Britain	15	0.916	1.4705
25005	" "	Norwich	25	0.916	1.4703
	Contains Sesame Oil.				
24892	Druggist's label	New Haven	15	0.916	1.4705
25076	" "	Norwalk	15	0.916	1.4705
25036	" "	So. Norwalk	15	0.916	1.4707
25015	" "	Willimantic	15	0.915	1.4699

found this year, that sold by grocers as a rule is shown to be of greater purity. No adulterated olive oil was found in grocers' stocks from 1905 to 1908. The results of the inspection of druggists' samples are shown below.

	Not found Adulterated.	Adulterated.	Per Cent. Adulterated.
1897	13	5	27.8
1900	17	13	43.3
1905	21	9	30.0
1906	55	11	16.7
1907	65	11	14.5
1909	63	10	13.7

PANCREATIN.

(*Pancreatinum.*)

The Pharmacopœia defines pancreatin as "a mixture of the enzymes naturally existing in the pancreas of warm-blooded animals, usually obtained from the fresh pancreas of the hog or the ox, and consisting principally of amylopsin, myopsin, trypsin and steapsin, and proved to be capable, when assayed by the process given below, of converting not less than 25 times its own weight of starch into substances soluble in water."

In addition to this definition it is required to be a cream-colored, amorphous powder, containing not more than 10 per cent. of substances insoluble in water, and should completely peptonize cow's milk under certain fixed conditions.

It is apparent from the above definition that pancreatin should contain all the enzymes of the pancreatic juice, the chief of which are trypsin, which converts coagulable proteins into proteoses and peptones; and amylopsin, or pancreatic diastase, which converts starch to dextrin and maltose. Myopsin, which coagulates milk casein, and steapsin, which emulsifies fats, are also normal constituents of the pancreatic juice.

In the examination herein reported only the proteolytic and the amylolytic powers of the pancreatin were tested. The samples were examined, however, for water-insoluble matter, and for starch and reducing sugars.

Thirteen samples were examined; these are believed to represent all the brands on the Connecticut market. Five of these came to us as the product of four manufacturers; the others simply bore the druggist's label.

Table XLV shows the results of our examination.

Color and Appearance. Eight of the samples were amorphous powders, varying in color from yellow-white to cream-white. Four of the samples occurred in yellow-white to dirty-yellow lumps of a sticky consistence. No. 23111 was a deep-yellow powder. Only eight of the thirteen samples, therefore, satisfied the U. S. P. requirements as to color and appearance.

Cost of Material. The cost of the samples showed a wide range. In most cases one-half ounce samples were purchased; these ranged in price from 25 to 50 cents. In the two cases where one ounce was asked for the prices were 50 and 75 cents.

TABLE XLV.—ANALYSES OF PANCREATIN.

			Weight of material.			Amylolytic Power. U. S. P. test. 0.3 gm. pancreatin.				Proteolytic Power.	Coagulation with acetic acid after digestion in U. S. P. test. 5.6 mgms. pancreatin, 247.2 mgms. milk casein taken.		
Sample Number.	Color and appearance.	Cost of material.	Claimed.	Found.	Insoluble in Water.	Starch taken.	Water taken.	Test with Iodine.	Starch digested times weight of pancreatin	Coagulable Protein in residue by U. S. P. test.	Casein undigested.	Casein digested.	Casein digested times weight of pancreatin.
		cts.	gms.	gms	%	gms.	cc.				mgms	mgms.	
23148	Yellow-white powder	25	15.5	12	*21.6	7.5	120	No color	+25	Yes	221.4	25.8	4.6
23672	Cream-white powder	75	15.5	12	15.9	2.1	34	Slight purple	− 7	"	175.5	71.7	12.8
23137	Yellow-white powder	40	15.5	12	14.9	5.4	86	No color	+18	"	143.6	103.6	18.5
23201	Yellow-white powder	50	31.0	16	16.9	7.5	120	No color	+25	"	181.8	65.4	11.7
23047	Yellow-white powder	75	31.0	30	17.7	3.9	62	No color	+13	"	185.7	61.5	11.0
23675	Cream-white powder	30	15.5	16	20.5	7.5	120	No color	+25	"	143.6	103.6	18.5
22307	Yellow-white lumps	35	15.5	14	21.6	7.5	120	Faint purple	−25	"	176.1	71.1	12.6
23203	Dirty-yellow lumps	30	15.5	15	34.0	7.5	120	Faint purple	−25	"	181.8	65.4	11.7
23086	Yellow-white powder	25	15.5	15	*11.1	5.4	86	No color	+18	"	215.6	31.6	5.6
23174	Yellow-white lumps	35	15.5	13	7.1	5.4	86	No color	+18	"	146.7	100.5	18.0
23676	Cream-white powder	50	15.5	11	26.5	5.4	86	Faint blue	−18	"	171.0	76.2	13.6
23674	Yellow-white lumps	40	15.5	15	10.0	2.7	43	No color	+ 9	"	147.4	99.8	17.8
23111	Deep-yellow powder	40	15.5	16	*71.5	0.3	5	Green-blue	0	"	233.5	13.7	2.3

* Contained reducing sugar.

Weight Claimed and Weight Found. Six of the samples slightly exceeded or approximately equaled the weights claimed. The other samples showed deficiencies of from 1.5 to 15 grams, or from 10 to 50 per cent. of the claimed weight. The only original package received with seal unbroken satisfied the claimed weight. The responsibility for the shortage in weight would seem to rest, in these particular samples at least, with the dispenser and not the manufacturer.

Insoluble in Water. The insolubility ranged from 7.1 to 71.5. One sample was superior to the U. S. P. requirement of "not more than 10 per cent.," one exactly equaled it, and another slightly exceeded it. The other ten samples exceeded the limit by from 50 to 600 per cent. No. **23111** showed the exceedingly high insolubility of 71.5 per cent.

Amylolytic Power. Under the conditions of the U. S. P. test, some of the samples converted over twenty-five times their weight of starch into water-soluble substances (dextrin and maltose) and others none at all. No. **23111** showed no amylo-

lytic power whatever. Five samples exceeded or nearly equaled the U. S. P. strength, four showed a deficiency of about 25 per cent., one a deficiency of about 50 per cent., and two deficiencies of about 65 per cent.

Proteolytic Power, U. S. P. Test. Under the conditions of the U. S. P. test all the samples showed coagulation, indicating that the casein had in no case been completely peptonized.

Proteolytic Power, Acetic Acid Test. Of the 247.2 mgms. of milk casein employed in each test, only 13.7 to 103.6 mgms. were digested, or in other words the pancreatin digested only from 2.3 to 18.5 times its weight of milk casein, as compared with forty-four times, as required by the U. S. P. One of the samples, No. **23675**, showing high amylolytic power, also showed the highest proteolytic power. On the other hand, No. **23148**, of high amylolytic power, was next to the lowest in proteolytic power. No. **23111** showed the lowest proteolytic power, holding the same low rank it did in all the other tests, and showing it to be practically valueless as an enzymatic agent.

Summary.

Of the thirteen samples examined, eight satisfied the U. S. P. standard for color and appearance. Three satisfied the standard for insoluble matter. Five samples showed the required amylolytic power and none the required proteolytic power. None of the thirteen samples satisfied all the requirements of the U. S. P.

Methods of Analysis.

The following methods of analysis were used:

Insoluble in Water. Treat 0.3 gm. of material with 10 c.c. of water (40° C.) in a test tube, and heat for fifteen minutes in a water bath at the same temperature, with frequent agitation to break up the lumps and facilitate solution. Wash on to a tared filter paper with water (40° C.) and continue the washing with small quantities of water at a time at this temperature until 100 c.c of filtrate have passed through. Dry the filter and insoluble material in a water oven at 100° C. to constant weight. An effort to use Gooch crucibles with suction failed because of clogging of the filter.

Amylolytic Power. It was our desire to ascertain not only whether the different samples were up to standard, but, if below, how great was the deficiency. Repeated tests were made, therefore, on all the samples, using varying amounts of starch and water, but always in the same relative amounts. The amount of pancreatin used was constant, 0.3 gm., in all the experiments. In this way a close approximation to the amylolytic power of the pancreatin may be obtained. It was observed that the color of the solution increased after a few minutes, e.g., a pink developed into a pronounced violet or purple. "No color" in the table means that no color, even pink, was produced by the addition of two drops of the converted starch solution.

Table XLVI shows all the tests made on the different samples and gives the data on which our judgment as to their starch-converting power was based. For convenience the quantity of starch taken was always a multiple of 0.3 gm., the amount of pancreatin used in all the tests.

TABLE XLVI.—STARCH-DIGESTING POWER USING EQUAL AMOUNTS (0.3 GM.) OF PANCREATIN AND VARYING AMOUNTS OF STARCH AND WATER.

No.	Starch.	Color.	No.	Starch.	Color.	No.	Starch.	Color.
	gms.			gms.			gms.	
23148	7.5	none	23047	7.5	blue	23086	7.5	blue
23672	7.5	blue		6.0	blue		6.0	blue
	6.0	blue		4.5	blue		5.7	blue
	4.5	blue		3.9	none		5.4	none
	2.4	blue		3.6	none		4.8	none
	2.1	faint blue		3.3	none		4.5	none
	1.5	none	23676	6.0	faint blue	23174	7.5	blue
23137	7.5	blue		5.4	very faint blue		6.0	blue
	6.0	blue		5.4	none		5.7	blue
	5.7	blue	22307	7.5	very faint purple		5.4	none
	5.4	none		6.0	faint pink	23675	7.5	none
	4.5	none		4.5	faint pink		6.0	none
23201	7.5	none		3.0	faint pink	23674	6.0	blue
	7.5	very faint blue	23203	7.5	very faint purple		3.0	faint blue
	6.0	none		6.0	none		2.7	none
23111	0.3	blue		4.8	none		2.1	none
	0.3	blue						

Proteolytic Power, U. S. P. Method. Weigh 0.28 gm. of pancreatin and 1.5 gm. of sodium bicarbonate, and dissolve the two together in 100 c.c. of water at 40° C. Heat 400 c.c. of fresh cow's milk to 38° C., and add the solution above prepared to it, and allow to stand in a water bath at 38° C. for thirty minutes. Remove from the bath and pipette 10 c.c. into a test tube, and add three drops of concentrated nitric acid and shake; the appearance of no coagulation indicates that the milk has been completely peptonized.

The U. S. P. method is indefinite as to the amounts of the peptonized milk and nitric acid to be used. After several trials we found the quantities stated above to be satisfactory.

Proteolytic Power, Acetic Acid Method. As all of the samples showed decided coagulation by the U. S. P. test, we desired to determine their relative proteolytic power. Nitric acid being naturally excluded because of its nitrogen content, acetic acid was employed in the following way:

The preliminary treatment of the milk with the pancreatin was exactly the same as in the U. S. P. test. 10 c.c. of the peptonized milk was pipetted into a test tube and 0.5 c.c. of acetic acid (1:3) added, and the contents after shaking were heated to incipient boiling, and filtered and thoroughly washed with cold water. The filter papers and residues were then transferred to Kjeldahl flasks and nitrogen determined, proper correction being made for the nitrogen of the paper. This insoluble residue represented the milk casein not peptonized by the pancreatin.

The milk used contained 3.00 per cent. of casein, and the 8 c.c. used in the test contained therefore 247.2 mgms. of casein.

The question was raised whether a portion of this insoluble nitrogen might not be due to the pancreatin itself. To determine this point, tests were made in every sample exactly as before, except that 400 c.c. of water was used instead of the milk. The greatest amount of nitrogen found in any case was 0.02 mgm., a negligible quantity, and in eight of the thirteen samples none was found.

Starch and Reducing Sugar. The filtrates from the determination of water-insoluble material were tested for starch and reducing sugars.

SUGAR OF MILK.

(*Saccharum Lactis.*)

Forty-eight samples were examined; all of these showed almost complete purity by the polariscope.

The U. S. P. requires that the percentage of ash should not exceed 0.25 per cent. In most of the samples examined the ash was very low, ranging from 0.018 to 0.230 per cent. In four samples, however, the U. S. P. limit was exceeded, and percentages of 0.274, 0.30, 0.32 and 0.72 were found. In these samples lime was found to the amount of from 0.095 to 0.236 per cent.

The samples were generally true to weight, but the selling prices of the same quantity, 4 oz., ranged from 10 to 20 cents.

MISCELLANEOUS DRUGS.

(*Spirit of Peppermint.*)

23297. Arthur's Pure Spirits Peppermint, U. S. P. The Arthur Chemical Co., New Haven. Price, 10 cents for 1.1 oz. It contained 11.60 per cent. oil of peppermint by volume and was free from artificial color. It was up to standard.

23040. Social Brand U. S. P. Pure Ess. Peppermint. Edward D. Depew & Co., New York. Price, 10 cents for 1.4 oz. It contained 5.80 per cent. oil of peppermint by volume and was free from artificial color. It was only 58 per cent. U. S. P. strength.

MISCELLANEOUS MATERIALS SENT BY PRIVATE INDIVIDUALS.

Milk. Twelve samples were tested for fat, all of which satisfied the legal standard.

Skimmed Milk. The single sample tested contained 0.05 per cent. of fat.

Cream. Fifty-one samples were tested; they ranged from 10.25 to 41.92 per cent. of fat; fourteen contained less than 16 per cent.

Vinegar. Fifteen samples were tested, eight of which satisfied the legal standard; the other seven were low in acidity or solids or both.

Root Beer. Two samples were tested for alcohol; they contained 1.14 and 0.57 per cent. by volume.

Wheat Flour and Biscuit. A sample of wheat flour contained 18.61 per cent. arsenious oxide; a biscuit supposedly made from this flour contained 0.988 per cent. of arsenious oxide. It is supposed that the arsenic was added to the flour in the form of "Rough on Rats" with criminal intent.

Rye Flour. Two samples damaged by smoke and water were submitted. Both were condemned as unfit for human use.

Whiskey. Two samples were tested for wood alcohol with negative results.

African Ginger. The sample tested was found to conform with the standard.

Coffee. A sample of ground coffee was found to be adulterated with chicory.

Granulated Sugar. The two samples examined were found to be pure sugar.

Butter. Five samples were examined; all were found to be pure, except for an excess of water in one case.

Condensed Milk. A sample of Van Camp's Condensed Milk contained 8.41 per cent. of fat, and was fully up to standard in this particular.

Mace. Two samples of compound mace were tested with the following results:

	23925	23926
Ether extract	23.19	25.96
Non-volatile ether extract	20.02	22.54
Total ash	2.03	1.99
Ash insoluble in HCl.	0.25	0.18

Wine. A sample of local manufacture showed specific gravity at 15.5°, 1.0727, and 8.49 per cent. alcohol by weight, or 10.55 per cent. by volume.

Linseed Oil. No adulteration was detected in the two samples examined.

India Relish. The sample examined contained no sodium benzoate.

Water from Boiled Corned Beef. The sample examined contained no saltpeter.

Bismuth Subcarbonate. The sample contained 88.92 per cent. of bismuth oxide, and traces of iron. No arsenic, lead or copper was present. It was slightly below U. S. P. strength.

Jamaica Ginger. The sample analyzed as follows: specific gravity at 15.5° C., 0.8238; alcohol by volume, 95.18; wood alcohol, none; total solids, 0.79; solids soluble in alcohol, 0.79; solids soluble in water, 0.21 per cent. The total solids are rather low for pure Jamaica ginger, and the solids soluble in water are relatively high. Sugar was absent.

Medicines. Twenty-six samples of various medicines were submitted by a New Haven detective, as the product of a firm of physicians temporarily practicing in New Haven among the poorer class of Italians. The samples were small and only partial analyses were made, the details of which will not be given here. Two samples contained morphine in considerable quantity.

FOOD AND DRUG PRODUCTS EXAMINED FOR THE DAIRY COMMISSIONER IN THE YEAR ENDING JULY 31, 1910.

The following samples were referred to this station by the dairy commissioner for examination:

Butter and Butter Substitutes. Of the fifty samples examined six were adulterated, and forty-four were oleomargarine, renovated butter or materials required to pay the oleomargarine tax by the Internal Revenue Department. In many cases the illegality of the samples consisted in the failure to display the required sign when selling oleomargarine, or failure to stamp renovated butter at the time of sale.

Milk. Of the fifty-four samples examined, thirty-six satisfied the legal standard. Of the delinquent samples, two were skimmed and fourteen were watered.

Molasses. No adulteration was found in any of the two hundred and twenty-one samples examined, although in a few samples the water content slightly exceeded the standard of 25 per cent.

Vinegar. Two hundred and sixty-four samples were examined, of which fifty-six failed to meet the legal standard or were sold illegally.

Flavoring Extracts. Five lemon, four peppermint, four vanilla, two orange, one wintergreen, and two ginger extracts were examined. One lemon extract was pure, three adulterated and one compound; both peppermint extracts were adulterated; two vanilla extracts were pure, one adulterated and one compound; both orange extracts, the wintergreen extract and both ginger extracts were adulterated.

Lard. The sample examined was adulterated with cottonseed oil.

Jam. A sample of raspberry jam was a legally labeled compound. A sample of "Pineapple Chunks" was found free of preservatives and artificial color.

Ketchup. The sample examined was adulterated, containing 0.24 per cent. sodium benzoate, which was not declared on the label.

Ice Cream. Three samples of vanilla ice cream contained 8.80, 9.15 and 9.79 per cent. of butter fat.

Catarrh Remedies. Eight samples were examined, all of which contained a salt of cocaine, thus rendering their sale illegal, except on a physician's prescription.

Spirit of Camphor. Nine samples were examined, only three satisfying the U. S. P. standard.

Hydrogen Dioxide. The sample contained acetanilide, which was not declared on the label.

Cough Medicine. Two samples marked "Cough Medicine" and one marked "Liniment" were submitted. One of the cough medicines was found to be identical with the liniment. This careless error in labeling of the New Britain druggist made a child, who took the medicine, violently ill and threatened its life. The preparation contained 2.70 per cent. ammonia, camphor, opium and 75 per cent. of alcohol.

Oakite. A cleansing powder. Its alkalinity was equivalent to 7.3 cc. normal sodium carbonate per gram. Carbonates and borates were present.

TABLE XLVII.—SUMMARY OF RESULTS OF EXAMINATION OF FOOD AND DRUG PRODUCTS IN 1910.

	*Not found Adulterated.	*Adulterated or below standard.	Compound.	Total number examined.
Sampled by Station.				
Almond Extract	8	6	--	14
Banana Extract	--	1	1	2
Bouillon	6	--	--	6
Canned Peas	--	--	--	111
Cerena	--	--	--	1
Ginger Extract	7	20	7	34
Gluten Preparations	--	--	--	5
Ice Cream Cones	22	5	--	27
Ketchup	5	52	17	74
Mince Meat	17	1	1	19
Orange Extract	13	7	--	20
Peppermint Extract	4	6	3	13
Pineapple Extract	--	3	10	13
Raspberry Extract	1	3	3	7
Strawberry Extract	--	6	9	15
Tomato Soup	12	--	--	12
Wintergreen Extract	6	5	--	11
Alcohol	5	65	--	70
Diluted Alcohol	--	1	--	1
Bismuth Subnitrate	25	--	--	25
Formaldehyde	8	3	--	11
Fowler's Solution	25	30	--	55
Tincture of Ginger	12	2	--	14
Olive Oil	64	10	--	74
Pancreatin	--	13	--	13
Spirit of Camphor	54	15	--	69
Spirit of Peppermint	1	1	--	2
Sugar of Milk	44	4	--	48
Total	339	259	51	766
Sampled by Dairy Commissioner.				
Butter and Butter Substitutes	6	44	--	50
Ginger Extract	--	2	--	2
Jam or Preserves	1	--	1	2
Ketchup	--	1	--	1
Ice Cream	--	--	--	3
Lard	--	1	--	1
Lemon Extract	1	3	1	5
Milk	36	18	--	54
Molasses	221	--	--	221
Orange Extract	--	2	--	2
Peppermint Extract	--	4	--	4
Vanilla Extract	2	1	1	4
Vinegar	208	56	--	264
Wintergreen Extract	--	1	--	1

* Also includes misbranding.

TABLE XLVII.—SUMMARY OF RESULTS OF EXAMINATION OF FOOD AND DRUG PRODUCTS IN 1910—*Continued.*

	*Not found Adulterated.	*Adulterated or below standard.	Compound.	Total number examined.
Sampled by Dairy Commissioner.				
Spirit of Camphor	3	6	--	9
Catarrh Remedies	--	8	--	8
Cough Medicine	--	--	--	2
Hydrogen Dioxide	--	1	--	1
Liniment	--	--	--	1
Oakite	--	--	--	1
Total	478	148	3	636
Sampled by Private Individuals.				
Bismuth Subcarbonate	1	--	--	1
Biscuit	--	1	--	1
Butter	4	1	--	5
Coffee	--	1	--	1
Condensed Milk	1	--	--	1
Corned Beef Liquor	--	--	--	1
Cream	37	14	--	51
Diabetic Bread	--	--	--	1
Ginger	1	--	--	1
Ginger Extract	1	--	--	1
India Relish	1	--	--	1
Linseed Oil	2	--	--	2
Mace	--	--	2	2
Medicines	--	--	--	26
Milk	12	--	--	12
Skimmed Milk	--	--	--	1
Root Beer	--	--	--	2
Rye Flour	--	2	--	2
Granulated Sugar	2	--	--	2
Vinegar	8	7	--	15
Wheat Flour	--	1	--	1
Whiskey	--	--	--	2
Wine	--	--	--	1
Total	70	27	2	133
Total from all sources	887	434	56	1535

* Also includes misbranding.

PART VII.

TESTS OF SUMMER SPRAYS ON APPLES AND PEACHES IN 1910.

BY G. P. CLINTON, S. D., *Botanist*, and
W. E. BRITTON, PH.D., *Entomologist.*

CONTENTS.

Introduction. With the exception of some experiments early in the history of the Station by Thaxter, the first botanist, on pear and quince for scab and leaf blight troubles, later work by his successor, Sturgis, on peaches for scab and rot, and still more recent work by Britton in summer spraying of peaches for San José scale and by Walden, for the sawfly,—the spraying work undertaken by the Station on fruit trees has been confined chiefly to treatments of the dormant trees, largely to destroy the San José scale. The prominence that the peach industry has attained in the State, and the serious injury that results from scab and rot, hitherto uncombated, together with the revival of interest in apple growing and the recent advocacy of new summer sprays to supplant the standard Bordeaux Mixture, all combine to make necessary further experiments with summer sprays.

With these considerations in view, work was begun the past season with our two most important fruit trees, the apple and peach. Previous experimentation, in various states, has largely determined when and how often it is necessary to spray for each particular trouble of these fruit trees; so, taking advantage of this knowledge, the work has been chiefly the testing of new sprays as regards their fungicidal value as compared with those previously used, and especially with reference to avoiding spray injury, so frequently produced under the older methods.

This report includes the summarized results of the single season's work. The details of the counts and observations made in each orchard being very voluminous cannot be given within the limits prescribed by law for our report. The work involved the careful counting, examining and recording of some 60,000 individual apples and 25,000 peaches. Of course these results will prove of permanent value only as subsequent tests under the varying seasonal and other conditions verify them. In the main, however, there seems to be no reason to doubt their general application, especially since the results of recent experiments by others are largely in accord with them. It is expected, however, that at least another season's test will be made of those treatments which have shown the most value the past season.

SPRAYING EXPERIMENTS WITH APPLES.

Details of Experimentation.

Object. Because of serious injury in this State, especially in 1909, from the use of Bordeaux Mixture, which caused spotting and premature fall of the foliage and russeting of the fruit, and because of the introduction of commercial lime and sulphur preparations as summer sprays and repeated requests for information concerning them, the Station undertook last season extended experiments looking into these subjects. No better fungicide than Bordeaux Mixture is known. It has long been the one most generally used to combat fungous attacks on a great variety of plants, and has given uniformly better results than any other, with no injury resulting from its use in most cases. But with apples under certain weather conditions, injury sometimes results that outbalances its benefits as a fungicide.

The question, therefore, is not a better fungicide for apples than Bordeaux, but one of equal or nearly equal merits that will not produce these occasional injuries. Another question connected with this is whether or not all the russeting of the fruit is caused by the Bordeaux or whether part of it is due to certain seasonal conditions such as late frost.

Orchards under Experimentation. The results of spraying, aside from the kind of spray used, depend upon the varieties experimented with, their previous treatment with spray mixtures, and the character of the season. Simple as it may seem, it is rather difficult to obtain all of these conditions favorable for a test. For example, this season as a whole was not favorable for fungous attack, so there is not as great a difference shown between our sprayed and unsprayed apples in this respect as there would have been with a different season. Again, Baldwin, Greening and Russet apples are perhaps the standard varieties grown in the State, and as such were the ones chiefly experimented with; but they are not nearly so susceptible to attack from the scab fungus as are the McIntosh, Fameuse, and certain other varieties which are also grown here more or less, but which unfortunately were not available in the orchards under experiment. At least two of the orchards had been thoroughly sprayed in the past, both for fungi and for insects, and these showed less difference between the sprayed and unsprayed trees this year than the orchards not previously sprayed.

Seven orchards in different parts of the State were used in the work, and they included trees varying in size from those just set out to very large ones, perhaps fifty years old. The owners and localities are as follows: E. M. Ives, Meriden; B. T. Jones, Centerville; E. Rogers, Southington; S. A. Smith, Cheshire; C. H. Savage, Storrs; J. E. Stoddard, Abington; Experiment Station (Webb orchard), Centerville. The Station is under obligation to those who thus placed their orchards at its disposal and helped the work in other ways and to Prof. C. D. Jarvis of the Connecticut Agricultural College for his cordial coöperation in placing under our direction several of the orchards where he was doing demonstration work in connection with the Connecticut Pomological Society. Credit is also due to E. M. Stoddard, assistant in botany, and to B. H. Walden and A. B.

Champlain, assistants in entomology, for help in conducting the experiments.

Altogether about 350 trees were sprayed from two to four times (including the winter treatments), and at least seventy-five others were reserved for checks. The counts at the end of the season were made from only part of these trees. The varieties used were chiefly Baldwin, Russet, Greening and Pound Sweet, but besides these there were occasional trees of Hurlburt, Gravenstein, Jonathan, King, Yellow Transparent, Hubbardston, etc.

Treatment. As Bordeaux Mixture is the fungicide almost universally used in this State, and as it was the one to be replaced, if possible, we used it in every one of the orchards, for comparison with the other fungicides as well as with the check or unsprayed trees. Ordinarily the Bordeaux used is the 4-4-50 formula, that is, 4 lbs. copper sulphate, 4 lbs. lime, and 50 gallons of water. This was used in the different experiments, and varied to 3-4-50, 2-4-50, and even 1-4-50 strengths by using less copper sulphate, which is the chemical furnishing the fungicidal value (copper hydroxide) and at the same time the injurious substance of the spray.

The second type of mixtures tried was the commercial lime and sulphurs that have been used for some time on dormant trees for the San José scale, but have only recently claimed attention as summer sprays of fungicidal value when used in weaker solutions. On the dormant trees these are ordinarily used at strengths of from 1 to 12 up to 1 to 8. In our winter treatments we used one of these at a strength of 1 to 9, and in our summer spraying we used them in strengths of 1 to 50, 1¼ to 50, and 1½ to 50, the lower strength being about the limit of usefulness, and the higher near the danger point of injury to the foliage, as stated by previous investigators. The commercial lime and sulphur sprays have for their fungicidal agent sulphides of lime, produced by chemical action (under heat) of the lime and sulphur used in their preparation. The preparation is a clear amber-colored liquid, very easily mixed with water, and very convenient and easy for spraying. Some few manufacturers, as in the case of the Niagara lime and sulphur, add an excess of lime as a sediment, to protect against injury to the fruit and foliage by burning. So far as we could judge by general appearances, the

different brands used in the tests were of the same quality, and specific gravity tests of the three used at the Smith farm showed them to be about the same strength. The brands used in the experiments were Grasselli, Blanchard, Sherwin-Williams, and Niagara.

The third type of sprays used were those commercial preparations having beside lime and sulphur some other ingredient or ingredients in their make-up. Of this type the three brands used were "Sulfocide," "Bogart's Sulphur Compound," and "One for All." None of these were used to the extent that the straight commercial lime and sulphur brands were used, because there seems to be more danger of burning the foliage with them. "Sulfocide" contains as one of its ingredients some caustic soda, and this, if neutralized in its manufacture, probably produces no harm, but if not all neutralized, it is liable to burn the foliage. Likewise, when either Paris green or arsenate of lead is added, some soluble arsenate is formed which is quite injurious to the foliage. Bogart's "Sulphur Compound," according to the manufacturer, "is composed of pure brimstone sulphur reduced to a soluble form; the only other ingredients in the compound are such vegetable oils as to produce a sticky spray." If caustic soda is used at all to dissolve sulphur, it might explain the injury caused by this preparation when used with arsenate of lead. "One for All" is a paste of the color of mustard and water, and contains wool grease, lime, sulphur and arsenic. The manufacturers claim it to be a fungicide, and both an arsenical and a contact poison for insects. In our tests it was diluted according to directions at the rate of 6 and 5 lbs. of the paste to 50 gallons or one barrel of water.

The fourth type of sprays tested was self-boiled lime and sulphur. This is a homemade mixture in which the heat of the slaking lime is used to dissolve a small amount of sulphur, forming sulphides of lime. We used the formula 8-8-50, recommended by Scott, of the U. S. Department of Agriculture, and made it after his directions, as follows: Eight pounds of lime were slaked with a small amount of water in a barrel, and when thoroughly heated, 8 lbs. of flowers of sulphur were sifted and thoroughly stirred in, making a moderately thin paste, which was allowed to heat for fifteen minutes, and then was diluted with water to 50 gallons. The mixture was thoroughly stirred and then strained through ordinary wire strainers into the spray barrel. This mixture is rather more cumbersome to make than Bordeaux, and, having more sediment, clogs the spraying apparatus more easily.

In all of the above spray mixtures, except "Sulfocide," arsenate of lead was used as the insecticide, being added to the spray mixture in paste form at the rate of 3 lbs. to 50 gallons, or to the barrel. In some cases, however, the poison was omitted for the first spraying (before blossoming), and in the last (fourth or fifth) spraying, as the important applications of poisons are those two made first after the blossoming period.

For the apple it has been found by previous experiments that from two to four summer treatments are necessary to control the different fungous pests, and insects may be controlled at the same time by the addition of poison to the fungicide. Ordinarily these treatments were as follows: (1) On the young unfolding leaves just before the blossoms open; (2) on the leaves just after the petals fall; (3) about two weeks later, or on the very young fruit; (4) three or four weeks later on the small fruit. This year, being a season when blossoms started early, and then held back over a longer period than usual, the summer sprayings were made at the various orchards between the following dates: (1) April 27th to May 1st; (2) May 10th to 20th; (3) June 3d to 18th; (4) July 7th to 19th. The second and third sprayings were made in all the orchards, as the most desirable where only two could be made, especially as regards insects, while the first spraying was omitted in five of the orchards, and the fourth in four. No orchard received all four treatments. Most of the orchards, however, had been given a winter treatment for San José scale by their owners. Plates XVII, XVIII.

Collecting Data. At each spraying the trees were examined in a general way for injury to the leaves or fruit from the previous treatment and for fungi and insects; but the specific conclusions were based on inspection of the fruit at harvest time. As far as possible the fruit was examined when picked. Some of the sprayed trees bore little or no fruit, and in other cases it was not found necessary to make counts of all trees which had the same treatment in the same orchard. When only a small number of apples were borne, all of them were included in the counts,

but where the crop was large, usually only five hundred to one thousand were counted for each tree. In the latter case we aimed to get these from different parts of the tree, but otherwise to take them as they came.

In collecting the data no attention was paid to the comparative yield of the sprayed and the unsprayed trees, because the trees in the different orchards varied considerably in the amount of bloom and consequently in the amount of fruit set; but unless trees are of the same variety and bloom the same, it is impossible to tell whether or not any difference in yield is due to the spraying. Likewise, one has to be very cautious in comparing with each other trees that are of different varieties or in different orchards. There is also a difference in results whether one counts only picked apples or includes the windfalls also. Except in two cases, the Jones and Savage orchards, the apples did not include any windfalls.

Altogether about 60,000 apples were individually examined and records made of each, whether or not it was perfect, russeted or attacked by fungi or insects, and in case of fungous or insect injury, the kinds were noted. From these numbers the percentages of each were worked out, based on the whole number of apples examined from that tree. These percentages usually foot up a little more than 100, since occasionally an apple had to be counted twice or rarely even three times, because of the presence of two or three troubles. The most common duplicates were codling moth and rot, or russet with some fungous or insect trouble. In order to give a better understanding of the fungous and insect pests, brief descriptions are here given of those present in the orchards examined, which include the ones most injurious in the State.

Fungous Diseases.

Baldwin Spot. While we have included this with the fungous troubles, it is certainly not such, since each year for several years we have tried to obtain cultures from these spots in the fruit, and have uniformly failed. It is a physiological disease, but its cause is not known, though attributed to a variety of things. From observations that have been made in Mr. Ives's orchard there are some grounds for the belief that possibly it may be due to the Rosy Apple Aphis, which occurs on the young fruit, and on certain trees, more abundantly in some seasons than in others. The Baldwin spots show as small collapsed masses of brownish tissue, usually a short distance beneath the skin, and these may finally appear at the surface as small sunken areas. While the Baldwin is the most susceptible variety, it is not the only one having this trouble, which usually shows on the apples late in the season and in storage. Certain of the fruit speck troubles, due to fungi, are very similar in appearance and are hard to distinguish in the field when the apples are not cut open, so that these two troubles as they appear in our tables are only superficial determinations. No remedy is known for the Baldwin spot. Plate XXI, a.

Black Rot, Sphæropsis malorum. This fungus causes cankers on the larger branches, kills the twigs, produces the common small brown spots that so often pepper the apple leaves in early summer, besides rotting the fruit. With the summer varieties and in stored apples it causes a brown rot that finally turns black, hence the common name. The ordinary winter apples and hardier fall apples do not usually suffer from this trouble, except through insect injuries or in the form of fruit speck troubles that do not develop as true rots until after some time in storage. As this trouble often develops on the leaves most conspicuously under infected branches, the remedy is to keep the trees pruned of all dead wood, and if there are cankers, to have these cut out and painted over. Likewise, any fungicide applied during the early part of the season is helpful, though it is difficult to entirely prevent the spotting of the foliage by spraying alone. The use of insecticides, also, in keeping out codling moth, lessens the rot starting from this cause. Plate XXI, b.

Fruit Spot, Cylindrosporium pomi. This is a fungus that causes more or less numerous small specks extending only slightly beneath the skin, usually showing late in the summer, and it is most common in our experience on seedling apples, especially those with a light-colored skin, where it may usually be distinguished by the purplish-colored spots much like those caused by the San José scale. The fungus does not seem to fruit on these spots, and so has been overlooked by us as a fungous trouble until this season. Besides this fruit speck, there

is that mentioned above, caused by the black rot fungus, and a species of Alternaria is apparently responsible for another. All these are common in storage apples, and are more difficult to distinguish by the naked eye. Late treatments with fungicides decrease these troubles, and so where they are prevalent the fourth treatment mentioned above is of value. Plate XXI, c.

Rust, Ræstelia pyrata. This is the rust ordinarily found on apples here, though another very closely related species sometimes occurs. It infects the leaves most abundantly, but the fruit is also attacked. On the upper side of the leaves it forms bright orange-colored spots, appearing usually in June or July, and in the spots are small black specks, producing spore-like bodies whose function is unknown. On the under surface of the leaves in these spots there later appears the true spore stage in the shape of a cluster of short hair-like projections that on maturity become converted into fringed and recurved cup-like receptacles containing an orange-colored mass of spores. These spores do not spread the disease further on the apple, but carry it to the red cedar, and form eventually the "cedar apples" that in the spring produce jelly-like horns from these galls in which another spore stage is formed, which on germination carries the disease back to the apple. There is a great difference in the susceptibility of different varieties to attack by this fungus, among those most susceptible being the Wealthy, Fallawater, Hurlburt, Jonathan, King and Russet. The Baldwin and Greening are not very susceptible. The fruit, especially when of a resistant variety, often produces when attacked only the imperfect stage. Of course the presence of cedars in the vicinity of the orchard favors the development of this fungus, but apparently the spores can be carried from some distance and still infect an orchard considerably. Spraying has to be done thoroughly and repeatedly in order to do much good, so that the four treatments mentioned previously are apparently required. Plate XXI, d.

Scab, Fusicladium dendriticum. This fungus is recognized on the fruit by the small, scabby, olive-black outbreaks it produces in the skin, and if abundant enough, often causes distortion and stunting, as the infection takes place when the fruit is quite young. The fungus also occurs on the leaves, producing radiating olive-black superficial growths in spots on either surface, which if abundant, cause premature shedding in the fall. It occurs less frequently on the young twigs. Its mature stage forms in the spring on the old leaves of the previous year, and re-infection takes place from these or from the parasitic stage carrying over on the twigs. As with the rust, wet, cold springs are very favorable for the development of this fungus. There is considerable difference in varietal resistance to it, such summer and fall varieties as Early Harvest, Fall Pippin, Fameuse, and McIntosh being most susceptible, apparently in part because the fungus winters over in the twigs. This is the fungus that started the work with fungicides on apples in this country, and is generally considered the worst fungous pest of the orchard. On the whole we do not believe it so serious in this State as in many other regions, partly because the Baldwin, Greening and Russet apples are not so subject to its attacks. The first three treatments previously mentioned are the ones usually given for this trouble, and where Bordeaux has been used, have given very satisfactory results so far as controlling the fungus is concerned. Plate XXI, e.

Sooty Blotch, Phyllachora pomigena. This fungus causes a superficial black spotting of the surface of the apples without especial injury to the skin, so that the fungus may be largely removed by a vigorous polishing. This superficial growth consists of the mycelium or vegetative stage, certain cells of which apparently function as spores. The flyspeck fungus, so named from its appearance, is often associated with it, and is regarded by some botanists as not distinct. The chief injury caused by this fungus is due to the untidy appearance it gives the infested apples, and in this respect it is a serious drawback. Just what the life history of the fungus is has not been clearly worked out, but apparently it passes over the winter on the twigs in some way, and probably matures on the fallen rotten fruit. The fungus is most conspicuous on light-colored fall and winter apples, especially on neglected seedlings. The Greening is often seriously affected by it. During dry seasons this fungus is not conspicuous, but in wet ones, especially those wet in late summer and early fall, it becomes one of the most, if not the most, injurious apple fungus of the State. Where orchards are thoroughly sprayed each year, especially where the fourth, or latest application is included, this fungus does comparatively little harm unless the season is exceptionally bad. Plate XXI, f.

Other Rots. Besides the preceding, on some of the summer varieties and on apples in storage there occur a few other fungi that cause rot, but they are not easily differentiated from one another, and are not so important commercially as those mentioned above. There are also a few leaf or branch fungi found here of more or less economic importance that are not included in the above list.

Insect Injuries.

Apple Maggot or Railroad Worm, Rhagoletis pomonella Walsh. A small maggot injures the fruit by tunneling in the flesh, and decay soon follows. The adult is a small two-winged fly, with wings conspicuously marked with four black cross bands. The egg is laid just beneath the skin, hatches in a few days, and the larva when full grown emerges from the fallen fruit and pupates in the ground. Probably there is only one brood each season, and the late insects develop after the fruit is stored, if the temperature is not too low. The pest is much worse in soft and non-acid varieties. As the maggot is beneath the skin, it is out of the reach of sprays, and destruction of fallen fruit and surface cultivation of the orchard are the remedies. Pasturing with hogs or with sheep is also effective. Though no form of spraying can be recommended against this insect, the orchards which have been carefully sprayed are often less affected. Plant late varieties having a firm flesh and acid flavor. Plate XXIV, a.

Bud Moth, Tmetocera ocellana Schiff. This insect often ruins the apple crop by attacking the cluster buds and eating out the undeveloped flowers. There is probably but one brood each season in Connecticut, and the half-grown caterpillar passes the winter in a silken case attached to the twigs. In early spring the caterpillars feed on the opening buds, curling and fastening together the young leaves, as is shown on Plate XXIV, j. They reach full size in June, and are light chestnut brown in color with head, legs and thoracic shield shiny dark brown or black. The cocoon is formed in the dead leaves, and a short time afterward the adult appears as a gray moth, with a wing-spread of about five-eighths of an inch and with broad yellowish cross bands on the forewings. Thorough spraying with lead arsenate is the remedy, and at least one application should be made before the blossoms open.

Canker Worms, Alsophila pometaria Harris (fall canker worm), and *Paleacrita vernata* Peck (spring canker worm). Canker worms feed upon the young leaves in May, often entirely defoliating orchards in different sections of the State. Most of the damage is done here by the fall species, which emerges from the ground and lays eggs during the warm days of November and December. The spring canker worm lays eggs in March and April. The eggs of both species hatch late in April or early in May, and the young caterpillars eat small holes through the leaves or devour all of the green tissue, leaving only the large veins. Later, as the leaves become larger and tougher, the worms often leave the network, which turns brown in June and looks as if a fire had gone through the orchard. The caterpillars loop when they crawl, and vary from leaf-green to nearly black in color, but are marked lengthwise with fine whitish lines. They are usually through feeding and go into the ground to pupate during the first week in June, the adult moths appearing the following autumn, or, in case of the spring species, the next spring. Both sexes are gray, with indistinct markings. The female is wingless and must crawl up the trunks of the trees, and may be kept off by the use of sticky bands, as described in the Report of this Station for 1907-1908, page 792. In orchards where spraying is practiced no other method need be considered, as the pest can be controlled by the use of arsenical poisons.

Codling Moth or Apple Worm, Carpocapsa pomonella Linn. This is probably the most important insect attacking the fruit of the apple in Connecticut. The adult is a brown moth with a wing-spread of about three-fourths of an inch, and lays eggs on the leaves or young fruit soon after the fruit sets. The young larvæ feed on the leaves or fruit, and burrow into the latter, usually entering through the calyx cavity and working in around the core. When nearly full grown, late in July, it eats its way out of the apple, leaving a large hole. It is then nearly three-fourths of an inch long, and of a pinkish or flesh color. The

cocoons are formed under loose bark or under rubbish around the tree, and in this stage most of the insects pass the winter; some of the early ones, however, emerge and lay eggs for the second brood, which is probably not extensive in Connecticut. The proper treatment is to spray with arsenical poison soon after the blossoms fall, and again about a month later. Plate XXIV, i.

Curculio (see under Peach, page 609).

Lesser Apple Worm, Enarmonia prunivora Walsh. The larva of a small moth often feeds on the surface of the nearly mature fruit in the manner shown on Plate XXIII, b, and the injury resembles certain forms of codling moth injury, for which it has been mistaken. The work often continues after the fruit is gathered and placed in storage, and on account of its inconspicuous nature, is at first apt to be overlooked. It seriously affects the keeping qualities and appearance of the fruit. There are two broods each season, and the systematic use of arsenical poisons, as for the codling moth, is the best treatment that can now be recommended.

Plant Lice. Green Apple Leaf Aphis, *Aphis pomi* DeG., and Rosy Apple Aphis, probably *Aphis sorbi* Kalt., both attack and injure the apple. The former is found more especially on the terminal leaves of younger trees, and is an important pest of the nursery, where it seriously checks the growth. The Rosy Aphis attacks more especially the fruit clusters on the inside of the tree, and causes the young fruit to be small and ill-shaped. (See Report of this Station for 1909-1910, page 343.) Spraying the dormant trees with a concentrated lime-sulphur mixture to kill the eggs, and the foliage with kerosene emulsion to kill the aphids, are the principal remedies. Plate XXIV, f.

San José Scale (see under Peach, page 610).

Tent Caterpillar, Malacosoma americana Harr. The caterpillars hatch from the egg-mass late in April, and make large nests or tents in the crotches or forks of the larger branches of apple and wild-cherry trees. They remain in the nests during the night and in stormy and cloudy weather, going out of it in pleasant weather to feed. They become full grown about the middle of

June, and make white cocoons under the leaves or rubbish on the ground. Two weeks later the adults emerge as fawn-colored moths, having a wing-spread of about an inch, and lay cylindrical masses of eggs encircling the small twigs. The eggs are covered with a transparent varnish-like substance, and hatch the following spring. The nest is shown on Plate XXIII, d. Cutting and burning the egg-masses in winter, brushing off the nests in May, and poisoning the foliage are the remedies.

Other Insects. There are many other insects attacking the apple; the fall web worm and the borer are distributed throughout the State, but as they were not noticed especially in the orchards under experiment, they are not described here. The gypsy and browntail moths are also important apple pests, but as the former is known to be present in Connecticut only at Stonington and at Wallingford, and the latter only in the extreme northeastern corner of the State, it was deemed best to omit them from this paper.

General Results of Spraying Apples.

Injury. Leaf Burn. Spraying injury generally shows in two ways; namely, spotting of the leaves and russeting of the fruit. The injury to the leaves may show as a general burning of the edges, or as interior isolated spots which vary from circular to quite irregular. The spots usually range from a quarter inch in diameter to much larger sizes by running together. These spots frequently so nearly resemble those caused by the black rot fungus that it is quite difficult to tell them apart, especially as the fruiting stage of the fungus rarely appears on the infected leaves. Where a fungicide produces serious injury of the leaves, there results a more or less decided leaf fall. Leaves not seriously spotted on such trees also frequently turn yellow and drop off. With the Bordeaux Mixture the injury is frequently overlooked by the orchardist if the leaves are not shed. This year, not only in our experiments, but with others who have used Bordeaux, the apple leaves suffered more or less serious spotting and leaf fall. In the experimental orchards the most serious injury resulted where the Bordeaux was used strongest and most frequently; namely, at the Smith, Station, and Ives orchards, where from a few to about one-half the leaves were dropped. The least injury to the leaves was probably in the Jones orchard, where only two sprayings (second and third) were made with the 2-4-50 formula.

So far as the commercial lime-sulphur sprays are concerned, the injury to the foliage, even with the 1½ to 50 strength, was so slight as not to need especial mention. With the self-boiled lime and sulphur, also, there was no particular injury. With the commercial lime-sulphur sprays containing other ingredients, however, the results were quite different. "Sulfocide" was tried only at the Station farm, but each of the sprayings there produced more or less serious burning of the foliage. As Paris green without lime had been used with the "Sulfocide," a series of experiments was made on small trees with this fungicide, using it without any poison, with Paris green with and without lime, and with arsenate of lead. At a strength of 1 to 200 without a poison, the "Sulfocide" did very little harm, and none at 1 to 400, but with the addition of either Paris green or arsenate of lead at the latter strength, considerable burning resulted, though when lime was added with the Paris green this was largely reduced. Mr. Ives also used "Sulfocide," 1 to 200, with Paris green without lime, in one of his orchards, and it produced a very serious burning, with leaf and fruit fall. (See Plate XX, b.) As stated before, the chemical combination of soda with the arsenic of the poison produces some arsenate, which is soluble and very destructive to plant tissues, and therefore makes "Sulfocide" dangerous to use with insecticides. "Bogart's Sulphur Compound," first used at the Station orchard at a strength of 1½ to 50, produced considerable leaf injury, but was not tried sufficiently at lower strengths to see if this could be overcome, though in two sprayings at 1 to 75 it seemed largely diminished. "One for All," used twice on Baldwin apples in the Ives orchard at the rates of 5 and 6 to 50, produced as serious a burning with leaf fall as did the "Sulfocide." It was not tried at weaker strengths. It did not, however, russet the fruit or cause it to fall at this strength.

Injury. Russeting of Fruit. In every one of the orchards where Bordeaux was used, it produced more or less russeting of the fruit, depending on the strength of the Bordeaux and the variety sprayed. In some cases the injury was so serious as to include a large percentage of the apples, producing a russeting that affected not only the appearance but even the size and shape of the fruit. The most injury was shown at the Rogers and Smith orchards, though it was quite evident at the Ives and Stoddard orchards. At the Station only a few trees were sprayed, and these did not produce much fruit, otherwise the injury here would have been serious. The russeting of both fruit and leaves at Mr. Jones's was less conspicuous than in any of the other orchards. The most extensive injury to a variety was shown on the Pound Sweets at Mr. Smith's, where 89.5 per cent. of the apples sprayed with Bordeaux were russeted against practically none on the unsprayed trees. At Mr. Rogers's, Mr. Stoddard's and Mr. Ives's the Baldwins also russeted seriously from the spraying, the Bordeaux trees in the first-named orchard showing an average of 42.3 per cent. russeted against 12.3 per cent. for all the checks. At Mr. Rogers's, Greenings, not included in our experiments, were badly russeted, apparently by the Bordeaux Mixture used. At Mr. Stoddard's, while the Baldwins showed a high per cent. of russeting, one of the check trees also ran very high. Table I shows that counts made from all the Baldwins sprayed with Bordeaux in our experiments gave 42.9 per cent. russeted against 19.5 per cent. on the twenty-three check Baldwins, an increase of over 23 per cent. See Plate XX, a.

While the commercial lime-sulphur sprays, and especially the self-boiled lime and sulphur, seemed to produce some russeting in certain cases as compared with their checks, this was never so general or conspicuous as with the Bordeaux. Table I shows that the average russeting of all the treatments in every orchard was lower than the average of the checks, except with the Bordeaux, where it was conspicuously higher, and with the self-boiled lime and sulphur, where it was about the same. With the other treatments, however, there were occasional trees (as in the case of a Baldwin tree at Mr. Ives's treated with the Niagara lime-sulphur) where the amount or character of the russeting was quite pronounced over that of the checks. This usually seemed to be in the nature of a sun scald, being on the side of the tree and fruit most exposed to the sun.

Injury. Frost. Aside from the russeting produced by spraying, however, there was more or less in every orchard due to

some other cause, as shown by the check or unsprayed trees in these orchards. Even the same variety of trees receiving the same treatment in the same orchard shows quite a variation in the amount of russeting. The highest per cent. of russeted fruit on any check tree was 63.8 per cent. on a Baldwin in the Stoddard orchard, while another Baldwin in the same orchard (with very little fruit, however), had only 6.7 per cent. Table I shows that the average russeting on seventy-nine trees, on which seven different fungicides were used, was only slightly higher (21.7 per cent.) than that of the thirty-three check trees of the same varieties, which was 18.4 per cent. Of course part of this russeting may be natural, but on the whole we believe that it was largely due to the unusually late frosts the past season in May and early June, which were serious enough in certain parts of the State to kill the foliage of scrub oaks, etc. These frosts were most serious in the northern part of the State, and were most evident in a given region in the low spots, a few feet in some instances making quite a difference in injury to the vegetation. This may explain the difference shown by the same varieties in the same orchard. For instance, the check Baldwin which was seriously russeted in the Stoddard orchard was in a lower place than any of the other Baldwins from which counts were made. Likewise, the Smith, Jones and Station orchards, which are nearer the Sound, where the frosts were less severe, showed less russeting than the Ives and Rogers orchards further inland, and still less in comparison with the Savage and Stoddard orchards still further north. Of course the varieties were not the same in all the orchards, which also has to be taken into account. We have seen apples injured almost as badly as those shown on Plate XX, a, which have not been sprayed, though as a rule such fruit is much more common on the sprayed than on the unsprayed trees.

Benefits. General. It was not the purpose of these experiments to show increased yields due to spraying, so no account was taken of the total yield of different trees under different treatments. Even if this had been the case, the unevenness of blossoming this year was enough to prevent obtaining data of value. However, there is no reason to doubt that where spray injury did not occur, there was an increase in the number and size of the apples. This was especially shown in the Jones orchard, where the windfalls were much more numerous from the unsprayed than from the sprayed trees. Likewise, the data obtained do not take into consideration the benefit to the foliage in preventing insect and fungous attacks. It was very evident at the end of the season at the Station and Jones orchards at least (see Plate XIX), that the foliage of the sprayed trees was of a better color and was retained longer than that of the unsprayed trees. This has its effect on succeeding crops.

The data obtained merely relate to the character of the fruit with respect to its freedom from insects, russeting and fungi. Table II shows the relative results obtained by the different treatments in the different orchards. To explain this more fully, we find, for instance, that in the Ives orchard there were trees treated with Bordeaux, Niagara lime and sulphur, self-boiled lime and sulphur, besides the check trees. Of these the Bordeaux trees stood fourth, or last, in per cent. of perfect apples, and also fourth in number of russeted apples, while as regards the least number of apples attacked by fungi and insects, they stood first in each case. As three of the treatments were tried in only one or two orchards, we have omitted consideration of them, and have taken the average standing of the other treatments and compared them with the average ranks as obtained from the average total percentages given in Table I, with the following results:

	Perfect.			Russeted.			Fungi.			Insects.		
Rank in Table......	I	II	Av. rank.	I	II	Av. rank.	I	II	Av. rank.	I	II	Av. rank.
Bordeaux	6	6	6	6	6	6	2	1	1½	4	1	2½
Grasselli	2	4	3	2	2	2	3	5	4	3	5	4
Niagara	3	1	2	3	1	2	4	4	4	2	2	2
Sherwin-Williams	1	2	1½	1	2	1½	5	3	4	1	3	2
Self-boiled	4	3	3½	4	5	4½	1	1	1	5	4	4½
Check	5	5	5	5	4	4½	6	6	6	6	6	6

This shows that the Bordeaux and check trees had the least perfect fruit. With the Bordeaux this was due to a high per cent. of russeted fruit caused by the spraying, while with the

check trees it was due to a greater per cent. of insect and fungous attack, due to lack of spraying. It will also be seen from this table that the fungicides producing the least russeting were those having apparently the least fungicidal value.

Benefit. Fungi. The past season on the whole was quite unfavorable for a general development of fungous diseases of the apple. While the early, wet, cold spring favored the development of scab and rust, the very dry summer and fall were equally unfavorable for the fruit specks and sooty blotch. In all of the orchards under experiment the injury by fungi was comparatively small, and this was especially true of the orchards that had been sprayed in previous years for fungous troubles. The following table shows the per cent. of the fruit attacked by fungi on all of the trees in the different orchards:

	Sprayed.	Unsprayed.	
Ives	2.4%	4.8%	
Jones	11.4%	31.9%	
Rogers	2.7%	3.1%	
Savage	1.4%	1.4%	(sprayed with arsenate of lead)
Smith	5.0%	10.8%	
Stoddard	5.8%	11.5%	

While in all of the orchards the sprayed trees gave lower per cents. of fungi, as shown by the above table, the fungi were too inconspicuous even on the check trees in three of the orchards to expect any decided results from spraying. All these orchards where the percentages of fungi on the check trees were over 10 per cent. had not been sprayed before, and the per cent. in one of these, the Jones orchard, was greatly increased because the counts included apples from the ground as well as from the trees. The low per cent. of fungi of the season is best shown by Table I, which gives the average per cent. for all the unsprayed trees of all the orchards as only 5 per cent., which was reduced on the sprayed trees to 3.5 per cent.

As regards particular fungi, we may state that while the season was on the whole favorable for scab, the varieties in the experiments were not very susceptible to this trouble, so even on the checks, or unsprayed trees, it was not abundant enough to determine the real value of the different sprays in controlling it. Sooty blotch, while not specially conspicuous, appeared on the checks in the Smith and Stoddard orchards in sufficient amount to show that the sprayed trees were benefited by the treatments. Rust was the most frequent fungus in all the orchards, when we take into consideration the fact that only certain varieties are attacked by it. So far as the spraying as a whole was concerned, however, the sprayed trees did not have any less rust than the unsprayed. Individual trees in some cases seemed to show less, due to the spraying. With this fungus it seems essential that all four treatments be given in order to make any headway against it, and none of the orchards had this number. Rot was also a common fungous trouble in the orchards, and much of the benefit derived from the spraying was due to its prevention. In this respect the arsenate of lead was as helpful as the fungicides, since most of the rot followed insect injury.

Concerning the fungicidal value of the different sprays, the season was not such as to give them a fair test, but so far as the evidence goes it shows that the commercial lime-sulphur sprays were not quite equal to the Bordeaux or the self-boiled lime-sulphur. On the whole, the Bordeaux gave the better performance, since in two of the three orchards where it and the self-boiled lime-sulphur were used it ranked higher.

Benefit. Insects. The work of the codling moth was the principal insect injury appearing on the fruit at harvest time, and generally speaking it equalled or exceeded the sum total of all other insect injuries. In fact, it probably caused even greater injury than the percentages would indicate, as doubtless many of the scars and pits accredited to "other insects" were really caused by the codling moth. From the figures it appears that the codling moth was more prevalent in the Jones orchard than elsewhere, which is probably true; yet lest the reader be misled, it should here be stated that at harvest time most of the fruit, especially from the unsprayed trees, was on the ground, as the result of a storm a few days before. Hence, in order to get apples to count it was necessary to include the windfalls. As the crop here was small at the most, other things being equal, we might expect a larger proportion of the apples to be wormy. These trees had not been sprayed previously with poison, as they had been in some of the other orchards.

TABLE I.—COMBINED DATA ON SPRAYING FROM ALL SIX APPLE ORCHARDS.

Treatment.	Variety.	Trees Sprayed.	Trees Counted.	Total Apples.	Perfect.		Russeted.		Fungi.		Insects.		Irregular.
					No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	
1. Bordeaux Mixture	Baldwin	----	11	6552	3225	49.2	2808	42.9	68	1.0	506	7.7	32
	Greening	----	3	1196	776	64.9	233	19.5	78	6.5	227	19.0	4
	Pound Sweet	----	2	622	43	6.9	557	89.5	14	2.3	125	20.1	----
	Russet	----	3	1065	691	64.9	8	0.8	101	9.5	277	26.0	----
	Totals	74	19	9435	4735	50.2	3606	38.2	261	2.8	1135	12.0	----
2. Grasselli L. & S.	Baldwin	----	8	3172	2055	64.8	692	21.8	109	3.4	349	11.0	----
	Pound Sweet	----	3	1220	1098	90.0	----	----	54	4.4	68	5.6	----
	Russet	----	1	229	154	67.2	3	1.3	18	7.9	54	23.6	----
	Totals	44	12	4621	3307	71.6	695	15.0	181	3.9	471	10.2	----
3. Niagara L. & S.	Baldwin	----	10	5129	3315	64.6	1214	23.7	162	3.2	452	8.8	25
	Pound Sweet	---	2	1021	864	84.6	----	----	40	3.9	132	12.9	----
	Russet	----	1	623	475	76.2	2	0.3	72	11.6	76	12.2	----
	Totals	55	13	6773	4654	68.7	1216	18.0	274	4.0	660	9.7	----
4. Sherwin-Williams L. & S.	Baldwin	----	8	3175	2197	69.2	640	20.2	82	2.6	280	8.8	----
	Pound Sweet	----	3	2385	2110	88.5	----	----	155	6.5	122	5.1	----
	Russet	----	1	134	110	82.1	0	0	16	11.9	8	6.0	----
	Totals	45	12	5694	4417	77.6	640	11.2	253	4.5	410	7.2	----
5. Blanchard L. & S.	Greening	----	3	187	106	56.7	21	11.2	8	4.3	71	38.0	----
	Russet	----	2	577	297	51.5	2	0.3	50	8.7	242	41.9	----
	Totals	13	5	764	403	52.7	23	3.0	58	7.6	313	41.0	----
6. Self-Boiled L. & S.	Baldwin	----	7	3945	2634	66.8	901	22.8	34	0.9	365	9.2	15
	Greening	----	2	305	149	48.8	37	12.1	27	8.8	113	37.0	----
	Russet	----	2	434	219	50.5	0	0	61	14.1	172	39.6	----
	Totals	22	11	4684	3002	64.1	938	20.0	122	2.6	650	13.9	----
7 Arsenate of Lead & Sulphur	Baldwin	----	5	1672	1204	72.0	288	17.2	24	1.4	157	9.4	3
	Greening	----	2	495	448	90.5	----	----	18	3.6	29	5.9	----
	Totals	26	7	2167	1652	76.2	288	13.3	42	1.9	186	8.6	----
8. Arsenate of Lead	Baldwin	----	3	1225	876	71.5	205	16.7	27	2.2	137	11.2	----
	Russet	----	1	587	406	69.2	2	0.3	94	16.0	87	14.8	----
	Totals	24	4	1812	1282	70.7	207	11.4	121	6.7	224	12.4	----
9. Checks	Baldwin	---	23	11058	6681	60.4	2160	19.5	336	3.0	1949	17.6	121
	Greening	----	4	1420	654	46.1	322	22.7	204	14.4	309	21.8	3
	Pound Sweet	----	3	638	454	71.2	----	----	68	10.7	121	19.0	----
	Russet	----	3	381	94	24.7	---	----	44	11.5	260	68.2	----
	Totals	----	33	13497	7883	58.4	2482	18.4	652	4.8	2639	19.6	----
	Totals 1 to 7	----	79	34138	22170	64.9	7406	21.7	1191	3.5	----	----	----
	Totals 8 to 9	----	37	15309	9165	59.9	2689	17.6	773	5.0	----	----	----
	Totals 1 to 8	----	83	35950	----	---	----	----	----	----	4049	11.3	----

TABLE II.—RELATIVE RANKS OF TREATMENTS AS TO MOST PERFECT FRUIT (P.), AND LEAST RUSSETING (R.), FUNGI (F.), INSECTS (I.)

Treatment.	Ives.				Jones.				Rogers.				Savage.				Smith.				Stoddard.				Average of all six Orchards.			
	P.	R.	F.	I.	P.	R.	F.	I.	P.	R.	F.	I.	P.	R.	F.	I.	P.	R.	F.	I.	P.	R.	F.	I.	P.	R.	F.	I.
Bordeaux	4	4	1	1	3	4	3	2	7	7	1	1	5	5	5	3	5	5	1	5	5	6	1	2	6	6	1	1
Grasselli L. & S.	----	----	----	----	----	----	----	----	2	2	7	3	4	4	1	5	1	1	3	2	4	3	3	4	4	2	5	5
Niagara L. & S.	1	1	3	2	----	----	----	----	1	1	6	2	3	3	2	2	3	1	2	3	1	2	4	3	1	1	4	2
Sherwin-Williams L. & S.	----	----	----	----	----	----	----	----	3	3	3	4	2	2	4	4	2	1	4	1	3	4	2	1	2	2	3	3
Blanchard L. & S.	----	----	----	----	1	1	1	3	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Self-Boiled L. & S.	2	3	2	3	2	2	2	1	4	5	2	6	----	----	----	----	----	----	----	----	----	----	----	----	3	5	1	4
Arsenate of Lead & Sulphur	----	----	----	----	----	----	----	----	5	6	4	5	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Arsenate of Lead	----	----	----	----	----	----	----	----	----	----	----	----	1	1	3	1	----	----	----	----	2	1	6	5	----	----	----	----
Check	3	2	4	4	4	3	4	4	6	4	5	7	----	----	----	----	4	1	5	4	6	5	5	6	5	4	6	6

The treatment, however, reduced the total insect injury more than one-half in all cases, and in the Stoddard orchard more than three-fourths, as an inspection of the figures will show.

The following table shows the average percentages of all kinds of insect injury to the fruit from all trees of the different orchards:

	Sprayed.	Unsprayed.
Ives	7.7%	14.4%
Jones	40.0%	83.1%
Rogers	6.7%	19.1%
Savage	15.4%	no check
Smith	8.5%	18.9%
Stoddard	8.9%	40.2%
Average for all orchards	14.53%	35.12%

The different sprays containing the same amount of poison show no marked difference in results in the averages of the six orchards. From this we may be reasonably certain that the arsenate of lead is fairly effective in destroying biting insects when combined with any of the lime-sulphur mixtures tried, or with Bordeaux.

SPRAYING EXPERIMENTS WITH PEACHES.

Details of Experimentation.

Object. In 1900, Sturgis, while botanist of the Station, conducted extensive spraying experiments with peaches for the prevention of scab and rot. These experiments showed that it

was dangerous to spray peaches when in foliage with most of the fungicides then in use, and especially with Bordeaux. Of the various fungicides tried by Sturgis, potassium sulphide, rate of 1 lb. to 50 gallons of water, seemed to possess considerable fungicidal value without especially injuring the foliage. In 1906, the writer, taking up this matter where Sturgis left it, started a small experiment, using Bordeaux, 4-4-50, as a winter treatment on the trees just before the buds began to swell, and the half strength, 2-4-50, after the blossoms fell, and expected to make further sprayings with potassium sulphide, but the half-strength Bordeaux produced such serious shot-hole injury to the foliage, with subsequent leaf fall, that further sprayings were abandoned as useless.

Encouraged by the success attending Scott's experiments in Georgia with the self-boiled lime and sulphur, as shown by his bulletin* and a lecture before the Connecticut Pomological Society† in February, 1910, we took up this line of work again last season. Since Bordeaux had caused serious injury even at half strength, this fungicide was not included in the tests. The need for some remedy for the brown rot and scab is shown by the serious injury caused by these fungi in seasons at all moist, especially by the rot if wet weather prevails at harvest time. In fact, some of the early varieties, as Triumph, are not much grown now because of sure loss through rot. Besides the ques-

* U. S. Dept. Agr., Bur. Pl. Ind., Bull. 174, 1910.
† Ann. Rept. Conn. Pom. Soc., XII, 160, 1910.

tion of an efficient fungicide to prevent scab and rot, there is also the question whether or not effective results can be obtained with only two or three sprayings, since the expense and labor involved in more would greatly hinder the general introduction of any treatment in the peach orchards of the State.

Orchards Under Experiment. For the purpose of a preliminary test, three orchards, where experiments with spraying apples were conducted, were selected for experiment with peaches. These orchards were those of Mr. Jones, Mr. Ives and Mr. Rogers. At each place varieties especially subject to rot were chosen, viz., Triumph at Ives's, Champion at Jones's, and Waddell at Rogers's. By far the most extended experiments were conducted at the Jones orchard, as this was the handiest for the work. While the season, as a whole, except one week early in September, was not such as to develop rot especially, sufficient data were obtained to show that both the scab and rot can be greatly lessened by spraying, and without injury such as is caused by Bordeaux. The data from these orchards were taken at harvest time, when all the fruit on the trees was counted (about 25,000 peaches) and the percentages of sound and injured peaches obtained. Altogether about 125 trees were sprayed from one to four times and about half that number left unsprayed for checks.

Treatments. At the Ives and Rogers orchards only the self-boiled lime-sulphur (8-8-50), made up in the manner previously described under apples, was used. At the Jones orchard, however, there was used besides this, "Sulfocide" 1-400, Niagara lime-sulphur, 1-75 and 1-100, and potassium sulphide, 1-50. The Rogers orchard had been sprayed in late winter with home-made lime-sulphur, and a miscible oil had been used on the Ives orchard. The Jones orchard, however, had never been sprayed before, either in winter or in summer. On part of the trees here, therefore, Blanchard's lime-sulphur, 1 to 9, was used just as the buds began to swell, both for the San José scale and for peach leaf curl.

In all these orchards three summer treatments were given, as follows: (1), May 12-19, soon after the blossoms fell; (2), June 3-9, on the young fruit; (3), July 6-12, on the large fruit.

At the Jones orchard, however, certain of these treatments were omitted and various combinations made on certain sets of trees, to determine if possible what sprayings proved the most beneficial for certain troubles. Usually, in the first and second treatments at each place, arsenate of lead, rate of 3-50, was added to the fungicide used.

The most common and serious fungous and insect troubles of peaches in Connecticut are briefly described in the following paragraphs. Peach yellows, a physiological trouble, causes perhaps more serious, and certainly more permanent injury than any of these, and while we do not know definitely its cause, we do know that spraying does no good, so it is not included in these descriptions.

Fungous Diseases.

Brown Rot, Monilia fructigena. This is the fungus that causes the common rot of peaches, both in the orchard and the market. It is also the cause of rot of plums and cherries, and less frequently of pears, apples and quinces. The summer spore stage is frequently to be seen as small, thickly placed, dusty tufts covering the rotten surface. Usually only the ripening fruit is attacked, but occasionally, through insect injury, the green fruit, especially of cherries, becomes rotten. The summer stage of the fungus lives over winter on the branches of peach trees and, if the weather is right at blossoming time, not only the flowers, but the leaves and small twigs are infected and killed. The mature leaves suffer no injury except occasionally, when in contact with the rotten fruit. The summer stage also carries over on the mummies that remain attached to the tree. Those mummies that fall to the ground and become half buried in the soil, however, frequently develop in early spring the mature stage of the fungus, which is entirely different in appearance from the summer stage. This stage looks much like a minute toadstool, having a slender stem and expanding above into a funnel-shaped fruiting body. The spores from these are carried up to the blossoms. The destruction of these mummies after harvesting, including those both on the tree and on the ground, helps to lessen but does not prevent this disease. Also, thinning the fruit where it sets too abundantly, thus keeping the peaches from contact with each other, and spraying to lessen insect injury, are helpful preventive methods; but the most benefit comes from spraying with fungicides, as described above. Plate XXII, b.

Leaf Curl, Exoascus deformans. This is a fungous trouble that seriously injures only the leaves. It develops on them early in the spring, gaining entrance while they are quite young, and when abundant, causes serious defoliation. Later on the trees may repair this injury by a new set of leaves, but the fruit will suffer indirectly, either through spring drop or smaller size. The fungus, gaining entrance to the leaves, ramifies through their tissues, and by attacking them in their young state, causes more or less curling and distortion. The leaf, also, has at first a reddish or yellowish tint, while the infected tissues show a whitish bloom when the fungus begins to produce its spores. The fungus seems to cause little or no further damage to the foliage from these spores, though they probably serve to infest or rarely to infect the young twigs or buds for another season's appearance. It has been known for some time that this trouble can be largely, or entirely, prevented if the trees are sprayed when the buds begin to swell in the spring. Sometimes a second spraying is given on the young unfolding leaves, but if the first one is just right, this second treatment does not seem to be necessary. At first Bordeaux was used as the fungicide, and as long as only the dormant trees are sprayed, no harm results. More recently the lime and sulphur sprays have been found as effective as the Bordeaux. Plate XXII, c.

Scab, Cladosporium carpophilum. The scab fungus, while it occurs on both the leaves and twigs, as well as on the fruit, causes very little injury to the former. By infecting the twigs it is carried over the winter and is ready to infect the fruit early the next season. These infected twigs, usually of the year's growth, show spots about a quarter of an inch in diameter having a purplish border. Soon after the trees blossom, these spots produce the summer spores, which are washed down on the young peaches, infecting them and spreading the fungus more or less over their surface. Usually the upper surface or end of the fruit shows these scabby spots most abundantly, thus revealing the source of infection from twigs above. The mature stage of the fungus is not known. The fruit, though

chiefly infected early in the season, does not show the fungus prominently until it has attained considerable size, from the middle of July on, when small superficial black spots cover the surface more or less abundantly. If very abundant, the fungus may cause some slight distortion of the fruit, and more frequently causes it to crack open, thus giving entrance later to the rot fungus. The chief injury, as with the sooty blotch of apples, is due to the marred appearance of the infected peaches. Two or three sprayings, the first soon after blossoming and the others at intervals of a month, practically control this trouble. Plate XXII, a.

Insect Injuries.

Curculio, Conotrachelus nenuphar Herbst. The plum curculio attacks and injures both apples and peaches, as well as plums and cherries. The adult, a small snout beetle, punctures the young growing fruit for food and for the purpose of laying eggs in it. A characteristic crescent-shaped mark is cut around the egg, which has been deposited just beneath the skin. Most of the eggs do not hatch in the apple, but make it gnarled and ill-shaped, while with other fruits the grub feeds inside, causing the fruit to fall to the ground and decay. The insect then pupates in the soil. There is but one brood each year, and spraying the foliage with arsenical poisons reduces the injury to a minimum. Jarring is often practiced on peach, plum and cherry trees. Plate XXIV, g, h.

Peach Sawfly, Pamphilius persicum MacG. During June the adult four-winged fly comes from the ground, and on the under sides of the peach leaves lays white eggs, which hatch in from six to eight days. The pale-green caterpillar rolls the edge of the leaf over itself, making a case in which it lives and feeds upon the leaf, becoming full grown in from eight to ten days. It then goes into the ground, where it passes the following winter, then transforms to the pupa stage, and later to the adult. The caterpillars usually work first on the leaves in the center or more shaded portion of the tree, but when abundant, they soon defoliate it. The remedy is to spray the leaves late in June and early in July with lead arsenate, using about 2 lbs. to 50 gallons of water. Between 4,000 and 5,000 trees in one orchard were sprayed in 1907. The work of this insect is shown on Plate XXIII, a.

San José Scale, Aspidiotus perniciosus Comst. This is a small circular scale found on the bark, leaves and fruit, and well distributed about the State. Each individual sucks the sap for its food, and is covered by a shell of wax which it secretes. There are three or four generations each year, and the species multiplies very rapidly. The remedy is to spray the dormant trees with the lime-sulphur mixture or with one of the miscible oil preparations. For further information the reader should consult Bulletin 165 of this Station. See Plate XXIII, c.

Other Insects. The peach borer, canker worm, and fall web worm are sometimes destructive pests of peach trees, but they were not particularly noticeable in these experiments, and are therefore not described here.

General Results of Spraying Peaches.

Injury. The use of the self-boiled lime-sulphur caused no injury by burning the leaves. There is some objection, however, to this fungicide if sprayed so late that the sediment is prominent on the fruit at market time, thereby injuring its sale. There has been some complaint of this trouble from other states, and at the Rogers orchard on the Waddell, which matures very early, there was sediment enough showing on the under sides of the peaches to slightly affect their marketing. Ordinarily, however, the season would not be as dry as the past one, and most of the sediment would be washed off. On the other hand, if no spray adheres to the fruit at the time of its ripening and wet weather occurs then, the rot is likely to do considerable injury. Everything considered, it does not seem wise to spray with the self-boiled lime-sulphur later than the middle of July, and ordinarily with the two previous treatments this should still be effective, with rains at harvest time. If a later spraying should be required, however, for an unusually rainy July or August, it should be made with a commercial lime-sulphur mixture or with potassium sulphide.

"Sulfocide," rate of 1 to 400, did no injury at the Jones orchard, though the same strength on young trees elsewhere caused more or less shot-hole and leaf fall. Used weaker than the above, it would hardly seem to have much value as a fungicide. The use of either Paris green or arsenate of lead with "Sulfocide" on peaches is certainly very dangerous, as shown by almost complete defoliation of trees in the Jones and Station orchards with subsequent fruit drop. The young twigs were also more or less severely injured. Some few were killed outright, while others showed purplish spots, similar to those caused by the scab fungus. Potassium sulphide, rate of 1 to 50, produced no serious injury on the peach trees, but when either Paris green or arsenate of lead was added, the damage was even more severe than that caused by "Sulfocide." It is quite evident that neither of these fungicides can be used with the above insecticides, without danger of not only defoliating the trees, but even killing them with the soluble arsenate that is formed. With the commercial lime-sulphur (Niagara being the only brand tried, however,) there is not this danger of injury where an arsenical insecticide is used. As, at a strength of 1 to 75, some little injury to the foliage was observed with the Niagara lime-sulphur, it does not seem wise to use these preparations stronger than 1 to 100.

Benefits. General. Before proceeding to a discussion of the effect of the spraying in preventing the individual fungous diseases, we will consider, as far as possible, the respective merits of the different fungicides in controlling these troubles as a whole, as shown in the Jones orchard. In the first place, the serious injury resulting from both the potassium sulphide and the "Sulfocide" on the second summer treatment, caused by the use of arsenate of lead in them, makes it impossible to determine their real fungicidal value, since most of the trees were included in this treatment, and none produced any fruit of consequence, due to the serious drop that followed. In Table III the per cents. of the few peaches from both the "Sulfocide" and potassium sulphide treatments show that neither gave results equal to the checks as regards scab, and that the potassium sulphide alone showed any improvement as regards rot. Potassium sulphide, without the use of a poison which makes it dangerous, would, we believe, show benefit in reducing both scab and rot, if used in three summer treatments similar to those given with the self-boiled lime-sulphur. "Sulfocide," owing to the weak strength that must be used and the danger in combining it with insecticides, does not merit use at all in peach orchards.

With both the self-boiled lime-sulphur and the Niagara lime-sulphur there was a decided improvement in the sprayed fruit over the checks, and the data for these were sufficient to prove that this was due to the treatments. Table III shows that the trees sprayed with the self-boiled lime-sulphur gave an average of 68.5 per cent., and those sprayed with Niagara lime-sulphur 63.1 per cent. perfect fruit, as against the 28.2 per cent. on the check trees with a winter treatment and 20.8 per cent. on checks with no treatment at all.

Benefits. Leaf Curl. The winter treatment with Blanchard's lime-sulphur, rate of 1 to 9, in the Jones orchard, where the only spraying was made for leaf curl, showed that if a commercial lime-sulphur is sprayed on the buds at just the right time it is very effective in controlling this trouble. In fact, Bordeaux could have given no better results. The spring of 1910 was very favorable for the development of leaf curl in orchards all over the State, there being more than we have seen before. On the forty trees sprayed on April 1st with the Blanchard lime-sulphur, a careful examination was made for leaf curl on May 17th (after which it failed to spread further), and only sixty-two infected leaves were found, or an average of one and one-half to a tree! Eleven unsprayed trees gave at the same time by actual count 1,459 leaves having the curl, or an average of 132 per tree. As the trees, as shown by counts on one, had in round numbers about 4,300 leaves, this would give about 3 per cent. average infection for the check trees. Individual trees, however, went very much higher than this.

Benefits. Rot. Contrary to their usual custom, the Waddell peaches in the Rogers orchard did not rot badly this season, even where not sprayed, as the seven checks showed an average of only 2.6 per cent. rotten. This was reduced by the three sprayings with the self-boiled lime-sulphur on ten trees to an average of 1 per cent. At the Ives orchard, where only four trees were sprayed, each three times, with self-boiled lime-sulphur, the two sprayed Triumphs showed only 21.3 per cent. and 24.5 per cent. rot against 66.5 per cent. rot on the unsprayed Triumph. Two sprayed Carmen had only 8 per cent. and 5.2 per cent., but there was no check tree for comparison. At the Jones orchard (see Table III) the average total rot of the self-boiled treatments was only 22.3 per cent. and that of the Niagara lime-sulphur treatment 24 per cent., as against 65.6 per cent., the average on the check trees. The data from the Jones orchard show that the winter treatment gives so little benefit in lessening rot that it may be omitted. As regards number and importance of the summer sprayings, the data from the self-boiled and the Niagara lime-sulphur treatments does not always entirely coincide, as in some cases a single summer treatment gave a little better result than this with an additional treatment. However, in the main those trees having the three summer treatments had the least rot, and in a wet season this would certainly be so. The total average per cents. of rot on the self-boiled lime-sulphur trees with different applications are shown as follows: Second, third and fourth treatments, only 14.2 per cent.; third and fourth, 25.2 per cent.; first and second, 39.5 per cent.; third, 16.4 per cent.; fourth, 23.4 per cent.; first (winter), 50.3 per cent.; checks (average of all unsprayed trees), 65.6 per cent. This shows that the trees sprayed three times in summer had over 50 per cent. less rot than those not sprayed.

Not only did the spraying prevent rot on the trees, but the sprayed fruit kept better, as illustrated by the following experiment. At the time of packing, August 29th, two baskets, each containing eighty perfectly sound Champion peaches, one from an unsprayed tree and one from a tree which had been given the three summer treatments with self-boiled lime-sulphur, were saved and examined daily. The peaches were removed and counted as soon as the first signs of rot appeared, with the following results:

Date.		Sprayed Number removed.	Unsprayed. Number removed.
August	30	0	7
"	31	7	27
September	1	7	28
"	2	34	13
"	3	12	3
"	4	11	1
"	5	2	0
"	6	3	1
"	7	3	0

This shows at the end of the third day after picking 78 per cent. of the unsprayed and only 18 per cent. of the sprayed peaches had rotted, and that at the end of the fourth day the percentages were 94 per cent. and 60 per cent. On the whole, the sprayed peaches kept two days longer than the unsprayed, quite an important factor in marketing. One sprayed peach, in fact, never rotted, but merely dried up.

Benefit. Scab. The peaches at the Ives orchard were so free from scab that no counts were made. Also, at the Rogers orchard, scab was on the whole inconspicuous. However, on one check tree having considerably more than usual, counts showed 20.4 per cent. scabby as compared with only 0.4 per cent. on one of the sprayed trees showing an average amount. In the Jones orchard the average for all treatments was 5.2 per cent. for the self-boiled and 3.8 per cent. for the Niagara lime-sulphur, as against 13.1 per cent. on all the check trees. These differences really should be greater, since the scab on the entirely rotten peaches is so hidden that it could not be counted, and therefore a greater per cent. was missed this way on the checks than on the sprayed fruit.

As regards time and number of sprayings, the winter treatment showed no special value in lessening scab, since the average scab on all these trees, 12.9 per cent., was practically the same as for all of the checks, 13.1 per cent. The third treatment, made upon the young fruit about June 7th, was the most effective single treatment in controlling scab, but to be surely effective it should at least have the preceding or the following treatment. The best results on the whole may be expected when the three summer treatments are given. The average per cent. of scab on the fruit sprayed with self-boiled lime-sulphur is as follows for the different sprayings: First (winter treatment), 13.8 per cent.; first and second, 9.3 per cent.; second, third and fourth, 0.4 per cent.; third and fourth, 0.4 per cent.; third, 4.6 per cent.; fourth, 17.4 per cent.; checks, 18.1 per cent.

Benefit. Insects. So far as is shown by the figures, there seems to be no benefit to the fruit from the use of any arsenical poison in the spray applied in summer. In fact, the percentages of insect injury are somewhat greater on the sprayed than on the check trees. This may be accounted for, perhaps, on the ground that on the checks, most of the fruit attacked by curculio and other insects rotted and was so counted; or dropped, and was therefore not recorded. The sprayed trees, on the other hand,

through the application of the lime and sulphur, which in large measure prevented rotting and thus preserved the fruit, were able to retain much of the crop even after the insects had made their attacks upon it. Had there been present any insects feeding upon the foliage, of course the arsenical poison would have proved a benefit.

TABLE III.—TOTALS OF DIFFERENT TREATMENTS WITH PEACHES IN JONES'S ORCHARD.

Treatments.	No. of Trees.	Total Peaches.	Perfect.		Rot.		Rot and Scab.		Scab.		Curculio.		Other Insects.	
			No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No	Per cent.	No.	Per cent.
Self-Boiled L. & S.	14	2084	1427	68.5	456	21.9	9	0.4	100	4.8	72	3.5	20	1.0
Niagara L. & S.	15	2635	1663	63.1	622	23.6	10	0.4	91	3.4	172	6.5	77	2.9
Potassium Sulphide	2	314	110	35.0	109	34.7	12	3.8	70	22.3	13	4.1	0	0
"Sulfocide"	4	292	55	18.9	158	54.1	26	8.9	40	13.7	13	4.4	0	0
Checks, with winter treatment	13	2203	622	28.2	1190	54.0	63	2.9	221	10.0	87	3.9	20	0.9
Checks, with no treatment	25	2548	529	20.8	1595	62.6	77	3.0	258	10.1	68	2.7	21	0.8

RECOMMENDATIONS.

The treatment of an orchard depends largely on what fungi and insects are ordinarily injurious there. These in turn depend in large part on previous treatment, varieties grown, and character of the season. It thus happens that one orchard may require more sprayings than another to obtain similar results. Ordinarily four or five sprayings, one of which is a winter treatment, will control all the fungous and insect pests (with the possible exception of rust) which are likely to produce injury in any orchard in this State. Certain of these treatments, however, as stated above, may be omitted with equally good results, if the pests for which they are used are likely to be absent or inconspicuous. The following paragraphs give the time and treatments for the particular troubles.

Treatment for Apples.

First, or Winter Treatment. If San José scale is very bad, give a late fall treatment, preferably in November, with a good miscible oil, rate of 1 to 15, and in early spring, before the buds begin to swell, spray with any of the straight commercial lime-sulphur preparations, rate of 1 to 8 (or home-made, 20-14-40). Where scale is not serious, the single spraying with lime-sulphur in the spring will do, and at the same time will serve in a small way to help protect against such fungi as live over on the twigs.

Second, or First Summer, Treatment. Where scab or rust are bad, spray the unfolding leaves with a fungicide before the blossoms open. If bud moth or canker worms are injurious, arsenate of lead may also be added as an insecticide.

Third, or Second Summer, Treatment. Soon after the petals fall, usually May 10th to 20th, use a spray containing both fungicide and insecticide, to prevent scab, rust, canker worms and codling moth.

Fourth, or Third Summer, Treatment. Same as third, but about two or three weeks later, June 8th to 10th, and for same purpose, including sooty blotch.

Fifth, or Fourth Summer, Treatment. If sooty blotch and fruit speck troubles are bad, this additional treatment (July 1st to 10th), may be made with a fungicide only.

In ordinary orchards, where no particular trouble is conspicuous and where only two treatments can be given, the third and fourth treatments, which combine an insecticide and a fungicide, are the most valuable and the ones commonly made. As regards fungicides, if Bordeaux is to be used, we recommend that the full strength formula, 4-4-50, be used only at the second (or first summer) treatment, and that the subsequent one or two sprayings be made with the 1-4-50 formula. We believe, however, that the straight commercial lime-sulphur sprays (those tested by us were Blanchard, Grasselli, Niagara, and Sherwin-Williams) may well be used in place of the Bordeaux at a strength of 1¼ to 1½ to 50. Arsenate of lead, rate of 3 to 50, may be combined with either of the above as the insecticide, and in orchards where fungous troubles are inconspicuous it may be used alone.

Treatment of Peaches.

First, or Winter Treatment. Same as on apple for scale, but when leaf curl also is to be prevented, the spraying with the commercial lime-sulphur should be made just as the buds begin to swell, preferably the last week in March.

Second, or First Summer, Treatment. Spray with fungicide and insecticide for scab, rot and curculio, within a few days after the petals have all fallen, usually about May 5th to 15th.

Third, or Second Summer, Treatment. Same as second, and for same purpose, but made about one month later, June 1st to 15th, on the young fruit for above and the sawfly.

Fourth, or Third Summer, Treatment. With fungicide only, for rot chiefly, one month after third, July 5th to 15th, on the large fruit.

On the whole, we are inclined at present to recommend for *general use* only the self-boiled lime-sulphur for a summer fungicide for peaches, though our experiments indicate that the straight commercial lime-sulphur sprays (we used Niagara only) at a strength of 1 to 100 may be as valuable. With the self-boiled lime-sulphur, however, the last spraying should never be made later than the middle of July, and in a dry season some risk is run from a thorough treatment then, on account of the sediment that may adhere to the fruit at market time. Possibly this last spraying might be given with a straight lime-sulphur mixture, 1 to 100, or with potassium sulphide, 1 to 50. We do not advocate the use of "Sulfocide" on peaches, and under no conditions should this or potassium sulphide be used in combination with an insecticide, as serious spray injury is almost sure to result. Arsenate of lead, rate of 3 to 50, may be used in the second and third treatments in the case of the self-boiled lime-sulphur and the straight commercial lime-sulphur sprays. If only two treatments can be given the orchard, the third and fourth are the most important, or if three can be given, the second, third and fourth, but these will not stop leaf curl or San José scale.

CO-OPERATIVE EXPERIMENTS IN 1911.

In order to test further the commercial lime and sulphur sprays, the self-boiled lime and sulphur, and perhaps one or two others in 1911 on a greater variety of fruit trees, including cherry, plum, pear and quince, as well as on the apple and peach, the Station wishes to arrange co-operative experiments with those growing one or more of these fruits for the market, especially if their trees have been subject to serious attack by fungi or insects.

In most cases it is desired merely to make a preliminary visit to the orchard before the summer spraying season commences and to arrange details as to manner and times of spraying certain trees by the owner, leaving a few trees as checks. Then at harvest time the Station wishes to obtain data as to the results from certain of these trees. In a few cases, however, where the conditions indicate unusual opportunity for experimentation as regards particular troubles, the Station will take charge of the spraying, etc.

Any fruit grower who wishes to coöperate along these lines should communicate with the Director of the Experiment Station as soon as possible, so that details may be arranged.

a. Winter treatment in the Jones apple orchard.

b. Spraying in the Station apple orchard.

METHODS OF SPRAYING.

a. Apparatus used in the Ives apple orchard.

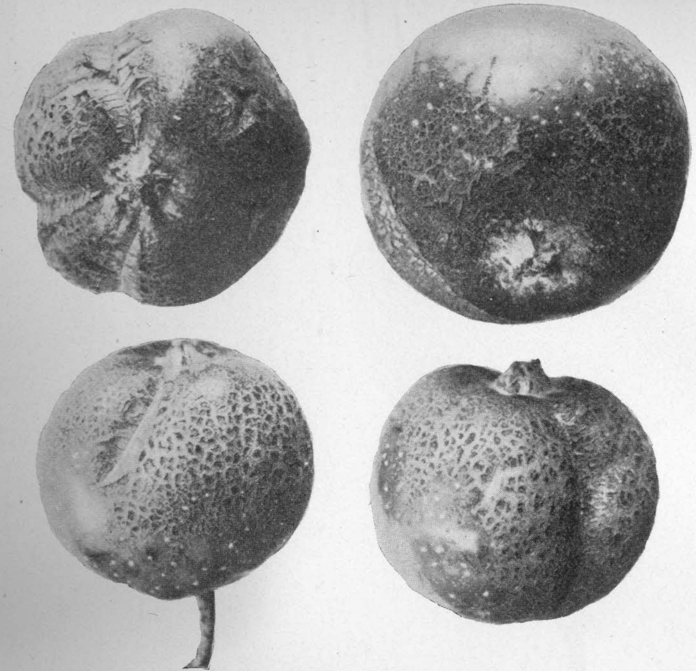
b. Spraying peaches in the Rogers orchard.

METHODS OF SPRAYING.

a. Tree sprayed May 16 and June 8 with self-boiled lime and sulphur.

b. Check tree which received no treatment.

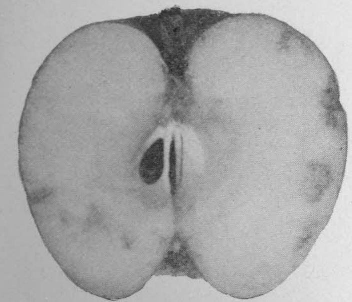
APPLE TREES PHOTOGRAPHED OCT. 4 IN JONES ORCHARD.



a. Fruit Russet caused by Bordeaux.

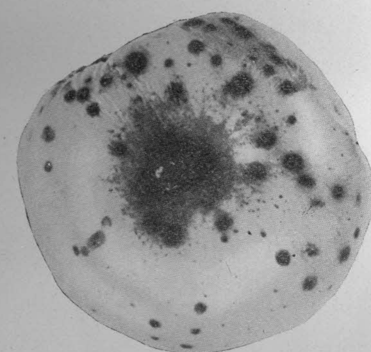
b. Leaf burn caused by "Sulfocide."

INJURIES PRODUCED BY SPRAYING.



a. Baldwin Spot, p. 589.

b. Black Rot, p. 590.



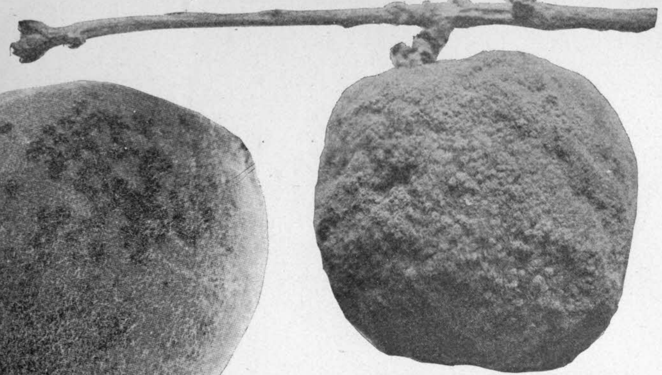
c. Fruit Spot, p. 590.

d. Rust, p. 591.

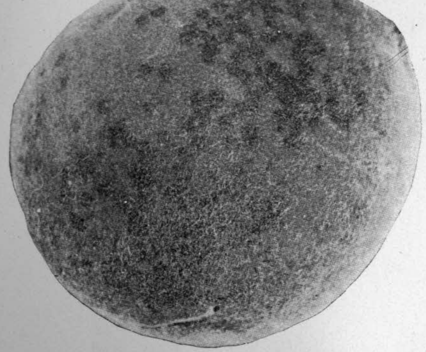
e. Scab, p. 591.

f. Sooty Blotch, p. 592.

FUNGOUS DISEASES OF APPLE.



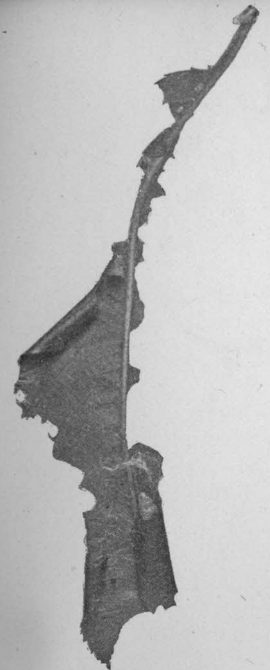
b. Brown Rot, p. 607.



a. Scab, p. 608.

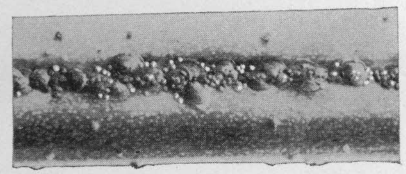
c. Leaf Curl, p, 608.

FUNGOUS DISEASES OF PEACH.

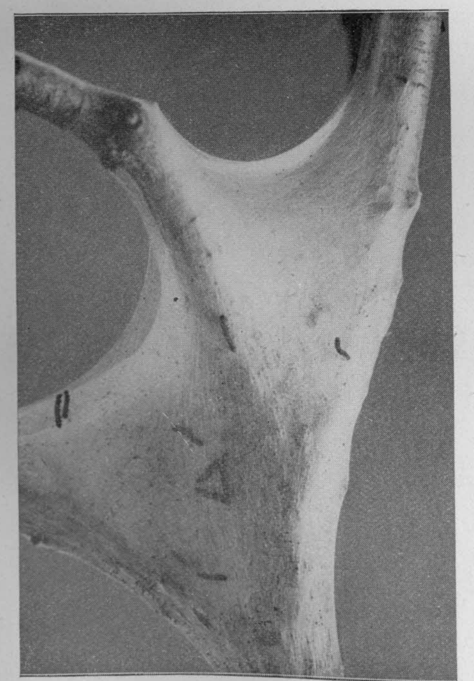


a. Work of Peach sawfly.

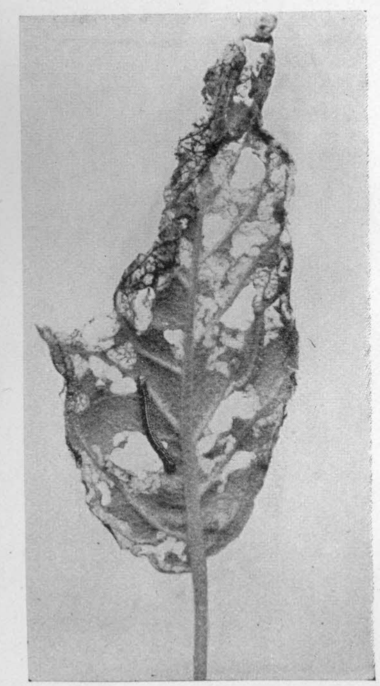
b. Apple injured by lesser apple worm.



c. San José Scale, much enlarged.

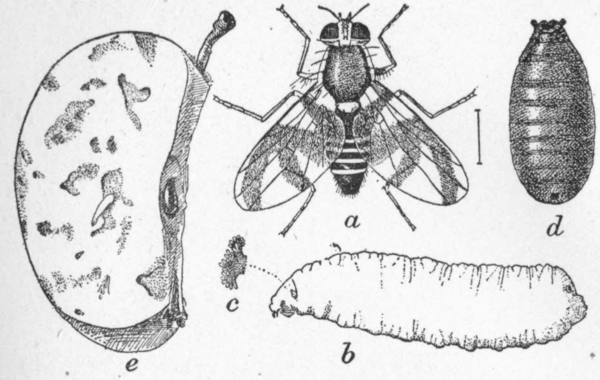


d. Small nest of tent-caterpillar.

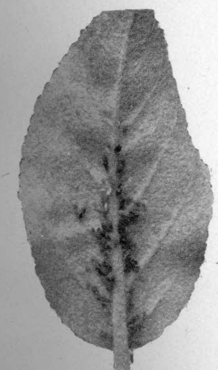


e. Apple leaf partly devoured by canker worms.

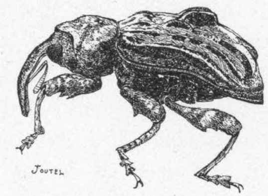
APPLE AND PEACH INSECTS AND THEIR WORK.



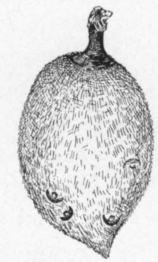
a. Apple maggot or railroad worm, adult; b. Larva; c. Spiracle of larva; d. Puparium; e. Apple showing injury; All enlarged. [After Quaintance, Bur. Ent., Circ. 101.]



f. Green apple aphis.



g. Plum curculio much enlarged.



h. Newly set peach showing crescent marks of plum curculio.

i. Work of codling moth in apple.

j. Work of bud worm.

APPLE AND PEACH INSECTS AND THEIR WORK.

PART VIII.

COMMERCIAL FEEDING STUFFS.

By E. H. Jenkins and J. P. Street.*

THE LAW REGULATING THEIR SALE.

Section 4591 of the general statutes of Connecticut so defines the term "concentrated commercial feeding stuff" that it covers practically all feeds *excepting the following:*—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.

Section 4593 requires every manufacturer, importer, agent, or seller to file with this station, upon request, a certified copy of the statement above described.

The penalty prescribed for violation of the foregoing sections is not more than $100 for the first offense and not more than $200 for each subsequent offense.

Section 4595 authorizes this station to take samples from any manufacturer, importer, agent, or dealer, in a prescribed fashion, and requires this station to analyze, annually, at least one sample of each brand which it has collected and to publish these analyses in station bulletins, "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 provisions of these sections of the statutes.

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* The analytical work here described has been done by Messrs. Street, Roe and Shepard. The report has been prepared mainly by Mr. Street.

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.

During the fall of 1910 the station sampling agent visited fifty towns and villages of this State and collected 208 samples of feeds as prescribed by law. The results of the chemical and microscopical examination of these samples are here given and discussed and the chemical analyses are given in Table III.

There are also given sixty-one analyses of samples sent by individuals.

Oil Seed Products.

Cotton Seed Meal, Sampled by the Station.

Of the eleven samples analyzed all satisfied their guaranties, except **25357** and **25382**, which were 1.17 and 0.87 per cent. low in fat, respectively. There was but little difference in the average protein and average selling prices compared with those of last year.

Cotton Seed Meal, Sampled by Purchasers.

23977. *Dixie Brand,* Humphreys, Godwin & Co., Memphis, guaranteed 38.50 per cent. protein; sent by H. B. Coger, Botsford; contained 38.37 per cent. protein.

25208. *Dixie Brand,* Humphreys, Godwin & Co., Memphis, guaranteed 38.62 per cent. protein; sent by C. G. Lawton, Brooklyn; contained 40.00 per cent. protein.

25634. *Dixie Brand,* same manufacturer and guaranty as last, sent by C. L. Gold, West Cornwall; contained 41.63 per cent. protein.

25635. *Dixie Brand,* guaranteed 41 per cent. protein; sent by The Coles Co., Middletown; contained 38.50 per cent. protein.

25637. Sent by The Coöperative Feed Co., North Haven; no guaranty; contained 41.88 per cent. protein.

25638. *Dixie Brand,* guaranteed 38.62 per cent. protein; sent by The "Prentice" Stores, Turnerville; contained 42.19 per cent. protein.

25643. *Dixie Brand,* guaranteed 38.62 per cent. protein; sent by Bosworth Bros., Putnam; contained 41.94 per cent. protein.

25645. Humphreys, Godwin & Co., Memphis, guaranteed 38.50 per cent. protein; sent by H. B. Coger, Botsford; contained 41.50 per cent. protein.

25893. Sent by The Coles Co., Middletown; contained 44.94 per cent. protein.

Cotton Seed Feed Meal.

The sample analyzed was 3.00 per cent. below its protein and 1.21 per cent. below its fat guaranty. Its selling price is only $2.50 below that of standard cotton seed meal, yet it contains less than half as much protein and fat, and nearly three times as much fiber. The feed is a mixture of hulls and meal. At the South a mixture of cotton seed meals and hulls is much used as feed, but Connecticut farmers cannot afford to pay freight on hulls to use for feed.

Linseed Meal, Sampled by the Station.

The two samples of new process and five of old process meal satisfied their guaranties in every case.

Linseed Meal, Sampled by the Purchaser.

25180. Sent by W. A. Kenyon, Brooklyn; no guaranty; contained 36.25 per cent. protein.

Wheat Products.

24827. *No. 1 Durum Wheat;* sent by Harvey Jewell, Cromwell; contained 14.38 per cent. protein.

Bran from Winter Wheat.

25302, *Cox's L-K Bran* and **25321,** *Grafton Bran,* did not have a guaranty as required by law. The other eight samples were properly and correctly guaranteed.

Bran from Spring Wheat.

All of the thirteen samples were properly and correctly guaranteed.

Of the eight samples of unclassified brans, **25264,** *New Star Bran,* **25268,** *Ogilvie's Bran,* and **25379,** *Robin Hood Bran,* did not have a guaranty as required by law; all were, however, of normal quality.

Middlings from Winter Wheat.

The five samples were properly guaranteed, and all satisfied their guaranties except **25220**, *Hecker's "H" Middlings*, which was low in fat.

Middlings from Spring Wheat.

25390 had no name of manufacturer or guaranty as required by law. The other seventeen samples were properly guaranteed, and met their guaranties except **25249**, *Pillsbury's "B" Middlings*, which was 2 per cent. low in protein, and **25229**, *Pillsbury's XX Daisy Middlings*, and **25253**, *Washburn-Crosby's Adrian Middlings*, which were both low in fat.

Of the unclassified middlings five were properly guaranteed, and one **25225**, *Mapleleaf Middlings*, was not. **25330**, *"Colonial Middlings,"* satisfied its guaranty, but its name is misleading. It is not middlings, as it contains a corn product; its selling price was only slightly lower than that of standard middlings, and it contains over 4 per cent. less protein.

Wheat Feed from Winter Wheat.

25419, *Wabash Mixed Feed*, had no guaranty as required by law. The other fourteen samples were properly guaranteed, and satisfied their guaranties except **25245**, *Hecker's Queen Mixed Feed*, which was low in fat.

Wheat Feed from Spring Wheat.

All of the twelve samples were properly and correctly guaranteed.

All of the five unclassified wheat feeds were properly guaranteed except **25305**, *Buckeye Mixed Feed*. The other samples satisfied their guaranties except **25239**, *Bull's Eye Mixed Feed*, which was slightly low in fat.

Wheat Products, Sampled by Purchasers.

25200, *"Bran,"* sampled from stock bought of Chas. Slossberg by the Norwich Hospital for the Insane. The bags when examined by our agent were not branded or tagged. The sample contained only 12.50 per cent. protein; ground corn cob was

mixed with it and it was not therefore wheat bran. **25179**, *Osota Mixed Feed*, National Milling Co., Toledo, O., sent by S. E. & W. G. Brown, Kensington, contained 16.38 per cent. protein. **25462**, *Thoroughbred Feed*, made in Lexington, Ky., sent by C. E. Beers, Newton, contained 17.06 per cent. protein.

Maize Products.

Maize Meal.

The single sample received contained 8.19 per cent. protein.

Maize (Grain).

25902 and **25903** are samples of Longfellow flint corn grown for seed in 1910 by Geo. A. Hopson, Wallingford. The first named sample was grown on land much more heavily dressed with commercial fertilizers than the other. Three samples were taken from corn grown on the farm of Col. Phelps Montgomery in 1909. **23989** is white flint, **23991** is Long Tom yellow flint and **23990** is Woods White Dent. The analyses are given below.

A comparison of composition is best made on the water-free basis. All of the flints contain considerably more protein and fat than the single dent variety. All were well cured, but as usual even late in January the dent variety contains rather more moisture than the flints.

Of the two flint varieties raised by Col. Montgomery it took 71½ pounds of ears to give 56 pounds of shelled corn and of the dent variety 77 pounds.

A struck bushel of shelled corn of one of the flint varieties weighed 55.1 pounds, of the other 58 pounds and a struck bushel of the dent variety weighed only 47.6 pounds.

Analyses.

	25902	25903	23989	23991	23990
Water	18.63	17.88	19.10	16.02	22.22
Ash	1.35	1.28	1.38	1.36	1.29
Protein	10.53	10.44	9.54	10.30	8.49
Fiber	1.04	1.15	1.06	1.09	1.47
Nitrogen-free extract	64.09	64.64	64.78	66.91	62.98
Fat	4.36	4.61	4.14	4.32	3.55
	100.00	100.00	100.00	100.00	100.00

Calculated water-free.

Ash	1.66	1.56	1.70	1.62	1.66
Protein	12.94	12.71	11.79	12.26	10.91
Fiber	1.28	1.40	1.30	1.30	1.89
Nitrogen-free extract	78.76	78.72	80.09	79.68	80.98
Fat	5.36	5.61	5.12	5.14	4.56
	100.00	100.00	100.00	100.00	100.00

An acre of yellow Leaming corn at Springside farm, New Haven, was measured by a station representative and harvested and weighed under his supervision on September 23, 1910. It was not fully mature and should have stood at least ten days longer but was harvested too early from necessity. The husked ears weighed 8647 pounds, which if figured as has been the rule in "corn contests" would have counted for 123.5 bushels of shelled corn, reckoning 70 pounds to the bushel. Thirty pounds of ears were carefully dried at the station and the water determined. From this is calculated the weight of shelled corn with fourteen per cent. of water, which was just sixty-three bushels, little more than one-half of the yield which would be figured in a "prize contest," based, as has been the general custom, wholly on the weight of the harvested ears. This is an exaggerated case which serves admirably to illustrate the unfairness of any comparison of yields which is not based *on the yield of dry matter.* The other method is based on the assumption that all corn crops have the same amount of water at husking time, and every one knows that this is very far from true.

A flint corn from S. H. Kingsbury, Scitico, which yielded 7704 pounds of ears, contained 5052 pounds of shelled corn with 14 per cent. of water.

A flint corn from J. E. Watson, Marbledale, which yielded 5106 pounds of ears per acre, contained 3803 pounds of shelled corn with the above named per cent. of water.

Another flint corn from L. S. White, Collinsville, which yielded 8400 pounds of ears, contained 5828 pounds of shelled corn, 14 per cent. moisture.

Still another of a hybrid variety, grown by W. S. Pinney, Suffield, yielded 8119 pounds of ears, or 5052 pounds of shelled corn.

Calculating the above figures first by the unfair method of 70 pounds of ears at husking time to the bushel of shelled corn and then by the fairer method of 56 pounds of shelled corn with 14 per cent. of moisture to the bushel, we get the following yields per acre:

YIELDS OF SHELLED CORN PER ACRE IN BUSHELS.

	70 lbs. Ears to bushel.	56 lbs. Shelled Corn to bushel.
Springside	123.5	63
Scitico	110.0	90
Marbledale	72.9	68
Collinsville	120.0	104
Suffield	116.0	90

Gluten Feed, Sampled by the Station.

Six brands were found on sale in the State, and these are represented by fifteen analyses.

Atlantic Gluten Feed failed to meet its fat guaranty, but exceeded the protein guaranty by four per cent. It is made from wheat gluten and contains nearly five per cent. more protein than any of the corn gluten feeds analyzed this year, while its price is also about $3.00 higher than the average for gluten feed.

Buffalo Gluten Feed. The three samples satisfied their guaranties for protein, but one was low in fat. All were branded as artificially colored.

Cedar Rapids Gluten Feed. Neither of the two samples satisfied the protein guaranty, the deficiency averaging nearly two per cent. The fat content, however, was greatly in excess of the guaranty, indicating the possible addition of corn germ to the feed.

Cream of Corn Gluten Feed. The three samples met their guaranties. All were branded as artificially colored.

Crescent Gluten Feed. Both samples satisfied the protein guaranty, but one was low in fat. Both were branded as artificially colored.

Globe Gluten Feed. The three samples all met their protein guaranty, but two were slightly low in fat. All were branded as artificially colored.

The unnamed brand taken from the stock of Meech and Stoddard, showed a protein deficiency of 3.37 per cent.

Gluten Feeds, Sampled by Purchasers.

23978, *Atlantic Gluten Feed,* sent by Meech and Stoddard, Middletown, contained 37.81 per cent. protein. **24216**, unknown brand, sent by Wilson H. Lee, Orange, contained 28.63 per cent. protein. **24265**, unknown brand, sent by D. E. Carroll and Co., Waterbury, through R. J. Hardy and Sons, Boston, contained 25.50 per cent. protein. **24597**, unknown brand, sent by W. W. Perry, New Canaan, contained 24.63 per cent. protein. **24858**, unknown brand, sent by N. A. Bennett, Hanover, contained 23.44 per cent. protein. **25043**, unknown brand, sent by W. C. Robinson, Columbia, contained 26.69 per cent. protein.

Hominy Feed, Sampled by the Station.

Thirteen samples were analyzed. **25266**, *Yellow Hominy Feed*, had no guaranty as required by law. The other samples were properly and correctly guaranteed except **25256**, *Buffalo Cereal Co.'s Hominy Feed*, which was 1.12 per cent. below its protein guaranty.

Hominy Feed, Sampled by Purchasers.

24275, *Miner-Hilliard Milling Co.'s Steam Cooked Hominy Feed*, guaranteed 10 per cent. protein; sent by R. H. Ensign, Simsbury; contained 10 per cent. protein. **25201**, *American Hominy Co.'s Homco Feed*, guaranteed 8.5 per cent. protein; sent by Henry N. Pollock, Norwich; contained 11.81 per cent. protein.

Star Feed.

This material is a mixture of hominy feed, corn and cob meal and a small amount of salt. The two samples satisfied their guaranties. It contains only about four-fifths as much protein as hominy feed, and nearly three times as much fiber, while its selling price is only slightly less.

Rye Products.

Two of the four samples of rye middlings were properly and correctly guaranteed. **25292** was not guaranteed as required by law, and **25219** was low in fat.

Buckwheat Products.

The single sample of buckwheat middlings failed to reach its rather high protein guaranty of 32 per cent. by nearly 2.5 per cent.

Barley Products.

Malt Sprouts.

The two samples satisfied their protein guaranties, but **25238** was low in fat.

A sample of barley sprouts sent by Albert N. Beard, Milford, contained 28.13 per cent. protein.

Dried Brewers' Grains.

The single sample analyzed was of high quality and satisfied its guaranty.

Wet Brewers' Grains.

24498, sent by A. J. Pierpont, Waterbury, contained 6.64 per cent. protein. It sold for 10 cts. per bushel plus $2.00 per load for carting.

Dried Distillers' Grains.

The single samples of *Ajax Flakes* and *Dearborn Distillers' Grains* satisfied their guaranties, and were both high-grade products.

24859, *Corn Three D Grains* (formerly called *Corn Protegran*), made by The Dewey Bros. Co., Blanchester, O., guaranteed 26 per cent. protein; sent by W. P. Holmes and Son, Griswold; contained 31.38 per cent. protein.

Miscellaneous Feeds.

Corn and Oat Feeds.

The nine samples examined consist chiefly of corn and oats products, as their name indicates. In certain of these, however, **25284, 25243, 25315**, and **25347**, the high percentages of fiber indicate that an inferior part of the grain has been used in their compounding.

25342, *Korn-Oats*, was low in fat.

24261, sent by H. B. Coger, Newtown, contained 9.63 per cent. protein. **24860** and **24861**, sent by J. T. Benham Est., New Haven, each contained 9.50 per cent. protein.

Oat Feeds.

The three samples examined consisted chiefly of oats, the hulls being in large excess. **25265**, *Jim Dandy Feed*, also contained a very little corn. **25380**, *Cox's Oat Feed,* was 1.25 per cent. low in protein. **25340**, *Dow's Oat Feed,* had no guaranty as required by law. At the price asked these feeds cannot be considered an economical purchase.

Wheat and Corn Cob Feeds.

These feeds, while sold as *Mixed Feeds,* a name properly belonging from trade usage only to mixtures of wheat bran and middlings, in three cases bore tags indicating the presence of corn cobs. **25262**, *Holstein Mixed Feed,* however, bore no such tag, and is adulterated under the law. Furthermore it is 1.25 per cent. below its protein guaranty. Otherwise these feeds satisfied their guaranties. They sold for about $3.50 less per ton than genuine wheat feed, and contained only about two-thirds as much protein.

Proprietary Horse Feeds.

All of the six samples were properly guaranteed. **25231**, *Bonnie Horse Feed,* was 3.25 below guaranty in protein. **25331**, *Algrane Horse Feed,* and **25410**, *Sugarota Horse Feed,* were also 1.37 and 1.19 per cent. low in protein, respectively.

Sucrene Horse and Mule Feed contains corn, oats, barley and wheat products, a few weed seeds and molasses.

Buffalo Horse Feed, Bonnie Horse Feed and *Algrane Horse Feed* contain corn, oats and wheat products.

Sugarota Horse Feed contains wheat, corn and oats products, barley residues, a small amount of cotton seed meal, a few weed seeds and molasses.

Schumacher's Special Horse Feed contains cracked corn, whole oats, oat hulls and barley.

Proprietary Dairy and Stock Feeds.

All of the twenty-five feeds of this class bore the required guaranties except **25397**, *Haskell's Stock Feed,* in which the guaranty for fat was wanting. **25287**, *Sucrene Dairy Feed,* was slightly low in both protein and fat. One sample of *Unicorn Dairy Ration,* **25240**, was 1.50 per cent. low in protein, with a considerable excess of fat; and **25366**, *Daisy Dairy Feed,* **25223**, *Algrane Milk Feed,* and **25290**, *Economy Feed,* were all below guaranty in fat. Both of the samples of *Sugarota Milk Meal* failed to meet their fat guaranty by nearly 3 per cent.

Sucrene Dairy Feed contains distillery products, corn, oats and wheat products, cotton seed meal, a little linseed meal, malt sprouts, weed seeds and molasses.

Union Grains Ready Ration contains wheat and corn products, distillery residues, malt sprouts, and cotton seed and linseed meals.

Blatchford's Calf Meal contains linseed, cotton seed and bean meals with a wheat product and fenugreek.

Unicorn Dairy Ration contains wheat and corn products, distillery grains, barley residues, malt sprouts, cotton seed and linseed meals and a small amount of oats.

Wirthmore Stock Feed contains corn (hominy) and oats products.

White Cross Stock Feed contains corn and oats products with a small amount of wheat.

Daisy Dairy Feed contains corn and oats products, alfalfa, cotton seed meal, a few weed seeds and molasses.

Gregson Calf Meal contains linseed and cotton seed meals, and barley and oat products with fenugreek.

Sterling Stock Feed contains corn, oats and wheat products, and a small amount of cotton seed meal.

Haskell's Stock Feed contains corn (hominy) and oats products.

Algrane Milk Feed contains corn (gluten feed), wheat and oats products (much hulls) and cotton seed meal.

New England Stock Feed contains corn and oats products.

Husted Dairy Feed contains corn, wheat and oats products, cotton seed meal and possibly linseed meal.

Mayflower Stock Feed contains corn and oats products.

Zenith Stock Feed contains corn and oats, and wheat and barley products in small amounts.

Badger Dairy Feed contains distillery and brewery residues, corn and oats products, malt sprouts, alfalfa, a little cotton seed meal, a few weed seeds and molasses.

Sugarota Calf Meal contains linseed and cotton seed meals, and wheat and barley products.

Sugarota Milk Meal contains barley residues, malt sprouts, wheat and oats products, cotton seed meal and a few weed seeds.

Schumacher's Stock Feed contains corn, oats and barley products, and a small amount of cotton seed meal.

Schumacher's Calf Meal contains wheat and oats products, linseed meal, casein (statement of manufacturer), and a small amount of cotton seed meal.

Wirthmore Balanced Ration Feed contains barley residues, malt sprouts, wheat, corn and oats products, cotton seed meal and possibly linseed meal.

Economy Feed contains corn and oats products and a small amount of brewers' grains.

Dairy Feeds, Sampled by Purchasers.

24230, *Wirthmore Balanced Ration Feed,* guaranteed 26 per cent. protein and 5 per cent. fat; sent by Bosworth Bros., Putnam; contained 26.69 per cent. protein and 4.74 per cent. fat. **24889**, *Unicorn Dairy Ration,* sent by Chapin and Co., Boston, contained 26.88 per cent. protein.

Proprietary Poultry Feeds.

The nine samples all bore the required guaranties except **25217**, *Vincent Bros. Dry Mash,* to which only the formula was attached. **25322**, *Wirthmore Growing Feed,* was nearly 2 per cent. below guaranty in both protein and fat. **25248**, *Algrane Poultry Feed,* was also below guaranty in protein and fat, and **25333**, *Sugarota Scratch Feed,* was 1.75 per cent. low in protein.

Wirthmore Growing Feed contains corn, wheat and oats products.

Wirthmore Poultry Mash contains corn, oats and wheat products, alfalfa, millet, barley and weed seeds.

Algrane Poultry Feed contains chiefly wheat, oats and corn products, with a small amount of ground meat.

Husted Poultry Feed contains wheat and corn products and alfalfa.

Sugarota Scratch Feed contains corn, wheat, barley, oats, kaffir corn, sunflower seeds and buckwheat.

Park and Pollard's Dry Mash Feed contains wheat, corn, oats and barley products, alfalfa and animal matter (bone and fish (?)).

Park and Pollard's Growing Feed contains chiefly corn, wheat and oats products.

American Poultry Feed contains wheat, corn and barley products, with a little oats and cotton seed meal.

Vincent Bros. Dry Mash contains corn, wheat and oats products, linseed meal, alfalfa and meat scrap.

Poultry Feeds, Sampled by Purchasers.

23995 and **25631**, *M. and S. Scratch Feed,* made and sent by Meech & Stoddard, Middletown, contained 11.38 and 10.19 per cent. of protein, and 3.94 and 3.88 per cent. of fat, respectively. **24176**, *Dry Mash,* made and sent by D. L. Dickinson & Son, Waterbury, contained 19.13 per cent. protein and 6.68 per cent. fat. **24177** and **24178**, *Park and Pollard's Dry Mash,* both sent by W. E. Sayles, Danielson, contained 20.19 and 29.63 per cent. protein, respectively.

ALFALFA PRODUCTS.

24175. Hay, sent by Wilson H. Lee, Orange.

24217. Hay, sent by C. M. Jarvis, Berlin, and cut on his farm.

24258. Hay, sent by Wilson H. Lee, Orange, and cut on his farm.

25914. Hay, sent by C. M. Jarvis, Berlin.

24208. Feed or Meal, sent by C. M. Jarvis, Berlin.

24260. Screenings, sent by C. M. Jarvis, Berlin.

25916 and **25917**, Meal, Kornfalfa Feed Milling Co., Kansas City, Mo., sent by C. M. Jarvis, Berlin.

	24175	24217	24258	25914	24208	*24260	25916	25917
Water	.....	25.17	5.88	5.41	7.92	8.04	.....	.....
Ash	.....	7.00	7.03	7.27	9.39	7.13	.....	.....
Protein	14.87	15.20	13.88	15.00	15.63	30.00	18.00	15.19
Fiber	.....	23.93	34.26	36.17	27.60	14.86	.....	.....
Extract	.....	27.24	37.05	34.82	37.78	32.86	.....	.....
Fat	2.46	1.46	1.90	1.33	1.68	7.11	.....	.....

Rice Feed.

25175. Sent by Chas. M. Cox Co., Boston. Contained 13.44 per cent protein.

Mealine.

25042. Sent by W. C. Robinson, Columbia. Contained 18.25 per cent protein.

* Contains 3 per cent. of weed seeds.

Scrapings from Bake Ovens.

24259. National Biscuit Co. Sent by C. M. Jarvis, Berlin. Contained 6.75 per cent protein.

Core Flour.

24321. Sent by The Turner & Seymour Mfg. Co., Torrington. Contained 21.21 per cent mineral matter.

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.	* Low in Fat.	* Low in Both.
Cotton Seed Meal	11	11	----	----	2	----
Cotton Seed Feed	1	1	----	----	----	1
Linseed Meal	7	7	----	----	----	----
Wheat Bran	31	26	5	----	----	----
Wheat Middlings	29	27	2	1	3	----
Wheat Feed	32	30	2	----	2	----
Gluten Feed	15	15	----	3	5	----
Hominy Feed	13	12	1	1	----	----
Star Feed	2	2	----	----	----	----
Corn Meal	1	----	1	----	----	----
Rye Middlings	4	3	1	----	1	----
Buckwheat Middlings	1	1	----	----	----	1
Malt Sprouts	2	2	----	----	1	----
Brewers' Grains	1	1	----	----	----	----
Distillers' Grains	2	2	----	----	----	----
Corn and Oat Feeds	9	8	1	----	1	----
Oat Feeds	3	2	1	1	----	----
Wheat and Corn Cob Feeds	4	4	----	1	----	----
Horse Feeds	6	6	----	3	----	----
Dairy and Stock Feeds	25	25	----	1	6	----
Poultry Feeds	9	8	1	1	----	2
	208	193	15	12	21	4

* Deficiencies of less than one per cent. protein and 0.25 per cent. fat are ignored in this tabulation.

Digestibility of Feeding Stuffs.

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, 1905, page 240 *et seq.*):

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	66	..	92	91
Hominy Meal and Star Feed	65	67	89	92
Gluten Feed	85	76	89	83
Wheat Bran	77	39	71	63
Wheat Middlings	77	30	78	88
Wheat Mixed 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
Corn and Oat Feed, provender	71	48	83	87
Wheat and Corn Cob Feed	63	28	71	92

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 feeding-stuffs as determined by our last inspection and arranged according to their protein percentage; 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, 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	16.4	21.4	3.3
2	" 25 to 30 " "	15.1	30.0	2.5
3	" 20 to 25 " "	12.3	36.5	5.4
4	" 15 to 20 " "	9.3	32.0	2.8
5	" 10 to 15 " "	5.4	37.2	3.9
6	" less than 10 " "	4.0	46.0	2.8

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	7.80	6.61	40.65	8.28	28.50	8.16	34.1	2.9	22.2	7.7	$34.55
Linseed Meal, new process	8.67	6.72	36.44	8.42	37.87	1.88	30.6	6.2	30.3	1.7	39.00
" " old process	9.00	5.39	36.17	7.49	34.90	7.05	32.2	4.3	27.2	6.3	40.00
Gluten Feed, Atlantic	7.20	0.96	32.00	1.03	58.32	0.49	27.2	0.8	51.9	0.4	32.00
Ajax Flakes	5.63	2.02	30.81	11.60	36.84	13.10	22.5	11.0	29.8	12.4	33.50
II. Protein 30-25 per cent.											
Dried Brewers' Grains	5.87	3.06	29.50	13.57	40.43	7.57	23.9	6.6	23.0	6.7	27.00
Buckwheat Middlings	10.09	4.78	29.56	10.63	37.59	7.35	25.1	1.8	31.2	6.5	32.00
Blatchford's Calf Meal	9.32	5.36	28.13	5.26	46.76	5.17	----	----	----	----	70.00
Gregson Calf Meal	7.83	5.72	27.94	4.74	46.99	6.78	----	----	----	----	50.00
Gluten Feed, Globe	8.36	4.60	27.17	6.29	51.31	2.27	23.1	4.8	45.7	1.9	28.33
Sugarota Calf Meal	9.73	4.30	26.56	4.58	48.71	6.12	----	----	----	----	70.00
Malt Sprouts	10.95	5.86	26.41	11.87	43.31	1.60	21.1	4.0	29.9	1.6	25.50
Wirthmore Balanced Ration	8.79	4.46	26.31	8.21	46.78	5.45	----	----	----	----	32.00
Gluten Feed, Crescent	8.52	4.26	25.54	6.52	51.82	3.34	21.7	5.0	46.1	2.7	28.25
" " Buffalo	9.57	5.00	25.44	6.26	51.03	2.70	21.6	4.8	45.4	2.2	29.00
" " Cream of Corn	8.18	3.10	25.25	6.46	52.87	4.14	21.5	4.9	47.1	3.4	30.00
Sugarota Milk Meal	7.90	8.32	25.22	11.63	43.68	3.25	----	----	----	----	29.50
III. Protein 25-20 per cent.											
Unicorn Dairy Ration	7.80	3.88	24.82	9.17	46.83	7.50	----	----	----	----	32.50
Dearborn Distillers' Grains	6.33	1.93	24.81	12.44	44.96	9.53	18.1	11.8	36.4	9.1	28.50
Union Grains, Biles' Ready Ration	7.76	4.79	24.28	9.13	46.25	7.79	----	----	----	----	34.00
Husted Dairy Feed	9.48	5.96	22.50	6.47	50.19	5.40	----	----	----	----	32.00
Gluten Feed, Cedar Rapids	7.06	1.21	20.10	6.41	57.67	7.55	17.1	4.9	51.3	6.3	28.50
IV. Protein 20-15 per cent.											
Schumacher's Calf Meal	8.34	2.55	19.69	1.54	59.55	8.33	----	----	----	----	31.00
Algrane Milk Feed	8.70	4.90	19.13	12.18	51.89	3.20	----	----	----	----	31.00
Badger Dairy Feed	9.80	8.14	19.06	12.54	47.12	3.34	----	----	----	----	28.00
Cotton Seed Feed	8.07	4.05	19.00	24.69	40.90	3.29	----	----	----	----	32.00

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.
Wheat Middlings	9.88	4.37	17.67	6.33	56.50	5.25	13.6	1.9	44.1	4.6	$29.84
Wheat Mixed Feed	9.41	5.37	17.03	7.49	55.96	4.74	13.3	4.6	43.1	4.1	28.28
Wheat Bran	9.11	6.50	16.20	9.51	53.87	4.81	12.5	3.7	38.2	3.0	26.65
Rye Middlings	9.80	3.95	15.96	4.36	62.39	3.54	----	----	----	----	28.88
Sucrene Dairy Feed	8.75	7.72	15.63	12.78	51.87	3.25	----	----	----	----	29.00
Daisy Dairy Feed	6.15	7.65	15.50	14.33	54.19	2.18	----	----	----	----	28.00
V. Protein 15-10 per cent.											
Buffalo Horse Feed	8.87	3.42	12.19	8.51	61.62	5.39	----	----	----	----	31.00
Wheat and Corn Cob Feed	9.08	4.74	11.91	16.14	54.89	3.24	7.5	4.5	39.0	3.0	24.75
Sucrene Horse and Mule Feed	9.73	7.59	11.63	10.64	56.65	3.76	----	----	----	----	30.00
Schumacher's Stock Feed	8.77	4.18	11.13	9.20	62.70	4.02	----	----	----	----	27.00
Economy Feed	7.54	3.01	10.94	14.32	59.88	4.31	----	----	----	----	27.00
Sugarota Horse Feed	9.45	6.58	10.81	16.19	53.51	3.46	----	----	----	----	32.00
Zenith Stock Feed	9.63	2.95	10.81	5.26	66.12	5.23	----	----	----	----	29.00
Bonnie Horse Feed	9.63	2.87	10.75	8.02	64.78	3.95	----	----	----	----	31.00
Algrane Horse Feed	7.65	4.02	10.63	10.10	62.91	4.69	----	----	----	----	30.00
Sterling Stock Feed	7.86	3.98	10.25	11.14	61.50	5.27	----	----	----	----	29.00
Hominy Feed	8.95	2.55	10.13	4.01	66.58	7.78	6.6	2.7	59.3	7.2	27.92
White Cross Stock Feed	9.66	2.12	10.00	4.09	69.99	4.14	----	----	----	----	31.00
VI. Protein under 10 per cent.											
New England Stock Feed	6.80	4.40	9.94	12.05	60.80	6.01	----	----	----	----	30.00
Wirthmore Stock Feed	7.52	3.26	9.63	7.90	64.07	7.62	----	----	----	----	32.00
Haskell Stock Feed	7.36	3.31	9.44	7.03	65.64	7.22	----	----	----	----	27.00
Mayflower Stock Feed	9.64	3.41	9.19	6.52	65.31	5.93	----	----	----	----	25.00
Schumacher's Special Horse Feed	8.06	3.12	9.00	9.02	66.50	4.30	----	----	----	----	29.00
Star Feed	8.32	3.20	8.75	10.68	63.13	5.92	5.7	7.2	56.2	5.4	27.50
Corn and Oat Feeds	8.68	3.24	8.50	8.66	66.63	4.29	6.0	4.1	55.3	3.7	29.22
Corn Meal	11.78	1.30	8.19	1.88	72.89	3.96	5.4	----	67.1	3.6	26.00
Oat Feeds	6.59	6.07	5.94	25.78	53.25	2.37	4.2	12.4	44.2	2.1	24.33

Table III.—Analyses of Commercial Feeds Sampled in 1910.

Station No.	Brand.	Retail Dealer.	Pounds per Hundred.						Price per ton.
			Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
	Oil Seed Products. *Cotton Seed Meal.*								
25316	——. American Cotton Oil Co., Memphis, Tenn.	*Wallingford:* E. E. Hall	7.73	7.02	40.25	7.86	28.22	8.92	$34.00
25357	Choice. American Cotton Oil Co., Yazoo City, Miss.	*Hartford:* G. M. White Co.	7.38	7.40	43.19	6.00	28.20	7.83	36.00
25382	Choice. American Cotton Oil Co., Huntsville, Ala.	*Colchester:* M. Klingon	7.67	6.12	40.81	8.29	28.98	8.13	36.00
25368	Dove Brand. F. W. Brodé, Memphis, Tenn.	*Manchester:* G. W. Kuhney	8.33	5.75	38.25	10.67	30.25	6.75	34.00
25393	Owl Brand. F. W. Brodé, Memphis, Tenn.	*Moosup:* T. E. Main & Sons	7.32	7.32	41.50	7.86	27.80	8.20	36.00
25372	Buckeye. Buckeye Cotton Oil Co., Cincinnati, O.	*Stafford Springs:* G. L. Dennis	8.01	5.93	39.06	9.92	30.17	6.91	34.00
25370	Good Luck. S. P. Davis, Little Rock, Ark.	*Rockville:* Edward White	7.23	6.95	43.94	6.91	26.51	8.46	32.00
25237	Dixie Brand. Humphreys, Godwin & Co., Memphis, Tenn.	*New Haven:* R. G. Davis	8.38	7.36	40.25	8.15	27.07	8.79	34.00
25375	Dixie Brand. Humphreys, Godwin & Co., Memphis, Tenn.	*Willimantic:* H. A. Bugbee	7.91	6.26	39.13	9.00	29.19	8.51	35.00
25234	Medium Grade. Ozark Oil Co., Ozark, Ala.	*New Haven:* R. G. Davis	8.09	6.64	40.69	8.35	28.06	8.17	33.00
25378	Prime. J. E. Soper & Co., Boston, Mass.	*Willimantic:* E. A. Buck & Co.	7.81	5.91	40.13	8.04	28.98	9.13	36.00
----		Average guaranty	----	----	**39.58**	----	----	**7.15**	----
----		Average of these 11 analyses	**7.80**	6.61	**40.65**	**8.28**	**28.50**	**8.16**	**34.55**
----		Average digestible	----	----	**34.1**	**2.9**	**22.2**	**7.7**	----
	Cotton Seed Feed Meal.								
25381	Humphreys, Godwin & Co., Memphis, Tenn.	*Colchester:* M. Klingon	8.07	4.05	19.00	24.69	40.90	3.29	32.00
----		Guaranty	----	----	**22.00**	**28.00**	----	**4.50**	----
	Linseed Meal, New Process.								
25236	American Linseed Co., Chicago, Ill.	*New Haven:* R. G. Davis	8.46	6.90	37.31	8.25	37.06	2.02	38.00
25404	" " " " "	*New London:* P. Schwartz Co.	8.88	6.54	35.56	8.60	38.68	1.74	40.00
----		Average guaranty	----	----	**36.00**	----	----	**1.00**	----
----		Average of these 2 analyses	**8.67**	**6.72**	**36.44**	**8.42**	**37.87**	**1.88**	**39.00**
----		Average digestible	----	----	**30.6**	**6.2**	**30.3**	**1.7**	----
	Linseed Meal, Old Process.								
25261	American Linseed Co., New York	*Stamford:* H. S. Bellinger	8.73	4.96	38.94	7.19	33.99	6.19	38.00
25421	Kelloggs & Miller, Amsterdam, N. Y.	*Canaan:* Ives & Pierce	10.17	5.48	35.56	7.40	34.80	6.59	41.00
25296	Guy G. Major Co., Toledo, O.	*Ansonia:* Flour & Grain Co.	8.68	5.94	32.56	8.54	37.67	6.61	40.00
25417	Mann Bros. Co., Buffalo, N. Y.	*Winsted:* Platt & Coe	8.47	4.77	37.56	6.85	32.61	9.74	40.00
25373	Midland Linseed Co., Minneapolis, Minn.	*Stafford Springs:* G. L. Dennis	8.95	5.81	36.25	7.47	35.38	6.14	41.00
----		Average guaranty	----	----	**32.20**	----	----	**5.40**	----
----		Average of these 5 analyses	**9.00**	**5.39**	**36.17**	**7.49**	**34.90**	**7.05**	**40.00**
----		Average digestible	----	----	**32.2**	**4.3**	**27.2**	**6.3**	----
	Wheat Products. *Bran from Winter Wheat.*								
25246	Ballard's. Ballard & Ballard, Louisville, Ky.	*New Haven:* Abner Hendee	9.25	7.23	15.06	9.20	54.62	4.64	28.00
25408	Cain's. The Cain Mill Co., Atchison, Kan.	*Collinsville:* F. W. Konold	8.96	6.72	17.13	9.14	53.76	4.29	27.00
25302	L-K Bran. *C. M. Cox Co., Boston, Mass.	*Hamden:* I. W. Beers	8.38	6.42	16.38	10.13	53.51	5.18	25.00
25321	Grafton Roller Mill Co., Grafton, N. Dak.	*Meriden:* Grain & Feed Co.	8.97	6.15	15.63	11.23	53.20	4.82	29.00
25385	Gwinn's. The Gwinn Milling Co., Columbus, O.	*Putnam:* Bosworth Bros.	8.62	6.46	16.25	8.46	55.96	4.25	26.00
25303	Dreadnought. Hunter-Robinson-Wenz Mill Co., St. Louis, Mo.	*Plainville:* F. B. Newton	8.48	5.99	16.31	7.74	56.91	4.57	28.00
25394	Anchor. Kemper Mill & Elevator, Kansas City, Mo.	*Yantic:* A. R. Manning	8.59	6.61	15.63	9.12	55.99	4.06	25.00

* Statement of Dealer.

TABLE III.—ANALYSES OF COMMERCIAL FEEDS SAMPLED IN 1910—*Continued.*

Station No.	Brand.	Retail Dealer.	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.)	
	WHEAT PRODUCTS.—*Continued.*									
	Bran from Winter Wheat.									
25387	Quality Mills, Enterprise, Kan.	*Danielson:* Young Bros. Co.	25387	8.32	7.16	15.81	9.65	54.74	4.32	$25.00
25235	Stanard Tilton Milling Co., St. Louis, Mo.	*New Haven:* R. G. Davis	25235	9.92	6.73	17.00	8.32	53.49	4.54	25.00
25282	Vimco. Valley City Milling Co., Grand Rapids, Mich.	*Waterbury:* Spencer Grain Co.	25282	9.46	6.24	15.19	8.03	56.51	4.57	28.00
		Average of these 10 analyses	-----	**8.90**	**6.57**	**16.04**	**9.10**	**54.87**	**4.52**	**26.60**
		Average digestible	-----	----	---	**12.4**	**3.5**	**39.0**	**2.8**	-----
	Bran from Spring Wheat.									
25349	Winona. Bay State Milling Co., Winona, Minn.	*Bristol:* G. W. Eaton Est.	25349	9.54	6.13	16.31	9.88	52.77	5.37	27.00
25297	Clover Leaf. Seymour Carter, Gardner Mill, Hastings, Minn.	*Derby:* Peterson Hendee Co.	25297	9.11	6.95	15.94	9.26	53.99	4.75	25.00
25386	Commander. Commander Mill Co., Minneapolis, Minn.	*Danielson:* Young Bros. Co.	25386	7.64	7.04	14.88	11.44	54.08	4.92	25.00
25383	Adrian. Detroit Milling Co., Detroit, Mich.	*Putnam:* F. M. Cole	25383	9.78	6.10	16.31	7.88	55.29	4.64	25.00
25401	Imperial. Duluth Superior Mill Co., Duluth, Minn.	*Mystic:* J. L. Manning & Co.	25401	8.50	6.12	16.50	10.10	54.10	4.68	26.00
25306	Eagle Roller Mill Co., New Ulm, Minn.	*Plainville:* G. W. Eaton Est.	25306	9.03	6.71	16.00	10.97	52.07	5.22	27.00
25342	Ben Hur. Hennepin Mill Co., Minneapolis, Minn.	*Middletown:* Meech & Stoddard	25342	9.62	6.12	16.06	9.60	53.38	5.22	27.00
25295	Northwestern Consolidated Milling Co., Minneapolis, Minn.	*Ansonia:* Flour & Grain Co.	25295	8.84	6.86	16.25	9.89	53.29	4.87	28.00
25226	Pillsbury's, Minneapolis, Minn.	*Bridgeport:* Berkshire Mills	25226	9.04	6.84	15.81	10.10	53.42	4.79	27.00
25423	Sleepy Eye Mill Co., Sleepy Eye, Minn.	*E. Haven:* F. A. Forbes	25423	9.16	6.64	16.75	10.19	52.39	4.87	25.00
24254	Coarse. Washburn-Crosby Co., Minneapolis, Minn.	*Springdale:* Monroe & Palmer	25254	10.01	6.75	15.06	10.48	52.72	4.98	27.00
25354	Western Canada Flour Mill Co.	*Hartford:* Smith Northam Co.	25354	8.96	5.69	17.00	9.27	54.11	4.97	28.00
25377	Black Hawk. Western Flour Mill Co., Davenport, Ia.	*Willimantic:* E. A. Buck & Co.	25377	9.06	6.13	15.75	9.73	54.96	4.37	25.00
		Average of these 13 analyses	-----	**9.10**	**6.47**	**16.05**	**9.91**	**53.57**	**4.90**	**26.31**
		Average digestible	-----	----	----	**12.4**	**3.9**	**38.0**	**3.1**	-----
	Bran, unclassified.									
25294	A. B. P. Bran	*Ansonia:* Flour & Grain Co.	25294	9.84	5.98	17.06	9.09	52.62	5.41	28.00
25414	Badger. Berger Crittenden Mill. Co., Milwaukee, Wis.	*Winsted:* F. Woodruff & Sons	25414	9.61	6.15	16.44	8.68	54.40	4.72	28.00
25224	C. M. C. Bran	*Bridgeport:* Standard Feed Co.	25224	9.35	6.87	17.50	8.65	52.51	5.12	28.00
25230	Lucky. Federal Milling Co., Lockport, N. Y.	*So. Norwalk:* Manuel T. Hatch	25230	9.00	6.79	15.88	9.00	54.67	4.66	28.00
25264	New Star Roller Mills, Math. Brann & Co., Wahpeton, No. Dak.	*Ridgefield:* S. D. Keeler	25264	8.95	6.76	16.00	11.18	52.41	4.70	29.00
25268	Ogilvie's Bran	*Danbury:* F. C. Benjamin & Co.	25268	10.76	6.51	16.31	10.03	51.08	5.31	26.00
25379	Robin Hood. Saskatchewan Flour Mills Co.	*Colchester:* M. Klingon	25379	7.97	6.40	16.44	9.98	53.44	5.77	25.00
25418	*U-Knead-It. Watson Mill Co., Wichita	*Winsted:* E. Manchester & Son	25418	9.68	6.31	17.38	8.43	53.58	4.62	26.00
	Middlings from Winter Wheat.									
25371	Ballard's Ship Stuff. Ballard & Ballard, Louisville, Ky.	*Rockville:* Edward White	25371	9.69	4.39	18.13	5.41	57.68	4.70	30.00
25317	The Gwinn Milling Co., Columbus, O.	*Meriden:* Grain & Feed Co.	25317	10.09	4.05	20.44	4.96	55.58	4.88	26.00
25220	"H." Hecker-Jones-Jewell Mill. Co., New York	*Bridgeport:* Vincent Bros.	25220	10.09	5.30	17.69	7.94	53.85	5.13	27.00
25283	Vimco Choice. Valley City Mill. Co., Grand Rapids, Mich.	*Waterbury:* Spencer Grain Co.	25283	9.94	4.17	16.44	4.87	59.53	5.05	30.00
25352	Star. Western Star Mill Co., Salina, Kan.	*Hartford:* L. C. Daniels Grain Co.	25352	10.85	3.40	17.75	3.48	60.25	4.27	34.00
		Average of these 5 analyses	-----	**10.13**	**4.26**	**18.09**	**5.33**	**57.38**	**4.81**	**29.40**
		Average digestible	-----	----	----	**13.9**	**1.6**	**44.8**	**4.2**	-----

* Bran and Screenings.

Table III.—Analyses of Commercial Feeds Sampled in 1910—*Continued.*

Station No.	Brand.	Retail Dealer.	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.
	Wheat Products.									
	Middlings from Spring Wheat.									
25363	No. 8. Chapin & Co., Milwaukee, Wis.	*Suffield:* Spencer Bros.	25363	9.56	3.92	17.88	4.96	58.23	5.45	$34.00
25392	Flour. Wm. G. Crocker, Minneapolis, Minn.	*Danielson:* Quinebaug Mills	25392	9.89	4.19	18.63	5.79	55.70	5.80	32.00
25402	"S." Duluth Superior Mill. Co., Duluth, Minn.	*Mystic:* J. L. Manning & Co.	25402	9.29	4.60	18.25	6.50	56.28	5.08	27.00
25307	Eagle Roller Mill Co., New Ulm, Minn.	*Plainville:* G. W. Eaton Est.	27307	9.39	5.15	17.69	8.46	53.87	5.44	30.00
25350	" " " " " " "	*Bristol:* W. O. Goodsell	25350	9.17	5.23	17.00	9.11	54.03	5.46	29.00
25396	Lucky. Federal Milling Co., Lockport, N. Y.	*Yantic:* A. R. Manning	25396	9.10	4.47	18.50	6.64	55.84	5.45	29.00
25293	Madelia Roller Mills, C. S. Christensen Co., Madelia, Minn.	*Ansonia:* Flour & Grain Co.	25293	10.27	4.77	17.06	7.07	55.43	5.40	30.00
25346	Meech & Stoddard, Middletown	*Middletown:* Meech & Stoddard	25346	9.80	4.80	17.94	7.99	53.95	5.52	27.00
25395	National Milling Co., Toledo, O.	*Yantic:* A. R. Manning	25395	9.46	4.76	18.56	7.40	53.67	6.15	28.00
25422	Fancy. Northwestern Milling Co., Little Falls, Minn.	*E. Haven:* F. A. Forbes	25422	9.22	4.72	17.81	8.15	54.67	5.43	28.00
25250	Northwestern Consolidated Milling Co., Minneapolis, Minn.	*Branford:* S. V. Osborn	25250	9.42	5.34	16.00	10.00	52.65	6.59	30.00
25276	Pillsbury's A Middlings, Minneapolis, Minn.	*New Milford:* F. R. Green	25276	10.71	3.93	17.81	4.71	58.23	4.61	30.00
25249	" B " " "	*Branford:* S. V. Osborn	25249	9.34	5.07	16.00	10.52	53.65	5.42	29.00
25229	" XX Daisy, Minneapolis, Minn.	*Norwalk:* Holmes, Keeler & Selleck Co.	25229	11.04	3.47	18.50	2.49	60.43	4.07	32.00
25359	" Daisy Middlings, Minneapolis, Minn.	*Thompsonville:* H. K. Brainard	25359	11.05	3.44	18.94	2.87	59.13	4.57	31.00
25253	Adrian. Washburn-Crosby Co., Minneapolis, Minn.	*Springdale:* Monroe & Palmer	25253	11.14	2.96	18.13	2.68	60.81	4.28	33.00
25255	Standard. Washburn-Crosby Co., Mineapolis, Minn.	*Springdale:* Monroe & Palmer	25255	10.33	4.42	18.44	7.33	54.18	5.30	30.00
25390	No tags	*Danielson:* Quinebaug Mills	25390	8.83	4.87	17.44	7.37	55.51	5.98	28.00
		Average of these 18 analyses	----	**9.83**	**4.45**	**17.81**	**6.67**	**55.91**	**5.33**	**29.87**
		Average digestible	----	----	----	**13.7**	**2.0**	**43.6**	**4.7**	----
	Middlings, unclassified.									
25298	Flour. Banner Milling Co., Buffalo, N, Y.	*Derby:* Peterson Hendee Co.	25298	10.18	3.94	17.56	6.12	57.35	4.85	30.00
25409	Dexter. Chapin & Co., Milwaukee, Wis.	*Simsbury:* R. H. Ensign	25409	9.83	4.32	17.69	5.91	56.72	5.53	30.00
25361	Wirthmore. Chas. M. Cox Co., Boston, Mass.	*Suffield:* Arthur Sikes	25361	10.48	4.05	17.19	5.60	58.01	4.67	34.00
25225	Mapleleaf Mill Co., Canada	*Bridgeport:* Berkshire Mills	25225	8.79	4.99	18.19	8.03	53.98	6.02	29.00
25330	*"Colonial." Miner-Hilliard Mill Co., Wilkesbarre, Pa.	*New Britain:* C. W. Lines Co.	25330	10.05	3.22	13.25	3.68	64.37	5.43	29.00
25312	Standard. Russell Miller Milling Co.	*Wallingford:* Gallagher Bros.	25312	9.61	4.78	17.56	7.47	54.85	5.73	28.00
	Mixed Feed from Winter Wheat.									
25289	Erie. Chapin & Co., St. Louis, Mo.	*Waterbury:* D. L. Dickinson & Son	25289	9.98	5.97	18.31	8.14	53.33	4.27	27.00
25356	Huron. Chapin & Co., Milwaukee, Wis.	*Hartford:* G. M. White Co.	25356	9.22	4.73	16.94	6.57	58.15	4.39	31.00
25310	Manhattan. Hecker-Jones-Jewell Mill. Co., New York	*No. Haven:* Coöperative Feed Co.	25310	9.33	5.69	17.06	8.44	54.30	5.18	27.00
25245	Queen. Hecker-Jones-Jewell Mill. Co., New York	*New Haven:* Abner Hendee	25245	10.16	6.10	16.38	10.71	51.80	4.85	28.00
25415	Sunshine. Hunter-Robinson-Wenz Co., St. Louis, Mo.	*Winsted:* F. Woodruff & Sons	25415	8.84	5.71	16.88	7.37	56.60	4.60	29.00
25325	Wild Fire. Hunter-Robinson-Wenz Co., St. Louis, Mo.	*Meriden:* A Grulick	25325	9.56	5.62	17.06	6.98	56.13	4.65	28.00

* See page 622.

TABLE III.—ANALYSES OF COMMERCIAL FEEDS SAMPLED IN 1910—*Continued.*

Station No.	Brand.	Retail Dealer.	Pounds per Hundred. Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
	WHEAT PRODUCTS.—*Concluded.* *Mixed Feed from Winter Wheat.*								
25399	Kehlor Flour Mill Co., St. Louis, Mo.	*Westerly:* C. W. Campbell Co.	8.79	6.12	17.38	8.16	54.77	4.78	$27.00
25300	Anchor. Kemper Mill and Elev. Co., Kansas City, Mo.	*Hamden:* I. W. Beers	8.88	5.79	17.31	7.49	55.97	4.56	26.50
25272	Crescent. Kemper Mill and Elev. Co., Kansas City, Mo.	*New Milford:* G. T. Soule	9.71	5.75	17.25	7.35	55.58	4.36	27.00
25355	Snowflake. Lawrenceburg Roller Mill Co., Lawrenceburg, Ind.	*Hartford:* G. M. White Co.	9.40	5.30	16.94	7.11	56.84	4.41	30.00
25419	Wabash. Sparks Milling Co., Terre Haute, Ind.	*Winsted:* E. Manchester & Sons	9.56	4.85	16.94	6.71	57.81	4.13	27.00
25281	Cow. Valley City Mill. Co., Grand Rapids, Mich.	*Waterbury:* Spencer Grain Co.	9.62	5.50	16.88	6.37	57.11	4.52	30.00
25388	Farmers' Favorite Cow. Valley City Mill. Co., Grand Rapids, Mich.	*Danielson:* Quinebaug Mills	9.16	5.32	16.19	7.14	57.67	4.52	31.00
25374	Waggoner-Gates Mill. Co., Independence, Ind.	*Willimantic:* H. A. Bugbee	8.36	5.91	17.19	7.48	56.42	4.64	28.00
25271	Kent. Williams Bros. Co., Kent, O.	*Danbury:* O. H. Meeker	9.43	5.05	16.69	5.85	58.76	4.22	29.00
-----		Average of these 15 analyses	**9.33**	**5.56**	**17.03**	**7.46**	**56.08**	**4.54**	**28.37**
-----		Average digestible	----	----	**13.3**	**4.6**	**43.2**	**3.9**	-----
	Mixed Feed from Spring Wheat.								
25326	White Satin. Barber Mill. Co., Minneapolis, Minn.	*Meriden:* A. Grulick	9.20	4.91	17.81	6.94	55.98	5.16	29.00
25348	Winona. Bay State Mill. Co., Winona, Minn.	*Bristol:* G. W. Eaton Est.	9.68	5.74	17.13	8.54	53.70	5.21	30.00
25411	Rutland. Chapin & Co., Milwaukee, Wis.	*Torrington:* D. L. Talcott	8.93	5.26	17.44	8.44	54.27	5.66	28.00
25398	Vermont. " " " "	*Norwich:* Chas. Slosberg	9.90	5.06	17.13	7.00	56.10	4.81	29.00
25267	Claro. Claro Mill. Co., Lakeville, Minn.	*Danbury:* Keeler Grain Co.	9.98	5.50	17.13	8.67	53.88	4.84	29.00
25364	Boston. Duluth Superior Mill. Co., Duluth, Minn.	*Manchester:* G. W. Kuhney	8.80	5.31	17.75	7.47	55.69	4.98	28.00
25275	Lucky. Federal Mill. Co., Lockport, N. Y.	*New Milford:* F. R. Green	9.32	5.86	16.94	9.21	53.47	5.20	29.00
25273	Fancy. Pillsbury, Minneapolis, Minn.	*New Milford:* G. T. Soule	10.37	4.66	17.06	5.87	57.71	4.33	30.00
25269	Accident. Russell Roller Mill Co., Minneapolis, Minn.	*Danbury:* F. C. Benjamin & Co.	9.93	5.09	17.94	7.70	54.33	5.01	28.00
25329	Gold Mine. Sheffield King Mill. Co., Minneapolis, Minn.	*New Britain:* C. W. Lines Co.	8.96	5.33	16.88	7.09	56.67	5.07	29.00
25337	Superior. Washburn-Crosby Co., Minneapolis, Minn.	*Guilford:* G. F. Walter	9.57	4.84	16.44	7.01	57.25	4.89	28.00
25301	Webster Mill Co., Webster, So. Dak.	*Hamden:* I. W. Beers	8.56	5.68	16.56	8.88	55.08	5.24	26.50
-----		Average of these 12 analyses	**9.43**	**5.27**	**17.18**	**7.74**	**55.35**	**5.03**	**28.63**
-----		Average digestible	----	----	**13.4**	**4.8**	**42.6**	**4.4**	-----
	Mixed Feed, unclassified.								
25239	Bull's Eye. Blish Mill. Co., Seymour, Ind.	*New Haven:* R. G. Davis	10.93	5.67	15.75	7.49	55.96	4.20	26.00
25311	Regent. Charles M. Cox Co., Boston	*No. Haven:* Coöperative Feed Co.	9.06	5.17	16.69	7.43	56.44	5.21	26.00
25332	Wirthmore. " " " "	*New Britain:* C. W. Lines Co.	8.92	4.68	17.50	6.09	57.97	4.84	30.00
25279	Delmar. National Feed Co., St. Louis, Mo.	*Bethel:* Johnston & Morrison	9.89	5.75	16.88	7.20	55.84	4.44	26.00
25305	Buckeye. Quaker Oats Co., Chicago	*Plainville:* F. B. Newton	9.37	4.03	16.56	6.80	58.83	4.41	28.00
	MAIZE PRODUCTS. *Gluten Feed.*								
25343	Atlantic. Atlantic Starch Works, Westport	*Middletown:* Meech & Stoddard	7.20	0.96	32.00	1.03	58.32	0.49	32.00
-----		Guaranty	----	----	**28.00**		----	**1.00**	-----
-----		Digestible	----	----	**27.2**	**0.8**	**51.9**	**0.4**	-----
25218	*Buffalo. Corn Products Refining Co., New York	*Bridgeport:* Vincent Bros.	9.57	4.00	23.88	5.72	54.19	2.64	29.00
25278	* " " " " " "	*New Milford:* F. R. Green	9.32	5.48	26.94	6.58	49.87	1.81	28.00

*Labeled "Colored."

TABLE III.—ANALYSES OF COMMERCIAL FEEDS SAMPLED IN 1910—*Continued.*

Station No.	Brand.	Retail Dealer.	Pounds per Hundred. Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
	MAIZE PRODUCTS.—*Continued.* *Gluten Feed.*								
25420	*Buffalo. Corn Products Refining Co., New York	*Canaan:* Ives & Pierce	9.83	5.51	25.50	6.49	49.02	3.65	$30.00
----		Average guaranty	----	----	**24.00**	----	----	**2.50**	----
----		Average of these 3 analyses	**9.57**	**5.00**	**25.44**	**6.26**	**51.03**	**2.70**	**29.00**
----		Average digestible	----	----	**21.6**	**4.8**	**45.4**	**2.2**	----
25351	Cedar Rapids. Douglas & Co., Cedar Rapids, Ia.	*Bristol:* W. O. Goodsell	7.12	1.21	20.00	6.12	58.42	7.13	29.00
25367	" " " " " " "	*Manchester:* G. W. Kuhney	7.00	1.21	20.19	6.71	56.93	7.96	28.00
----		Average guaranty	----	----	**22.00**	----	----	**3.25**	----
----		Average of these 2 analyses	**7.06**	**1.21**	**20.10**	**6.41**	**57.67**	**7.55**	**28.50**
----		Average digestible	----	----	**17.1**	**4.9**	**51.3**	**6.3**	----
25257	*Cream of Corn. American Maize Products Co., New York	*Stamford:* W. L. Crabb	7.33	2.66	25.69	6.51	54.39	3.42	33.00
25324	*Cream of Corn. American Maize Products Co., Roby, Ind.	*Meriden:* A. Grulick	8.39	3.64	25.75	6.21	52.06	3.95	29.00
25424	*Cream of Corn. American Maize Products Co., Roby, Ind.	*Westville:* W. E. Warner & Bro.	8.82	3.01	24.31	6.67	52.14	5.05	28.00
----		Average guaranty	----	----	**23.00**	----	----	**2.50**	----
----		Average of these 3 analyses	**8.18**	**3.10**	**25.25**	**6.46**	**52.87**	**4.14**	**30.00**
----		Average digestible	----	----	**21.5**	**4.9**	**47.1**	**3.4**	----
25274	*Crescent. Corn Products Refining Co., New York	*New Milford:* L. Wischert	8.97	3.84	24.69	7.10	50.51	4.89	29.00
25341	*Crescent. Corn Products Refining Co., New York	*Middletown:* Meech & Stoddard	8.07	4.68	26.38	5.94	53.15	1.78	27.50
----		Average guaranty	----	----	**24.00**	----	----	**2.50**	----
----		Average of these 2 analyses	**8.52**	**4.26**	**25.54**	**6.52**	**51.82**	**3.34**	**28.25**
----		Average digestible	----	----	**21.7**	**5.0**	**46.1**	**2.8**	----
25241	*Globe. Corn Products Refining Co., New York	*New Haven:* R. G. Davis	9.34	3.67	26.81	5.56	52.05	2.57	29.00
25338	* " " " " " " "	*Guilford:* G. F. Walter	9.16	5.09	27.13	6.48	50.17	1.97	28.00
25384	* " " " " " " "	*Putnam:* Bosworth Bros.	6.57	5.05	27.56	6.82	51.72	2.28	28.00
----		Average guaranty	----	----	**24.00**	----	----	**2.50**	----
----		Average of these 3 analyses	**8.36**	**4.60**	**27.17**	**6.29**	**51.31**	**2.27**	**28.33**
----		Average digestible	----	----	**23.1**	**4.8**	**45.7**	**1.9**	----
25344	Gluten Feed. Meech & Stoddard, Middeltown	*Middletown:* Meech & Stoddard	5.74	0.87	18.63	6.47	63.15	5.14	27.50
----		Guaranty	----	----	**22.00**	----	----	**4.00**	----
----		Digestible	----	----	**15.8**	**4.9**	**56.2**	**4.3**	----
	Hominy Feed.								
25313	Homco. American Hominy Co., Indianapolis, Ind.	*Wallingford:* Gallagher Bros.	8.91	2.54	10.56	3.50	66.84	7.65	28.00
----		Guaranty	----	----	**8.50**	----	----	**7.00**	----
25256	Buffalo Cereal Co., Buffalo, N. Y.	*Stamford:* W. L. Crabb	9.84	2.19	8.88	3.19	68.94	6.96	28.00
----		Guaranty	----	----	**10.00**	----	----	**7.00**	----
25304	Wirthmore. Chas. M. Cox Co., Boston	*Plainville:* F. B. Newton	8.80	2.65	10.31	4.29	65.59	8.36	30.00
25227	" " " " "	*Norwalk:* Holmes, Keeler & Selleck Co.	9.33	2.56	9.88	3.87	66.86	7.50	28.00
----		Average guaranty	----	----	**10.00**	----	----	**7.50**	----
----		Average of these 2 analyses	**9.06**	**2.60**	**10.10**	**4.08**	**66.23**	**7.93**	**29.00**
25369	Success. Deutsch & Sickert Co., Milwaukee, Wis.	*Rockville:* Rockville Mill. Co.	7.34	3.07	10.88	5.07	65.19	8.45	29.00
----		Guaranty	----	----	**11.00**	----	----	**7.00**	----
25221	Yellow. Husted Mill Co., Buffalo, N. Y.	*Bridgeport:* Standard Feed Co.	9.49	2.22	9.69	3.30	68.67	6.63	29.00
----		Guaranty	----	----	**9.00**	----	----	**6.00**	----

* Labeled "Colored."

TABLE III.—ANALYSES OF COMMERCIAL FEEDS SAMPLED IN 1910—*Continued.*

Station No.	Brand.	Retail Dealer.	Pounds per Hundred. Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
	MAIZE PRODUCTS.—*Continued.*								
	Hominy Feed.								
25285	Steam Cooked. Miner-Hillard Mill. Co., Wilkes-barre, Pa.	*Thomaston:* L. E. Belmer	9.45	2.59	10.19	4.22	65.16	8.39	$28.00
25314	Steam Cooked. Miner-Hillard Mill. Co., Wilkes-barre, Pa.	*Wallingford:* E. E. Hall	8.95	2.59	10.31	4.54	65.33	8.28	25.00
25413	Steam Cooked. Miner-Hillard Mill. Co., Wilkes-barre, Pa.	*Litchfield:* Litchfield Grain Co.	8.55	2.85	10.44	4.72	64.40	9.04	29.00
-----		Guaranty	---	---	**10.00**	----	-----	**7.50**	----
-----		Average of these 3 analyses	**8.98**	**2.68**	**10.31**	**4.49**	**64.97**	**8.57**	----
25407	The Patent Cereal Co., Geneva, N. Y.	*Collinsville:* Collinsville Grain Co.	9.21	2.54	10.31	4.07	65.92	7.95	28.00
-----		Guaranty	----	----	**10.00**	----	-----	**7.00**	----
25252	Wm. H. Payne & Son, New York	*New Canaan:* C. H. Fairty	8.26	2.64	10.44	3.93	66.71	8.02	27.00
-----		Guaranty	----	----	**11.00**	----	-----	**8.00**	----
25266	Yellow. Quaker Oats Co., Chicago	*Danbury:* Keeler Grain Co.	9.48	2.12	9.50	3.36	69.47	6.07	28.00
25406	Blue Ribbon. J. E. Soper & Co., Boston, Mass.	*New London:* P. Schwartz Co.	8.68	2.56	10.31	4.06	66.51	7.88	26.00
-----		Guaranty	----	----	**10.00**	----	-----	**8.00**	----
-----		Average guar'ty all hominy feeds	----	----	**9.96**	----	-----	**7.29**	----
-----		Average of all (13) analyses	**8.95**	**2.55**	**10.13**	**4.01**	**66.58**	**7.78**	**27.92**
-----		Average digestible	----	----	**6.6**	**2.7**	**59.3**	**7.2**	----
25263	Star Feed. Toledo Elevator Co., Toledo, O.	*Ridgefield:* S. D. Keeler	8.26	3.55	9.31	10.14	62.64	6.10	29.00
25339	" " " " " " "	*Guilford:* Morse & Landon	8.37	2.85	8.19	11.23	63.62	5.74	26.00
-----		Average guaranty	----	----	**7.00**	----	-----	**5.50**	----
-----		Average of these 2 analyses	**8.32**	**3.20**	**8.75**	**10.68**	**63.13**	**5.92**	**27.50**
-----		Average digestible	----	----	**5.7**	**7.2**	**56.2**	**5.4**	----
	Corn Meal.								
25403	Ground by J. L. Manning & Co., Mystic		11.78	1.30	8.19	1.88	72.89	3.96	26.00
-----		Digestible	----	----	**5.4**	----	**67.1**	**3.6**	----
	RYE PRODUCTS.								
	Rye Middlings.								
25247	The Boutwell Mill. & Grain Co., Troy, N. Y.	*New Haven:* Abner Hendee	10.59	3.81	16.19	4.42	61.38	3.61	28.50
25219	Hecker-Jones-Jewell Mill. Co., New York	*Bridgeport:* Vincent Bros.	9.74	3.90	16.00	3.87	63.06	3.43	27.00
25292	Miner-Hillard Mill. Co., Wilkesbarre, Pa.	*Ansonia:* Flour & Grain Co.	10.45	3.22	15.44	3.56	64.15	3.18	30.00
25412	Washburn-Crosby Co., Minneapolis, Minn.	*Torrington:* D. L. Talcott	8.44	4.85	16.19	5.59	60.99	3.94	30.00
-----		Average of these 4 analyses	**9.80**	**3.95**	**15.96**	**4.36**	**62.39**	**3.54**	**28.88**
	BUCKWHEAT PRODUCTS.								
	Buckwheat Middlings.								
25389	Ground by Quinebaug Mills, Danielson		10.09	4.78	29.56	10.63	37.59	7.35	32.00
-----		Digestible	----	----	**25.1**	**1.8**	**31.2**	**6.5**	----
	BARLEY PRODUCTS.								
	Malt Sprouts.								
25244	Atlantic Export Co., Chicago	*New Haven:* Abner Hendee	10.74	6.08	25.69	12.53	43.15	1.81	26.00
-----		Guaranty	----	----	**25.00**	----	-----	**1.50**	----
25238	The C. Zwickel Malting Co., Buffalo, N. Y.	*New Haven:* R. G. Davis	11.16	5.64	27.13	11.21	43.47	1.39	25.00
-----		Guaranty	----	----	**25.00**	----	-----	**2.00**	----
-----		Average of these 2 analyses	**10.95**	**5.86**	**26.41**	**11.87**	**43.31**	**1.60**	**25.50**
-----		Average digestible	---	----	**21.1**	**4.0**	**29.9**	**1.6**	----

TABLE III.—ANALYSES OF COMMERCIAL FEEDS SAMPLED IN 1910—*Continued.*

Station No.	Brand.	Retail Dealer.	Pounds per Hundred. Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
	BARLEY PRODUCTS.—*Concluded.*								
	Dried Brewers' Grains.								
25362	Pilsner. Rosekhaus Snyder Co., Philadelphia, Pa.	*Suffield:* Arthur Sikes	5.87	3.06	29.50	13.57	40.43	7.57	27.00
----		Guaranty	----	----	25.00	----	----	5.00	----
----		Digestible	----	----	23.9	6.6	23.0	6.7	----
	Dried Distillers' Grains.								
25358	Ajax Flakes. Ajax Mill. and Feed Co., Buffalo, N. Y.	*Thompsonville:* H. K. Brainard	5.63	2.02	30.81	11.60	36.84	13.10	33.50
----		Guaranty	----	----	30.00	----	----	11.00	----
----		Digestible	----	----	22.5	11.0	29.8	12.4	----
25345	Dearborn Distillers' Grains. The J. W. Biles Co., Cincinnati, O.	*Middletown:* Meech & Stoddard	6.33	1.93	24.81	12.44	44.96	9.53	28.50
----		Guaranty	----	----	22.00	----	----	8.00	----
----		Digestible	----	----	18.1	11.8	36.4	9.1	----
	MIXED FEEDS.								
	Corn and Oat Feeds and Oat Feeds.								
25284	Buffalo Cereal Co., Chop Feeds. Buffalo Cereal Co., Buffalo, N. Y.	*Thomaston:* L. E. Belmer	8.64	3.42	8.31	10.26	64.89	4.48	29.00
----		Guaranty	----	----	7.00	----	----	3.00	----
25380	Oat Feed. Chas. M. Cox Co., Boston, Mass.	*Colchester:* M. Klingon	6.28	6.38	4.75	27.10	53.35	2.14	23.00
----		Guaranty	----	----	6.00	----	----	2.00	----
25288	Adrian Chop Feed. Detroit Mill. Co., Detroit, Mich.	*Waterbury:* D. L. Dickinson & Son	7.97	3.15	8.69	7.47	66.81	5.91	30.00
----		Guaranty	----	----	8.50	----	----	5.00	----
25340	Oat Feed. Dow Cereal and Mill. Co., Pilot Mound, Manitoba	*Guilford:* Morse & Landon	6.72	6.00	6.50	24.91	53.68	2.19	25.00
25243	Boss Feed. The Great Western Cereal Co., Chicago	*New Haven:* Abner Hendee	8.13	5.27	8.13	10.16	63.94	4.37	26.00
----		Guaranty	----	----	8.00	----	----	3.00	----
25315	Provender	*Wallingford:* E. E. Hall	8.02	3.96	7.00	15.08	62.32	3.62	25.00
25265	Jim Dandy Feed. The H. O. Co., Buffalo, N. Y.	*Danbury:* Keeler Grain Co.	6.78	5.84	6.56	25.33	52.72	2.77	25.00
----		Guaranty	----	----	7.50	----	----	2.75	----
25242	Corn and Oats. Husted Mill. Co., Buffalo, N. Y.	*New Haven:* R. G. Davis	10.87	1.94	9.19	3.93	70.25	3.82	34.00
25277	" " " " " " "	*New Milford:* F. R. Green	9.51	3.41	9.94	5.14	65.62	6.38	29.00
----		Average guaranty	----	----	9.00	----	----	4.00	----
----		Average of these 2 analyses	10.19	2.68	9.57	4.53	67.93	5.10	31.50
25320	Imperial Feed. Imperial Grain and Mill. Co., Toledo, O.	*Meriden:* Grain & Feed Co.	8.44	1.83	10.25	3.66	71.56	4.26	38.00
----		Guaranty	----	----	10.00	----	----	4.50	----
25347	Korn-Oato. Meech & Stoddard, Middletown	*Middletown:* Meech & Stoddard	7.55	3.32	7.06	13.48	66.24	2.35	26.00
----		Guaranty	----	----	7.00	----	----	3.00	----
25232	Victor Feed. Quaker Oats Co., Chicago	*New Haven:* J. T. Benham Est.	8.99	2.85	7.94	8.77	68.04	3.41	26.00
----		Guaranty	----	----	7.50	----	----	3.00	----
----		Average of these 12 analyses	8.16	3.95	7.86	12.94	63.28	3.81	28.00
----		Average digestible	----	----	5.6	6.2	52.5	3.3	----
	Wheat and Corn Cob Feeds.								
25262	Holstein Mixed Feed. Indiana Mill. Co., Terre Haute, Ind.	*Greenwich:* J. P. Johnson	9.02	4.72	11.75	17.70	53.53	3.28	26.00
----		Guaranty	----	----	13.00	---	----	3.50	----

TABLE III.—ANALYSES OF COMMERCIAL FEEDS SAMPLED IN 1910—*Continued.*

Station No.	Brand.	Retail Dealer.	Pounds per Hundred.						Price per ton.
			Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
	MIXED FEEDS—*Continued.* *Wheat and Corn Cob Feeds.*								
25233	Jersey Mixed Feed. Indiana Mill. Co., Terre Haute, Ind.	*New Haven:* J. T. Benham Est.	9.19	5.15	11.69	16.10	54.71	3.16	$23.00
25270	Jersey Mixed Feed. Indiana Mill Co., Terre Haute, Ind.	*Danbury:* F. C. Benjamin & Co.	9.12	5.11	11.88	15.27	55.03	3.59	23.00
----		Average guaranty	----	----	**12.00**	----	----	**3.00**	----
25416	Blue Grass Mixed Feed. A. Waller & Co., Henderson, Ky.	*Winsted:* Theo. Wachter	8.98	3.99	12.31	15.47	56.32	2.93	27.00
----		Guaranty	----	----	**9.00**	----	----	**2.00**	----
----		Average of these 4 analyses	**9.08**	**4.74**	**11.91**	**16.14**	**54.89**	**3.24**	**24.75**
----		Average digestible	----	----	**7.5**	**4.5**	**39.0**	**3.0**	----
	Proprietary Horse Feeds.								
25286	Sucrene Horse and Mule Feed. American Milling Co., Chicago	*Thomaston:* L. E. Belmer	9.73	7.59	11.63	10.64	56.65	3.76	30.00
----		Guaranty	----	----	**10.00**	----	----	**3.00**	----
25258	Horse Feed. Buffalo Cereal Co., Buffalo, N. Y.	*Stamford:* W. L. Crabb	8.87	3.42	12.19	8.51	61.62	5.39	31.00
----		Guaranty	----	----	**10.00**	----	----	**4.00**	----
25231	Bonnie Horse Feed	*So. Norwalk:* Manuel T. Hateh	9.63	2.87	10.75	8.02	64.78	3.95	31.00
----		Guaranty	----	----	**14.00**	----	----	**4.00**	----
25331	Algrane Horse Feed. The H. O. Co., Buffalo, N. Y.	*New Britain:* C. W. Lines Co.	7.65	4.02	10.63	10.10	62.91	4.69	30.00
----		Guaranty	----	----	**12.00**	----	----	**4.50**	----
25410	Sugarota Horse Feed. North West Mills Co., Winona, Minn.	*Torrington:* F. U. Wadhams	9.45	6.58	10.81	16.19	53.51	3.46	32.00
----		Guaranty	----	----	**12.00**	----	----	**3.00**	----
25405	Schumacher's Special Horse Feed. Quaker Oats Co., Chicago	*New London:* P. Schwartz Co.	8.06	3.12	9.00	9.02	66.50	4.30	29.00
----		Guaranty	----	----	**9.00**	----	----	**3.00**	----
	Proprietary Dairy and Stock Feeds.								
25287	Sucrene Dairy Feed. American Milling Co., Chicago	*Thomaston:* L. E. Belmer	8.75	7.72	15.63	12.78	51.87	3.25	29.00
----		Guaranty	----	----	**16.50**	----	----	**3.50**	----
25251	Union Grains, Ready Ration. The J. W. Biles Co., Cincinnati, O.	*New Canaan:* C. H. Fairty	7.80	4.51	24.25	8.83	46.27	8.34	34.00
25291	Union Grains, Ready Ration. The J. W. Biles Co., Cincinnati, O.	*Waterbury:* D. L. Dickinson & Son	7.72	5.08	24.31	9.43	46.23	7.23	34.00
----		Guaranty	----	----	**24.00**	----	----	**7.00**	----
----		Average of these 2 analyses	**7.76**	**4.79**	**24.28**	**9.13**	**46.25**	**7.79**	**34.00**
25376	Calf Meal. Blatchford's Calf Meal Fact., Waukegan, Ill.	*Willimantic:* H. A. Bugbee	9.32	5.36	28.13	5.26	46.76	5.17	70.00
----		Guaranty	----	----	**25.00**	----	----	**5.00**	----
25240	Unicorn Dairy Ration. Chapin & Co., Buffalo, N. Y.	*New Haven:* R. G. Davis	7.91	3.39	24.50	9.52	46.62	8.06	32.00
25280	Unicorn Dairy Ration. Chapin & Co., Milwaukee, Wis.	*Bethel:* Johnston & Morrison	7.68	4.38	25.13	8.82	47.05	6.94	33.00
----		Guaranty	----	----	**26.00**	----	----	**5.50**	----
----		Average of these 2 analyses	**7.80**	**3.88**	**24.82**	**9.17**	**46.83**	**7.50**	**32.50**

TABLE III.—ANALYSES OF COMMERCIAL FEEDS SAMPLED IN 1910.

Station No.	Brand.	Retail Dealer.	Pounds Per Hundred.						Price per ton.
			Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
	MIXED FEEDS—*Continued.* *Proprietary Dairy and Stock Feeds.*								
25318	Wirthmore Stock Feed. Chas. M. Cox Co., Boston, Mass.	*Meriden:* Grain & Feed Co.	7.52	3.26	9.63	7.90	64.07	7.62	$32.00
----		Guaranty	----	----	**9.00**	----	----	**4.00**	----
25353	White Cross Stock Feed. Albert Dickinson Co., Chicago	*Hartford:* Smith Northam Co.	9.66	2.12	10.00	4.09	69.99	4.14	31.00
----		Guaranty	----	----	**10.00**	----	----	**3.50**	----
25366	Daisy Dairy Feed. The Great Western Cereal Co., Chicago	*Manchester:* G. W. Kuhney	6.15	7.65	15.50	14.33	54.19	2.18	28.00
----		Guaranty	----	----	**15.00**	----	----	**3.00**	----
25365	Gregson Calf Meal. The Great Western Cereal Co., Chicago	*Manchester:* G. W. Kuhney	7.83	5.72	27.94	4.74	46.99	6.78	50.00
----		Guaranty	----	----	**25.00**	----	----	**5.00**	----
25327	Sterling Stock Feed. The Great Western Cereal Co., Chicago	*Meriden:* A. Grulick	7.86	3.98	10.25	11.14	61.50	5.27	29.00
----		Guaranty	----	----	**10.00**	----	----	**4.00**	----
25397	Stock Feed. W. H. Haskell & Co., Toledo, O.	*Norwich:* Chas. Slosberg	7.36	3.31	9.44	7.03	65.64	7.22	27.00
---		Guaranty	----	----	**8.00**	----	----	----	----
25223	Algrane Milk Feed. The H. O. Co., Buffalo, N. Y.	*Bridgeport:* Standard Feed Co.	8.70	4.90	19.13	12.18	51.89	3.20	31.00
----		Guaranty	----	----	**14.00**	----	----	**4.00**	----
25308	New England Stock Feed. The H. O. Co., Buffalo, N. Y.	*Plainville:* G. W. Eaton Est.	6.80	4.40	9.94	12.05	60.80	6.01	30.00
----		Guaranty	----	----	**9.00**	----	----	**4.00**	----
25260	Husted Dairy Feed. Husted Mill. Co., Buffalo, N. Y.	*Stamford:* H. S. Bellinger	9.48	5.96	22.50	6.47	50.19	5.40	32.00
----		Guaranty	----	----	**20.00**	----	----	**4.00**	----
25259	Mayflower Stock Feed. Husted Mill. Co., Buffalo, N. Y.	*Stamford:* H. S. Bellinger	9.64	3.41	9.19	6.52	65.31	5.93	25.00
----		Guaranty	----	----	**7.50**	----	----	**3.50**	----
25222	Zenith Stock Feed. Husted Mill Co., Buffalo, N. Y.	*Bridgeport:* Standard Feed Co.	9.63	2.95	10.81	5.26	66.12	5.23	29.00
----		Guaranty	----	----	**10.00**	----	----	**4.00**	----
25328	Badger Dairy Feed. Chas. A. Krause Mill Co., Milwaukee, Wis.	*Meriden:* A. Grulick	9.80	8.14	19.06	12.54	47.12	3.34	28.00
----		Guaranty	----	----	**16.00**	----	----	**3.50**	----
25360	Sugarota Calf Meal. North West Mills Co., Winona, Minn.	*Thompsonville:* H. K. Brainard	9.73	4.30	26.56	4.58	48.71	6.12	70.00
----		Guaranty	----	----	**25.00**	----	----	**6.00**	----
25334	Sugarota Milk Meal. North West Mills Co., Winona, Minn.	*New Britain:* Stanley Svea Grain Co.	8.00	8.86	25.44	11.37	43.30	3.03	32.00
25400	Sugarota Milk Meal. North West Mills Co., Winona, Minn.	*Westerly:* C. W. Campbell Co.	7.81	7.78	25.00	11.89	44.05	3.47	27.00
----		Guaranty	----	----	**25.00**	----	----	**6.00**	----
----		Average of these 2 analyses	**7.90**	**8.32**	**25.22**	**11.63**	**43.68**	**3.25**	**29.50**
25228	Schumcher's Stock Feed. Quaker Oats Co., Chicago	*Norwalk:* Holmes, Keeler & Selleck Co.	8.77	4.18	11.13	9.20	62.70	4.02	27.00
----		Guaranty	----	----	**10.00**	----	----	**3.25**	----

TABLE III.—ANALYSES OF COMMERCIAL FEEDS SAMPLED IN 1910—*Concluded.*

Station No.	Brand.	Retail Dealer.	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.
	MIXED FEEDS—*Concluded.*									
	Proprietary Dairy and Stock Feeds.									
25299	Schumacher's Calf Meal. Quaker Oats Co., Chicago	*Hamden:* I. W. Beers	25299	8.34	2.55	19.69	1.54	59.55	8.33	$31.00
		Guaranty	-----	----	----	**19.00**	----	-----	**8.00**	-----
25319	Wirthmore Balanced Ration Feed. St. Albans Grain Co., St. Albans, Vt.	*Meriden:* Grain & Feed Co.	25319	8.79	4.46	26.31	8.21	46.78	5.45	32.00
		Guaranty	-----	----	----	**26.00**	----	-----	**5.00**	-----
25290	Economy Feed. Tioga Mill and Elev. Co., Waverly, N. Y.	*Waterbury:* D. L. Dickinson & Son	25290	7.54	3.01	10.94	14.32	59.88	4.31	27.00
		Guaranty	-----	----	----	**10.00**	----	-----	**5.00**	-----
	Proprietary Poultry Feeds.									
25322	Wirthmore Growing Feed. Chas. M. Cox Co., Boston, Mass.	*Meriden:* Grain & Feed Co.	25322	10.95	1.96	12.94	2.91	68.15	3.09	38.00
		Guaranty	-----	----	----	**15.00**	----	-----	**5.00**	-----
25323	Wirthmore Poultry Mash. Charles M. Cox Co., Boston, Mass.	*Meriden:* Grain & Feed Co.	25323	9.33	3.87	13.94	8.23	60.25	4.38	38.00
		Guaranty	-----	----	----	**12.00**	----	-----	**3.00**	-----
25248	Algrane Poultry Feed. The H. O. Co., Buffalo, N. Y.	*New Haven:* Abner Hendee	25248	9.68	3.78	15.88	7.03	58.78	4.85	37.00
		Guaranty	-----	----	----	**17.00**	----	-----	**5.50**	-----
25336	Poultry Feed. Husted Mill. Co., Buffalo, N. Y.	*New Britain:* Stanley Svea Grain Co.	25336	10.25	3.93	14.88	7.03	59.72	4.19	39.00
		Guaranty	-----	----	----	**12.00**	----	-----	**4.00**	-----
25333	Sugarota Scratch Feed. North West Mills Co., Winona, Minn.	*New Britain:* Stanley Svea Grain Co.	25333	10.32	1.53	10.25	1.98	71.88	4.04	39.00
		Guaranty	-----	----	----	**12.00**	----	-----	**3.50**	-----
25309	Dry Mash Feed. Park & Pollard Co., Boston, Mass.	*Plainville:* G. W. Eaton Est.	25309	8.83	13.61	23.19	4.01	47.19	3.17	45.00
		Guaranty	-----	----	----	**20.00**	----	-----	**3.00**	-----
25391	Growing Feed. Park & Pollard Co., Boston, Mass.	*Danielson:* Quinebaug Mills	25391	10.20	6.85	13.50	2.58	62.85	4.02	44.00
		Guaranty	-----	----	----	**14.00**	----	-----	**3.00**	-----
25335	American Poultry Feed. Quaker Oats Co., Chicago	*New Britain:* Stanley Svea Grain Co.	25335	9.14	3.19	12.81	4.81	63.88	6.17	39.00
		Guaranty		----	----	**12.00**	----	-----	**3.00**	-----
25217	Dry Mash. Vincent Bros., Bridgeport, Conn.	*Bridgeport:* Vincent Bros.	25217	9.00	9.19	21.50	10.02	45.49	4.80	35.00

The variations in the amounts of digestible fat supplied in the different groups are comparatively small, except in the third group. The differences in the other two food compounds, however, 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 fertilizers, 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 protein. But even if he wishes to buy starchy food, he can get more for the same money in group three than in four, and nearly as much as in five. Considering that he gets from two to three times as much protein together with nearly the amount of carbohydrates in group three as in groups five and six, the economy of buying these very low protein foods even for the starchy matter in them is more than doubtful.

In this era of high prices practical economy demands that the feeder shall give the closest attention to the cost of the feeds he buys. The table shows that for prices ranging from $26 to $28 per ton he may buy feeds containing from 8.19 to 29.50 per cent. of protein. Again for $32 he may buy feeds ranging from 9.63 to 32.00 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.

PART IX.

TENTH REPORT

OF THE

STATE ENTOMOLOGIST OF CONNECTICUT

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

I hereby transmit my tenth annual report as state entomologist of Connecticut. The work has been conducted along the same lines as last year, and shows an increasing amount of inspection and control work, due chiefly to the discovery on December 14, 1909, of a gypsy moth colony at Wallingford; to the apiary inspection work imposed upon this office by the last General Assembly; and to the increase in the imports of nursery stock into the state.

The financial report is for the state fiscal year ending September 30th, but the remainder of the report covers the calendar year of 1910.

Respectfully submitted,

W. E. Britton,

State Entomologist.

REPORT OF THE RECEIPTS AND EXPENDITURES OF THE STATE ENTOMOLOGIST FROM OCTOBER 1ST, 1909, TO SEPTEMBER 30TH, 1910.

Insect Pest Account.

RECEIPTS.

From E. H. Jenkins, Treasurer	$3,000.00	
Account of 1908, balance	1,151.86	
Sale of lantern slides and electrotypes	3.65	
		$4,155.51

EXPENDITURES.

For field, office and laboratory assistance	$1,976.26
Printing and illustrations	354.90
Postage	51.23

Stationery	$ 8.50	
Telegraph and telephone	3.60	
Express, freight and cartage	39.24	
Library	171.50	
Laboratory apparatus and supplies	145.44	
Spraying supplies	14.35	
Office supplies	53.98	
Traveling expenses	244.55	
Balance, cash on hand	1,091.96	
		$4,155.51

Gypsy Moth Control Account.

RECEIPTS.

From E. H. Jenkins, Treasurer	$4,150.00	
Account of 1909, balance	410.22	
		$4,560.22

EXPENDITURES.

For salary of superintendent, and labor	$3,725.66	
Printing	77.00	
Tools and supplies	498.42	
Express, freight, and cartage	30.58	
Traveling expenses	210.61	
Balance, cash on hand	17.95	
		$4,560.22

Memorandum:—This account of the state entomologist has been duly audited by the State Auditors of Public Accounts.

PUBLICATIONS BY THE ENTOMOLOGIST, 1910.

The Official Entomologist and the Farmer. *Journal of Economic Entomology,* Vol. III, p. 12. 8 pages.

Report of Committee on Injurious Insects, W. E. Britton, Chairman. Read at the annual meeting, February 3, 1910. Report of the Connecticut Pomological Society, 1910, p. 145. 4 pages.

Ninth Report of the State Entomologist (Part IV of the Station Report for 1909-1910); 52 pages, 9 text figures, 16 plates; 9,000 copies distributed in May, 1910.

Notes of the Season in Connecticut. *Journal of Economic Entomology,* Vol. III, p. 434. 2½ pages.

Spraying to Destroy the San José Scale in Connecticut. *The National Nurseryman,* March, 1910, p. 510.

The Gypsy Moth in Connecticut. *Guide to Nature,* June, 1910, p. 84. 2 pages. (Illustrated.)

The following articles were printed in the *Connecticut Farmer* under the dates given below:

White Grubs in Grass Lands. February 19, 1910.

Elm Leaf Beetle. April 2, 1910. (Also issued as a correspondence slip.)

Canker Worms. April 9, 1910. (Illustrated.)

Progress of the Gypsy Moth Work at Wallingford. April 9, 1910.

The Bud Moth *Tmetocera ocellana* Schiff. May 21, 1910.

Cutworms. June 4, 1910. (Also issued as a correspondence slip.)

Some of the More Important Insects Found in Connecticut. June 11, 1910. (Illustrated.)

The Maple Borer. July 9, 1910. (Illustrated.)

The Gypsy Moth Infestation at Wallingford. July 16, 1910. (Illustrated.)

A Pest of Birch Trees in Connecticut, *Bucculatrix canadensisella* Chamb. September 24, 1910.

DEPARTMENT STAFF.

W. E. BRITTON, PH.D.	*State and Station Entomologist.*
B. H. WALDEN, B.AGR.	*Assistant.*
DONALD J. CAFFREY, B.AGR.	*Assistant.*
ALFRED B. CHAMPLAIN	*Assistant.*
MISS E. B. WHITTLESEY	*Stenographer.*

Mr. G. H. Hollister, who for three years has had charge of the gypsy moth work, was appointed to a more lucrative position in Keney Park, Hartford, and left this department about October 15th, 1909. He is now foreman of Keney Park. Mr. Donald J. Caffrey, a graduate of the Massachusetts Agricultural College, was secured and took charge, on January 24th, of the gypsy moth work at Wallingford, which was continued until the last of August, when Mr. Caffrey was transferred to the work of inspecting nurseries until November 1st, when he returned to the gypsy moth work.

Mr. Alfred B. Champlain, formerly of the laboratory of the Economic Zoölogist at Harrisburg, began his duties as assistant April 1st. He has assisted in the inspection of imported nursery stock and of the Connecticut nurseries, and has made a number of charts and drawings and done considerable work on the insect collection, as he is a specialist in the family Carabidæ of the beetles.

Mr. B. H. Walden has continued as general assistant, and has had charge of the work of the office in my absence. He has also done most of the photographic work of the department. Miss Elizabeth B. Whittlesey has also continued her work as stenographer, assisting each morning in the correspondence and the necessary indexing and filing of the office. During her absence Miss K. E. Flynn and Miss M. K. Falsey were each employed for a short time. All of the persons mentioned have rendered satisfactory services, and their work is appreciated.

Chief Lines of Work.

The work of this department has been conducted along lines similar to that of last year, and shows an increased amount of inspection and control work, due principally to the discovery on December 14th, 1910, of a gypsy moth colony at Wallingford; to the apiary inspection imposed upon this office by the last General Assembly, and to the increase in the imports of nursery stock into the state. Nursery and orchard inspection has been carried on as usual.

In addition to the inspection and control work which is described in the following pages, this department has coöperated with the botanical department in conducting a series of experiments in the spraying of apple and peach orchards in summer to control their various insect and fungous enemies. About 350 apple trees in seven different orchards, wlth 75 others reserved as checks, and 125 peach trees in three different orchards, with half as many checks, were under experimentation. An account of this work in detail, with the results obtained, has been published as Part VII of this report.

A number of commercial insecticides, mostly lime and sulphur preparations for destroying San José scale, have been tested in a small way, and similar tests have been made with some of these mixtures in destroying the eggs of plant lice on apple trees.

The entomologist is now preparing a check list of the insects which have actually been collected in Connecticut.. This will be published by the Geological and Natural History Survey of the state. Mr. Walden's paper on the Orthoptera of the state, finished some time ago, is now in press and will soon be issued as Bulletin 16 of the Survey. The paper on the Hymenoptera, prepared some time ago by Mr. Viereck, must await the action of the General Assembly before it can be published, as the funds for publishing will be exhausted before it can be reached.

The brown-tail moth has made its appearance in this state at Thompson and Putnam, and some scouting and spraying has been done because of it.

Brief studies have been made on two kinds of moths, the caterpillars of which we found on imported nursery stock from Japan; a Phorid fly infesting onion seeds in the germinator; a lepidopterous larva feeding on barberry; also observations on the 15-spotted lady beetle, birch bucculatrix, elm leaf beetle, San José scale, canker worms, and the various injurious and beneficial species that are sent for identification and that we run across in our field work.

Where such studies are in any sense complete, or where new facts have been brought out, the matter has been given more extended notice in the following pages.

Summary of Inspection and Office Work.

326 samples of insects received for identification.
47 orchards and gardens examined for insects.
47 nurseries inspected.
44 certificates granted. One certificate revoked.
707 boxes, bales and packages imported nursery stock examined.
208 apiaries containing 1,595 colonies inspected.
158 apiaries containing 793 diseased colonies found infested with European foul brood disease.
44 second inspections made.
1,881 letters written on official work.
61 packages sent out.
17 addresses made before granges, farmers' institutes and village improvement associations.

Exhibits.

As part of the general exhibit of the station this department exhibited insects and their work at five agricultural fairs during the fall. Beginning September 6th and ending October 8th, going to a different place each week, exhibits were made at Norwich, Willimantic, Rockville, Berlin and Danbury. Though much time was required to prepare these exhibits, they were seen by thousands of people, many of whom learned for the first time of the entomological work of the station.

The exhibit of the entomological department contained many pinned specimens illustrating the more important orders or groups of insects, including butterflies and moths, dragon flies, beetles, grasshoppers, crickets, flies, bees, bugs and scale-insects. There was also one case each devoted to gall insects, garden insects, fruit insects, forest insects and beneficial insects. Several life history sets of well-known insect pests and common species were shown, as well as large charts of the former, and a number of insecticides and spray nozzles.

The gypsy moth, against which the state of Massachusetts has expended nearly $2,000,000, and which is present in Connecticut at Wallingford and Stonington, was the subject of a part of the exhibit, and was accompanied by figures showing the results of the work in Connecticut.

A feature of the exhibit which usually attracts attention was the living caterpillars and mosquito larvæ or wrigglers, and many paused to look at the latter and expressed their surprise to learn that they turn into mosquitoes—but the proof was before them. The exhibit of insects was also supplemented by over one hundred photographs of insects and their work, and by some of the publications of the state entomologist.

New Quarters.

The entomological department moved June 20th, 1910, into its new quarters on the second floor of the new brick addition, for the building and equipment of which the last General Assembly made an appropriation of $30,000. Much better facilities for work are now afforded than ever before. Including insectary, dark-room and storage closet, 1,500 square feet of floor space are now occupied by the department, apportioned as follows: Office and library, 14½ x 21½ ft.; collection room, 21½ x 27 ft.; laboratory, 19 x 22½ ft.; insectary, 6 x 16 ft.; and dark-room, 7½ x 8 ft. (both opening out of laboratory); storage closet, 4 x 7 ft. The office, collection room, laboratory and storage closet all open from the hall. The collection room is connected with both office and laboratory, and the latter is provided with closets, drawers, microscope tables, hood and sink. The collection room has three west and two north windows, and the laboratory has three north and two east windows, so that an abundance of north light is available. The rooms are heated by steam and lighted by both gas and electricity, and gas and electric outlets are conveniently arranged for all kinds of laboratory work. In the basement a room 21 x 26½ ft. is used jointly by the entomological and botanical departments for a display of insecticides, fungicides, pumps and spraying apparatus.

Entomological Features of 1910.

The season of 1910 brought a comparative scarcity of plant lice, and especially of the rosy apple aphis, which was so abundant and caused such damage to apple trees in Connecticut in 1909. In some orchards it was necessary to search a long time in order to find a single colony, and in no case did it cause injury. The 15-spotted lady beetle, *Anatis 15-punctata* Oliv., was extremely abundant, more so than I have ever seen it before, and from fifteen to twenty egg-clusters, containing altogether several hundred eggs, could be found on nearly every tree.

The green apple aphis, *Aphis pomi* DeG., was present in moderate numbers, as in 1909.

Canker worms, chiefly the fall species, *Alsophila pometaria* Harr., were abundant, and their devastation was widespread throughout the state on many different kinds of trees. It was especially noticeable, however, on apple trees, and many orchards were brown in early summer, as if scorched by fire. Mr. Champlain observed a large ground beetle, *Calosoma willcoxi* Lec., which was very abundant during the season, feeding upon canker worms, and some of the helpers on the station grounds saw a grey squirrel devour about forty canker worms on the trunk of an oak tree below the Tanglefoot band.

The elm leaf beetle, *Galerucella luteola* Müll., did a great deal of damage in certain parts of the State, especially in Thompson and in Glastonbury, according to reports received from correspondents. In some other places, however, like New Haven and Milford, where a careful and systematic spraying of the trees was practiced in 1909, the beetles were rather scarce, and some observers apparently thought that the pest was on the wane and would give us no further trouble. These towns and cities, however, sprayed their trees again in 1910, and the trees, especially in New Haven, presented a better appearance toward the end of the summer than for many years. The spraying should be continued.

Cut worms were especially troublesome, and much damage to tobacco fields and gardens in June was reported to this office.

June beetles were very abundant early in the season, as might be expected from the damage to grass lands in 1909 from white grubs. June beetles defoliated trees in the vicinity of New London.

Rose beetles were also present in rather more than their usual numbers, and caused the ordinary amount of damage in gardens and vineyards.

Sawfly larvæ of several uncommon kinds were observed feeding upon plants not usually attacked, and an attempt was made to rear the adults of several species. The peach sawfly, *Pamphilius persicum* MacG., defoliated many trees in some of the large peach orchards, and though I have not heard of any attempt to check its ravages by spraying, some of the orchardists are now planning to spray their trees in 1911 with lead arsenate to prevent a repetition of the injury.

Sphinx larvæ were scarce in 1910, and nearly all of those observed were strongly parasitized. This was particularly true of the common tobacco or tomato worm, as every caterpillar which we collected showed before pupation the cocoons of *Apanteles congregatus* Say.

The brown-tail moth, *Euproctis chrysorrhœa* Linn., made its appearance in the state at Thompson in April, and was later found at Putnam. For several years this pest has been known to be near the borders of our state in Massachusetts and Rhode Island, but until this season it has not been found in Connecticut except on nursery stock imported from France. On other pages of this report are given accounts of this insect, and its occurrence in Windham County and on imported nursery stock.

During the latter part of August and during September the birch trees known as the white, grey, or bobbin birch, were stripped of their leaves throughout the northern and eastern portions of the State. The insect causing this defoliation was the birch bucculatrix, *Bucculatrix canadensisella* Chamb., a pest of northern New England and found in certain seasons in Massachusetts and Rhode Island; but it has not during my residence of over sixteen years in Connecticut shown any such outbreak. A fuller account of this insect is included in this report.

The increasing damage to shade trees by the leopard moth, *Zeuzera pyrina* Linn., which is boring in the branches of various kinds of trees in the cities, should be mentioned here; also that of the woolly maple leaf scale, *Phenacoccus acericola* King, which in Connecticut confines its attacks chiefly to sugar maples. The sugar maple borer, *Plagionotus speciosus* Say, is still a serious pest of sugar maple shade trees in towns and cities. Over sixty adult beetles were taken from the trunks of the street trees of Wallingford last summer by the gypsy moth men during their work of turning bands.

The San José scale has apparently diminished somewhat in its virulence or powers of spread and injury. Several instances have come to my notice where old apple trees which were infested several years ago, and which I thought would be dead before this, have taken on a new lease of life, and on examining them I find very few living scales. There seems to be no particular natural enemy that is responsible for the welcome check in the spread of this hitherto serious and destructive orchard pest.

Cabbage loopers, *Autographa brassicæ* Riley, have been common during the season, and in some fields apparently did even more damage than the cabbage worm. The remedy, however, is the same.

Two kinds of insects, both lepidopterous larvæ, have been brought into this country on nursery stock from Japan. One, feeding upon a deciduous shrub resembling lilac, was reared, and the adult finally identified as *Hemiscopis cinerea* Warren, which is mentioned elsewhere in this report. The other was feeding upon a conifer, *Abies tomomi,* and was found in shipments sent to two Connecticut nurseries. The adult stage, however, was not obtained.

Inspection of Connecticut Nurseries.

The inspection of growing nursery stock was commenced September 1st, and completed about November 1st. It was done by Messrs. Walden, Caffrey, Champlain and Britton.

On the whole the nurseries were in better condition as regards the scale than for several years. This is probably due to the increased care and attention given the growing nursery stock by some nurserymen and to the diminished power of multiplication of the San José scale.

The list of nurserymen changes slightly from year to year. This year's list contains forty-two names as against forty-seven last year and forty in 1908. Of these, six have been dropped, though three of them may receive certificates when they have carried out the directions of the state entomologist in regard to the treatment of infested stock. One has been added since last year, and another nursery has changed hands. Altogether forty-eight nursery inspections were made during the year, forty-four certificates were granted, and one of these was revoked on account of the nurseryman moving his business elsewhere.

The list follows:

List of Nursery Firms in Connecticut Receiving Certificates in 1910.

Name of Firm.	Location.	Certificate issued.	Number of certificate.
Atwater, C. W.	Collinsville	Oct. 7,	383
Barnes Bros. Nursery Co.	Yalesville	Oct. 13,	386
Beattie, Wm. H.	New Haven	Nov. 12,	412
Bowditch, J. H.	Pomfret Center	Sept. 24,	376
Brainard, D. Wm. & C. F.	Thompsonville	Nov. 12,	409
Braley & Co., S. A.	Burnside	Oct. 4,	382
Brooks Bros.	Westbrook	Oct. 1,	379
Burroughs, Thos. E.	Deep River	Sept. 30,	378
Burr & Co., C. R.	Manchester, Buckland, Durham,	Sept. 20,	374
Chapman, C. E.	North Stonington	Oct. 27,	399
Comstock & Lyon	Norwalk	Oct. 24,	396
Conine Nursery Co., The F. E.	Stratford	Oct. 8,	384
Conn. Agricultural College	Storrs	Nov. 5,	408
Conn. Agr. Experiment Station, Forest Nursery (S. N. Spring, State Forester, New Haven)	New Haven and Rainbow	Nov. 12,	411
Conway, W. B.	New Haven	Oct. 24,	398
Cross Highway Nurseries	Westport (2)	Oct. 22,	394
Dehn & Bertolf	Greenwich	Oct. 14,	387
Dwyer, John E.	Manchester	Sept. 15,	373
East Rock Park Nursery (G. X. Amrhyn, Supt.)	New Haven	Sept. 20,	375
Elm City Nursery Co,	New Haven	Sept. 27,	377
Fernwood Nursery	Stamford	Oct. 20,	390
Hale, J. H.	So. Glastonbury	Nov 2,	405
Houston & Sons, J. R.	Mansfield Depot	Nov. 3,	407
Hoyt's Sons Co., Stephen	New Canaan	Oct. 3,	380
Hubbard & Co., Paul M.	Bristol	Oct. 28,	401
Hunt & Co., W. W.	Hartford	Oct. 21,	392
Kelsey & Sons, David S.	West Hartford	Dec. 22,	415
Keney Park Nursery (G. A. Parker, Supt.)	Hartford	Dec. 8,	413
Mount Carmel Forest and Nursery Co.	Mt. Carmel	Nov. 2,	406
North-Eastern Forestry Co.	Cheshire and East Haven	Oct. 27,	400
New Haven Nursery Co.	New Haven	Oct. 18,	388
Phelps, J. Wesson	Bolton	Nov. 2,	404
Pierson, A. N.	Cromwell	Oct. 13,	385
Platt Co., The Frank S.	New Haven	Oct. 28,	402
Purinton, C. O.	Hartford	Dec. 12,	414
Rosemore Nursery Co.	Litchfield	Oct. 24,	395
Schleichert, F. C.	Bridgeport	Oct. 20,	391
Schoonman, W. J.	Danielson	Oct. 24,	397
Scott, J. W.	Hartford	Oct. 22,	393
Sierman, C. H.	Hartford	Nov. 12,	410
Vidbourne & Co., J.	Hartford	Oct. 19,	389
Woodruff, C. V.	Orange	Oct. 29,	403

INSPECTION OF IMPORTED NURSERY STOCK.

By W. E. Britton and B. H. Walden.

On account of our experience the previous year (see Report of this Station for 1909-10, page 328) in finding nests of the brown-tail moth on nursery stock imported from France, and in the continued absence of any system of Federal inspection of such stock, in order to protect the state from wholesale and rapid infestation with this most undesirable pest, an attempt was made to inspect all woody nursery stock brought into Connecticut during 1910. We were notified of many shipments by Dr. L. O. Howard of the Bureau of Entomology at Washington, and of others by Mr. George G. Atwood, who has charge of the nursery inspection work in the State of New York. Thanks are due to both these men for many courtesies extended to us in this matter. There were some shipments, however, which we could not trace, and some arrived unheralded and were duly inspected. The total amount of nursery stock imported into Connecticut in 1910 was more than twice that of 1909, according to our records of the stock examined.

On January 31st, 1910, the following letter was sent to every Connecticut nurseryman:

New Haven, Conn., Jan. 31, 1910.

Dear Sir:—Last winter 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 this winter these nests have been found on rose stock from France brought into New York State, and 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 during the fall or winter not already inspected, 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.

In reply to this letter the nurserymen as a rule promptly notified this office of the arrival of stock, and some of them put themselves to much inconvenience and furnished labor at considerable expense to aid the inspection work. There were a number of small packages consigned to private places which were planted out or distributed among friends, and could not be examined. The inspection work was done by Messrs. Walden, Champlain and Britton, and of course a large proportion of this stock arrived in March and April. In all 707 boxes, bales and packages were examined, coming from nine different countries. Fewer brown-tail nests were found than last year, but fourteen of these were found in five cases of pear, apple and rose stocks brought into three Connecticut nurseries in widely separated localities. The nests came from three different French nurseries—André Leroy, Angers, two nests on pear; Franco-American Seedling Company, Angers, nine nests on apple; and E. T. Dickinson, Chateny, three nests on *Rosa multiflora.*

All stock from the infested boxes was dipped, root and branch, in Scalecide (1–20), and all the packing material was treated in the same way or else burned to destroy any caterpillars which might have crawled from the nests.

In addition to the brown-tail nests, two shipments of ornamental stock from Japan contained living caterpillars, one of *Hemiscopis cinerea* Warren (described elsewhere in this report) on a deciduous shrub resembling lilac, and an undetermined larva feeding on *Abies tomomi* and appearing to be capable of doing considerable damage.

The inspection of this imported stock required an amount of time equivalent to one man's work for more than two months.

One man could not have examined it all, however, without great delay and in some cases serious injury to some of the stock. In the rush of the season the services of three men were required on some days, all in different nurseries.

Sources of Imported Nursery Stock.

Holland	376
France	104*
Belgium	91
England	63
Japan	26
Scotland	19
Ireland	18
Germany	9
Russia	1
Total	707

INSPECTION OF APIARIES.

The last General Assembly made provision for the inspection of Connecticut apiaries on account of the diseases known as "foul brood," and the inspection work was placed in charge of the state entomologist. The law took effect at the beginning of the fiscal year, October 1st, 1909, but it was too late to make any inspection of apiaries until the following spring. Following the provisions of the act, however, inspectors were appointed as follows: Mr. A. W. Yates of Hartford for the northern half of the state, including Litchfield, Hartford, Tolland and Windham counties: Mr. H. W. Coley of Westport for the southern half, including Fairfield, New Haven, Middlesex and New London counties.

The full text of the act is as follows:

An Act Concerning the Suppression of Contagious Diseases Among Bees.

Chapter 185 Public Acts of 1909.

Section 1. *Duty of state entomologist to act on complaint.* For the purpose of suppressing contagious or infectious diseases of the honey bee, it shall be the duty of the state entomologist, when complaint is duly made, to examine and verify, and treat or destroy cases of foul brood among honey bees.

* Five cases of stock from three French nurseries, shipped to three Connecticut firms, were infested with fourteen nests of the brown-tail moth.

SEC. 2. *Authority to appoint inspectors and to examine apiaries.* In pursuance of the provisions of this act, the state entomologist or any person whom he may appoint for that purpose shall have access at reasonable times to such apiaries or places where bees are kept and where honeycomb and appliances are stored as may be designated in any such complaint.

SEC. 3. *Authority to make regulations.* The state entomologist is authorized and empowered to prescribe suitable forms for and make regulations regarding such complaints, and shall keep the same on file and open to public inspection; and he is further authorized and empowered to make, in his discretion, reasonable rules to govern, and reasonable payments for the services of agents whom he may appoint to carry out the provisions of this act.

SEC. 4. *Obstruction illegal. Penalty.* Any person who impedes, resists or hinders the state entomologist or any agent whom he may appoint in the performance of the duties imposed by this act shall be fined not more than twenty-five dollars.

SEC. 5. *Provision for defraying expenses.* To carry out the provisions of this act the necessary expenses, to an amount not exceeding five hundred dollars, shall be paid by the comptroller on duly accredited vouchers.

Approved August 2, 1909.

Though inspections can be made only on complaint a man can sign a complaint against his own apiary, and this was done in perhaps a majority of cases. The complaints were sufficient to exhaust the appropriation during the first season. The inspections began the last week of April and were finished by the end of August. In all 208 apiaries, containing 1,595 colonies or hives of bees, were inspected. Of this number 158 apiaries and 793 colonies were found infested with European foul brood, *Bacillus alvei.* In all cases the inspector either treated the diseased colonies or instructed the owner how to treat them. If in the last stages, the colonies were usually destroyed by fire, but if only slightly diseased, the bees were shaken out on to new frames and foundation and placed in a clean hive, and the old hives and sometimes the frames were disinfected by scorching. The second inspections showed great improvement, and in most cases entire freedom from the disease.

The European foul brood was thus found in twenty-five towns of the state. In seven towns where inspections were made no diseased colonies were found, but in these cases only one or two, or at most but a few apiaries were inspected. So it is not fair to assume that the foul brood does not exist in these towns, as further work is almost certain to reveal it. So far, most of

the inspecting work has been done in Fairfield, Hartford and Windham counties. Very few inspections have been made in Middlesex, New London and New Haven counties, and none in Litchfield and Tolland counties. It is probable, however, that considerable foul brood will be found in nearly all parts of the state as soon as anyone looks for it. Other portions of the state will be examined as soon as additional funds are available for the work.

A card catalogue in duplicate, one arranged alphabetically and one by towns, is on file in this office. It is desirable to have this catalogue as complete as possible, and it should contain the name and address of every beekeeper in the state. All records available, such as number of colonies, date and result of inspections, etc., are placed on these cards for future reference. We therefore request all readers to coöperate by sending in names of beekeepers known to them, especially those who are not members of the Connecticut Beekeeper's Association.

SUMMARY OF APIARY INSPECTION.

	Apiaries	Colonies
Number, first inspection	208	1,595
Infested with European Foul Brood	158	793
Number, second inspections	44	
Number of towns containing diseased bees	25	
" " where disease was not found	7	
Money expended		$499.85
Average cost per apiary		2.40

Other troubles reported by the inspectors:

Paralysis	2 cases
Spring Dwindle	2 "
Wax Moth	1 case
Poisoned from sprayed trees	3 cases

CONTROLLING THE GYPSY MOTH IN CONNECTICUT.

WALLINGFORD INFESTATION.

The discovery of the gypsy moth at Wallingford in December, 1909, was recorded in my last report. (See Report of this Station for 1909-10, page 337.) Immediate steps were taken to eradicate the scourge, and at first helpers from the station were sent to creosote the egg-masses which were in plain sight in order to destroy them before the eggs were scattered. On January 24th Mr. Donald J. Caffrey took charge of the field work as superintendent, and resided in Wallingford through the spring and summer. He was given authority to hire and discharge whomever he saw fit, under certain regulations. At first he employed but few men, and worked with them, teaching them how to do the different parts of the work. As opportunity offered, other men were taken on, and the best ones retained. There was pruning and scraping, carting and burning of brush, filling and tinning of cavities, in connection with the trees and fences, rubbish and outbuildings to overhaul during the winter, besides a careful examination of the entire village and the surrounding country to ascertain the limits of the infested area. Mr. Caffrey did much of the scouting himself, besides looking after the men, and the results of the work are largely due to his faithfulness and thoroughness.

It may be stated here that no infestation has been found outside of the village of Wallingford, though much hunting has been done by state and Federal scouts, and the map on page 339 of the last report still shows very accurately the location of the infestation. The only change to be made is in extending the area in its southern portion eastward across Fair Street to Elm Street. According to computations made by Mr. R. W. Bolton, the area in Wallingford actually infested with the gypsy moth equals only 0.378 of a square mile. In the summer the trees throughout the infested section and in a surrounding zone were banded with burlap to trap any stray caterpillars or to catch those hatching from any egg-cluster which might have been overlooked. Some of these bands were turned each day during the caterpillar season, and all were examined frequently, and all caterpillars found were destroyed. Nearly all of the trees known to be infested were sprayed with arsenate of lead to kill the caterpillars feeding upon the foliage, in the hope of making sure of some in this way that might escape the bands.

Tree Tanglefoot bands were applied to many trees for the purpose of preventing the caterpillars from going up or down the trunk or branch of the tree. This material is effective in many cases where it is impossible or impracticable to catch the caterpillars under burlap or by spraying with poison. There

are sometimes egg-masses in cavities of trees or holes in fences which cannot be reached or covered, and by placing a band of Tanglefoot entirely around the spot, the young caterpillars are caught in it on leaving the nest for their food. Thousands of young caterpillars were killed in this way.

At the end of the caterpillar season in August, the bands were removed from the trees and all work suspended until November 1st, when the leaves were off the trees and scouting for egg-masses could be done to advantage.

I wish to express here my hearty appreciation of the spirit of coöperation which was manifested by the town and borough officers, who supplied help in the first days of the work; furnished storage room for tools and supplies; loaned us ladders, and caused several back yards to be cleared of rubbish. The residents and property owners generally have shown interest in the matter and have coöperated with us. Nearly all seemed anxious to help clean up the infested territory, and this work was greatly furthered by the efforts of the Village Improvement Association, which culminated in a "clean-up day" on March 25th, when much rubbish was carted to the Whittlesey Avenue dump and burned under the direction of our men. The only hindrance encountered was from an insane man on Franklin Street, who drove the men off his grounds and tore the bands from his trees, but he was removed to a retreat early in the season, and after that his trees were properly treated.

Scouting for Egg-masses.

As the egg-clusters were very abundant in the worst infested centers, nearly 6,000 were found and destroyed by the station helpers during the first two weeks of the work at Wallingford. Then a heavy snow prevented effective work for a month. This first work had been hurried, as it was important that all exposed egg-clusters be treated at once so that if they were broken and the eggs scattered, as was sure to happen with some of them, the eggs would not hatch. Birds undoubtedly break open some of the clusters, and those on the trunks of trees are often scattered by boys scraping them off or by horses rubbing against them. Many of those first found in Wallingford had been broken and the eggs scattered in this manner. When Mr. Caffrey and his men began, therefore, most of the prominent egg-masses had been found and creosoted, but it was necessary to hunt for them in cavities of trees, under fence rails, under verandas, in tin cans, and in various out-of-the-way places. This work was done very thoroughly, and kept up until May 1st, when it was time for the eggs to hatch. Three or four large shellbark hickories south of Center Street near Whittlesey Avenue were found to be infested with egg-masses, most of them being on the under sides of the loose pieces of bark or "shingles," and discovered only after these were removed from the tree. Two such trees had about 400 egg-clusters on each.

One apple tree on Prince Street contained ninety-seven egg-masses and thirty-seven were found between the old boards of a patched fence on Williams Street. Some of the egg-masses were in singular places. One was found on the shade or cover of an incandescent electric street light, and a hollow branch of a pear tree (shown on Plate XXIII, a) having a crack on one side contained forty-nine egg-masses, one of which was deposited upon the side of a small hornet's nest in the hollow.

In all 8,234 egg-masses were found and destroyed. Mr. Caffrey was continually scouting, not only during the destruction of the egg-masses but throughout the caterpillar season.

In addition to the scouting done by the state men, three Federal scouts were placed in Wallingford February 9th, and later the number was increased to five. These scouts covered the territory under authority from this office granted by the legislature in Section 2, Chapter 114, of the Public Acts of 1907, page 666, which reads as follows:

"The state entomologist shall have authority to suppress and exterminate said gypsy and brown-tail moths, and may employ such assistants and laborers as he deems expedient; may cut and burn brush and worthless trees in fields, pastures, or woodlands, or along the roadsides on any public or private grounds; and may prune, spray, scrape, or fill cavities in any fruit, shade or forest trees, or clean up any rubbish for the purpose of furthering said work. The said state entomologist, or any of his assistants, deputies, agents, or employees, shall have the right, at all times, to enter any public or private grounds in the performance of their duties."

The Federal scouts examined the entire region around the village where our men had not gone over the ground. They spent the entire season scouting, and covered the whole town of Wallingford except in the center of wooded areas; Meriden, both city and town; Berlin; New Britain; New Haven; parts

of Orange, including West Haven; East Haven, Branford and North Haven; and are at the time of this writing scouting around the city of Hartford and the town of Newington, and expect to cover the territory northward on both sides of the river to the Massachusetts line. In all this scouting work no gypsy moth infestation was found outside of the village of Wallingford. Another force of Federal scouts covered a portion of the northeast corner of the state, including the towns of Thompson, Putnam, Pomfret and Woodstock. In all probability the pest will soon spread into this part of the state from the nearby infested territory of Massachusetts and Rhode Island, as is the case with the brown-tail moth, as described on page 683 of this report.

Commencing November 1st, Mr. Caffrey and three men examined the entire infested area in Wallingford, but though a careful search was made, only twenty-three egg-masses could be found.

Pruning and Scraping Trees.

Many vacant lots in Wallingford contain apple trees, some of them being the remnants of old orchards on the land before it was cut up into building lots. Such trees have not been cared for, and at the beginnning of the gypsy moth suppression work were crowded with living and dead branches, cavities and water sprouts. Nearly every back yard also contained one or more fruit trees, and though many of these were in good condition, some had been neglected like those on the vacant lots, and all needed more or less attention. These trees were first pruned, all dead branches were removed, then such living ones as might be necessary to the best growth of the tree and enough to let light and air into its top. All wounds were painted over with dark green or brown paint. A few property owners burned their own brush, but hundreds of loads thus removed had to be disposed of, and most of it was carted to the dump on Whittlesey Avenue and burned after drying slightly. Then all rough loose bark was scraped from the trunks and larger branches, care being taken not to injure the cambium, but leaving no upturned edges of bark under which caterpillars could hide.

Most of the trees thus treated were on private property, and where the owners were not likely to take any action, and in most cases did not know what to do. Few street trees were pruned in this way by men on the force, but some of the street trees were pruned by men employed by the warden of the borough, Mr. William E. Becroft. Altogether over 900 trees were pruned by men employed by the state in order to make it possible to do effective work in controlling and suppressing the gypsy moth in Wallingford.

Hedge around Cemetery.

The Norway spruce hedge around the cemetery was infested with egg-masses along the Center Street side. The egg-clusters were not only on the trunks and branches, but also on the small twigs, and even on dead leaves in the tops of the trees. The growth of these trees was extremely thick in the tops, which had been sheared each year, and it was impossible to treat the egg-masses without destroying this portion of the hedge.

Many of the trees had died, rendering the hedge unsightly, and as it was close to the street and trolley line and high enough to obscure the view of approaching teams, automobiles and trolley cars at the corner, and as several accidents had occurred, some of the citizens asked us to remove the hedge. A conference was held with the town and borough officials, and it was finally decided to remove the hedge along the Center Street side of the cemetery and for a few feet back on Orchard and Colony streets, so as not to obstruct the view at these corners. On April 18th the hedge was removed for a distance of 875 feet, containing 148 trees. The trees were sawed off close to the ground, lifted upon a wagon and carried to the dump, where they were trimmed. All egg-masses found on the trunks and branches were creosoted and all of the small brush burned.

The hedge on the other three sides of the cemetery (over 2,000 feet and containing 340 trees) had lost its lower branches, making it unsightly. These were cut off, carted away and burned, together with all dead leaves and other rubbish under the hedge. Several loads of tin cans also had to be removed.

It has since been decided by the local authorities to widen the street against the cemetery and to build a wall in place of the hedge.

Covering and Filling Cavities.

Many of the trees that were pruned also needed attention in other directions. Deep or shallow cavities, hollow trunks or

branches and broken and torn limbs all provided hiding places for caterpillars and had to be eliminated before thorough and effective work could be done. Wherever possible all cavities were covered with patches of tin, closely fitted and nailed to the wood and painted dark green or brown, to make them inconspicuous. This is much less expensive than to fill the cavities with cement concrete, but in some cases where the margins were ragged and uneven, or where it was desired to prevent the exit of any caterpillars hatching from undiscovered egg-masses which might possibly be in the cavity, the latter treatment was used. One part of the best Portland cement was mixed with three parts sand and five parts crushed stone, and in large cavities brick or larger stone was used to help fill the opening. Several large and irregular cavities in the street trees on Center Street were filled in this way. These trees were in such shape as to make moth extermination impossible without treatment, and a thorough job was done, partly as an object lesson. Some of the tin patches have been injured by thoughtless or careless persons puncturing holes in them, so that they must be renewed, thus increasing the cost of the work.

In all twenty-seven large cavities were filled with cement and 1,959 were covered with tin patches.

Fences and Walls.

Mention has already been made of an old fence between Williams and Meadow streets which had been patched up with boards from time to time until it scarcely resembled a fence. As this was in the worst infested center in the town, and many egg-masses were found and creosoted on the outside of it, it was necessary to overhaul it in order to destroy the eggs which were almost sure to be found between the boards. This was done on April 15th, and thirty-seven egg-masses were found. The old fence was taken away entirely and a new fence of wire netting built in its place.

On Franklin Street a retaining wall had been built of old railroad ties at the rear of a residence, and close beside it stood one of the large hickory trees which have already been mentioned as being badly infested. This wall made an excellent place for caterpillars to crawl in where they might transform and the eggs be laid entirely out of our reach. We had planned, therefore, to cover the face of the bank with wire netting and plaster it up with cement mortar to keep out the caterpillars. The owner, hearing of this, wished to build a permanent wall, and asked us to help toward it instead of making temporary repairs which would be of no benefit to him. A sum equal to the cost of the wire and plaster work was therefore paid, and a tight permanent stone wall was built. Some plaster work and pointing up was done on the next lot, making the bank wall safe against further infestation.

Banding Trees with Burlap.

All trees throughout the infested area and in a wide zone around it were banded with burlap during the month of May. This means that all fruit, shade and ornamental trees growing within the area covered by the map shown on page 339 of the report for 1909, and some further southwest and east, were banded. In all, this amounts to about 10,000 trees, and 2,493 yards of burlap were required. The eight-ounce grade was used, and it was purchased cut in eight-inch strips ready to apply. It was fastened to the trees with jute twine, about 102 pounds being used.

Banding Trees with Tanglefoot.

In the most densely infested portion of the area, bands of a sticky substance known as "Tree Tanglefoot" were placed around the trunks to prevent the crawling up of caterpillars, many of which might be expected to hatch from the eggs scattered upon the ground. The Tanglefoot was smeared upon the bark at a convenient height, and served to catch thousands of small caterpillars. This material remained sticky for several weeks, but had to be combed over occasionally to prevent it from becoming hard enough for insects to cross. Tanglefoot was also used on many fence posts, and was placed on a large sheet of paper around the hollow pear limb shown on Plate XXIII, a, and all the caterpillars were caught in it as soon as they hatched and tried to crawl away. Many of these bands had to be renewed. In all 365 trees were thus treated, requiring 120 lbs. of Tree Tanglefoot.

Spraying with Poison.

Most of the trees in the worst infested section were sprayed with arsenate of lead, 5 lbs. in 50 gallons of water. The trees sprayed were mostly in yards and in the cemetery, though street trees were sprayed on Williams, Orchard, Union and Franklin streets, Whittlesey Avenue and between Main and Elm streets. In fact, they were sprayed in all of the badly infested spots.

The remaining portion of the hedge, nearly half a mile in length, was thoroughly sprayed twice. Hundreds of shrubs, rose bushes, and vines were also sprayed. Most of the spraying work was done by J. Taylor, who was employed with a team for half of each working day. Some hand work was done by the other men, however, as the small wheel outfit enabled them to go into back yards for small jobs without a team. From the dead caterpillars observed on the leaves of small trees in back yards, we know that the poison killed hundreds and probably thousands of them.

Some of the elm trees of the borough were sprayed by the Village Improvement Association, and by property owners to prevent the ravages of the elm leaf beetle. Though this work was not directed against the gypsy moth, it all helped toward controlling that pest.

Over 200 street and back yard trees, exclusive of those in the cemetery hedge and the shrubs and vines, were sprayed by our men, and 768 lbs. of lead arsenate was used.

Destroying Caterpillars.

The men employed to turn bands were supplied with small forceps and small stoppered jars or bottles containing denatured alcohol or gasolene. All caterpillars found were dropped into the liquid and brought to the tool house, each man reporting each day and showing his catch.

The first egg-mass to hatch was one inside the tool house, which commenced hatching on March 30th. The first caterpillars were observed out of doors on April 18th, but they were not found under the burlap bands until May 27th, when they were about an inch long. The most taken in one day was 1,312 on June 14th. The last one was gathered on August 5th, and in all 8,936 caterpillars were destroyed at burlap bands and on the trunks of the trees, exclusive of those killed by spraying and by the Tanglefoot. Some of the caterpillars pupated, and ninety-five cocoons were found and destroyed.

Food Plants of the Caterpillars at Wallingford.

Gypsy caterpillars are known to feed upon nearly six hundred different kinds of plants, yet they have a choice, and when they are able to exercise it they have a much shorter *menu*. At Wallingford they were observed by Mr. Caffrey to feed upon the following trees and plants: Apple, pear, plum, cherry, quince, rose, wild cherry, maple, hickory, chestnut, elm, sycamore, willow, poplar, spruce, larch, grape, wistaria and lettuce.

Natural Enemies.

No natural enemies of the gypsy moth were noticed at Wallingford except in one case, when some caterpillars were gathered and one had twenty-five white Tachinid eggs on its back. This was placed in a separate jar, and after feeding, in due time pupated, but the adult moth never emerged. On September 1st a large two-winged fly appeared in the jar, and this was identified by Mr. C. W. Johnson as *Tachina mella* Walk., a species previously recorded as being parasitic upon the gypsy moth in Massachusetts. The gypsy moth cocoon was closely packed with Tachinid puparia, but no other flies emerged and evidently they could not get out.

Observations.

While working in a tree, one of the men, Mr. R. W. Bolton, observed a gypsy caterpillar crawling along a telephone cable which passed through between the branches of the tree. This method of spreading may account for the caterpillars appearing in certain trees where all egg-masses had been destroyed and a Tanglefoot band placed around the trunk. Telephone wires passed directly from infested trees into these described.

Mr. Caffrey found an unusually large egg-mass on August 22d, which had apparently been laid at one time by one female, and on counting, it was found to contain 1,485 eggs.

The first hatching of eggs was in the tool house on March 30th. Outside the first caterpillars were observed on April 18th and first taken under bands on May 27th. The first pupa was found on June 23d, and the first adult female July 7th.

Tool Houses.

As quarters were needed for storing tools, pumps and supplies, and as a place for the men to report each morning, Mr. Becroft, warden of the borough, kindly placed at our disposal a basement room under the town hall, which was used throughout the season. This point was central and near the trolley lines. For the storage of poison, pumps, etc., space was allotted us in a large storehouse used by the borough near the steam railroad.

Force Employed.

Except for the first two weeks before Mr. Caffrey took charge, local men were employed. For the scouting and pruning not many men were needed, but in the summer, when there was pruning, cavity work, spraying, turning bands and applying burlap and tanglefoot, more help was necessary, and as many as eighteen men were employed, while the least number working at any time was five.

Cost of the Work.

Up to the end of the calendar year of 1910 the total amount of money expended by the state for the suppression and control of the gypsy moth at Wallingford was $3,823.34. The last General Assembly appropriated the sum of $10,000 for this work for the biennial period ending September 30th, 1911.

A considerable sum has also been expended by the Federal authorities for scouting in this part of the state, but the exact figures are not at hand at the time of this writing.

The work at Wallingford is summarized below, but the figures do not include the thousands of young caterpillars killed by spraying and by the Tanglefoot bands, or the hundreds of trees in the spruce hedge of nearly half a mile in length around the cemetery, all of which were sprayed twice.

SUMMARY OF THE GYPSY MOTH WORK AT WALLINGFORD, 1910.

Egg-masses destroyed	8,234
Trees banded with burlap	10,000
Trees banded with Tanglefoot	365
Trees pruned	904
Cavities filled with cement	27
Cavities covered with tin patches	1,959
Trees sprayed with poison	219
Caterpillars destroyed at burlap bands	8,936
Cocoons destroyed	95
Number of trees found infested	248
Amount of lead arsenate used, lbs.	768

Amount of Tanglefoot used, lbs.	120
" " burlap used, yds.	2,493
Number of men employed—maximum—	18
" " " " —minimum—	5
Cost of state work at Wallingford	$3,823.24

Stonington Infestation.

The work here was in charge of Mr. Horace Niles Trumbull, a student of Union College, who has been employed on the work for two or three seasons under Mr. Hollister. As Mr. Trumbull could not commence work until about the second week in June, he arranged that the banding of the trees should be done by Mr. J. E. Fairbrother, who was familiar with the work on account of having assisted in it in 1909.

As only ninety-eight caterpillars were found in 1909, much the smallest number since the discovery of the infestation in 1906, and as the combined efforts of state and Government scouts revealed but a single egg-mass in December, 1909, it was expected that few, if any, caterpillars would appear in the summer of 1910. But evidently one egg-mass had been overlooked, for during the summer 146 caterpillars were found and destroyed by our men. It was considered necessary at the beginning of the season to band and spray trees, and in fact manage the whole matter exactly as if caterpillars were known to be present, so the banding was done in the usual manner. No caterpillars were found until June 17th, when Mr. Trumbull noticed one feeding on some foliage in the yard of Mr. Koelb of Elm Street. A careful search was made, and over sixty were found and destroyed that afternoon. The grass, raspberry bushes and other vegetation along the wall were cut and burned, and the wall burned out with oil. All other vegetation in the yard was sprayed with lead arsenate. Later a few caterpillars were found at the Stanton place and at Mr. Darrell's, and all the trees and shrubs in the vicinity of those infested on both places were sprayed. The bands were examined for several weeks after any caterpillars were found.

Mr. Trumbull did much scouting for caterpillars outside of the yards infested. As in 1909, no caterpillars were found at Walnut Grove, though all the trees there were banded and a sharp watch was kept for them. The first cocoon was found July 14th.

Brush and weeds were cut and burned in several places, but it was not necessary to do much pruning or cavity work, as this had all been done in previous years. All bands were removed and the work closed on August 20th.

Following is a summary of the season's work at Stonington:

Summary of the Gypsy Moth Work at Stonington.

Egg-masses destroyed	1
Trees banded with burlap (approx.)	6,500
Trees banded with Tanglefoot	105
Trees sprayed (mostly small) (approx.)	200
Number of trees found infested	20
" " places found infested	5
Caterpillars destroyed	146
Amount of lead arsenate used, lbs.	100
" " Tanglefoot used, lbs.	40
" " oil used, gallons	25
" " burlap used, yds.	1,226
Number of feet of stone wall burned out	900
" " men employed—maximum—	5
" " " " —minimum—	3
Cost of season's work at Stonington	$588.58

The total cost to the state of all suppression work against the gypsy and brown-tail moths and in inspecting imported nursery stock in Connecticut for the past year has been $4,542.27. In addition to this the Federal authorities have expended $4,817.74 in scouting different parts of the state.

THE BROWN-TAIL MOTH IN CONNECTICUT.

In two previous reports of this station (see Reports for 1902, page 165, and for 1907, page 313) as well as in Bulletin 153, page 8, information has been given regarding the brown-tail moth, *Euproctis chrysorrhœa* Linn., but at the time that these publications were issued that insect had not been found in Connecticut, all reports to the contrary notwithstanding. Several newspapers have reported its presence, but whenever the reports were investigated, the insect always proved to be some other species or else the report could not be traced to its source and the responsibility for it fixed. On April 6th, 1910, specimens of nests and dead caterpillars were received from Mr. Richard Barton of Thompson, with the following letter:

Dear Sir:—I am mailing to you under separate cover in a box some caterpillars' nests found near the highway on a pear tree by one of Mr. H. L. Frost's men, who was doing some pruning in this village. He thought it was the brown-tail, and so I took them and carefully cyanided them and sent them to you for identification. I really hope that they are not brown-tails, as we have not yet been troubled with them in this section. However, if you find that they are, if you will kindly let me know at once I will see what I can do to have a search made in the village with a view to stamping them out.

Yours very truly,

RICHARD BARTON.

The insect proved to be the brown-tail moth, and Mr. Barton was notified to that effect. The information came at a time when all the men were very busy, and imported nursery stock was arriving daily, and of course had to be inspected at once. Messrs. Walden and Champlain visited the place on May 4th and hunted for nests and for the work of the caterpillars. Mr. Walden made notes as follows:

"Looked up Mr. Barton, who is manager of the estate of Norman B. Ream. He stated that a Mr. Lynch, foreman for the H. L. Frost Company, found the nests on a pear tree on the place of E. S. Backus, which adjoins the Ream estate. Mr. Barton took us to the place and showed us the tree. The end of a branch for two or three feet showed insect work, and a web not unlike that of the tent caterpillar was seen on the branch, but on examining the caterpillars they were found to be those of the brown-tail moth. Nests were seen on a pear tree near the side of the barn and on two apple trees at the rear of the house. Upon examining trees in near-by yards, nests were found on trees in two yards on the other side of the street. They were found on one tree 400 to 500 feet from where first found. About 12 nests in all were seen.

"Apple, pear and cherry trees were examined on the road towards Rhode Island for about one-third of a mile, and no nests were found. We examined the trees on the road towards Massachusetts for about a mile. Apple trees were generally well covered with blossoms, and other trees were coming into leaf, so that it was rather difficult to find nests.

"On May 10th, went up to Thompson and sprayed the trees where brown-tail moth nests were found. Used 13 lbs. Swift's lead arsenate, 6½ lbs. to the barrel (about 50 gallons). Mr. Barton furnished two men, pump and team to do the work. It was very windy, but the trees were sprayed as thoroughly as possible under the conditions."

About a month later, two nearly full-grown dead caterpillars were received from Professor George H. Lamson, Jr., of the Agricultural College at Storrs. These were handed to him by Mr. J. H. Osgood, who found them feeding upon fruit trees at Putnam. On June 15th Mr. Walden visited Putnam and met Mr. Osgood, who boarded at Mr. E. Williams', 157 Elm Street, where he found the caterpillars on trees in the yard. Mr. Osgood had previously sent some of the nests to a Willimantic paper. He showed Mr. Walden around the place where he had observed the insect and its work. A pear tree in the yard of Mrs. Thurber, at 143 Elm Street, was nearly defoliated, and is shown on Plate XXXI, b. Two pear trees in a yard on the corner of Buck Street and three or four blocks west of Elm Street, were found infested, and a pear tree near a blacksmith's shop just west of Elm Street showed the work of the caterpillars. On School Street, east of the railroad and some distance from Elm Street, the work of the insect was apparent in two yards. In two other yards on the same street pears and apples were found infested. Mr. Walden made an effort to learn the extent of the territory infested rather than to discover all of the infested trees within that area.

At this time most of the caterpillars had pupated, so that spraying was not attempted.

In November, Mr. D. M. Rogers, special field agent of the Bureau of Entomology, in charge of preventing the spread of the gypsy and brown-tail moths, wrote that his men, who had been scouting Thompson, Putnam and Pomfret, found brown-tail nests in Thompson and Putnam, and at the latter place the nests were rather abundant on fruit trees in the yards about the town.

These infestations in Thompson and Putnam are probably on the edge of the area generally infested, which has nearly reached Connecticut for two years in both Massachusetts and Rhode Island. Mr. Rogers reports that his scouts have also found the pest at Wilbraham, Mass., which is just east of Springfield, and of course the infestation may extend all the way to Putnam. During the winter much scouting will be done in this locality, and all nests found will be destroyed. It is hoped also that scouting may be done along the state line from Thompson westward to the Connecticut River and southward to the Sound. 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 is not such a serious pest of vegetation as the latter, though very troublesome to humans on account of the poisonous and irritating hairs that break off from the caterpillars and adults.

As this insect is now present in Connecticut, a description of its different stages and its injury is given here, so that people may recognize it.

The Adult Moths.

Both sexes have the same color and markings, but the male is smaller than the female and has a more slender abdomen. Both pairs of wings are pure white, as is the thorax and a part of the abdomen, but the rear end of the body bears a tuft of

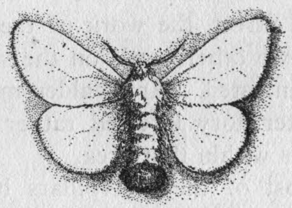

Fig. 10. Female Brown-tail Moth, natural size.

brown hairs which are rubbed off from the female in the process of egg-laying and incorporated with the eggs, and give the egg-cluster a reddish brown color. The female has a wing expanse of one and one-half inches, while that of the male is somewhat less, perhaps one and one-fourth inches. The male has feather-shaped antennæ, tinged with brown, and the forewings are edged with brown on the under side. The female has wings that are white on both sides, and the antennæ are white and much smaller than those of the male.

Both sexes fly, and fairly swarm around electric lights in a badly infested section at the time of their emergence in July. On account of the ability of the females to fly, it is difficult to exterminate an isolated colony. Sometimes, if there is a

storm during the flight of the moths, they are driven with the wind long distances. Many dead moths are found in the globes of the arc lights. The female is shown in Fig. 10.

The Egg Stage.

The eggs are usually laid in oval clusters of from 200 to 400 eggs each, and on the under side of a leaf. The eggs are laid the first three weeks of July, and the masses are reddish

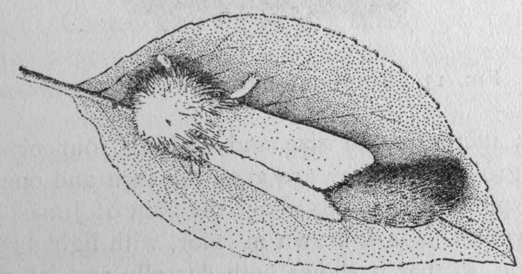

Fig. 11. Egg-mass as laid on leaf by brown-tail moth, natural size.

brown from the hairs of the female moth, and about three-fourths of an inch long. The eggs are spherical, and yellow in color. They hatch in from fifteen to twenty days after being deposited. The appearance of the egg-mass is shown in Fig. 11.

The Caterpillar.

The young caterpillars, after hatching from the eggs late in July or early in August, feed at first on the leaf containing the

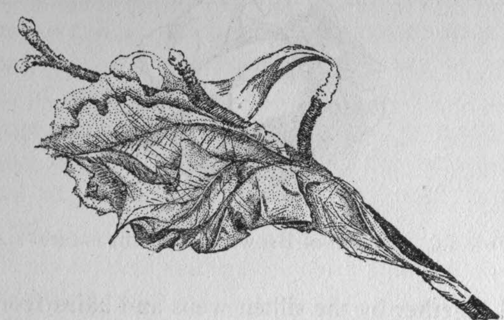

Fig. 12. Winter nest of brown-tail caterpillars, natural size.

egg-mass, but later other leaves are devoured. In September a number of leaves are drawn together and fastened and lined with the silk spun by the caterpillars, making a nest (see Fig. 12) in which the larvæ spend the winter, a hundred or more sometimes living in one nest. The larvæ emerge in spring and feed upon the leaves which first appear, and continue to devour

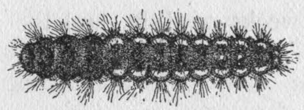

FIG. 13. Brown-tail caterpillar, natural size.

the foliage, increasing in size and molting four or five times until fully grown, and they are about an inch and one-half long when they spin their cocoons about the 20th of June.

The caterpillar is dark brown in color, with light brown hairs. On each side, so that it shows both dorsally and laterally, there is a row of white tufts, one on each segment, and appearing as an interrupted white band when seen from above. On each of the ninth and tenth segments there is a small red tubercle bearing hairs. (See Fig 13.)

THE COCOON.

The cocoon is usually made between folded leaves or in the crevices of the bark or some other sheltered place and is shown in Fig. 14. The pupæ are commonly found in masses more or less

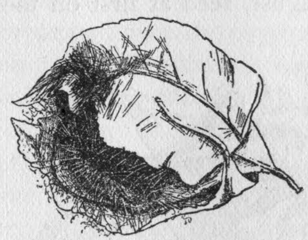

FIG. 14. Cocoon of Brown-tail Moth, natural size.

loosely held together by the silken webs and hairs from the caterpillars. This stage lasts about twenty days, depending somewhat upon the weather conditions.

METHODS OF CONTROLLING THE BROWN-TAIL MOTH.

The gypsy moth eggs, after being deposited, remain for about nine months before hatching, and this is much the longest period of any stage of the insect's existence. But with the brown-tail moth the egg state lasts only between two and three weeks, and the larva or caterpillar stage is the long period, during which the important control work must be done. Caterpillars occur on infested trees from August 1st until the latter part of the following June. Control measures are chiefly of two kinds—destroying the winter nests, and spraying the foliage with poison to kill the caterpillars.

Scouting for winter nests should be done when the trees are bare, and any kind of tree pruner with a long handle is advised. The nests are nearly always at the extremities of the twigs, and can be readily seen during the winter months. As they are clipped from the trees they should be gathered and burned. If left on the ground, the caterpillars inside them may keep alive and crawl upon the trees when warm weather comes in the spring.

After the leaves appear, the caterpillars are no longer found in the nests, and the only way of destroying them is to spray the foliage with poison. For this purpose lead arsenate should be used at the rate of 3 lbs. in 50 gallons of water for the young caterpillars, but 5 lbs. should be used against those nearly full-grown.

NATURAL ENEMIES.

The most important natural enemy of the brown-tail moth is a fungus, *Empusa aulicæ*, which in certain moist seasons destroys a large proportion of the caterpillars, which may be found dead on the trunks of trees and the stones of buildings and walls. Sometimes large numbers die in their nests. There are a number of native insect enemies and parasites of the brown-tail moth, besides several imported ones, which it is hoped may in time check this insect.

TESTS OF PROPRIETARY INSECTICIDES IN DESTROYING THE ROSY APPLE APHIS AND THE SAN JOSÉ SCALE.

By B. H. Walden.

The Rosy Apple Aphis.

Meriden Experiments. This orchard contained about one hundred and twenty bearing apple trees, and during the season of 1909 the rosy aphis caused considerable injury to the fruit. During the fall many aphid eggs were deposited on the fruit spurs and small twigs, indicating that the pest would again be present during the season of 1910. Plans were made to try late spring spraying to control the aphids. Word was received from the owner, March 30th, that the eggs were hatching, and on the following day spraying was commenced. Four rows of the trees were sprayed with Grasselli's lime and sulphur, 1 gal. to 11 gals. of water. The next two rows were sprayed with "One for All," 12 lbs. to 50 galls. water. On April 6th the remaining two rows were sprayed with Pratt's "Carboleine," 1 gal. to 8 galls. of water. The spraying was done as thoroughly as possible, using a large pump with the pressure averaging about 125 pounds.

The trees which were sprayed the week before were examined, and while many dead aphids were found, others were alive even on buds that were thoroughly coated with the lime and sulphur. Conditions were about the same where the "One for All" was used, though it was harder to tell if the twigs had been as thoroughly coated as those sprayed with the lime and sulphur.

As the season advanced the aphids disappeared from apple trees so that no final conclusions could be reached regarding the treatment.

Station Experiments. During the fall of 1910, eggs of the rosy aphis were observed on the small apple trees at the station. Rarely more than six or eight eggs were found on a twig, but from past experience, even where such small numbers have been present on the twigs of bearing trees, the aphids upon hatching will multiply sufficiently in a season favorable to their development to seriously check the growth of the fruit. The eggs were in crevices around the fruit spurs, or the buds and base of branches on the previous season's growth.

On November 30th eighteen of these trees were thoroughly sprayed with Niagara lime and sulphur, one part in eight parts of water, to note the effect on the eggs. Certain twigs were tagged where the eggs were most abundant. Some of these twigs, which were still well coated with the spray, were examined the first week in January. Most of the eggs were apparently alive, showing no effect from the treatment, although it will be necessary to examine the eggs at hatching time to learn the efficiency of the treatment.

San José Scale.

Meriden Experiments. In connection with the experiments against the rosy aphis in the Meriden orchard, the effect on the scale was also observed. This orchard had been sprayed in previous seasons to kill the scale, and while it was present, only a few trees toward the lower end of the orchard showed much scale in the spring of 1910.

The orchard was visited on November 15th and the effect of the treatment on the scale was noted. Very little living scale could be found on the trees sprayed with the lime and sulphur, and while there was less scale on these trees in the spring, considerable dead scale could be found at the time of examination.

Trees sprayed with "One for All" showed the most living scales. Two of these trees, which must have been well coated in the spring, had branches encrusted with them. The scales were present on the petioles of the leaves, and were noticed on the fruit at picking time.

Many living scales were found on the trees sprayed with "Carboleine," which was rather surprising, as the mixture was used much less dilute than is generally recommended.

A young orchard of apple and peach trees adjoining the one in which our experiments were conducted was sprayed with Grasselli's lime and sulphur during the later part of March. Here many of the trees were quite badly infested with scale, but in November very few living scales were seen.

Station Experiments. Five preparations were applied on April 13th to a block of small trees on the station grounds to note the effect on the San José scale. The trees, principally apple and peach, and moderately infested with scale, were set rather closely in rows about four feet apart. A screen was used to prevent the spray from blowing upon adjacent trees treated with different preparations. The buds were opening and a few leaves were out when the applications were made.

Grasselli's Lime and Sulphur. Used at the rate of 1 gal. to 11 gals. of water: Eighty-two trees were sprayed. No injury to the opening buds. No living scales on twigs examined June 30th.

Crowley's "Arbolineum." Used 1 part to 8 parts of water. Considerable injury to buds and young leaves showed the following day. No living scales on twigs examined June 30th. The trees showed the effect of injury throughout the season.

"One for All." Used at the rate of 12 lbs. in 50 gals. water. No injury to buds followed the treatment: 2.2 per cent. of living scales were found on twigs when examined June 30th.

Vreeland's Scale-Killing Compound. As no directions were given with this preparation, it was used at the rate of 1 gal. in 8 gals. water. Warm water was used, as it did not mix readily with cold water. This preparation did not injure the buds. When twigs were examined June 30th, 17.4 per cent. of the scales were found to be alive.

Bogart's Sulphur Compound was used 1 part to 15 parts of water. There was no injury to buds, but 2.7 per cent of the scales were found to be alive when the twigs were examined June 30th.

On November 30th, twenty-eight of the small apple trees were sprayed to kill the scale with Niagara lime and sulphur, 1 part in 8 parts of water. An examination of the scales February 28th showed 2.6 per cent. of the scales alive.

EXPERIMENTS ON STATION TREES, APRIL 13, 1910.

Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Percentage of Scales alive after treatment.
Apple Peach	69 13	Moderately infested " "	1 gal. Grasselli's Lime Sulphur 11 gals. water.	0.%
Apple Peach	22 14	" " " "	1 gal. Crowley's "Arbolineum" 8 gals. water.	0.%
Apple Peach	37 9	" " " "	1 lb. "One for All." 4 gals. water.	2.2%
Apple Peach	60 13	" " " "	1 gal. Vreeland's Scale Killing Compound 8 gals. water.	17.4%
Apple Peach	78 12	" " " "	1 gal. Bogart's Sulphur Compound 15 gals. water.	2.7%
Total	327			

A PHORID (*Aphiochæta rufipes* Meigen) INFESTING ONION SEED.

By B. H. WALDEN.

Specimens of a small maggot from the seed-testing department were brought into the laboratory on October 28th for determination. These were taken from onion seeds which had been put in the germinator to test their vitality. The maggots were first observed in three or four days, or soon after the seeds had begun to sprout. They soon ate out the interior of the seeds and were present in such numbers that it was impossible to obtain any data regarding the vitality of the seeds. Spinach and grass seeds which were in the germinator were not attacked, so the first supposition was that the onion seeds were infested when put in to test.

A re-test was made from the same lots of seeds (seven in number) and no maggots were found in these. A third test showed no infestation, which seemed to contradict the idea of the seed being infested before being placed in the germinator. The one in charge of the seed testing had not observed any similar insects in seeds before.

An examination of the germinator showed a chance for small insects to readily enter it through the slide provided for ventilation, and which was often open. Even the large door of the germinator was sometimes left open to lower the temperature.

All of the infested material was removed in the blotters to the entomological laboratory and placed under a bell-jar with the moisture and temperature regulated as far as possible to correspond with that of the germinator. The seeds and blotters were carefully examined to find the egg of the insect. One small oval white egg was found on a seed, and two similar eggs were found on the blotters. As these did not hatch it was not proven that these were the eggs of the insect.

In about ten days from the time the seeds were first placed in the germinator a number of the larvæ pupated.

The first adult emerged November 21st, twenty-four days after the pupæ were first observed, and proved to be a small two-winged fly, *Aphiochæta rufipes* Meigen. This insect belongs to the family Phoridæ, a group of flies, the larvæ of which infest decaying vegetable and animal matter, such as fungi, insect cocoons, dead caterpillars and snails, exhumed human bodies, etc. These flies are readily recognized, being quite small and very active. Many of them have the "hump-backed" appearance shown in the drawing representing this species, Fig. 15. The Phoridæ are separated by the peculiar wing venation and shape

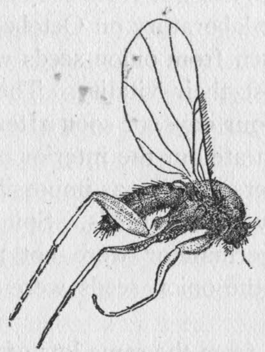

FIG. 15. Adult male of *A. rufipes,* enlarged.

of the antennæ. The above species is one of the more common and widely distributed species and is a very general feeder.

With the temperature of the germinator at about 86 degrees F. throughout the day and the excessive amount of moisture needed to start germination, caused the onion seed to give off an odor which would naturally attract insects of this nature. Seeds with no such fetid odor would naturally escape infestation by this insect. A number of these flies must have been present at the time the first lot of seed was placed in the germinator. After depositing eggs, the adults probably all died before the next lot of seed was started.

It was not learned how the insect was brought into the place though there was considerable dried vegetable matter in the laboratory, quantities of seeds, sacks with dried alfalfa hay, etc.

Egg. The egg found on the onion seed was shiny white in color, of an oval shape, tapering gradually toward the ends. Length .53 mm., width .019 mm.

Larva. General color, white, apparently caused by the fatty tissues seen through the transparent skin. Lateral edges nearly transparent. Length 3.79 mm., greatest width 1.017 mm., tapering toward either end, narrowing most toward the front. The segments not well defined, excepting when the larva crawls.

The first segment with two pairs of nearly equal, pointed tubercles which appear to be two-jointed. A lateral tubercle present on this and all other segments. Last segment with four tubercles corresponding to those on the first segment, the central pair smaller than the ones on either side. The second and third seg-

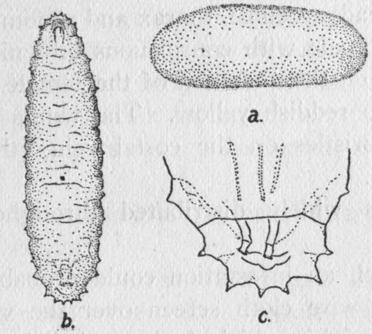

FIG 16. *Aphiochæta rufipes.* a, egg. b, larva. c, posterior extremity of larva.

ments with four small dorsal tubercles near their front margins. On the second segment back of the four tubercles is a pair of slender nearly black tubercles. The last segment is provided near its base with a pair of large, blunt, yellowish tubercles.

Pupa. Yellowish, changing to a dull brown color. About a week before the adult emerges the legs, antennæ, etc., can be

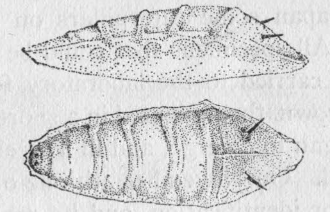

FIG. 17. Dorsal and lateral view of pupa of *A. rufipes* enlarged.

seen through the pupa skin. Length 3.17 mm., width 1.149 mm. The widest portion is at the apical fourth, from which it tapers sharply toward the apex, this part forming a triangle. It is narrowed much more gradually toward the rear with the anal end rounded, the four anal tubercles being well defined. The sides are depressed dorsally, forming a sharp margin. The thorax is provided with a pair of long slender black processes, corresponding to the pair of slender blackish tubercles, on the second segment of the larva. Laterally the pupa tapers more sharply toward the apex than it does toward the anal end. The general dorsal profile is more curved or bent than that of the ventral surface.

Adult. The head, antennæ, thorax and abdomen are black, the upper surface of male with conspicuous brownish black bristles which are absent on the abdomen of the female. The legs vary from brownish to reddish yellow. The wings are transparent, with very long bristles on the costal vein (the upper edge). Length 2.5–3 mm.

The species is widely distributed throughout the United States.

Remedies. Such an infestation could probably be prevented by having a fine wire cloth screen over the ventilator of the germinator. Material in which the insect is liable to breed should not be stored near the germinator.

A PYRALID CATERPILLAR ON NURSERY STOCK FROM JAPAN.

Hemiscopis cinerea Warren.

During the season of inspecting imported nursery stock on April 12th Mr. Walden found in a shipment of ornamental shrubbery from Japan some caterpillars on a deciduous shrub resembling lilac. All specimens that could be found were placed in a tight jar and carried to the laboratory for study. As they were nearly full-grown, they pupated in a short time. About June 10th the adults began to emerge, and in a week or so eight specimens had appeared. On November 4th one of these was sent to W. D. Kearfott for identification, and he replied in part as follows: "Your letter of the 4th with specimen of Japanese Pyralid safely received, and I have examined all of my literature trying to find the name of it and without success, and will have to send it to London for determination. The specimen is a female. Will you please look through any others you may have and see if you can find a male? If you will forward the male, I will send it over to Hampson, and he is usually very prompt in replying, so that you can expect action within a month."

Additional specimens were sent to Mr. Kearfott on November 21st. He acknowledged them, and sent a pair to Sir George Hampson. A month later Mr. Kearfott wrote: "I have just heard from the British Museum and secured the name of the Pyralid bred from Japanese nursery stock, which in your letter of November 4th you stated was lilac or some closely allied deciduous stock. The species is *Hemiscopis cinerea* Warren, belonging in the sub-family Pyraustinæ. This species was described in the Annals and Magazine of Natural History, Series 6, Volume IX, page 396, from Japan. It is referred to (by name only) by Hampson in Proceedings Zoölogical Society of London, page 223, 1889."

The following brief descriptions were drawn from the material studied in our laboratory.

Larva. About three-fourths of an inch long, one-tenth of an inch thick. Ground color cream or white, with a light salmon-pink spiracular stripe. Head light chestnut brown, shiny. Thoracic shield, legs, jaws and tubercles dark seal brown, shiny. Thoracic shield divided dorsally by a longitudinal whitish band or a continuation of the body color. The brown tubercles are arranged as follows: four rows show dorsally and the same number laterally, two above and two below the pinkish stripe. A bristle or hair is borne on each of the dorsal tubercles. Shown in Fig. 18.

Pupa. About seven-sixteenths of an inch long, about one-eighth inch thick. Color light brown. Enclosed in case of

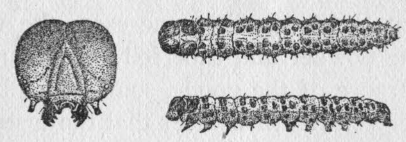

FIG. 18. *Hemiscopis cinerea*, dorsal and lateral view of larva, four times enlarged, and face of same, greatly enlarged.

particles of Sphagnum used for packing, and fastened together and lined with silk.

Adult. Wing-spread from seven-eighths to one inch. Color brownish, somewhat darker in the female, with a violet iridescence on upper surface of both wings: a darker V-shaped mark extending across both front and rear wing, as shown on Plate XXIX, c. Under surface unicolorous; t-p line and discal spot showing. Legs brown except tibiæ, which are covered with whitish scales. Head and body brown above. Under side of head and fourth, fifth and sixth abdominal segments bearing whitish hairs on the ventral side.

Letters were written to the Bureau of Entomology at Washington to learn whether or not this insect is regarded as a pest in Japan, but it seems not to have been mentioned in the accessible literature except the references given above. I have also written to Professor S. I. Kuwana of Tokyo, who states that *Hemiscopis cinerea* is rather uncommon in Japan, and that so far nothing is known about its life history and that it is not considered a pest there.

CARTRIDGE SHELLS RUINED IN TEXAS BY ANTS.

On February 23d, 1910, a box of paper shotgun cartridges which had been eaten apparently by insects, was sent to the station for examination and study by a manufacturer of cartridges, accompanied by the following statement: "These were returned by a customer in Texas. We do not know how long they had been in his possession, but they were loaded and shipped by us about November, 1906. Any information which you can give us in regard to the damage to these goods would be very much appreciated, and if there is any further information which we can supply you with to assist you in your investigations, please call upon us."

The cardboard shells, and in some cases the wads, had been eaten so that the powder and shot fell out and mixed together. From the appearance of the goods, some being badly eaten and others nearly perfect, it was evident that the insect had used the box of shells as a nesting-place rather than as a source of food.

One of the shells is shown on Plate XXIII, c.

After examining the injured material, the following letter was sent to the manufacturers in reply:

The samples of cartridges submitted by you, and showing the injury by some kind of insects, have been examined, and the letter of Feb. 23d was also received.

I have gone over the injured cartridges with considerable care, and from what I know about the injuries to some other articles by various kinds of insects, and from their appearance, I suspected at the start that it was caused by some kind of ants.

For instance, on each cartridge one can see where the ants have crawled up and down, having regular run-ways, corresponding to the interstices between the cartridges as packed in the boxes. A very careful examination of the debris gave me a portion of the rear wing of some kind of an ant, and also in another place I found an ant's head. These, of course, do not enable me to identify the species, but merely serve to show that the box has been infested by ants.

A few years ago a new kind of ant appeared in the vicinity of New Orleans, and caused great damage to all kinds of stored food products, as well as other articles of commerce. This ant has the peculiar habit of making its nest in almost any kind of material. In one case on record, a nest was found between the metal oil can and its wooden jacket. The ants therefore have used this box of cartridges as a nesting place, and the injury was not done on account of the food which they expected to obtain. At least this is my interpretation of it.

This particular species of ant which I refer to as being introduced around New Orleans is called the Argentine ant, and its scientific name is *Iridomyrmex humilis* Mayr. It is supposed to have been brought in some way in ship loads of coffee from South America, and has spread over the southern half of Louisiana, and no doubt has gone into Texas.

Of course I am not certain that this particular kind of ant did the injury, but it is very probable, and in case you wish to read up about the history and habits of this depredator, we have plenty of literature regarding it in our laboratory.

Since writing the above letter I have looked up the published articles on the Argentine ant to learn of its distribution. I have no knowledge that the species actually occurs in the state of Texas, yet it was reported by Newell* as being near the Louisiana-Texas line in 1908, having spread westward from New Orleans, where it was first seen in this country by Mr. Foster in 1891, and reported in literature by Titus in 1904.† It is entirely probable that the pest is now present in some parts of Texas, as its spread is liable to be rapid, especially if shipped with infested goods along the lines of the railroad. On the other hand, the cartridges may have been stored in Louisiana and have become slightly infested before they were shipped to Texas.

* *Journal Economic Entomology*, i, 21.

† Bureau of Entomology, Bull. 52, 79.

THE LEAF BLISTER MITE.

Eriophyes pyri Nal.

This pest is not an insect, but is a small animal belonging to the Arachnida, the same class containing the spiders. It is commonly known as the pear leaf blister mite, and forms small blisters or galls on the under sides of pear leaves in early summer. In bad cases the blisters are not wholly confined to the leaves, but sometimes occur on the soft twig-growth and on the fruit. At first the blisters are light green, but they soon turn red, and later brown, as the cell tissue dies in these spots. Where abundant, the injury causes the leaves to drop. This mite has long been known as a pest of pear, but only recently has it been recognized as an important apple pest on account of the serious injury which it has caused in the state of New York. It has there been studied by Professor P. J. Parrott, entomologist of the Agricultural Experiment Station at Geneva, who has found several other species causing similar blisters, and has described one of these as new. But none of these species do as much harm as *E. pyri,* and the practical orchardist need not consider them at all, as the method of controlling the pear leaf blister mite will also keep them in proper check.

During the past summer the work of this mite on apple was noticed on several trees in the orchard of E. M. Ives at Meriden, and Mr. Walden states that he saw it there in 1909. It has been sent to the station during the summer (on apple) from Litchfield, New Britain and Ellington. A sample was also received from Cummington, Mass., and from what the writer saw of it in western Massachusetts in August, it seems to be capable of considerable injury, as certain trees had lost at least one-third and possibly one-half of their leaves because of it. Much damage has been done by it in New York state, and it has caused more or less injury in Massachusetts, Pennsylvania, Illinois and Ontario, Canada. In New York state especially, the damage has increased to such an extent that for the past few years no insect attacking the apple, except the San José scale, has attracted more attention or provoked more discussion among growers than has the leaf blister mite. See Plate XXIII, b.

The mite passes the winter under the bud scales, and the most favorable times to reach it by spraying are in late fall after the leaves drop and in early spring before they appear. Professor Parrott's investigations regarding treatment were extensive, and were conducted in eleven different orchards. He found that the mites could be killed by spraying at the times mentioned above, either with a lime-sulphur mixture or with a miscible oil, but with the many excellent commercial lime-sulphur mixtures on the market, he prefers one of them to other forms of treatment. It will be seen that where this treatment is given to destroy the San José scale, it will answer for the leaf blister mite as well, and if on pear trees, the pear psylla will also be controlled.

A PEST OF BIRCH TREES IN CONNECTICUT.

Bucculatrix canadensisella Chamb.

Everyone traveling by steam or trolley cars in Connecticut during the months of August and September, 1910, has probably noticed the widespread defoliation of the slender white, grey, or bobbin birches (*Betula populifolia*) throughout the eastern part of the state. Especially was this devastation noticeable in Tolland and Windham counties, and I am told that it extended far into Rhode Island and Massachusetts. In the northern part of New London County, and especially around Norwich, this trouble was observed early in September. Over much of this area nearly every tree was stripped of leaves, and in some cases acres and acres of brush land presented a denuded appearance. In riding from Willimantic to New Haven via Hartford the trouble was not very noticeable south of Hartford, though trees here and there were attacked. The writer observed it at New Canaan and around New Haven, where an occasional tree was attacked and perhaps partially stripped, but most of the trees were uninfested. Messrs. Walden and Champlain observed the trouble at Cromwell and at Stratford.

The insect responsible for this condition of the trees is a small moth of the family *Tineidæ* called the birch bucculatrix, or birch leaf skeletonizer, *Bucculatrix canadensisella* Chamb. It is closely related to the apple bucculatrix or ribbed cocoon-maker of the apple, *B. pomifoliella* Clem.

The adult moth is brown, prettily marked with white, as shown in Fig. 19, and has a wing expanse of about three-eighths of an inch. The following description is by Dr. James Fletcher:

"Moth small, wings expanding ⅜ of an inch. General color, bright brown, the wings crossed with silvery white bars; three of these run from the outer edge about half way across the wings obliquely towards the apex, and there two shorter subtriangular blotches on the inner margin of each forewing. These latter, when the wings are closed, form two white dorsal saddles, the anterior of which is slightly the larger, and is followed closely by a tuft of raised black scales. At the extremities of

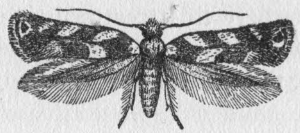

FIG. 19. *Bucculatrix canadensisella*, adult moth, greatly enlarged. (Redrawn from Packard, Insect Life, Vol. V, p. 14.)

the forewings are also several raised black scales, a few of which are separated into an apical spot by an irregular narrow white band. The cilia of the fringes are pale brown, head white; frontal tuft dark brown in the center; antennæ brown, slender, about ⅛ of an inch long. Thorax brown with margins, including the bases of the forewings, white. Legs and body pale fuscous, silvery."

Little appears to be known about the life history and habits of this insect, and no description of the egg could be found in its literature, though Dr. Felt mentions* the mining operations of the larvæ, which he states have not been observed. At the time the insects were feeding upon the trees I supposed that the species had been more carefully studied, and as we were busy, I neglected to make descriptions of the larval stages, though material was abundant. The caterpillars are only about a quarter of an inch long when fully grown. They are greenish yellow and feed upon both sides of the leaf, eating away the soft green tissue or parenchyma, leaving only the skeleton, which turns brown, and the leaf falls prematurely. There are many small circular whitish cocoon-like objects on both sides of the leaves. These are called pseudo or false cocoons, or molting cocoons, and serve as shelters during the molting period. The larva suspends itself by a thread when disturbed. The following description of the larva is taken from Packard's article in *Insect Life*:†

* Insects Affecting Park and Woodland Trees, p. 315.
† *Insect Life*, v, 14.

"*Larva.* Length 5 or 6 mm. The head is about two-thirds as wide as the body where thickest; it is pale honey-yellow. The body is long and slender, tapering regularly towards each extremity; the anal legs are rather large, project well behind the body, and diverge in creeping. The body is pale honey-yellow, with sometimes a slight greenish hue. The hairs are fine, scattered, arising from small pale warts; besides the four dorsal warts, which are arranged in a regular trapezoid, there is a lateral one visible on each side. The surface of the prothoracic segment is large and broad, though not so wide as the second thoracic segment; about six hairs project from the front edge. The segments are all very distinct, the sutures being deeply impressed, while the hinder edge of each segment is slightly raised and thickened. The second and third thoracic segments are much shorter than the prothoracic, while the first and seventh abdominal segments are longer, at least two-thirds, than the eighth. The ninth abdominal segment is much narrower than the eighth, and narrows posteriorly. There are four pairs of middle abdominal legs, and they are of the same color as the body. The oval cylindrical yellowish testes(?) are distinctly visible under the skin of the fifth abdominal segment."

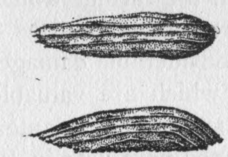

FIG. 20. Dorsal and lateral view of pupa of *Buccalatrix canadensisella*, five times enlarged.

The true cocoon (shown in Fig. 20) is about one-eighth of an inch long and nearly one-third as broad as long. The shape is that of a flattened cylinder with the ends curved downward, the surface being corrugated or ribbed. The number of ridges in our specimens varies from six in most cases to even eight in others. The cocoons are made on the birch leaves, though Packard records finding them on the leaves of wild cherry.*

The birch bucculatrix was noticed injuring yellow birches in New York state in 1886, and again in 1891. In Canada, and in Massachusetts and Rhode Island from 1890 to 1892, it did considerable damage to grey, paper and yellow birches. Felt† states that it was very abundant in New York state in 1901, and skele-

* *Insect Life,* v, 15.
† Insects Affecting Park and Woodland Trees, p. 315.

tonized the leaves of birches over large areas. The writer obeserved the work of this insect in New Hampshire on yellow birch, probably nine or ten years ago, but in his residence of nearly seventeen years in Connecticut, never before has he seen such an outbreak. According to Mr. Caffrey, some of the birches around Amherst, Mass., were stripped in 1909. Mr. Thompson writes* that this insect was observed in 1910 on birches throughout Rhode Island and eastern Massachusetts as far west as Springfield and north to Manchester, N. H., and to about twelve miles west of Nashua, N. H. It was also reported from Maine, at Waterville, and as far east as Augusta.

I have received several inquiries regarding the probable effect of this attack upon the trees. A single defoliation, coming as it does so late in the season, would not seriously affect the trees, but if continued each year for several years, might kill them. However, if some of these native grey birches should die from the attacks of this insect, the farmer would no doubt consider it more of a blessing than a curse. But as it does not confine its attacks to this species, considerable damage might be done to the other birches, some of which are valuable for timber and for fuel. Cut-leaf and other birches planted for shade and for ornament should be sprayed next year in July with lead arsenate, 3 lbs. in 50 gallons of water, to forestall further injury.

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Thompson. *Jour. Econ. Ent.,* iii, 436—1910.

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* *Journal Economic Entomology,* iii, 436.

THE 15-SPOTTED LADY BEETLE.

Anatis 15-punctata Oliv.

The 15-spotted lady beetle was unusually abundant in 1910, especially on apple trees. In one orchard in the town of Orange the writer noticed from fifteen to twenty yellow clusters, containing altogether several hundred eggs, on nearly every tree. Similar conditions were also observed in Meriden and other places. In 1909 the writer found this lady beetle abundant in New

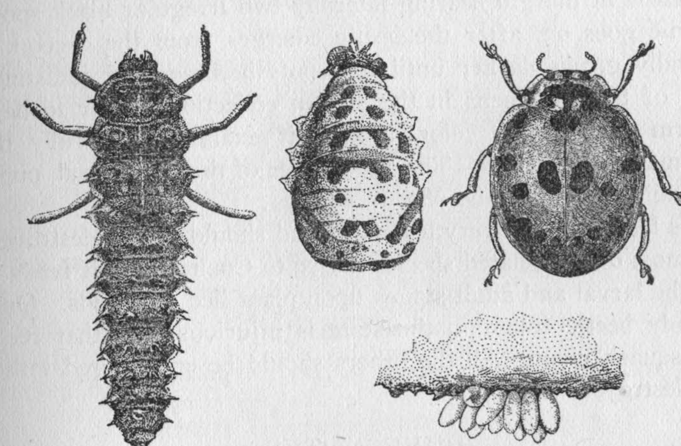


FIG. 21. The 15-spotted Lady Beetle in all its stages, enlarged about four times.

Canaan, where it was apparently feeding upon the aphids (probably *Callipterus betulæcolens*) on a cut-leaf white birch on private grounds. The rosy apple aphis was extremely abundant in apple orchards in 1909 and comparatively scarce in 1910, and it is probable that the 15-spotted lady beetle played no unimportant part in checking this destructive plant louse. The eggs are laid in clusters of ten or twelve, usually on the under side of the large branches of the tree. They are light yellow, and are oval in shape. The larva is very active, and crawls about on the bark and over the leaves, catching and devouring the plant lice. It is larger and darker in color than most lady beetle larvæ. In fact, it is nearly black, save for a fine whitish line extending longitudinally over the back of the thorax, and a broad lighter stripe running along each side of the body. Each segment bears a row of rather short, stout spines. The pupa is fastened by its posterior extremity to the bark or to the surface of a leaf, and is at first a cream color, marked with brown spots, but soon becomes darker. The adult beetle is about three-fourths of an inch long, and at first is a light reddish yellow, marked with nearly circular black spots. There are eight of these spots on each wing cover, but those on the inner margin at the base are often confluent, and appear as a single spot, hence the name. The thorax has a black patch with two light spots near the base of the wing covers, and a broad light margin bearing laterally two irregular black spots. As time goes on, after the beetle emerges from the cocoon, it gradually grows darker until the spots become very indistinct. Some of the specimens in the station collection appear to be a uniform dark brown color, though if examined carefully the spots may be discerned. The appearance of the egg, larval, pupal and adult stages may be seen in Fig. 21.

This lady beetle is very beneficial and should not be destroyed. Like most of the related species native to Connecticut, it feeds in both the larval and adult stages upon plant lice or aphids. Only one lady beetle found in the state is injurious, and that feeds upon squash vines. All the others should be encouraged rather than destroyed.

BRIEF NOTES.

Cabbage Looper. *Autographa* (*Plusia*) *brassicæ* Riley. This insect has been rather common for two seasons, and in some fields has actually caused more damage than the imported cabbage worm *Pontia rapæ* Linn., from which it can be distinguished by its lighter green color, smooth skin, and body tapering toward the head. It also "loops" or "measures" when it crawls, like the larvæ of the Geometridæ, because there are no prolegs on the sixth and seventh abdominal segments. The caterpillars often attack other vegetables, including celery, parsley, cauliflower, turnip, lettuce, dandelion and tomato, and sometimes get into greenhouses late in the fall and damage plants by devouring portions of them.

The caterpillar is from one to one and three-eighths inches long, and in color is light green, indistinctly striped with white. The adult is a dark brownish grey moth, having a wing expanse of about one and one-half inches, with a silver dot and U-shaped mark near the middle of each forewing.

There are two broods each year, and damage in the cabbage field may be prevented by spraying the plants with lead arsenate, 3 lbs. in 50 gallons of water, as for the imported or common cabbage worm.

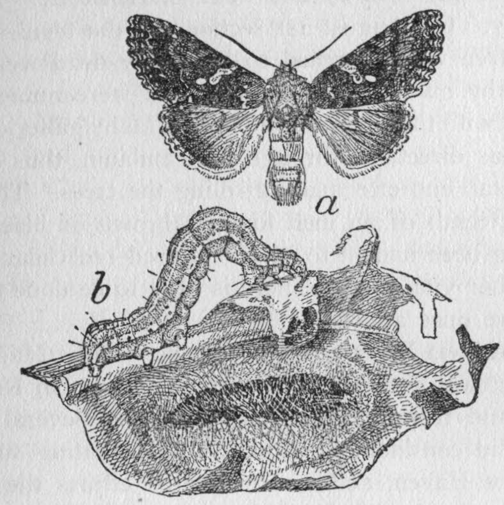


FIG. 22. Cabbage Looper, *A. brassicae*, showing adult, larva, and pupa stages, natural size. (After Chittenden, Bureau of Entomology, Bull. 33, U. S. D. A.)

Cottonwood Leaf Beetle. *Lina scripta* Fabr. This beetle is quite a pest in certain regions of New York and other states where basket-willows are grown, and for many years it has been known as a serious enemy of cottonwood in the Middle and Western states. Until the past season we have never taken it in Connecticut, nor had it reported as occurring here. While inspecting nurseries in September, Messrs. Walden and Champlain found this insect quite abundant at Stratford and at Buckland, feeding on Carolina poplar. At the latter place all stages were observed, though the pupæ were much the most abundant. Nearly all of the Carolina poplar trees in the nurseries at these two places were infested by this insect.

Mr. Champlain also found another species, *Lina interrupta* Fabr. (*lapponica* Linn.), very abundant and feeding upon alders at Lyme in May. Both of these species taken in the state during 1910 were not previously represented in the collection, and had not been reported to this office as occurring in the state. Either may at times injure ornamental trees and shrubs, but probably will not cause widespread damage. Spraying the foliage with lead arsenate is the best remedy.

Arbor Vitae Attacked by Red Cedar Bark Beetle. *Phlœosinus dentatus* Say. On August 1st sections of the trunk of a small arbor vitæ tree which seemed to be nearly dead were received from a nearby nursery. Under the bark were numerous small adult beetles with their larvæ and pupæ. Many galleries had been cut in various directions through the cambium, thus cutting off the flow of sap and effectually girdling the trees. The beetle is only one-sixteenth of an inch long, is brown or black in color, and has long been known to attack injured red cedar and white cedar, or arbor vitæ trees. There is little to be done to save the trees that are once attacked.

Maple Leaf-Stem Borer. *Priophorus acericaulis* MacG. Work of this insect was received from correspondents in Rockville on May 25th, and from Meriden on June 4th. Several years ago this insect did considerable damage by defoliating sugar maple trees in New Haven, and after repeated efforts the adult was finally obtained and proved to be a new species. It was described under the name given above by Dr. A. D. MacGillivray in *Canadian Entomologist,* vol. xxxviii, p. 306. The life history was worked out by the writer and published in *Entomological News,* vol. xvii, p. 313—1906. Since this date I have not seen the work of this insect until receiving the samples herein mentioned.

Rhododendron Lace Bug. *Leptobyrsa explanata* Heid. Rhododendrons are being injured, in some cases rather seriously, by a species of lace bug belonging to the family Tingitidæ, which has recently been described by Heidemann.* It lives on the foliage of mountain laurel and the native rhododendron, *R. maximum,* and has recently been injuring the cultivated varieties. The insect has been reported by Heidemann as occurring from Boston along the Atlantic seaboard to Florida. The insects occur in the nymph and adult stages on the under side of the leaves, where they suck out the sap. On leaves badly attacked a whitish spattered appearance is more or less prominent on the upper surface, injuring the appearance of the foliage. On the under surface are numerous brown dots, which are the excrement of the insect. Infested

* Proc. Ent. Soc. of Washington, vol. x, p. 105—1908.

leaves have been received from Rockville, South Manchester, Middlebury, and New Haven. The proper remedy is to spray the under sides of the leaves with kerosene emulsion or whale oil soap and water.

Grape Root Worm. *Fidia viticida* Walsh. This insect, which has done so much damage to vineyards of New York state, has not been conspicuous in Connecticut, but on June 28th leaves were received from Stamford showing the characteristic chain-like marks where the adult beetles had eaten the upper surface. The larvæ feed upon the roots, and thus greatly weaken the vine. The beetles are about one-fourth of an inch long, and are rather plump brown beetles, closely covered with very short grey hairs. It is a difficult insect to control, and where abundant, cultural methods, together with collecting the beetles and spraying with arsenical poisons, must be practiced.

June Beetles Defoliating Poplars. On June 13th two June beetles were received from South Lyme with the statement that they were very abundant and were defoliating Carolina poplars. The specimens belong to the genus *Lachnosterna,* the members of which are commonly known as May beetles or June beetles. The exact species has not been ascertained.

Clover Seed Chalcid. *Bruchophagus funebris,* How. A sample of clover seed was submitted to this department by Miss M. H. Jagger, seed analyst of the station. These seeds were infested, and the insect appeared to be the clover seed chalcid. This insect is distributed nearly all over the United States, and in some localities is a serious pest. The eggs are laid on the clover heads in the field, and the adult four-winged flies emerge from the ripened seeds. Early cutting of clover is a preventive.

Caterpillars on Fir from Japan. When inspecting imported nursery stock, some peculiar nests were noticed on a species of fir, *Abies tomomi,* and on examination, each was found to contain a caterpillar about an inch long. The body color was dirty white, with a ring of dark grey spots on each segment, almost forming a band or girdle. Head brown. Inflated larvæ were sent to the Bureau of Entomology at Washington, but could not be identified by anyone there. The plant was placed in a cage, and the caterpillars ate off nearly all the leaves. The specimens pupated, but we did not succeed in obtaining the adult moth.

Currant Span Worm. *Cymatophora ribearia* Fitch. On June 16th specimens of caterpillars were received from West Hartford feeding upon currant leaves. They were nearly fullgrown, and were whitish, with a wide yellow stripe along the back and a similar stripe along each side, with several black spots of different sizes on each segment. Length about one inch. There is but one generation each year, and the adult is a pretty yellow or tan-colored moth with suffused spots and markings of dark brown. It has a wing expanse of about one and one-quarter inches. Probably it will not become a pest, but if abundant, lead arsenate sprayed upon the leaves will control it.

Cluster Fly. *Pollenia rudis* Fabr. On March 5th samples of flies were received from North Stonington, with the statement that they were extremely abundant in the library building there. The fly is larger than the common house fly, and proved to be *Pollenia rudis,* a very common species which has the habit of entering unused dwellings or other buildings in large numbers late in summer and hibernating there, often becoming a great nuisance. The literature of this office contains accounts of its occurrence in several different parts of the country, though its early stages have evidently not been studied.

Pyrethrum, or insect powder, if fresh, and blown upon these flies with a powder gun or bellows, will stupefy them so that they will drop to the floor and can then be swept up and burned.

Abundance of Mocha-Stone Moth. *Melalopha inclusa.* The caterpillars of this insect feed upon the different species of poplar and willow, and were this past year more than usually common. They were observed in several different sections of the state when our men were inspecting nurseries, and considerable material was gathered. The caterpillars are gregarious and make nests or webs which remain upon the twigs and somewhat resemble the winter nests of the brown-tail moth. If examined, however, they are empty except for a few cast skins. The caterpillars do not pass the winter in them.

Scale Insect on Ferns. *Hemichionaspis aspidistræ* Sign. On March 12th, 1909, samples were received from Milford, mostly males, and on both sides of the fronds of the Boston fern. Mr. Walden found the same species on Boston fern in a large greenhouse in Cromwell on January 20th, 1910. It occurs on various plants in greenhouses, and out of doors in India, Ceylon, Brazil

and France. In India and Ceylon it is regarded as an important pest.

Caterpillars Feeding on Barberry. In August, 1908, specimens of caterpillars were received from Norwich feeding on the leaves of common barberry. They were black with white dots, and unfamiliar to us. We tried to rear the adult moths, but failed. In 1910 a large number of the same kind of caterpillars were collected and observed on Japanese barberry (*Berberis Thunbergi*). They were found on the writer's hedge and in several nurseries. Though the pupa stage was obtained, no adults have emerged at the time of this writing.

Curious Rat-tailed Pupae. *Eristalis tenax* Linn. Peculiar pupæ with long tails were received from Coventry on June 27th and from Waterbury on August 8th. This is one stage of the

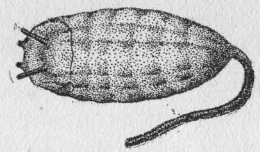
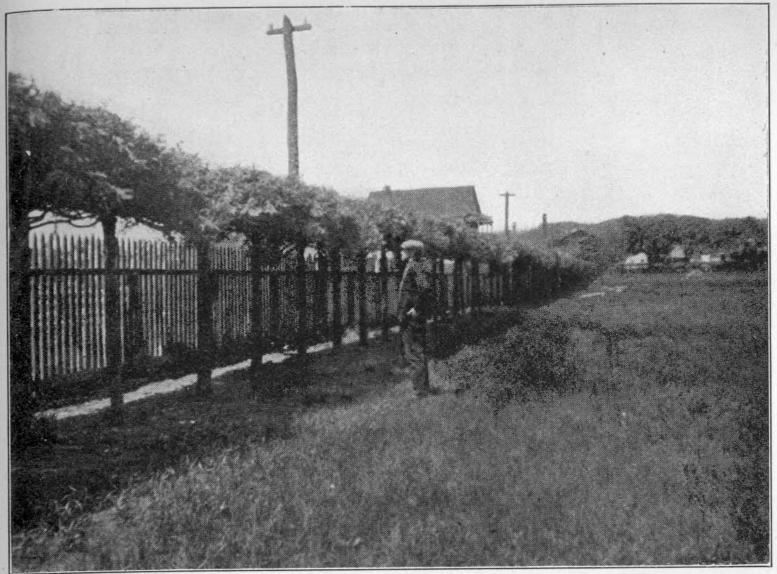


FIG. 23. Rat-tailed pupa of *Eristalis tenax*, twice natural size.

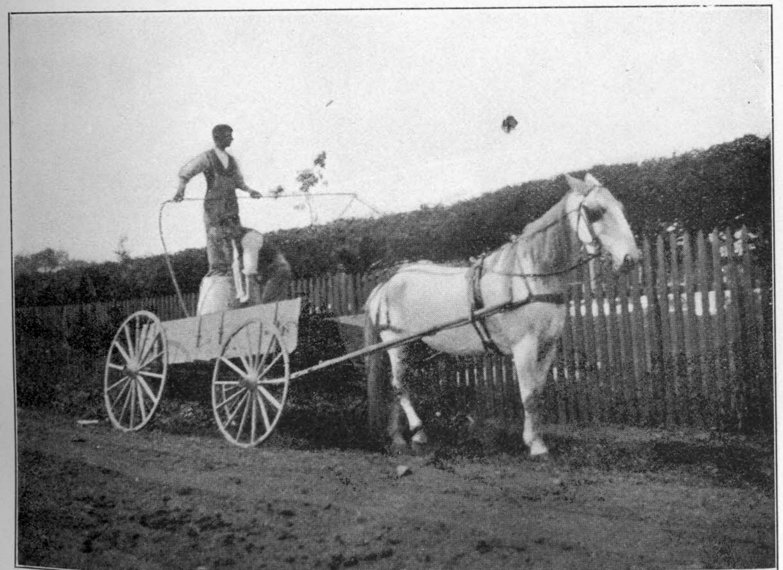
well-known chrysanthemum or drone fly that is so common late in the fall around chrysanthemums in the greenhouse. It resembles a honey bee, and belongs to the family Syrphidæ, many species of which are distinctly beneficial, as the larvæ feed upon plant lice and other injurious insects. The larva of *E. tenax* also has a tail like the pupa, and lives in foul mud and manure. The tail is for respiratory purposes and is shown in Fig. 23.

Thysanurids in Seeds. On October 10th Mr. C. E. Shepard brought to the laboratory some ginseng seeds that he said appeared to be infested with minute insects. We examined several and found nothing, but finally one was found that was filled with spring-tails. Several others were in the same condition. The inside had all been eaten out, and only the shell remained. We do not know whether these insects are responsible for the destruction of the seeds or whether they entered the injured seeds after some other agency had damaged them. The species proved to be *Isotoma* (*Folsomia*) *fimetaria* (L.) Tull. and was identified by Professor J. W. Folsom.

Spring-tails in Tobacco Beds. On March 26th we received from Avon a small vial containing hundreds of spring-tails which were found in a tobacco bed, though not reported as damaging the plants. Such insects are commonly found in gardens, feeding chiefly upon vegetable matter. A few kinds injure plants. Professor J. W. Folsom was kind enough to examine the specimens, which proved to be a species of *Isotoma* which he could not identify without comparing it with European material.



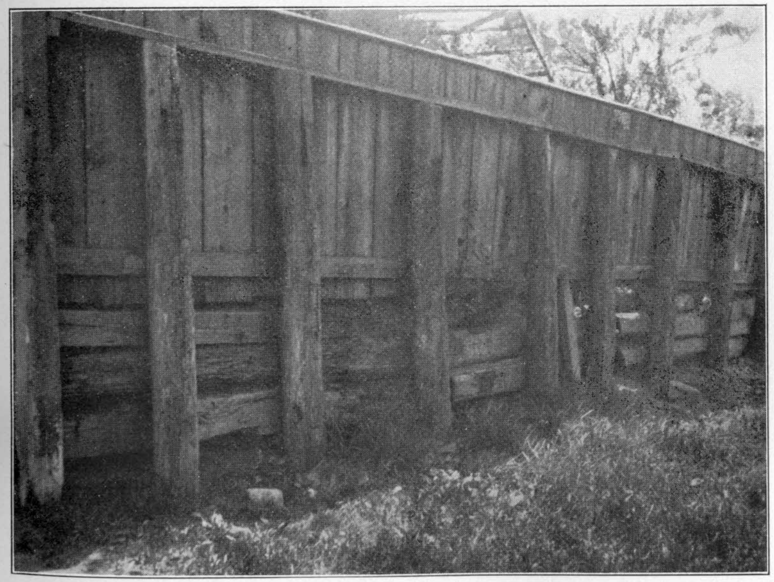
a. Hedge around cemetery after cutting off dead branches.



b. Spraying spruce hedge.

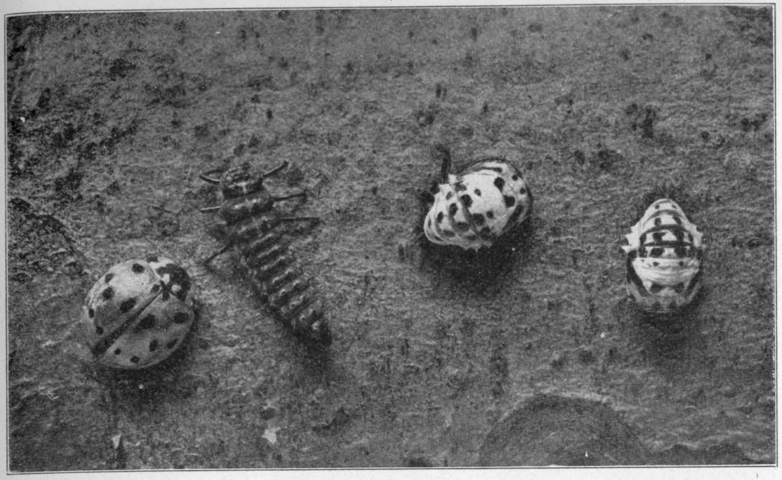
GYPSY MOTH WORK AT WALLINGFORD.

a. This fence, on Center Street in front of cemetery, contained many egg-clusters.



b. Retaining wall built of old railroad ties infested and replaced with masonry.

GYPSY MOTH WORK AT WALLINGFORD.

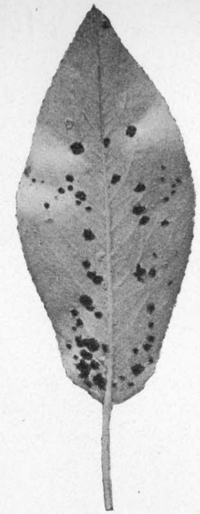


a. Larval, pupal and adult stages of 15-spotted lady beetle, natural size.

b. Pruning and cavity work on maple tree, Main Street, Wallingford.

FIFTEEN-SPOTTED LADY BEETLE: TREE WORK AT WALLINGFORD.

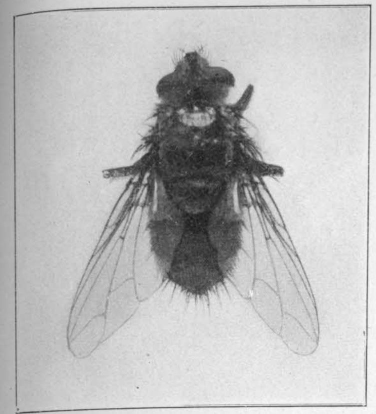
a. Hollow limb of pear tree containing 49 gypsy moth egg-clusters.



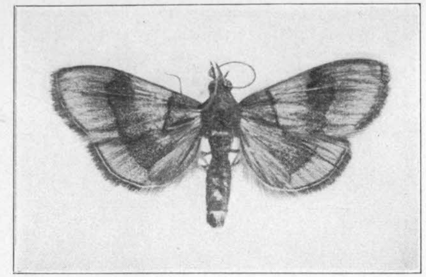
b. Pear leaf showing work of leaf blister mite, natural size.

c. Shot-gun cartridge injured by ants nesting in the box.

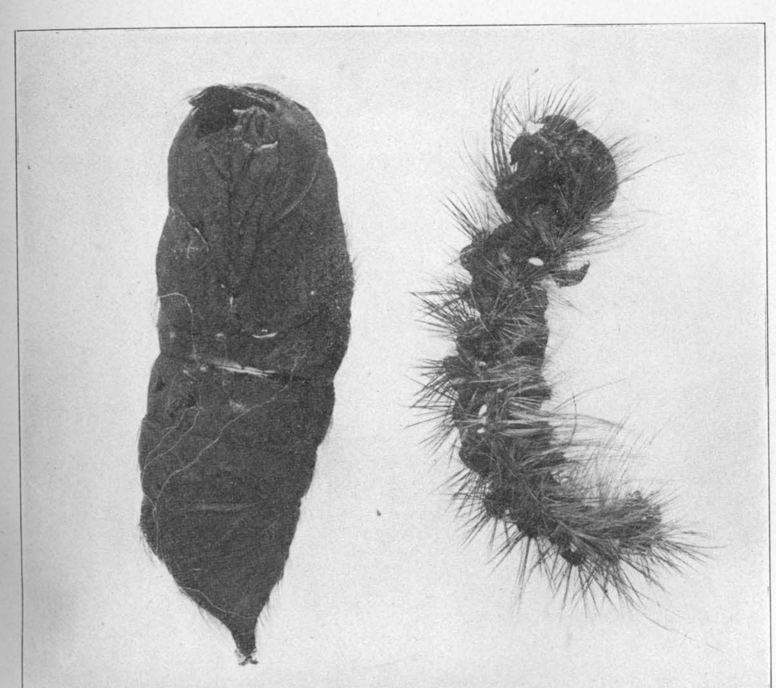
GYPSY MOTH EGG-CLUSTERS: WORK OF LEAF BLISTER MITE: WORK OF ANTS.



a. Fly *Tachina mella* reared from gypsy caterpillar at Wallingford.



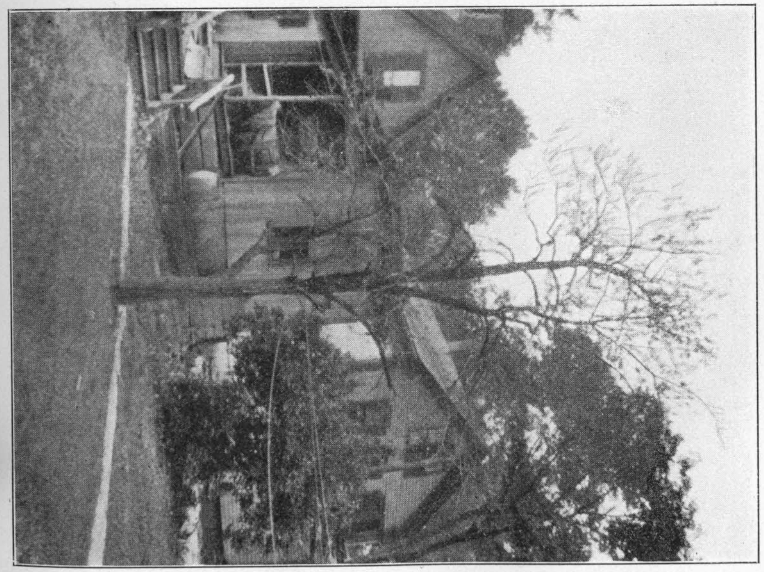
c. *Hemiscopis cinerea*, reared from caterpillar stage, brought in on nursery stock from Japan.



b. Cast skin of gypsy caterpillar showing eggs of parasite and gypsy cocoon from which the fly emerged.

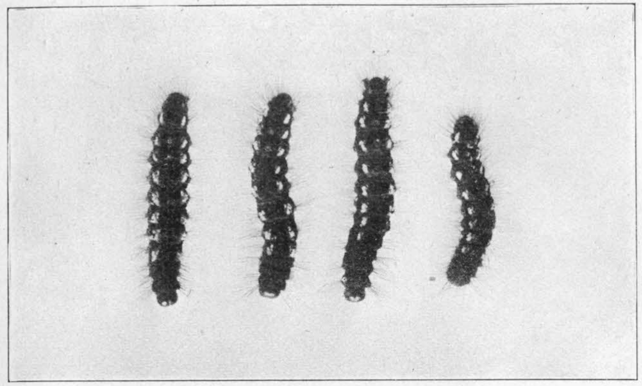
TACHINID PARASITE OF THE GYPSY MOTH: PYRALID MOTH FROM JAPAN.

a. Tree upon which the nests were first seen at Thompson.

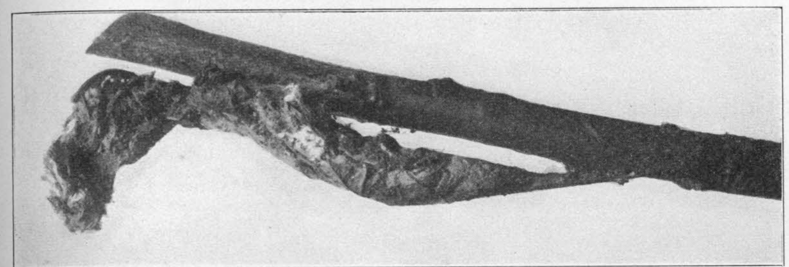


b. Pear tree at Putnam stripped by brown-tail caterpillars in 1910.

BROWN-TAIL MOTH IN CONNECTICUT.



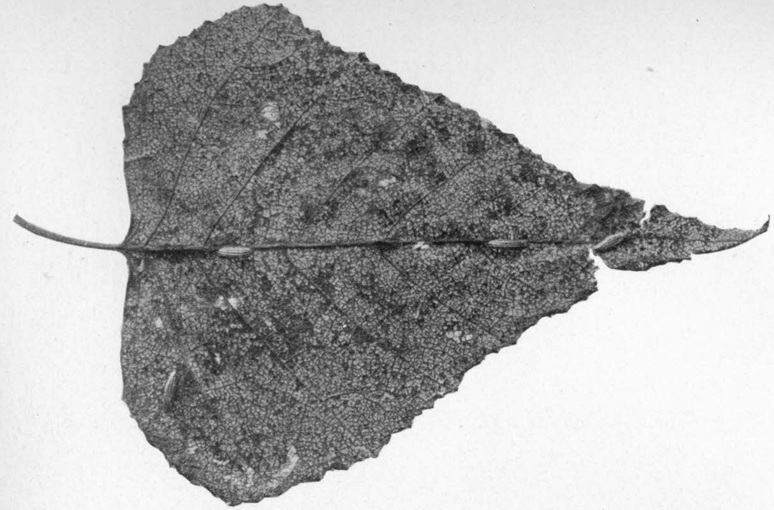
a. Brown-tail caterpillars, natural size.



b. Winter nest found on nursery stock imported from France, natural size.

c. Winter nests gathered from fruit trees at Thompson.

BROWN-TAIL MOTH IN CONNECTICUT.



a. Skeletonized leaf, showing cocoons, considerably enlarged.

b. Section of a leaf showing ribbed cocoons and white molting cases, greatly enlarged.

WORK OF THE BIRCH BUCCULATRIX.

PART X.

REPORT OF THE BOTANIST FOR 1909 AND 1910.

G. P. CLINTON, Sc.D.

I. NOTES ON PLANT DISEASES OF CONNECTICUT.

A. DISEASES IN RELATION TO WEATHER IN 1909 AND 1910.

Weather Conditions in 1909. The winter of 1908-09 was not especially severe, so that trees did not show any unusual injury, except from a couple of ice storms in February, 1909. These storms so heavily coated the limbs that considerable damage resulted, especially to shade and forest trees in the northern half of the state, where the storm was more severe. The spring of 1909 was rather wet and backward, so that such fungous troubles as peach leaf curl, apple scab, etc., that gain their foothold at this time of the year, were unusually prominent.

The summer, however, especially in July and August, like the two preceding seasons, was one of drought, but it was broken in August by rains that prevented serious damage to most of the crops. The late fall proved to be very dry. The first killing frost did not occur until October 13.

Diseases Prevalent in 1909. The following troubles were conspicuous or unusually injurious during this season. *Apple:* Black Rot (Leaf Spot form), Rust, Scab, and Spray Injury (Bordeaux). *Ash:* Rust. *Chestnut:* Bark Disease. *Egg Plant:* Wilt (Fusarium?). *Elm:* Leaf Spot. *Muskmelon:* Leaf Mold, Anthracnose. *Peach:* Brown Rot (spring form on twigs, etc.), Leaf Curl. *Plum:* Black Knot. *Potatoes:* Tip Burn, Scab. *Quince:* Leaf Blight. *Rose:* Rust. *Spinach:* Leaf Mold. *Strawberries:* Powdery Mildew, Winter Injury (root killing). *Tobacco:* Calico.

Of the above diseases the leaf spot of elm, which was quite serious in some places, is discussed later in this Report (p. 717).

The winter seemed in some way to have weakened the spinach crop in the vicinity of Greens Farms, for there were reports that several of the crops there failed because of the subsequent action of the leaf mold fungus described in the Report for 1905, page 275. Mr. Joseph Adams, writing of this trouble, said: "I have a patch of spinach (sown last September in connection with Mr. L. P. Wakeman), which is practically worthless from a black spot which covers the leaves. This is the worst I ever saw. This piece contains about an acre, and we have another piece that is not quite as bad." This fungus was identified by us previously as *Heterosporium variable* Cke., and Professor Thaxter, who examined these later specimens, writes that it was also described by Cooke as *Cladosporium subnodosum* (see Grev. 17: 67. 1889).

Specimens of strawberry plants were received about the middle of June, both from Essex and Naugatuck, with complaints that some trouble was killing off certain fields in those places. Examination revealed no fungus or insect as responsible, but showed that the rootlets were dead, while the crowns were still alive. This was a trouble similar to that seen once before, and discussed in the Report for 1905, page 276. Apparently there was enough life and food in the crowns to put forth leaves in the spring, but with the approach of warm weather these suddenly died off from lack of moisture, etc. The trouble seems to be due to winter injury of the roots, which had either suffered from drought the previous year or else had not been properly protected by snow or mulch during the winter.

Weather Conditions in 1910. The winter of 1909-10 was not especially severe on the whole, though one or two quite cold spells were recorded in January. March proved to be unusually warm and open, and the spring started early, but afterwards cool, rainy weather in May kept back the vegetation so that, as in the preceding spring, it was somewhat backward, and developed an unusual amount of spring fungous troubles. There were two very late frosts, in May and early June, that did more or less injury to fruit blossoms in certain parts of the state, especially cherries, apples and strawberries, and also killed or injured the foliage on certain shrubs, etc., especially in low places. At Windsor we saw small scrub oaks whose leaves were all killed as if by fire. Some injury to coniferous plants was also observed, and no doubt much of the russeting

of apples, so common this year, was traceable in part to these frosts.

Again the summer proved to be one of drought, thus making four years in succession that may be so classed. However, like the preceding one, it was temporarily broken in midsummer by rains that saved most of the crops from serious injury, though potatoes, especially early varieties, were a very light crop. The fall months were unusually dry, and this late drought was not broken until late in December, so that a water famine threatened many communities. As in the preceding year, the first fall frost was delayed until the middle of October, thus favoring the late crops.

Diseases Prevalent in 1910. Among the most conspicuous diseases of the year may be mentioned the following. *Apple:* Rust, Scab, Frost and Spray Injury. *Cherry* and *Plum:* Black Knot. *Chestnut:* Bark Disease, Drought Injury. *Corn:* Smut. *Hollyhock:* Rust. *Maple:* Leaf Scorch. *Muskmelon:* Mildew Blight. *Peach:* Leaf Curl, Brown Rot (chiefly spring infection of twigs, etc.). *Pear:* Scab. *Pines:* Pine-Sweetfern Rust. *Potatoes:* Rot (Blight), Tip Burn. *Rye* and *Barley:* Powdery Mildew. *Quince:* Rust. *Sycamore:* Anthracnose.

Concerning the spray and frost injury of apples, there appears a discussion in Part VII of this Report. There was more peach leaf curl than we have seen before in this state, and while the wet spring favored twig infection with brown rot, this did little harm to the mature fruit except during a wet week in September, when some injury was done to certain varieties in the vicinity of Wallingford. Potatoes suffered most from tip burn, but the rains came so that blight developed slightly on the late varieties and caused some rot of the tubers for the first time in several years. Blight, in late August and early September, carried off many of the melon fields that had not been sprayed.

The effect of successive droughts of the past four years has begun to be manifest on our shade and forest trees, so that an unusually large number of them are dying. This is especially true of the chestnuts, where the blight fungus plays a very important part on these weakened trees.

On the whole, 1909 and 1910, because of their dry summers, were not years in which fungi became especially troublesome, except those starting during the wet springs. In Parts B and C of this paper we discuss certain diseases that are new to the state, or concerning which special information was obtained.

B. NEW OBSERVATIONS ON DISEASES PREVIOUSLY REPORTED.

APPLE, *Pyrus Malus.*

Spray Injury. Both during 1909 and 1910 there was considerable injury resulting from spraying apples in this state with Bordeaux mixture. As previously reported, this injury was of the nature of leaf spotting and fruit russeting. Experiments conducted in 1910 with different fungicides to replace Bordeaux, because of this tendency to injure, showed that there was danger of serious leaf spotting and subsequent fall with "One for All" (rate 5 or 6 lbs. to 50 gallons of water), and also with "Sulfocide" (rate 1 to 200) when either Paris green or arsenate of lead was used with it, though the injury with Paris green when lime was added was lessened. Even without these insecticides, this strength of "Sulfocide" sometimes produces more or less leaf spotting. Some leaf injury was also caused by Bogart's "Sulphur Compound" used at the rate of 1½ to 50. Practically no russeting or leaf spotting was produced by any of the straight commercial lime-sulphur sprays, with arsenate of lead added, even at the rate of 1½ to 50, except what occasionally occurred in the shape of sun scald on the most exposed side of the fruit. While this rarely occurred, when it did it produced rather serious injury. On the whole, the straight commercial lime-sulphur sprays were the most satisfactory as regards least spray injury. For further information, see Part VII of this Report.

CHESTNUT, *Castanea dentata.*

CHESTNUT BARK DISEASE, *Diaporthe parasitica* Murr. In our Report for 1908, page 879, we gave an account of this trouble. At that time it had been reported in every one of the twenty-three towns of Fairfield County, and in eight towns in New Haven County, making thirty-one towns altogether. At the time of writing this article (March 20, 1911), its known distribution is as follows: Fairfield County, twenty-three towns; New Haven County, twenty-one towns; Litchfield County,

fourteen towns; Hartford County, seven towns; Middlesex County, two towns; Tolland County, three towns; Windham County, one town; New London County, one town. This makes a total of seventy-two towns, of which only seven are east of the Connecticut River. We have no doubt that a more thorough survey of that region would reveal its presence, in an inconspicuous way, in quite a few more towns.

This increased distribution in the last three years may indicate that the disease has spread to those new localities, or it may mean that a more thorough search has revealed its presence, and that it has also become more prominent because of the four years of drought that have occurred, beginning with 1907. There are those who believe, however, that unfavorable weather conditions have nothing to do with the prominence of this disease, which they suspect to be a recent importation into this country from Japan. If this theory is true, then we are just beginning to feel the effects of its devastation in this state. Personally, we have not yet found convincing proofs to cause us to change our views expressed in the above-mentioned Report. These views, briefly given, are (1) that the fungus is a native, weak parasite, usually very inconspicuous in its damage, and therefore rarely noticed; and (2) that the unusual winter of 1904, by severely injuring chestnut trees, gave it a chance to spring into unusual and sudden prominence, which it has since maintained and even increased by reason of four successive years of drought, that have injured not only chestnuts, but many other trees.

We do not, and never have, questioned its seriousness. Trees that have been marked in two localities by the botanical and the forestry departments have uniformly showed injury greatly in excess of that indicated when first examined. If our theory is correct, we do believe, however, with the return of several normally wet years the trouble will gradually grow less rather than more conspicuous as it should if weakened vitality of the trees has nothing to do with its development.

ELM, *Ulmus americana.*

LEAF SPOT, *Gnomonia Ulmea* (Schw.) Thuem. Plate XXXIV. During the summer of 1909 several complaints came to the station of elm trees shedding their leaves where the elm leaf beetle had not been at work. The most serious injury seemed to occur in the vicinity of Chapinville. At the request of Mr. Walter Angus, manager of the Scoville estate at that place, Mr. Walden first visited there in August, and as he found no insect responsible for the trouble the writer made an investigation early in September to determine if a fungus was the cause of it. By July, or earlier, some of the trees had almost entirely shed their leaves, and later put forth a new crop, and these, when examined by the writer, were quite free from fungous attack. Other trees, however, not originally so severely injured, showed the leaves quite badly infected with the above fungus, and these had been shedding their leaves more or less during the season. Where the defoliation had been rather severe, the young branchlets of the season had also frequently fallen off. While the fungus was present on some trees more than on others, and while some of the fallen leaves showed no sign of the fungus, it seemed quite evident, after a careful examination, that this fungus was primarily responsible for the trouble, but that drought had helped to exaggerate it. The illustration shows the condition as regards foliage of one of the trees photographed by Mr. Walden in August.

The fungus produces very numerous, small, black eruptions on the upper surface of the leaves, and these often merge more or less in small groups. In time the specimens show a whitish or grayish margin around these black cushions, due to the wearing away of the epidermis. We have been unable to find any fruiting stage in any of the specimens we have gathered in different years, as the only known stage produces its ascospores on the fallen leaves the subsequent spring. Infection seems to take place only early in the season, since the trees early denuded did not have their second crop of leaves attacked to any extent. Apparently the weather conditions in the spring determine the character and amount of infection, and these conditions seem to have been unusually favorable in 1909. In 1910, on the same estate in Chapinville, the fungus did practically no harm, though the trees bore a smaller crop of leaves, due to the shedding of the small twigs the previous year and to the death of others that were severely injured.

Spraying the unfolding leaves with Bordeaux would probably control this trouble, though the uncertainty of its appearance would make such a treatment rarely practical.

This fungus was placed by Ellis under the genus *Dothidella* as *D. Ulmea* (Schw.) E. & E. It is, however, quite distinct in its microscopic appearance, as Ellis states, from *Dothidella Ulmi* (Duv.) Wint., although the two have ascospores very similar. The latter fungus has its perithecia embedded in a distinct black stroma, and the necks open on the upper surface of the leaves. The former, by the crowding of the perithecia together, has something of the appearance of an imperfect stroma, while the perithecia open on the under surface of the leaves mature their asci later, and apparently have no other stage connected with them.

HEMLOCK, *Tsuga canadensis.*

HEMLOCK-HEATH RUST, *Pucciniastrum Myrtilli* (Schum.) Arth. (I. *Peridermium Peckii* Thuem.) The I stage of this fungus (see Report 1907, pp. 350, 383), which is not uncommon, though rarely abundant, in this state on hemlock, has now been connected by us, through artificial infections, with the II and III stage of the above *Pucciniastrum,* which we found in 1910 for the first time on various species of blueberry and huckleberry. *Pucciniastrum minimum* on cultivated azaleas, also found here (see Reports 1907, p. 392 and 1908, p. 854), is probably not distinct from this *Pucciniastrum.*

PEACH, *Prunus Persica.*

Spray Injury. Sturgis (Report 1900, p. 219) has recorded spray injury to the foliage of peach by Bordeaux and other fungicides used in his experiments to prevent peach rot and scab. He found potassium sulphide to be about the least injurious fungicide when used at the rate of 1 lb. to 50 gallons of water. In our experiments with spraying peaches in 1910, this strength was used, and very little injury, except shot-holes in a few of the leaves, resulted. However, when arsenate of lead (rate of 3 lbs. to 50 gallons potassium sulphide) or Paris green (1 lb. to 100) was added, the most serious injury resulted. Not only were the leaves badly injured by shot-holes, but in time they all fell off. Many of the young twigs were also badly spotted (purplish spots much like those produced by the scab fungus), and some were killed. A few young trees were so severely injured that they finally died.

Very similar results were obtained when either of these insecticides was used with "Sulfocide." This spray, even when used without them, at a rate of 1 to 200 produced more or less injury, and even some on young trees at 1 to 400. With both potassium sulphide and "Sulfocide" the injury resulting from the addition of the poisons was due to the production of a soluble arsenate which burned the tissues.

PINE, WHITE, *Pinus Strobus*.

So-called "Blight." In our Report for 1907, page 353, we described the white pine "blight," which was general that year not only in Connecticut but all over New England. We took the view that it was a physiological trouble due to adverse weather conditions (such as winter, drought, and frost injuries), though there were those who believed that it was of a contagious nature, due to fungous attack. We now have data at hand to prove that we were correct. In general this disease becomes evident by the leaves being killed to a greater or less extent from their tip downward, the dead portion turning reddish brown, and also by the undersized leaves, which remain bunched, due to the failure of the branches to lengthen out.

That the disease is not contagious was suggested strongly in our previous studies, since leaves on one tree may all be badly affected while those of an adjacent tree show no signs of the trouble. This noncontagious nature has been clearly proved by observations made in the station's forest plantation on a lot of white pine trees eight years old, in 1910, from planting. At our request the forester, Mr. Hawes, early in the spring of 1908 had all the diseased trees of this plot marked by permanent stakes. There were one hundred and twenty-four of these so marked, but it seems quite likely that some few that showed the disease slightly at the time were not included. We examined them that fall, and found that their condition on the whole seemed somewhat improved, and that there was no general increase of the trouble, though some trees that had not been marked showed signs of the disease. In July, 1909, and again in November, 1910, careful examinations were made of the plot, and the condition of each diseased tree noted. The comparative condition of these trees as regards foliage is shown in the following table:

Date of Examination	Diseased, but not marked in 1908	Dead	Not Improved	Improved	Cured	Total
July, 1909	24	5	54	38	21	142
Nov., 1910	18	6	9	65	44	142

This shows that there has been gradual improvement since the trouble first showed in 1907, and that there has been practically no subsequent spreading of the trouble. That is, in 1910 there were only eighteen trees showing the disease, among the 3,000 to 3,200 in the plot, that did not show it in the spring of 1908. Of these eighteen, at least thirteen were included as questionable; that is, there was not positive evidence that it was this trouble, as the leaves were only slightly affected. No doubt, too, some of these were trees that were not marked originally because they were not badly injured. It is also quite probable that some were trees whose leaves were injured by the frosts of 1910, of which we shall speak later, as the injured leaves were often largely on lower branches. Finally, there was no relationship in position between these trees and those badly diseased.

Concerning the effect of the so-called "blight" on the subsequent growth of the trees, we may state that those that were very badly injured have either died, or remained so stunted in growth that their subsequent usefulness is quite doubtful. Others that were rather severely injured have made some growth, and their foliage condition, especially as to color, has improved considerably, though the leaves often remain more or less stunted and bunched. Those least injured have recovered their normal leaf appearance, but are still somewhat backward in their growth. Some few seem to have almost entirely recovered from the effects, and are scarcely to be distinguished in size and appearance from the surrounding trees that were not injured.

Concerning the cause of the sudden appearance of this "blight" in 1907, we are now quite convinced that it was due to the severe frosts that occurred on May 11 and 21 of that year. We mentioned these as a possible cause in our previous Report, but at that time we had no proof as to their connection, as the "blight" was not called especially to our attention until August. In 1910, however, we saw the same trouble produced on certain pines by the late frosts of May and June of that year. Soon after these frosts we found the leaves of scrub oaks in certain regions entirely killed by the frosts, just as had been the case with the leaves of sycamore trees in 1907. In 1910, however, the frosts were much more local in their effects, and in a given region often killed the leaves only on the lower trees and the shrubs, especially those in low places. Shortly after the last of these frosts we visited the white pine plantations on the Whittemore estate at Middlebury, and here we found not only small oaks and other trees in low spots with injured foliage, but also the young pines in these low places showed "blight" injury on the tips of their leaves. Often a difference of only a few feet in the level of the ground on which these stood determined whether or not they were injured.

We have also noted elsewhere in this Report injury by these frosts to pine seedlings in the seed beds. Whether or not a pine tree is injured by the late frosts seems to be determined by the state of development of the foliage at the time, as well as by the lay of the land and the character of the frost. Previous to 1907 we had some few complaints of pine "blight," which we may attribute to winter injury of the roots, and no doubt drought or other injury to the roots, if severe, produces a similar effect. Hartig, in his Diseases of Trees, English ed., p. 111, notes a similar "blight" trouble in Europe, due to frost and drought injury.

PLUM, *Prunus* sp.

Bacterial Spot, *Pseudomonas Pruni* Sm. This has been reported here before on peach, causing spots on the leaves, and on the plum, causing large black spots on the fruit. In July, 1910, it was seen at the Ives farm, Meriden, for the first time causing a shot-hole spotting of plum leaves, similar to that not uncommon on the peach.

SPRUCE, NORWAY, *Picea excelsa*.

Smoke Injury. During the summer of 1910 the writer saw young spruce trees at East Rock Park, New Haven, that had been injured by smoke from a brick kiln about half a mile distant. The injury occurred suddenly on a day when the atmospheric conditions were just right for blowing the smoke among the trees. The young leaves of this year were killed and subsequently dropped off, but those of the previous year were

not injured. Some other conifers were also slightly injured, but the deciduous trees escaped injury, though in the vicinity of the kiln the maples and other trees are sometimes injured. Previous smoke injury, complicated with drought injury, to asparagus fields in the vicinity of this kiln, was mentioned in our Report for 1908, page 858, and similar injury is claimed to have been caused again this year.

C. DISEASES OR HOSTS NOT PREVIOUSLY REPORTED.

APPLE, *Pyrus Malus*.

Fruit Spot, *Cylindrosporium Pomi* Brooks. Plate XXXIII a. In our Reports for 1905, page 264, and 1907, page 340, we described a fruit speck of apples that formed small, brownish, spots in the skin of apples, being especially prominent after storage. Cultures proved this trouble to be of fungous origin, but as these cultures did not produce a fruiting stage of the fungus, we were not sure of its identity.

More recent study has shown that there are three fungi that occur in fruit spots or specks of apples. One of these is the black rot fungus, *Sphaeropsis Malorum,* which is more commonly known not as a spot trouble, but as a general rot of the fruit, especially on summer and fall varieties following insect injury. This fungus is the one that we have most commonly isolated from the fruit specks of market apples. Ordinarily it does not fruit in the culture media on which we have grown it, and so it was probably largely responsible for the fruit speck we describe in the above reports, though *Cylindrosporium Pomi* was possibly present in some cases. Besides the black rot, we have also occasionally isolated a species of *Alternaria* which seems to be responsible for speck injury, though we have as yet made no inoculation tests to prove this.

The third fruit spot, which we have seen frequently on the fruit before it was gathered from the trees, as well as afterwards, is that caused by *Cylindrosporium Pomi,* which was described a few years ago as a new species by Brooks, who found it responsible for a serious spotting of apples in New Hampshire. This fruit spot on the market apples is usually very difficult to distinguish from that of the black rot. Perhaps the black rot fungus may finally crowd it out in many cases. However, on certain light skinned varieties, especially seedlings, it shows in the summer as small spots in the skin having a decidedly pinkish or reddish purple color. We have seen roadside seedlings made very conspicuous by it in late fall. In storage the color of the spots is darker. So far we have not seen the fungus in fruit on these superficial spots, and ordinarily they do not seem to reach any considerable size, except perhaps when developed further by the presence of the black rot fungus. In one instance we isolated this *Cylindrosporium* from market quinces, a new host, and we have frequently seen similar spots, showing no fruiting fungus, on quinces before and after picking.

On our oat juice agar medium the fungus forms a large, yeast-like, pinkish colony with no aerial growth, but producing an abundance of spores. With age it turns a darker color, sometimes black, though in such cases it may be due to the presence of another fungus frequently associated with it, which we have isolated, but whose identity has not yet been determined.

AZALEA, *Rhododendron indicum*.

Pocket Curl, *Exobasidium Vaccinii* (Fckl.) Wor. Plate XXXIII b. Galls and hypertrophy caused by this or closely related species are not uncommon in this state on various wild species of the heath family, but this fungus on a cultivated species was called to our attention for the first time in the fall of 1909. Specimens of the above azalea, purchased a few months previously for a private greenhouse, were very badly injured. These plants were apparently infected when purchased, having been grown out of doors in a neighboring state, but did not show the trouble at that time. The disease appeared on the leaves, usually involving the apical part and causing a decided thickening of the tissues. This infected part covered more or less of the leaf, which often became decidedly concavo-convex, as shown in the illustration. The infected tissues were quite sharply marked off from the healthy part, both by their distortion and by their whitish color, being eventually covered by a mealy coating of spores, etc.

Cultures were made, and a fungus obtained that seems to be a conidial stage of this fungus, though its identity has not been thoroughly established.

The question whether or not the various forms of *Exobasidium* found on the different genera of the heaths are distinct or not has not been definitely decided. Often their macroscopic appearance on different hosts is quite distinct, but as Richards (Bot. Gaz. **21**: 101. 1896) succeeded in producing the ordinary leaf form from spores of the unusual large bladder form on a different host, it looks to the writer as if these differences were largely due to the age or parts of the host infected. Shirai has described two species of *Exobasidium* on *Rhododendron indicum,* to one of which our fungus possibly may belong if they are really distinct, though the spore measurements do not seem to agree entirely.

CELERIAC, *Apium graveolens* var. *rapaceum*.

Leaf Blight, *Cercospora Apii* Fr. We have reported before, on celeriac, the leaf spot due to Septoria, but not this fungus. Both produce brownish or grayish spots of considerable size on the leaves, often causing them to turn yellow and die prematurely. They are often found associated, the Cercospora being distinguished by its minute threads arising from the surface of the leaves, while the Septoria forms small, embedded, black specks.

CHESTNUT, *Castanea* sps.

Chestnut Bark Disease, *Diaporthe parasitica* Murr. Specimens of this serious disease of our native chestnuts have been collected on the Japanese chestnut, *Castanea japonica,* in a local nursery. Dr. R. T. Morris, who grows a large number of varieties of chestnuts on his Stamford farm, also reports (Conn. Farmer, March 11, 1911, p. 2) that, besides the Japanese species, the European species, *Castanea sativa,* and the American Chinquapin, *Castanea pumila,* have been more or less subject to this blight at this place. See page 716 of this Report.

CHESTNUT, *Castanea dentata*.

Powdery Mildew, *Microsphæra Alni* (Wallr.) Wint. We have not reported this host because we have found the mildew on it previously only in the woods, but in September, 1907, it was observed on cultivated trees in a small nursery at Storrs. It forms evident, mealy, whitish growths, in which the perithecia are embedded as small black specks, chiefly on the upper surface of the leaves. It is not an important disease of this host.

CHIVES, *Allium Schœnoprasum.*

RUST, *Puccinia Porri* (Sow.) Wint. This rust was collected by Dr. Britton during June, 1910, on chives in his garden in Westville, where it was doing considerable injury to the plants. Both the II and III stages were present, the former showing as minute, reddish, dusty pustules, and the latter as black, granular ones, more permanently covered by the epidermis. The leaves, when fairly abundantly infected, turned yellow and died prematurely. I have not seen any account of injury by this rust to cultivated species of *Allium* in this country, though in Europe it is not uncommon. Worthington Smith, in his Diseases of Field and Garden, page 39, mentions it, under the name *Puccinia mixta* Fckl., as causing serious injury to a crop of chives in England. There is more or less difficulty in deciding the proper genus of this fungus, since the telial spores in some specimens on certain hosts are almost or entirely single-celled, and so properly come under the genus Uromyces; other specimens show these spores largely two-celled, and so place it more properly under the genus Puccinia. Our specimens run more nearly to the former type, as not over one or two per cent. of the spores are two-celled. Winter considered the two as a single species, and we have followed him. Other writers place the single-celled form under *Uromyces ambiguus* (DC.) Fckl., and the form with most of its spores two-celled under *Puccinia Porri,* as given here. The rust on chives in Europe is generally reported under this latter name. Our specimens, however, have fewer two-celled spores than those we have seen from Europe on the same host. *Puccinia Allii* (DC.) Rud., also on species of *Allium,* is quite a different fungus.

CORNFLOWER, *Centaurea Cyanus.*

RUST, *Puccinia Cyani* (Schl.) Pass. Both the II and III stages of this rust were found, causing severe injury to the cornflowers in the writer's garden during the summer of 1909. The sori, while numerous, form rather inconspicuous, dusty outbreaks on both surfaces of the leaves and on the stems

Apparently this fungus has rarely been reported in this country. Another rust, *P. Centaureæ* DC., also occurs on other species of Centaurea both here and in Europe. Both of these species have frequently been grouped with other Puccinias, the species here reported being usually placed under *P. suaveolens,* along with the rust on *Cnicus* now commonly known by that name.

ELM, *Ulmus* sp.

ANTHRACNOSE, *Septoglœum Ulmi* (Fr.) Br. and Cav. This fungus was found on an escaped seedling of *Ulmus campestris* (apparently) along the roadside in Centerville. It produces numerous, minute, at first yellowish but finally reddish-brown spots on the upper surface of the leaves, while below the fruiting stage shows as minute, glistening, yellowish globules.

The fungus has usually been reported as *Phleospora Ulmi* (Fr.) Wallr., but the writer agrees with Briosi and Cavara that it belongs more properly under the above genus. *Cylindrosporium ulmicolum* Ell. and Ev. possibly is not distinct from this species, as its description is very similar. This *Septoglœum* is thought by some writers to be the spermagonial and *Piggotia astroidea* B. and Br., the pycnidial stage of *Dothidella Ulmi* (Duv.) Wint. [*Phyllachora Ulmi* (Duv.) Fckl.], though neither of these two stages were found associated with our specimens. The asco stage of *Dothidella Ulmi,* while not uncommon in Europe, does not seem to have been reported in this country except the doubtful specimen sent by Torrey to Schweinitz.

GOOSEBERRY, *Ribes* sp.

RUST, *Æcidium Grossulariæ* (Pers.) Schum. This rust was found on the leaves of a species of gooseberry, apparently escaped from cultivation, in the woods of an abandoned farm belonging to the water company at Ansonia. The fungus forms rather small clusters of cup-shaped fruiting bodies on the under surface of the leaves, producing discolored spots above. It is probably connected with some species of *Puccinia* on *Carex* as its mature stage, as has been found to be the case with several European forms on *Ribes* sp. We have never seen this *Æcidium* causing much harm to its hosts, and it seems to occur chiefly on the wild species.

HORSECHESTNUT, *Æsculus* sps.

Powdery Mildew, *Uncinula flexuosa* Pk. This mildew was found on a species of *Æsculus* with colored blossoms, on an estate at Chapinville in the fall of 1909. The conidial stage formed a conspicuous whitish coating on the upper surface of the leaves, while the perithecia were less prominent, though abundant, on the lower surface. The fungus has not been reported by us before, though Thaxter collected it in New Haven in 1888 on another cultivated species, *Æsculus Hippocastanum.*

MONKSHOOD, *Aconitum Fischeri.*

Stem Rot, ? *Hypochnus* sp. In our Report for 1907, page 351, we described this stem rot, which was found on a variety of herbaceous plants in a local nursery. This year it was sent to us from Westbrook, where it was injuring specimens of larkspur, one of the hosts reported before. Since our first report we have also found it on monkshood, in the same nursery where it was found originally. So far we have been unable to identify the fungus, as our cultures form only the sclerotial stage—small, reddish, usually subspherical bodies about 2 to 5 mm. in diameter. We have a similar fungus from potato stems, forming considerable small sclerotia, that was given to us by Morse of the Maine Station. While in Japan, we saw in Professor Hori's laboratory artificial cultures of a number of these sclerotial fungi, which he had described as species of *Hypochnus,* though we are not sure of this identification from what we have learned concerning them.

PINE, *Pinus* sps.

Pine-Oak Rust, *Cronartium Quercus* (Brond.) Schrœt. (I. *Peridermium cerebrum* Pk.) On specimens of jack pine, *Pinus Banksiana,* in the nursery of the station forest plantation at Rainbow in the spring of 1910, Mr. Filley, and later the writer, collected the I stage of this fungus. These seedlings were about four years old, and had been brought in 1908 from Michigan, where no doubt they were originally infected, as this fungus in none of its stages has ever before been found in this state. The fungus on the pine forms conspicuous swellings, usually globular in shape, and in early spring the fruiting stage shows under the denuding bark as orange-colored, dusty spore masses, with the peridia rarely forming distinct cups, as in the next species. The II and III stages occur on species of oak. So far as could be seen, these did not appear on the oaks in the vicinity, and as all the infected pines were destroyed, it is not likely to become established there. Infection experiments made in the laboratory from the I stage, however, produced the III stage only very readily on seedlings of both red and white oaks. So far this fungus has not done much damage elsewhere on either host. See Plate XXXVI b.

Pine-Sweetfern Rust, *Cronartium Comptoniæ* Arth. (I. *Peridermium pyriforme* Pk.) In the Report of 1907, page 380, the writer reported the I stage of this rust on both *Pinus rigida* and *P. sylvestris* from this state. It had become established on the latter host in the station forest plantation at Rainbow. In 1910 it was found there also on *Pinus rigida, P. austriaca,* and *P. maritima.* It was also found in its II and III stages on the sweetfern, to which it had spread since its introduction. Apparently most of these pines had become infected in their nursery beds at Poquonock before transplanting here some years ago, as thousands of seedlings of *Pinus rigida* grown from the first in their vicinity showed practically no infection. The specimens of *P. maritima,* however, had become infected there in their seed bed, yet we could find no infected sweetfern in their immediate vicinity this year. In order to prevent further spread of the rust, all infected pines were destroyed or the infected branches cut off, and the forester had all the sweetfern in the vicinity mowed off. Most of the pines, having the fungus on their main trunk, were of little value. Where infection takes place after the pines are a few years old, the damage is not likely to be nearly so severe as when it takes place in the seed bed. See Plate XXXVI c.

PINE, WHITE, *Pinus Strobus.*

Drought Injury. In the fall of 1909, Mr. Spring noticed a few spots in one of the seed beds at the station forest plantation where the white pine had been entirely killed out for the space of a few inches. Specimens of these and some of the adjacent living pines were brought to the writer at the time for examination. On the stems of the dead pines, and also somewhat on the living ones, was a conspicuous felt of mycelium of a hymenomycetous fungus which Professor E. A. Burt determined as *Coniophora byssoidea* (Pers.) Fr. At first we thought that this fungus was responsible for the death of the seedlings, but we were unable to find any account of injury caused by it elsewhere. A bunch of these young pines was kept in a crock in the greenhouse for several months, and there was no indication that the fungus injured the healthy young pines on which it originally occurred, or that it spread further. The fungus evidently ran up on the stems merely as a saprophyte, from various leaves on the ground on which it also occurred. The pines in the seed beds were probably killed by the drought, which was so severe in 1909, and the dead and injured seedlings offered a better condition for the development of the fungus than the surrounding mulch of leaves, as Professor Burt states that out of nine specimens in his herbarium seven are on pine and two on spruce. See Plate XXXV a.

Frost Injury. Plate XXXV b. In examining the seed beds of white pines at the station plantation at Rainbow in the fall of 1910, the writer found small spots scattered in the beds where the leaves of this year's growth had been killed. The injury was evidently caused by the late frosts of May and June of that year, as these had killed the leaves of the scrub oaks in this vicinity, as observed at the time. The young pines had developed their terminal branches an inch or two in length, and these had been severely injured or killed by the frost on both the one- and two-year-old seedlings. The leaves of the previous year remained uninjured. Afterwards these injured pines put out several lateral buds from or below the injured tip, but even as late as November 1, when seen by the writer, these had not usually attained a length of half an inch. This injury had severely stunted the growth of the plants during the season, as is indicated by the photograph, which shows one of the uninjured plants, besides several of the injured ones of the same age. A few seedlings of *Pinus montana* were also injured, but not so extensively as were those of the white pine.

PINE-CURRANT RUST, *Cronartium ribicola* Waldh. (I. *Peridermium Strobi* Kleb.) Plate XXXVI a. In our article on Heterœcious Rusts of Connecticut, published in the Report for 1907,

page 374, we mentioned this rust as one likely to be brought into this state on imported white pine seedlings from Europe. Its introduction really occurred sooner than was anticipated. Mr. F. A. Metzger first found specimens on a lot of three-year-old seedlings from Germany that had been imported by our State Forester for Mr. C. F. Street, and planted at Wilton. Mr. Metzger, who was employed to set them out, found in the 10,000 seedlings from fifty to one hundred that were infected with the rust. He brought specimens to the station the last of April, 1909, but as the writer was in Japan at that time, nothing further was done.

In the meantime Messrs. Metcalf and Spaulding, of the U. S. Department of Agriculture, who had been looking up infected seedlings in other states, came to this state about the middle of June, and with the forester examined the plantations of the New Haven Water Company at West Haven and the Ansonia Water Company near Ansonia, and found a few very suspicious specimens at these places. Arrangements were made soon afterward by which Mr. Spaulding and Mr. Graves for the Government and the botanical department for the station undertook during July to go over the plantations in the state where white pine seedlings had been imported from Europe, and inspect them for this rust, and to destroy any infected seedlings, if found, and any wild gooseberries or currants in their vicinity, as the II and III stages occur on the latter as alternate hosts. It was really then too late in the season to find the fungus on the pines, except far past its prime. However, twenty-four plantations, including about 580,000 seedlings, were inspected, and very suspicious or positively identified infected specimens were found at two additional places; viz., at the Plant estate plantation at East Lyme and at the Groton Water Company plantation at Poquonock. In none of the five places where signs of the pine rust were found were more than a dozen specimens seen, except at the Street plantation, where the diseased plants were noticed as they were being set out. A descriptive letter concerning the rust and its reputation was sent to all those who had used imported seedlings.

In 1910 the botanical and forestry departments of the station undertook to again go over these and other plantations, beginning early in the season, as soon as the rust ordinarily makes its appearance. During May and June four inspectors visited twenty-six plantations, inspecting about 425,000 seedlings, and made very careful examinations for the rust, in many cases examining every individual seedling. In spite of this thorough examination, not a single rusted plant was found! No doubt the severe drought of the preceding year had killed off those seedlings weakened by the rust, if such existed. Of course it is possible that examination another year might reveal a few rusted plants, as it is usual for the seedlings to go one or possibly more years after infection, before the æcial stage of the rust appears on them.

During the years 1907, 1908 and 1909, there were imported into the state, chiefly from Germany, under the supervision of the station's forestry department, about 640,000 white pine seedlings, which were set out in fifty-five different localities, and private individuals have imported at least 100,000 more. All of these seedlings, except about 95,000 set out mostly in small lots in twenty different localities, have now been inspected once or twice for the rust. No doubt, too, at the time they were set out the men would have discarded any specimens showing evidence of the rust. In all of the plantations examined, watch was kept for any signs of currants or gooseberries in the vicinity of the pines, and these were destroyed when found. Fortunately, species of *Ribes* in a wild or escaped state are comparatively rare here, so that even if this rust occurred on the pines, it would be much more difficult for it to pass to these hosts than in some of the more northern states where they are more frequent. In 1910 the station did not import any white pines because of the danger of bringing in this rust, and only one lot, to our knowledge, was imported by others. Examination of these showed no signs of the rust. From now on it is probable that most of the seedlings set out will be native grown stock, as plenty of this seems to be in evidence at fair prices. There does not seem to be much likelihood, therefore, that the rust will obtain a foothold in the state, though watch will still be kept for it. Anyone finding suspicious specimens should send them to the station for examination.

Infected white pine seedlings, out of the season when the fruiting stage appears, may be recognized in a general way

by the somewhat fusiform swollen stems and by the bunching of the leaves, shown by the halftones in Plate XXXVI a. Not all swellings of the stem, however, are due to rust, as insect and other injuries may produce such distortions in young seedlings. During the months of May and June the fruiting stage shows on the swollen stems as small, white, oblong blisters that upon rupture reveal an orange mass of spores. These gradually wear away, and then positive evidence of infection is more or less difficult. The mycelium remains in the infected tissues, gradually spreading to the new growth, and renews its fruiting stage each spring, unless the death of the host intervenes. The spores produced on the pine do not spread the disease to other pines, but develop two other spore stages on both gooseberries and currants, the last stage carrying the fungus back to the pines.

Many writers consider this rust as a very serious menace to white pines. The writer is not so much afraid of it in this state because of the scarcity of the alternative hosts, and also because it looks to him as if most of the damage comes from the use of infected seedlings, which we should be able to largely eliminate here. Such infection as might occur after the pines once got a good start in the forests we are inclined to believe would be rare, and not nearly so injurious to the host. We have heard of one large importer of white pines who intends also to import a large number of currant bushes for commercial purposes. Such a condition offers a chance for the rust to do considerable harm if it once gets started in either of his plantations.

The native pine-sweetfern rust, which we describe elsewhere, seems to us to be just as virulent as this rust, and one much more likely to spread generally here, on account of the frequency of its alternate host, the sweetfern. Yet, with the exception of the plantation at Rainbow, where pines were infected in the seed beds, we have seen and heard of no damage by this rust. This rust does not occur on the white pine, though it has several other species for its hosts.

PRIVET, *Ligustrum vulgare*.

ANTHRACNOSE, *Glœosporium cingulatum* Atk. Mr. Coe, of the Elm City Nursery Company, first called the writer's attention to this disease on a variety of privet called *italicum*, which was imported from France in the spring previous to our examination in the fall of 1910. The fungus causes diseased areas on the stem and branches, which are not very conspicuous, being slightly sunken and a different color, but when these cankers entirely girdle the branches, the leaves and finally the whole branch above die, and the trouble becomes very evident. The injury at this place was quite noticeable, through the dead branches and one or two dead bushes, but probably the shock of transplanting may have weakened the plants so that the trouble was more conspicuous than it would be under more favorable conditions for the host.

When Atkinson originally described this fungus (Bull. 49, Cornell Exp. Sta.) in 1892, he said nothing about the injury to the host, and we have seen no reference where it is said to have caused conspicuous injury, though it seems to be capable of it. Atkinson obtained cultures of the fungus, described the conidial stage, and suggested that it had a mature stage, which his student, Miss Stoneman, later described (Bot. Gaz. **26**: 101. 1898) as belonging to the genus *Gnomoniopsis*, now known as *Glomerella*.

Cultures of the fungus were easily obtained by the writer from the cankers, and these produced both the conidial and the asco stages. Miss Stoneman notes the presence in the cultures of setæ connected with the conidial stage, but did not find these on the host. The writer, however, found some of these setæ with the conidial stage on the host.

RASPBERRY, *Rubus strigosus*.

Rust, *Puccinastrum arcticum* var. *americanum* Farl. This rust, which was described a few years ago by Professor Farlow (Rhodora **10**: 13. 1908), has ordinarily been confused with the uredo stage of *Kueneola albida*, as, like that species, it forms very small orange outbreaks on the under side of the leaves. Microscopically, however, the two are quite distinct. The uredo stage was sent to the writer from Stamford in September, 1909, on cultivated raspberry, this being the first time it has been found in the state. It apparently did little harm to its host. The æcial stage is unknown, though it may be *Peridermium balsameum* on the balsam fir.

RYE, *Secale cereale*.

Powdery Mildew, *Erysiphe graminis* DC. In our Report for 1903 we listed the conidial stage of this mildew on cultivated barley. In 1910 specimens on rye were received from J. F. Shepard, of New Haven, and others were collected by the writer at the station farm at Centerville, these being the first collections on this host in the state. In the latter locality the perithecial stage was very conspicuous and abundant on rye, but on barley was practically absent. Considerable injury was caused to both these hosts through severe infection of the leaves, which died prematurely. Apparently the season was favorable for an unusual development of the fungus. It forms an evident grayish felt in small clusters, thickly covering the leaves, and the perithecia, when produced, show as small but evident black specks embedded in this. As usual with this species, none of the asci matured their spores on the living plants.

SQUASH, *Cucurbita Pepo*.

Chlorosis. In previous Reports we have mentioned chlorosis troubles of Lima and string beans, muskmelon, tobacco and tomato. Of these so far we have been able to prove only those of tobacco and tomato to be infectious, that is, capable of producing the trouble in healthy plants when juice from the chlorosis plants is placed on the young leaves. In June, 1910, we saw plants of summer squash in cold frames at the Farnham farm in Westville that were subject to a chlorosis trouble, though from its appearance it did not impress us as being of an infectious nature. The leaves were quite prominently streaked with irregular areas of lighter yellowish-green, the normal green color remaining more commonly around the veins. The cause of the trouble was not determined, though possibly too much manure in the beds may have had something to do with it.

SWEET PEA, *Lathyrus odoratus*.

Powdery Mildew, *Erysiphe Polygoni* DC. Previous to this we have reported in this state only one trouble of the sweet pea; viz., a rot disease. This powdery mildew forms a mealy, whitish growth on the leaves through the production of its conidial stage, but the perithecial stage was not found. Apparently the mildew is not a conspicuous parasite of the sweet pea, as it is not listed on this host in the more prominent works on the mildews. The absence of the mature stage renders its determination somewhat doubtful, but as the conidial stage agrees with the above species, and as this has been reported on several other species of *Lathyrus*, it is more likely to be this than any other species.

WALNUT, ENGLISH, *Juglans regia.*

White Mold, *Microstroma Juglandis* (Ber.) Sacc. We have reported this fungus before on cultivated specimens of our native butternut. It was sent to the writer in July, 1909, by Dr. R. T. Morris on the variety *Kaghazi* of the English walnut, grown on his farm at Stamford. While this fungus forms conspicuous white patches on the under sides of the leaves, it is not usually a very serious pest.

WHEAT, *Triticum vulgare.*

Stinking Smut, *Tilletia fœtens* (B. and C.) Trel. Very little wheat is grown in this state at the present time, so that this smut has not been collected here in the fields. However, it is of economic importance in another way. At least four times during the last few years samples of commercial wheat feeds, usually in the shape of middlings, have been sent to the station for examination because animals refused to eat the feed. Two of these samples have come from feed men and two from farmers. A microscopical examination in each case has shown the presence of the spores of the stinking smut. In a sample recently received from Mr. R. A. Jones of Bethlehem, the smut spores were unusually abundant. Mr. Jones said that the middlings had been fed to hogs, that it made them sick, and that some of them refused to eat more. After changing to other food the hogs got over their trouble.

Feeds that contain these spores indicate not only that they are made from middlings, but from badly smutted or injured wheat, which would be of no value for flour. Whether or not the smut spores are themselves the injurious principle might be questioned, but there seems to be no question, if they are not, that the action of this fungus, or its opening the way for

bacteria to act, produces in the plant tissues deleterious products that injure or render dangerous their use for feeding purposes.

Tubeuf, in the English edition of his Diseases of Plants, page 306, says concerning *Tilletia Tritici* (a very closely related smut, also found in grain in this country): "The smut also possesses poisonous properties which make flour contaminated with it dangerous to human beings and the straw or chaff injurious to cattle. . . . The symptoms in the few cases of disease observed do not agree very closely. A paralyzing effect on the centers of deglutition and the spinal cord seem to be regularly present. As a result one generally finds a continuous chewing movement of the jaws and a flow of saliva, also lameness, staggering, and falling. Cattle, sheep, swine and horses are all liable to attack."

McAlpine, in his Smuts of Australia, page 81, records a case in which six hundred and fifty Leghorns dropped in a few days from a daily average of one hundred eggs to sixteen when they were fed on smutted wheat, and when this was stopped and clean wheat substituted, they regained in three weeks an average daily yield of eighty eggs. He also records an experiment with pigeons in which one pair was fed smutted wheat for twenty-two weeks, while the other pair was fed sound wheat. The doves fed good wheat laid seven eggs during this period, while the others laid only two. Both pairs of pigeons at the start were in good plumage, and the pair fed on good wheat retained the good plumage and was fat at the end of the experiment, while the other pair was in poor condition, with the feathers all standing out.

While writing on this subject of deleterious animal foods, we might mention that we have also occasionally had whole oats sent in that horses refused to eat. We have never found any fungus that might be the cause of a musty condition of these oats. It has been thought that in these cases the oats were bleached by some sulphur process, and that this had left them unpalatable to the horses. We have also recently heard of a case where certain farmers last year purchased oats for feeding purposes, and as they looked plump and *white* they were also used for seed. None of the fields sowed with these oats came up, and as they were to serve as a cover crop for grass seed, the latter also failed. It seems quite probable that these oats had been sulphured, and their vitality entirely destroyed. Seed at all suspicious should be sent to the station to have its germination tested.

We have also had one or two cases called to our attention recently where animals have been made sick and some have died from eating silage. In such cases the silage had not been properly made and had become moldy, and the fungous growths no doubt had produced poisonous products in the decomposition of the silage. Similar troubles have been noticed elsewhere from feeding moldy silage (see Pammel's Manual of Poisonous Plants, p. 24).

II. SPRAYING POTATOES IN DRY SEASONS.

General Considerations.

Object. In our Report for 1904, page 363, we gave the results of spraying potatoes during the three wet years, 1902 to 1904, when blight was unusually severe in this state. The sprayed parts of these fields showed increased yields, varying from 18 up to 108 per cent., according to the season, thoroughness of the spraying, etc. During these experiments certain points came up for consideration upon which we had no data to base conclusions. For example: (1) Would manure tend to increase the amount of rot in a field badly blighted over the amount of rot in the same field in which a commercial fertilizer was used? (2) Would the use of the same land for two or three years in succession tend to increase the amount of rot in the successive crops, other things being the same; and would blight tend to appear earlier in such a field? (3) Would ridging the rows help to prevent the blight spores from being washed down to the tubers, and so decrease the per cent. of rot as compared with level culture under the same conditions?

In order to answer the above questions, the writer started a series of experiments in 1906, which were carried on for the four years ending in 1909. Unfortunately for the primary objects of the experiments, these years proved to be ones in which blight did very little harm in this state. In fact, in three of these years we were unable to find any of the blight fungus on potatoes in this experimental field, and in the other year it was so scarce as to cause practically no harm. However, while the main objects of the experiments remained unanswered, we still obtained data regarding spraying in dry seasons, also some data regarding scab, which we present in this paper.

Conditions of Experimentation. The experiments were carried on each year on the same plot of ground; viz., two-thirds of an acre of level, uniform, light loam, with a very leachy subsoil, at the station's temporary experimental farm leased of Mr. Webb at Centerville. This land had not been cultivated or fertilized for some years before our experiments began, and so was in very poor shape for growing crops of any kind. Amount of yield, however, except in a comparative way, was not contemplated in these experiments.

The land was divided into plots as follows: The east half each year was fertilized with manure at the rate of sixteen to eighteen tons per acre, while the west half received about the equivalent of the nitrogen in the manure in the shape of two applications of nitrate of soda (rate of 450 lbs. per acre). Each half received the same amount of muriate of potash (rate of 300 lbs. the first and second years, and 450 lbs. the other two years, per acre) and bone meal (rate of 200 lbs. per acre each year). As the manure had also some phosphorus and potash in it, this naturally gave that half of the field a somewhat better fertilization than the half on which sodium nitrate was used, and as a matter of fact it showed this each year in a more luxuriant growth and a larger yield.

Running crosswise of the manured and sodium nitrate halves, the field was divided into halves, one of which received level culture and the other modified ridge culture. This ridged half was really cultivated the same as the level until the first to the middle of July, when, during the last two cultivations, the potatoes were ridged by the shovel cultivators as much as possible, and in some seasons hilled further with a hoe. In order to bring the tubers in the level culture near the ground and those in the ridged culture as deep as possible, the former were planted only three or four inches deep, while the latter were planted five to seven inches. Ordinary cultivation, not averaging once a week, was given the whole field. Some hand work with the hoe was also given. Each year the halves given level and ridged culture were reversed, so that any inequality of land might be cancelled.

The central halves of the ridged and level cultivated rows were sprayed with Bordeaux mixture (4-4-50 formula), leaving similar unsprayed rows on either side. Usually about three sprayings with Bordeaux were given, and as these were made by hand, they were very thorough. The first spraying was generally given about the middle of July, and the last about the first of September. All the potatoes were sprayed for insects, either with Paris green or with arsenate of lead, so as to make conditions the same so far as insect injury was concerned.

These treatments divided the field into eight equal areas, each receiving some different point of treatment, as follows: (1) sprayed, manured, ridged; (2) unsprayed, manured, ridged; (3) sprayed, sodium nitrate, ridged; (4) unsprayed, sodium nitrate, ridged; (5) sprayed, manured, level; (6) unsprayed, manured, level; (7) sprayed, sodium nitrate, level; (8) unsprayed, sodium nitrate, level.

The potatoes were dug in October, after all the vines were dead, and comparative yields determined by taking the counts and weights from fifty-foot lengths in two separate rows of each plot for comparison, but the figures given in the tables are for the combined one hundred feet. To avoid any unevenness due to the difference in the land, the sprayed and unsprayed rows, which otherwise received the same treatment, were always taken as near together as possible.

Results. Sprayed versus Unsprayed. In the four years, out of the forty-four comparisons of fifty feet of sprayed vines with the corresponding unsprayed vines, the sprayed lots in every case except three gave a greater yield. In these three exceptions the average of the two tests of fifty feet of sprayed vines in each case was greater than the corresponding average of the two fifty feet of unsprayed vines, so that it can be stated that during the four years' tests the sprayed lots invariably gave a higher yield than the unsprayed. Table 1 gives the averages for the four years of these sprayed and unsprayed potatoes, and from this we find that the average increase of all the sprayed vines over unsprayed vines was about 32 per cent. The increased yield of the sprayed over the unsprayed by years was as follows: In 1906, 30 per cent.; in 1907, 24 per cent.; in 1908, 17 per cent.; in 1909, 53 per cent. Plate XXXVII b shows the comparative yields in 1906 on the sodium nitrate half (1) sprayed, ridged; (2) unsprayed, ridged; (3) sprayed, level; (4) unsprayed, level. As shown in our previous experiments, the increased yield of the potatoes was not only due to increased numbers of marketable tubers, but also to increased weight of the tubers, especially the larger ones.

In every one of these years, the spraying, theoretically, more than paid for itself, despite the fact that none were blight years. Stewart, in the 1906 Report of the Geneva, N. Y., Experiment Station, shows that out of fourteen coöperative experiments with farmers in different parts of the state in 1905, it cost from $2.44 to $6.84 per acre to make the sprayings, or an average cost for all of $4.25 per acre. We think that in this state, to be on the safe side, we may estimate the cost, including bother, of spraying at $10.00 per acre. It often requires more time to cart water and make up the mixture than it does to apply it. If the spraying is done by hand, it also costs more than when done with spraying machines, but a more thorough job can be done in this way with three sprayings than with five by any power sprayer we have seen. Taking the cost of spraying then, at $10.00 per acre, and the average yield of an unsprayed field in this state at the conservative figure of 130 bushels per acre, we find that the lowest increase in yield due to spraying, namely, 17 per cent., means 22 bushels, and the highest increase, 53 per cent., means 69 bushels. At the very low price of fifty cents per bushel, the lowest increase would mean $11.00, or one dollar net profit, and the highest, $34.50, or $24.50 profit. We have made these estimates especially conservative by taking comparatively low yields and a high cost of spraying per acre. Years when blight really did harm in the fields would of course make the gains very considerably greater, if the spraying were well done.

The question naturally comes up, why did the sprayed potatoes give this increased yield over the unsprayed if there was no particular injury caused by the late blight fungus? Some little benefit was no doubt derived from the prevention of the early blight, but this must have been scarcely appreciable because this fungus was not at all conspicuous these years. Again, some very small benefit may have been due to lessening insect attack, since potatoes sprayed with both Bordeaux and Paris green keep off the insects somewhat better than where sprayed only with Paris green. This is especially true as regards the potato flea beetle. But here again the gain was of a very minor kind. Ordinarily botanists have explained this increase as due to some stimulative effect the Bordeaux mixture has on the chlorophyll of the potato leaves in increasing starch production. Personally, the writer believes that the results are largely due to *conservation of moisture in the leaves in dry seasons by clogging up the stomata and water pores with the sediment of the spray.* The reasons for this belief are (1) that the potato leaves, through their numerous stomata and terminal water pores, lose water very easily, and are especially susceptible to what is known as tip burn in dry seasons; (2) that the unsprayed vines uniformly suffered earlier and more severely from tip burn than the sprayed, which were green for about two weeks after the unsprayed were dead; (3) that in

1910, which was a season like the preceding years, except with a little injury from blight at the very end of the season, spraying with "Sulphocide" and commercial lime-sulphur, sprays with comparatively little sediment, did not prolong the life of the vines or give increased yield, while spraying with Bordeaux mixture did.

Results: Ridged versus Level Culture. As to the primary object of these two methods of culture, we have very little data, since there was practically no rot in the potatoes during the four years. We hope to continue the experiment until seasons favorable for rot shall give us data on this subject. That there is some basis for the belief that ridging will be of help in lessening the rot was shown in our experiments in 1910 in another field, where the ridged rows, both sprayed and unsprayed, gave practically no rot against a small per cent. in the level rows. This was especially true of the unsprayed level rows, which gave about nine per cent. of tubers rotted against only one-half per cent. in the sprayed level rows, though the blight appeared on the foliage only in a small way toward the end of the season.

While our data are not very enlightening on this point, still the experiments do show results along a related line, namely, that the ridging did not materially lessen the yield. There are those in this state who advocate level culture because of the supposed increased yield over ridging, and if this is so, then any increased yield due to prevention of rot in the ridged potatoes might be more than outbalanced by the increased yield due to level culture, especially taking the yields year after year, many of which show no rot. However, with our modified ridged culture (as explained previously) we do not find in averaging the four years that the ridged potatoes gave any very materially smaller crop than the level, since the average of the latter was only about 6 per cent. higher than the former, and to offset this, the 1910 crop in a different field slightly favored the ridged. Taking the yields by years, the level culture gave slightly better crops in 1906, 1907, and 1908, and the ridged in 1909 and 1910. As these last four years were chiefly drought years, the test was even more severe than it would be in wet seasons. Likewise, the data that we obtained in some coöperative experiments with farmers in 1906 did not seem to show that the ridged potatoes were at a disadvantage, judging from the yields given and the general opinion of the growers where no measurements were taken.

In connection with the spraying, it may be noted that the *average* for the four years gave a slightly greater proportional increase in the sprayed ridged over the unsprayed ridged than was given by the sprayed level over the unsprayed level, on both the manured and the sodium nitrate plots, though in two of these years (1907 and 1909) the proportional increase was greater for the level. This perhaps may be explained by the unsprayed ridged potatoes suffering on the whole slightly more from the droughts.

Results: Manure versus Sodium Nitrate. Here again we did not get any data relative to whether or not manure increased the amount of rot in fields in blight seasons. From our correspondence with farmers, they seemed to favor the opinion that manured fields rot worse than those where chemical fertilizers only are used. While we did not get data on the blight, we did obtain data regarding scab and the use of manure, which we will mention later.

Of course the manured half of the field each year gave a greater yield than the sodium nitrate half, since it was better fertilized. The average increase for the four years of the manured over the sodium nitrate was about 47 per cent. There is no doubt that manure is a very good fertilizer for potatoes, but at the same time there is greater danger of injury from scab and apparently from rot with its use. The most sensible way to use manure seems to be either in a heavy application on corn the previous year, using only a commercial fertilizer the same year with the potatoes, or at least to put it on the land and plow it in the preceding fall rather than in the spring just before planting the potatoes, as was done in our experiments. As regards spraying, the sodium nitrate sprayed rows uniformly gave a higher per cent. of increase over the checks, either ridged or level, than did the sprayed manure rows over the unsprayed checks. We are not sure of the reason for this, unless it was because the manured rows suffered earlier and more severely from the drought. Our manured plot also had more weeds than the sodium nitrate plot.

Results: Scab. These experiments showed very strikingly how the continued use of the same land for potatoes greatly increases the amount of scab. Even if it were of no benefit in the prevention of rot, rotation certainly is of value in lessening scab. The first year the potatoes were on the land the per cent. of scab was so

small that it was not determined. It certainly was below 5 per cent., and probably not over 1 per cent. The second year, 1907, the scabby tubers had increased to 22 per cent., in 1908 to 47 per cent. (the same potatoes in our general rotation fields this year gave only about 1 per cent. scabby), and in 1909 to 63 per cent. The last two years the scab was so bad as to seriously affect the market value of the potatoes. The scab on the manured half was more serious than on the sodium nitrate half, since the average scab for the three years 1907 to 1909 for the former was 48 per cent., while on the latter it was only 33 per cent. As regards level and ridged rows, there was more scab in 1907 and

TABLE I.—SPRAYING EXPERIMENTS—AVERAGE, 1906, 1907, 1908 AND 1909.

Treatment	Very large		Large to medium		Medium to small		Total marketable		Very small	
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt	No.	Wt.
(1) Sprayed, Manured, Ridged	2	2	77	25	161	25	240	52	82	3
(2) Unsprayed, Manured, Ridged	0	0	61	19	141	21	202	39	74	3
(3) Sprayed, Sod. Nitrate, Ridged	3	2½	64	20	102	14	170	36	40	1
(4) Unsprayed, Sod. Nitrate, Ridged	0	0	50	14	90	12	140	25	45	2
(5) Sprayed, Manured, Level	2	1¼	78	25	183	27	264	54	119	4
(6) Unsprayed, Manured, Level	1	1	68	18	168	22	236	43	151	5
(7) Sprayed, Sod. Nitrate, Level	0	0	66	20	131	17	197	38	74	2
(8) Unsprayed, Sod. Nitrate, Level	0	0	45	13	116	15	162	28	80	3
Average—Sprayed	1	1	71	23	144	21	217	45	77	3
Average—Unsprayed	0	0	56	16	68	17	185	34	87	3

1909 in the ridged rows and less in 1908, and in the average for the three years the ridged ran slightly higher, though whether this means anything or not we do not know. As the level and ridged halves were alternated each year, this shows that it was the same side of the land that each time gave the most scab, and so the nature of the land rather than the manner of cultivation may have been the determining factor. It is certain, however, that the level rows suffered much more from sun scald.

Details of Experiments in 1906.

Treatment. May 2: Planted with Carmen No. 3. *June 21:* Sprayed all with Paris green. *July 6:* Gave second spraying with Paris green. *July 16:* Gave first spraying with Bordeaux mixture (4-4-50) by hand. Used Paris green in Bordeaux, and gave unsprayed half the third treatment with Paris green, as bugs were unusually bad. Also gave first ridging to ridged half about this time. *July 24:* Gave final ridging. *July 27:* Made second treatment with Bordeaux. *August 8:* No blight, but a little early blight and considerable tip burn, especially on unsprayed vines. *August 11:* Gave third spraying with Bordeaux. Found a very few blight leaves on unsprayed vines. *August 26:* Difference between sprayed and unsprayed vines quite marked in favor of former, due to tip burn and insect injury. *September 6:* Unsprayed vines fully two-thirds dead from tip burn, while on the sprayed not one-half the leaves were dead. Gave two rows only

TABLE II.—SPRAYING EXPERIMENTS IN 1906.

Treatment	Very large		Large to medium		Medium to small		Total marketable		Very small		Rot No.
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	
(1) Sprayed (3), Manured, Ridged	5	3¾	154	43	159	18½	318	65¼	28	¼	2
(2) Unsprayed, Manured, Ridged	0	0	125	32¼	140	14¼	265	46½	22	¼	14
(3) Sprayed (4), Sod. Nitrate, Ridged	2	1½	167	45¾	106	12¼	273	59½	15	⅕	5
(4) Sprayed (3), Sod. Nitrate, Ridged	5	3½	122	32¾	134	14¾	261	51	16	⅕	1
(5) Unsprayed, Sod. Nitrate, Ridged	0	0	103	25	109	10½	212	35½	22	¼	1
(6) Sprayed (3), Manured, Level	8	5	171	51	166	19½	345	75½	35	⅓	0
(7) Unsprayed, Manured, Level	3	2½	140	27½	201	20¾	344	60¾	29	⅓	4
(8) Sprayed (4), Sod. Nitrate, Level	2	1½	159	41	158	16½	318	59	24	¼	2
(9) Sprayed (3), Sod. Nitrate, Level	0	0	146	42¼	143	16½	289	58¾	21	¼	0
(10) Unsprayed, Sod. Nitrate, Level	0	0	102	29¼	164	17¾	266	47	26	¼	5
Average—Sprayed (3)	3	3	148	42	150	17	303	61	25	¼	1
Average—Unsprayed	1	1	117	28	153	16	272	47	25	¼	6

a fourth treatment, as vines were too far gone and blight was doing no particular harm.

Results: It is a question whether the fourth treatment did much good, though in the ridged rows it gave a better yield than the ridged row sprayed only three times. There was more rot this year than any other, yet not enough to do any harm. Besides the evident difference in the life of the vines, the yield also showed a corresponding difference in favor of the sprayed rows. The sprayed (3) manured ridged lot gave a 40 per cent. increased yield over the unsprayed manured ridged, as compared with 24 per cent. increase for the sprayed manured level over their unsprayed rows; the sprayed sodium nitrate ridged gave 43 per cent. increase over the unsprayed sodium nitrate ridged, while the sprayed sodium nitrate level gave 25 per cent. increase over the

unsprayed check rows. The average of all the sprayed rows over the unsprayed was about 30 per cent., or the second best results of the four years' test. The details of yields are given in Table II.

Details of Experiments in 1907.

Treatment. On *May 1* planted Green Mountain variety. *July 3:* Gave first application to all rows of insecticide, as bugs were late in starting this year. *July 8:* Gave first ridging to ridged half. *July 16:* Gave first spraying with Bordeaux, and used

TABLE III.—SPRAYING EXPERIMENTS IN 1907.

Treatment	Very large		Large to medium		Medium to small		Total marketable		Very small		Rot No.	Scab Per Cent.
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.		
(1) Sprayed (3), Manured, Ridged	0	0	19	7	143	21½	162	28½	164	6¾	0	34
(2) Sprayed (2), Manured, Ridged	0	0	20	7½	140	21½	160	29	130	5½	0	41
(3) Unsprayed, Manured, Ridged	0	0	21	6¾	112	17	133	23¾	97	4¼	0	32
(4) Sprayed (3), Sod. Nitrate, Ridged	0	0	24	7	93	12½	117	19½	87	2¾	0	10
(5) Sprayed (2), Sod. Nitrate, Ridged	0	0	33	10	96	13½	129	23½	68	2¼	0	16
(6) Unsprayed, Sod. Nitrate, Ridged	0	0	19	5½	92	12½	111	18	91	4¼	0	35
(7) Sprayed (3), Manured, Level	0	0	13	4½	162	25½	175	30	162	6½	0	19
(8) Sprayed (2), Manured, Level	0	0	22	8½	155	25¼	177	33¾	130	5¾	0	16
(9) Unsprayed, Manured, Level	0	0	9	3¾	127	19¾	136	23½	262	10	0	18
(10) Sprayed (3), Sod. Nitrate, Level	0	0	28	8¾	117	14	145	22¾	122	3½	0	14
(11) Sprayed (2), Sod. Nitrate, Level	0	0	10	3¾	118	18½	128	22¼	148	5½	0	10
(12) Unsprayed, Sod. Nitrate, Level	0	0	7	2¼	102	15½	109	17¾	149	6¼	0	16
Average—Sprayed (3)	0	0	21	7	128	19	149	26	128	5	0	20
Average—Unsprayed	0	0	14	5	108	16	122	21	150	6	0	25

insecticide with it and alone on unsprayed vines. *July 19:* Gave final ridging and cultivation of potatoes. *August 5:* Made second spraying with Bordeaux. No signs of blight, but tip burn bad, especially on unsprayed potatoes, and showed more with those on manured rows than on sodium nitrate rows. *September 6:* Gave third spraying to six rows only (three ridged and three level), as it was rather late to do much good. No signs of blight this season. Unsprayed vines with level culture more uniformly dead than the unsprayed ridged. Sprayed rows still showing considerable percentage of green leaves, especially on sodium nitrate part, but difference not so marked as in previous year.

Results. On account of drought, the yield this year was considerably less than any of the other years. The third spraying was too late to do any good at all. If the first spraying had been made about the first of July and the third the last of August, the results would have been better. The sprayed (3) manured ridged rows gave an increase of 20 per cent. over the unsprayed manured ridged portion, while this was increased to 27 per cent. on the sprayed manured level over the corresponding unsprayed portion. The sprayed (3) sodium nitrate ridged rows gave only 8 per cent. increase (30 per cent. in the case of those sprayed twice) over the unsprayed, while the sprayed (3) sodium nitrate level gave 28 per cent. over the unsprayed portion. The average increase of all the sprayed over the unsprayed was 24 per cent. Table III shows details of yields.

Details of Experiments in 1908.

Treatment. On *April 29,* planted Green Mountain variety. *July 5 to 10:* Gave first ridging. Vines were sprayed twice with arsenate of lead for bugs, which were not bad this year. *July 17:* Gave first spraying with Bordeaux. This was rather late, as the tip burn was already evident, especially on manured half. *July 27:* Gave second spraying with Bordeaux. Sodium nitrate half with less tip burn than the manured half, and sprayed vines somewhat better than unsprayed. *August 13:* Gave third spraying with Bordeaux. Very little early, and no late blight. Sprayed rows somewhat better than unsprayed. *September 11:* Vines nearly all dead except a few scattered ones. Sprayed vines showed less difference over unsprayed this year than any other, due no doubt to the fact that drought was bad and the first spraying was not given until tip burn began to show its effects on the vines. No blight at all.

Results: The spraying this year gave the least results of any year, showing only an average increase of 17 per cent. over the unsprayed. Had the first spraying been made earlier, there would no doubt have been less injury from tip burn, with a consequent increase in yield. As the drought affected the manured rows most, the increased yield due to spraying was least in these. The sprayed manured ridged gave 12 per cent. increase over the unsprayed, while the sprayed manured level gave only 5 per cent. increase over the unsprayed part. On the other hand, the sprayed sodium nitrate ridged gave 46 per cent. increase over the unsprayed rows, while the sprayed sodium nitrate level gave 20 per cent. increase over the unsprayed portion. See Table IV.

TABLE IV.—SPRAYING EXPERIMENTS IN 1908.

Treatment	Very large		Large to medium		Medium to small		Total marketable		Very small		Rot No.	Scab Per Cent.
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.		
(1) Sprayed (3), Manured, Ridged	1	1	71	23¾	128	20½	200	45¼	55	2¼	0	58
(2) Unsprayed, Manured, Ridged	0	0	56	20¼	126	20¼	182	40½	103	3¾	0	46
(3) Sprayed (3), Sod. Nitrate, Ridged	1	¾	61	21¾	75	11½	137	34	31	1¼	0	29
(4) Unsprayed, Sod. Nitrate, Ridged	0	0	44	13¼	67	10	111	23¼	39	1½	0	23
(5) Sprayed (3), Manured, Level	0	0	69	24½	163	23½	232	48	108	3¼	0	71
(6) Unsprayed, Manured, Level	0	0	77	24	158	21¾	235	45¾	174	5¼	0	58
(7) Sprayed (3), Sod. Nitrate, Level	0	0	40	12½	120	17¼	160	29¾	76	2¾	0	51
(8) Unsprayed, Sod. Nitrate, Level	0	0	43	12¼	92	12½	135	24¾	56	2¼	0	43
Average—Sprayed	1	0	60	21	122	18	182	39	68	2	0	52
Average—Unsprayed	0	0	55	17	111	16	166	33	93	3	0	43

Details of Experiments in 1909.

Treatment. Used Green Mountain variety this year, not planting until *May 11,* as the season was late. Gave all a couple of sprayings with arsenate of lead for bugs on *June 24* and *July 7.* About the middle of July gave first ridging, and the final one on *July 27,* when first treatment with Bordeaux was also made. *August 9:* Made second spraying with Bordeaux. *September 2:* Gave third spraying with Bordeaux. Sprayed rows now much greener than unsprayed, especially those ridged, as the vines in the unsprayed ridged rows were all dead from tip burn. *September 28:* Vines all dead except one here and there. No late blight, and very little early blight. Practically all of premature dying due to tip burn.

Results. The spraying this year gave the best results of any of the four, since the average increased yield was 53 per cent. The yields this year were better than any other year except 1906. The sprayed manured ridged gave an increase of 45 per cent. over the unsprayed manured ridged, while the sprayed manured level gave 48 per cent. over the unsprayed check. On the other hand, the sprayed sodium nitrate ridged gave 60 per cent., and the sprayed sodium nitrate level 79 per cent. over their unsprayed checks, the last being the greatest increased yield due to spraying obtained in any of the experiments during the four years. See Table V.

TABLE V.—SPRAYING EXPERIMENTS IN 1909.

Treatment	Very large		Large to medium		Medium to small		Total marketable		Very small		Rot No.	Scab Per Cent.
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.		
(1) Sprayed (3), Manured, Ridged	4	3½	64	24½	212	39½	280	67½	79	3¼	0	77
(2) Unsprayed, Manured, Ridged	0	0	44	15	185	31½	229	46½	73	2¾	0	84
(3) Sprayed (3), Sod. Nitrate, Ridged	5	4½	50	18	108	17½	163	40	28	1¼	0	66
(4) Unsprayed, Sod. Nitrate, Ridged	0	0	34	11½	91	13½	125	25	28	1¼	0	67
(5) Sprayed (3), Manured, Level	0	0	61	22	242	39½	303	61½	173	5½	1	60
(6) Unsprayed, Manured, Level	0	0	46	16	184	25½	230	41½	139	5¾	0	65
(7) Sprayed (3), Sod. Nitrate, Level	0	0	51	18½	145	21	196	39½	78	2¼	0	46
(8) Unsprayed, Sod. Nitrate, Level	0	0	29	9	108	13	137	22	89	2½	0	42
Average—Sprayed	2	2	56	21	177	29	235	52	89	3	0	62
Average—Unsprayed	0	0	38	13	142	21	180	34	82	3	0	64

Recommendations.

(1) *Seed.* The blight fungus carries over in the tubers, and the infected ones may be recognized in the spring by the slightly sunken, often pitted, reddish-brown, superficial dry rot. While the use of such tubers is not advisable, still blight may do much harm in a field in which the seed tubers were perfectly free from the fungus. As to varieties, we know of no good standard variety grown in this state that is not subject to blight of the vines and rot of the tubers, though there may be more variation in the latter respect than in the former. Such varieties as have been found by experiment to possess more or less resistance to either blight of the foliage or rot of the tubers seem to have it at the expense of quality of tubers. However, this is a subject for further investigation, and probably offers greater possibilities than have yet been developed.

(2) *Planting.* For early varieties early planting, in order to mature them as soon as possible to escape injury by blight or drought in midsummer, is no doubt advisable. But for late varieties we rather favor only medium early planting, say the last of April to the first week of May, because if planted too early, late potatoes suffer more in the years of drought than if planted later, since they are usually so far matured that a dry July or August will kill them, while the later planted fields, especially if sprayed, will manage to pull through until the moist fall season, and so really have a longer period of growth. We recommend that the seed be planted fairly deep, five to seven inches, to develop the tubers in the ground as deeply as possible as a protection against rot and sun scald.

(3) *Rotation.* We advise rotation, having potatoes on a different piece of land each year. A four years' rotation, such as the following, is not bad for this state: (1) Corn. (2) Potatoes. (3) Rye. (4) Leguminous crop (sow in fall with the rye, or the following spring). Growing potatoes on the same land two or more years in succession increases scab and possibly in favorable seasons an earlier appearance of blight and greater rot, though so far as the blight is concerned this is largely conjecture.

(4) *Fertilization.* Manure plowed into the land in spring just before planting the potatoes increases the amount of scab and possibly the amount of rot in blight seasons. If a heavy coat of manure was used with the corn the previous year, commercial fertilizers only may be used with the potatoes. Or if manure is used, plow it in the preceding fall. Horse manure is probably the least objectionable. The following home-mixed fertilizer (per acre), recommended by Dr. Jenkins, seems to merit extended use in this state: Nitrate of soda, 150 lbs.; muriate of potash, 200 lbs.; acid phosphate, 400 lbs.; tankage, 350 lbs.

(5) *Cultivation.* We recommend a thorough cultivation, to conserve the moisture, in the nature of a combined level-ridge culture. That is, give the vines thorough level culture up to the last two cultivations, and then begin sometime early in July to ridge up the rows with the shovel cultivators, moderately at first, and as much as possible the second time. After both of these ridgings, mulch up the soil between the ridges by shallow cultivation as much as possible without pulling down the ridges, so as to hold in the moisture. This ridging, we think, protects the tubers

more against rot, by burying them deeper under the soil, so that the blight spores are not washed down to them so easily. It also gives better ventilation to the vines, by allowing water on the foliage to dry off quicker, and by holding the vines erect and off the ground makes spraying easier and more effective.

(6) *Spraying.* As year after year, wet or dry, we have got increased yields due to spraying potatoes with Bordeaux mixture (4-4-50), we recommend the spraying as a yearly feature in growing late potatoes in this state. The spraying should be done thoroughly, whether by hand or by power, which means that it will take from two to three barrels of the mixture per acre. With the ordinary horse-power sprayers using fixed nozzles, it is necessary to go over the rows twice, in opposite directions, at each spraying, in order to properly coat the vines. The first spraying should be given about the first of July, and if desired, an insecticide, either Paris green, rate of ½ lb., or arsenate of lead, rate of 3 lbs., to 50 gallons of Bordeaux, may be added. We do not believe from our trials with various other sprays that there is anything as good for potatoes as the home-made liquid Bordeaux mixture.

For the late blight alone, the middle of July is early enough for the first spraying, but we advise the first of July, since better results against tip burn and early blight may be expected, and then, too, by the middle of July it is more difficult to reach the lower parts of the vines when a luxuriant growth has been made. The number of times of spraying will depend upon the weather and the manner of spraying. When it is done with leads of hose by men on the ground, only three or four sprayings are necessary. When stationary nozzles attached to the back of the wagon are used, whether the power is furnished by hand or by horse, it will take from four to seven sprayings, depending on the weather, to do good work. In any case it is essential that the vines be kept covered with spray up to the time of their death, otherwise the blight may develop slowly on the green foliage in the fall, and while doing no harm in preventing tuber formation, may work great havoc by rotting the tubers already formed by the spores washing down on them. See Plate XXXVII a.

III. OÖSPORES OF POTATO BLIGHT, *Phytophthora infestans.*

Importance. Very few fungi have caused the serious and widespread injury that in certain seasons has been wrought by the potato blight. So great was this damage in Europe about 1845, that three governments appointed commissions to investigate the trouble and determine surely the cause, as there was considerable difference of opinion on this latter point. In North America the blight was very destructive at the same time. Thoreau, in his book "The Maine Woods," written about 1846, says: "The potato rot had found him out here, too, the previous year, and got half or two-thirds of his crop, though the seed was of his own raising." A similar condition existed in Canada, as shown by a letter written in 1844 to Dr. Bellingham of Dublin (see Berkeley in Journ. Hort. Soc. London 1: 11. 1846), which reads as follows:

> During the months of July and August we had repeated and heavy showers, with oppressive heat and an atmosphere strongly charged with electricity. Toward the close of the month of August I observed the leaves to be marked with black spots, as if ink had been sprinkled over them. They began to wither, emitting a peculiar offensive odor; and before a fortnight the field, which had been singularly luxuriant and almost rank, became arid and dried up, as if by a severe frost. I had the potatoes dug out during the month of September, when about two-thirds were either positively rotten, partially decayed and swarming with worms, or spotted with brownish colored patches, resembling flesh that had been frost-bitten. These parts were soft to the touch, and upon the decayed potatoes I observed a whitish substance like mould.

Concerning the condition at this time in Europe, Berkeley, in the article mentioned above, writes: "Few subjects have attracted more attention, or have been more variously canvassed than the malady with which potatoes have been almost universally visited during the autumn of 1845." Since that great outbreak, which resulted in famine in Ireland, the blight has been frequently reported in the potato districts of the cooler temperate regions, but only under special conditions of moisture, such as rainy or foggy weather of some duration in July and August, has it developed in epidemics of widespread and unusual importance.

When the writer first came to this station in 1902, the potato blight was at the height of one of its periods of destructiveness. In that year the injury resulted largely from the very premature killing of the vines, some fields going down in a week during the latter part of July. In 1903 the vines were killed somewhat prematurely, and there was serious rotting of the tubers. This tuber rot was even more serious in 1904, being in fact more destructive in this respect than in any other of the ten years in which we have gathered data. Correspondence at the time with farmers over the state brought out the following items: J. B. Gelston, East Haddam,—"almost a total failure"; Vine Hill Farm, Elmwood,—"lost about sixty per cent. of crop"; W. S. Thomas, Groton,—"saved about one-third of crop"; W. S. Lee, Hanover,—"I probably lost three-fourths of my crop"; W. M. Shepardson, Middlebury,—"about one-half crop rotted"; E. Healey, Mystic,—"I think three-fourths rotted before they were dug"; C. M. Ladd, North Franklin,—"estimated two-thirds crop rotted." Since that year there has been comparatively little injury in the state from blight, especially during the dry years from 1907 to 1909. In 1910 some little rot started, but the vines were too far gone from tip burn before the appearance of the blight for it to get a good start.

With the reappearance of a season having a wet or muggy July and August, we may expect further outbreaks of this trouble. The work of this and other stations, however, has shown that much of the injury may be prevented by spraying and other protective measures, and that an increased yield even may be expected by spraying in seasons with practically no blight. (See preceding article, also our Report for 1904, p. 363.) This part of our object in studying potato blight has been largely accomplished.

Historical Interest. Another feature of potato blight that is of especial interest is its historical importance from a botanical standpoint. Some idea of the early study made of it is well illustrated by the following extract, published in 1846 in The Amer. Journ. Sci. and Arts, vol. 2, page 281, and written by J. P. Norton:

Little has as yet been done on any organized plan in this country (United States). In Europe the case has been very different. In Holland and Belgium a committee was first appointed to collect facts calculated to throw light on the nature of the disease. In one of the Dutch provinces, Groningen, a separate commission was appointed for the same purpose. In Germany, Liebig, among others, has turned his attention to the potato, and has lately published some observations on its nitrogenous constituents. A number of the French philosophers, both alone, and under the auspices of the Central Society of Agriculture, have also attended to the subject. M. Payen has lately published three or four reports containing the results of elaborate microscopic and chemical researches. The English government sent a commission to Ireland of three distinguished scientific men, with directions to obtain as much information as possible on the nature and extent of the disease. In Scotland originated the most extended schemes of all. The subject was taken up in its several branches, as it is connected with botany, meteorology, entomology, and chemistry. Each branch was referred to a competent person, and the investigation is still in progress.

Object of Investigation. Many investigators since have made careful studies of the life history of this fungus. Considerable interest was excited by the Smith-De Bary controversy concerning its disputed winter spore stage, known as oöspores. It is upon this point that the writer has become especially interested by reason of several years' study of the fungus in artificial cultures. Our object was to secure these oöspores in cultures through the use of special strains of the fungus or by particularly favorable cultural media, since in our first cultures no indication of their existence was revealed. In this respect we have finally been successful, though their abundant production has not yet been accomplished. We have made a special study of cultural media, environmental conditions, etc., in the hope that some light might also be thrown on the related question why certain stages of a fungus, usually the conidial ones, are grown readily in artificial cultures, while other stages, usually the mature one, rarely if ever appear, though not uncommon in nature. We cannot say that we have yet accomplished much in this direction, though it often takes tedious preliminary work of seemingly little importance to lead up to the final successful results.

Previous Work by Others. We have referred to the Smith-De Bary controversy, carried on in the seventies over the so-called oöspores of potato blight. The former claimed to have found these sexual spores in old leaves and tubers injured by the blight fungus. The latter, a more careful investigator, failed to find any oöspores of this nature that he could connect with the blight fungus, and he threw so much doubt on the conclusions of Smith that botanists generally have regarded that the existence of these oöspores has not been proven. Since that time other investigators have claimed, on a few occasions, to have found bodies like immature oöspores. The writer has found various suspicious bodies in the leaves and tubers of infected plants, but has never been convinced of their real nature. Some of these bodies are much like oöspores in appearance, but in our experience they have never been so abundant or typical as to convince us of their connection with the blight fungus. Plate XXXIX G-I shows some of these bodies which are easily distinguished from the true potato oöspores shown above.

Two French investigators, Matruchot and Molliard, were apparently the first to grow the blight fungus in artificial cultures. Their reports were made in 1900 and 1903. They were not successful in gaining any light concerning the oöspores from their cultures.

In 1904 the writer first made artificial cultures of the blight fungus, and about this time Jones and his assistants at the University of Vermont took up the study of the fungus in the same manner. The results of their work have not been published in detail, though the main points have been presented in two papers before our botanical societies, and brief abstracts of these have appeared in Science. In their work, so far as published, they have had more success than the writer, up to the present investigation, in obtaining curious, immature, and apparently somewhat abnormal bodies, apparently of an oögonial nature, but whose exact identity was left in doubt, since there were no signs of antheridia or of oöspores. The writer previously has been inclined to call these bodies chlamydospores. From the results of our present investigations we believe that they are essentially abnormally and imperfectly developed oögonia (possibly functioning as chlamydospores) due to lack of fertilization by normal antheridia.

Previous Work by the Writer. The results of our previous work with the blight fungus in artificial cultures have been presented in the Reports of this station for 1905 (p. 304) and 1908 (p. 891). In these investigations, while we occasionally obtained swollen and differentiated threads in the cultures, we were unable to produce these at will, or to further their development, so their nature was largely a matter of speculation. Jones and

his assistants in the meantime had been much more successful with the development of these bodies, but with culture media much less suited to the vigorous development of the fungus. Our efforts, however, were rewarded at the time by learning how to best obtain cultures of the fungus, and what media were best suited to its luxuriant development. In this respect we believe our cultures have proven better than any of those yet attempted. The Lima bean juice agar described in our Report for 1908 was up to that time the most satisfactory of these media. It has been by continued efforts to develop a specially favorable medium that, for the greater part, we have finally accomplished the desired results.

Present Investigations.

Nature of Work. We shall give in the following pages the general results of our recent endeavors to produce the oöspores of *Phytophthora infestans* in artificial cultures. A short preliminary account of this work has recently appeared in Science, vol. XXXIII, p. 744. We wish here to acknowledge indebtedness to our assistant, Mr. E. M. Stoddard, who has made most of these cultures under our direction, and has been very helpful in determining the results thus obtained, since it has required hundreds of cultures, and the examination of these several times, to obtain the required data. The main lines of procedure have been to secure favorable strains of the fungus for the work, and to induce these strains to produce oöspores by means of favorable media or special environment. We shall discuss these points in detail in the following paragraphs.

Strains. The cultures used in our previous work were lost or allowed to die out from time to time, so that these reported here are from different sources, except the one from Holland. These strains, besides representing a variation in origin, also present different lengths of time of growth in artificial cultures. For example, we have continuously grown the Holland strain, A, for over two years, and we do not know how much longer Professor Jones had it in culture; while the E strain has been cultivated less than two months. There seems to be no diminution in the vigor of their growth under continued artificial cultivation, though we do not know whether or not their power of infecting potato plants has declined. They all still retain this power, however, as determined by recent tests. These strains are designated by letters, A, B, C, etc., as a matter of easy identification. They have exhibited some slight variation in the luxuriance of their mycelial and conidial development, and even more in the matter of oöspore production. A short description of their source of origin, development, etc., follows:

Strain A. This was obtained about February, 1909, from Jones, who isolated it from tubers grown in Holland. From this culture we have grown at least twenty-two generations, represented by many cultures under varying conditions. It has formed a very fair growth on suitable media, though it is the least vigorous now of any of the strains. It was the first in which we noticed the appearance of imperfect oögonial formation, though this was perhaps more owing to the medium employed than the strain, since the B strain soon afterwards gave even better results in the same medium. It now stands about fourth in the matter of oöspore production, being less variable than D, but the oöspores produced are never very abundant, and are usually imperfect.

Strain B. This culture was isolated by the writer in November, 1909, from tubers furnished by Mr. Ellicott Curtis, and grown at Bantam, Conn., that year. His crop had been sprayed during the season and kept green until late in the fall, when the rains washed off the spray, and the blight got a foothold too late to injure the vines much, but enough to thoroughly infect the tubers, which were dug very late, and found to be badly rotted. We have grown this strain for at least nineteen generations, perhaps in more cultures and under more different conditions than any of the other strains. It makes a good vigorous growth, perhaps the best of any, though not always the most luxuriant. On the whole, the best results in oöspore production have been obtained with it. The most perfect oögonia, antheridia and oöspores have also been found in cultures of this strain.

Strain C. Cultures of this strain were obtained by the writer in January, 1910, from infected tubers purchased at a Westville grocery, and probably grown either in Maine or Long Island. About fifteen generations have been grown in cultures after the manner of A and B. For a long time this strain gave no indication of oögonial formation, though grown continuously on the medium most favorable for that purpose. About the tenth generation immature oögonia were first noticed, and succeeding generations developed these better and more abundantly, until finally antheridia also began to appear, and somewhat rarely, mature oöspores. At present it ranks about third as regards oögonial development. It ranks high in conidial production.

Strain D. This strain was separated by the writer in October, 1910, from the descendants of diseased tubers obtained from Mr. Curtis (see Strain B) and grown in 1910 on our experimental farm at Centerville. It has the general characteristics of B, and has given some cultures with a good development of oögonia, antheridia and mature oöspores, but as yet it seems much more variable than B in this respect, and so not to be depended on, though it has not been in culture nearly so long, as it has been carried through only seven generations. However, it now stands about second in oöspore production.

Strain E. Mr. Stoddard obtained this strain in February, 1911, from Maine grown tubers purchased at a local grocery. As yet it has not been thoroughly tested, as comparatively few cultures have been made, represented by only three generations, but in these oögonial production has not made its appearance even in a slight way.

Media. Synthetic media, because of known composition, offer the best means for determining the cause of oöspore production, if such depends on some particular chemical substance or element. Yet such media, especially when in liquid form, are not as favorable for general growth of fungi as media containing vegetable nutrients whose ingredients are quite complex and whose exact chemical nature cannot be determined. Consequently, we have not used synthetic media except in the sense that certain substances of known composition have been added to our vegetable media to determine their individual effect. Potassium and phosphorus are more or less fixed in literature as having importance in vegetable reproduction, and yet we have not in any way by the addition of potassium phosphate increased oöspore production in our cultures. Likewise, toxic or stimulative substances have an influence on vegetative growth, yet such substances as we have tried in a small way, copper sulphate, chloroform, ether, etc., have given no response in increased oöspore production.

Various Media. Most of our cultures have been on vegetable media, usually in combination with agar-agar. We have tried some few liquid media, but they have shown no special advantage, such as might be expected from the supposed relationship of *Phytophthora* and *Pythium,* and the reported favorable development of the oöspores of the latter in liquids. Likewise, we have not found gelatine a favorable medium in what little use we have made of it, though this was used largely by Jones in his cultures. In our work, besides various agar-agar media, we have tried a considerable variety of substances and combinations. We have used living aseptic vegetable tissues and quite a number of sterilized ones, either in whole or ground condition. We have also used filter paper soaked with nutrient liquid. Taking into consideration all of the various media, and their modifications, we have tried about seventy-five different combinations in over 1,200 cultures.

Most Favorable Media. Out of all these combinations, three media stand out as being especially favorable for the growth of the fungus. Of these the Lima bean juice agar was described in a previous paper. (Report, 1908, p. 898.) This has never given us mature oöspores, and immature ones only once. A second very favorable medium for aërial growth of the fungus, perhaps the most favorable of any we have used, is a "combination medium" consisting of the following ingredients, ground to powder in a food-chopper: Lima beans, 15 grms.; oats, 25 grms.; peanuts, 10 grms.; potato, 15 grms.; sweet corn, 10 grms.; wheat, 10 grms.; with agar, 10 grms., and water, 500 cc. This, however, has shown no special virtue so far as oöspore production is concerned. Potato juice agar gives a fair mycelial growth of the fungus, but not as luxuriant or vigorous as the other two media mentioned here. It needs to be used for the best development somewhat stronger than we first tried it, and we are now using at least 300 grms. of the sliced tubers to 500 cc. of medium. But potato juice agar, like the preceding, has so far been of no value in producing oöspores. The one medium that has stood alone so far as production of oöspores is concerned is our oat juice agar. Without this, apparently, we would never have produced perfect oöspores in cultures.

Oat Juice Agar. We have varied somewhat from time to time in the manner of making this, but in order to have as uniform a product as possible, we have finally adopted the following method: Fifty grms. of ground oats, such as are ordinarily fed to horses, are stirred into about 300 to 350 cc. of water, and steam from an autoclave, by means of glass and rubber tubing connected with the stopcock, is run into this in a covered dish for half an hour. This cooks the material without burning and at a uniform temperature. The coarse sediment of the oats is then strained off through an ordinary fine wire strainer, and 10 grms. agar is added to the liquid, which is again treated to the steam for half an hour to thoroughly melt the agar. Some water passes over with the stream during these cookings, so that what little, if any, is needed to bring it up to the required 500 cc. is added after the whole is drained into a graduated cyclinder. After the added water is uniformly distributed by repouring, the

medium is placed in the test tubes and these are sterilized in the autoclave for fifteen minutes under 7 to 10 lbs. pressure.

Chemistry of Oats. We are not sure what particular ingredient of oats, if any, is responsible for stimulating oögonial development in the oat juice agar. Chemical analyses of oats show that they have higher percentages of ash, fat, and lecithin than the other cereals. Taking the ash content, however, it seems that this higher per cent. is due largely to silica, so that the percentages of phosphorus and potash are even lower than in most of the other cereals, as well as in beans, though perhaps higher than in potatoes. So these constituents of the ash are apparently not the favorable factors. While the licithin is higher than in the other cereals and potatoes, it is lower than in beans. On the other hand, the fat is considerably higher than in the beans, or any other cereal except corn, which it slightly exceeds.

Lecithin is phosphorized fat (contains fatty acids, cholin and esters of phosphoric acid), and is more soluble than ordinary fat, being the form in which it is said by some to be digested. According to Loew*: "By the transformation of fatty matter into lecithin the higher fatty acids are offered to the protoplasm in a soluble form, and after being oxidized, other molecules of fatty acids may enter into the place of the former, and thus the same molecules of the glycerol-phosphoric acid can serve repeatedly as vehicles for the oxidation of fatty acids." In this manner the amount of lecithin really available in the oats, because of the much higher per cent. of fat, may greatly exceed that of the bean. Lecithin also, according to Loew, has considerable therapeutic value in cases of nervous debility, and is a high constituent of the nervous system (and it is also a prominent constituent of the spermatozoa of animals), and this might explain its value in stimulating the potato blight to sexual reproduction, especially in its effect on the antheridia, which seem to have most nearly disappeared.

Fat alone, possibly because not available for the fungus, does not explain the production of these oöspores, since corn, though but little lower than oats in its fatty content, did not stimulate their production. Likewise peanuts, very high in fat and probably higher in lecithin, failed to even produce a mycelial growth of this fungus, though several other fungi grew rather vigor-

*Bull. 45 Bur. Pl. Ind. U. S. Dept. Agr.

ously in the peanut juice agar. The fat is so evident in this medium that it shows plainly, even when only 25 grms. of ground peanuts are used per 500 cc. of medium, which is not the case with our oat juice agar. While the comparatively high per cent. of fat in oats, and the possibility of its easy conversion into lecithin, might explain the phenomenon of oöspore production in the potato blight fungus, we have no sure proof that this is so. In any case the fungus seems to "feel its oats" more or less.

Likewise, this oat medium seems to stimulate ordinary spore production with some other fungi. For example, *Monochætia Desmazierii* fruits abundantly in it, whereas it does not fruit at all, or very little, on several other media in which we have grown it. We have also several times had the sclerotia of *Sclerotinia Libertiana* attempt to form its asco stage in this medium, by developing long stalks which just fail to expand and develop the terminal fruiting cups. Several other fungi also produce in this medium a more luxurious fruiting condition than they do in the other media in which we have grown them.

Environmental Factors. Having secured this favorable medium and using the various strains at hand, we have attempted to determine if certain changes in the medium or its surroundings might not act more favorably on oöspore production. We will briefly discuss these factors in the following paragraphs. In summary, however, it may be stated that we have not found any very decidedly favorable factors, though there seem to be "tendencies" in certain directions, and that as yet we fail to uniformly insure or gradually increase oöspore production by taking advantage of these apparently favorable conditions.

Acid versus Alkaline Media. As made up by us, oat juice agar takes about 15 cc. of $\frac{N}{10}$ NaOH to neutralize 250 cc. of the natural medium, as determined by the phenolphthalein test. In order to test the effect of acid, neutral, and alkaline oat agar the following strengths were made at different times and the potato blight fungus grown in them: (1) 15 cc. acid (natural medium); (2) 5 cc. acid (used 10 cc. of $\frac{N}{10}$ NaOH to neutralize 250 cc. of medium); (3) neutral (used 15 cc. of $\frac{N}{10}$ NaOH, etc.); (4) 5 cc. alkaline (used 20 cc. of $\frac{N}{10}$ NaOH, etc.); (5) 15 cc. alkaline (used 30 cc. of $\frac{N}{10}$ NaOH, etc.) The strains A to D acted somewhat differently on these five strengths,* but as a rule vigorous mycelial growth occurred only on the 15 cc. and 5 cc. acid, and practically no growth on the 5 cc. and 15 cc. alkaline tubes. However, by gradually acclimating the various strains through the different strengths from the natural 15 cc. acid, they were all finally brought so that they would grow more or less on the 15 cc. alkaline tubes.

As regards oöspores, they formed less abundantly and more imperfectly on the alkaline tubes than they did on the acid tubes. On the whole, perhaps the 5 cc. acid tubes gave the best results, though in some of the comparative tests the 15 cc. acid and the neutral media did as well or even better. We had thought that perhaps a slightly alkaline medium would favor oöspore production, since in previous work with the Lima bean mildew (*P. Phaseoli*) we had found that by making the medium slightly more acid we had first cut off oöspore production, then conidial, and finally the mycelial development itself, and our first results with the potato blight seemed to indicate that a neutral or less acid medium than the natural oat juice agar favored better oöspore development. Out of the total of our experimentations, however, we can only say that alkaline oats agar is apparently less rather than more favorable, and that between neutrality and 15 cc. acidity is the best condition for oöspore production as far as this particular factor is concerned.

Light and Darkness. Some investigators have found that light favored spore germination in the smuts. We tried strong light, partial and total darkness, to see if light or its absence had any effect on oöspore production. Cultures kept in a jar exposed to full light of a north window made a less vigorous growth than those kept in an adjacent jar entirely protected from the light, while neither did quite as well as the cultures kept under our usual conditions of partially diffused light (in the same room in a glass front cupboard in open tin cans, for

*For instance, one tube of C grew fairly well on the 15 cc. alkaline tube when transferred directly from the 15 cc. acid tube.

convenience in holding them). Neither did those cultures exposed to the stronger light or those in total darkness show an increase in oöspore production, as the difference, if any, was in favor of our ordinary conditions of partially diffused light.

Temperature. The fact that ordinarily we have found the oöspores of *P. Phaseoli* on beans in the fall, about the time of the first frosts, indicated, as is the case with many other fungi which develop their mature stage in late fall or early spring, that cold is an important factor in the production of the sexual stage. Our experiments along this line, however, gave no indication that oöspore production in the potato blight could be stimulated in this manner. Comparative tests were made, and repeated with similar results, under four different conditions of temperature, the temperatures being taken three times a day during the duration of the tests. (1) Cultures were kept in an incubator varying from 29 to 33° C., and averaging 32.6°. (2) In another incubator they were kept at a temperature of 24 to 27° and averaging 24.6°. (3) Check cultures were kept under our ordinary room conditions of 16 to 22°, averaging 19.4°. (4) Cultures were kept in a box connected with an indirect ventilator to the outside of the building, in which the temperature ranged from 1.5 to 20°, averaging 14.5°.

The results of these tests showed that the fungus failed to grow at all in the higher temperatures of the incubators. The best growth was made under our ordinary room conditions, where the temperature averaged 19.4°. The cultures that were kept in the low and quite variable temperature, averaging only 14.5°, did very well and made fair growths despite these conditions. It would seem that the best temperature conditions for mycelial growth of the fungus were between 15 and 20°.

These temperature tests agree with the general prevalence of the disease in our more northern temperate regions, and its most severe outbreaks in seasons that are slightly below the average in temperature as well as above it in moisture. However, in spite of the great variability with those cultures grown under the colder conditions, there was no indication of increased vigor in oöspore production. In fact, these tubes did no better, if as well as the check tubes, under our ordinary temperature conditions. Low temperature, then, does not seem to be the factor determining oöspore production in this case.

Air. So far as we have seen, oöspore production takes place in the medium slightly below or at the surface of the agar. In fact, this, as well as most other fungi when grown on agar media, makes only a slight invasion into the medium itself. Jones, in his experiments with this fungus, however, seems to have used stab cultures to a very large extent, and here the oöspore-like bodies were produced deep in the medium, away from the air. We have not used stab cultures largely, but so far as we have tried them we have not obtained oöspores as abundantly or as perfectly developed as in the ordinary agar slant tubes. Jones, however, used gelatine in the place of agar. We have not used this in our work nearly so much as the agar, but so far as we have tried it we have not found it as desirable as agar. It would seem from our work that the exclusion of the air by stab cultures in gelatine media was not necessarily a favorable factor in oöspore production, and that Jones got his results in spite of, rather than because of, this condition. Possibly the strains he used were the real factors in his partial success.

Moisture. Moisture seems to be a very important factor in the spread of the potato blight fungus, since infected leaves of a plant, if kept in a dry atmosphere, develop the disease no further. Likewise, in cultures there seem to be certain conditions of moisture most favorable for success, but here excessive moisture is as unfavorable as too little moisture. Cultures inoculated into the base of a tube containing water do not do so well as those inoculated above and kept free from the water. Likewise, as a general rule, cultures inoculated toward the base of a tube do better than those inoculated in the drier upper edge. We have had the best results by inoculating the tubes at the base, if not bothered by water there, inserting a small amount of the medium with the fungus, and slightly imbedding this into the agar.

The chief difference in a tube seems to come in the production of the oöspores, which if present are most likely to be found in the upper and drier part of the tube. Whether the passing of the fungus from the more moist lower portion into the upper and drier portion (dries out quicker because thinner) explains this we do not know. We do know that the use of either a more or less dilute agar (we ordinarily use 10 grm. to 500 cc. of water) does not increase oöspore production to any appreciable degree. We have tried rolled tubes in a few cases, inoculating them at the base. These dry out much quicker than the ordinary slant tube, but we cannot say that they gave us any very unusual results. We have also tried running the water, when present in the base of the tubes, over the growth occasionally, and have pulled off the aërial growth every few days, but neither of these methods gave us unusual results as regards the oöspores. We have also tried growing the fungus in Petrie dishes, which offer a difference in moisture conditions, but our luck here has been no better than with the tubes.

While speaking of the Petrie dish cultures we might mention that we devised methods by which, with temporary slips of paraffined paper, we could pour a plate containing from two to four different kinds of media. Inoculating these at the center, the fungus gradually spreads out over these different media; or by a special contrivance it can be made to pass successively from one kind to another. But these variations have not given any particularly favorable results in oöspore production.

Clear versus Sedimentary Media. Besides stab cultures in a gelatine medium, a third factor in which Jones' methods have differed from ours has been his use of a clear or filtered medium, while we have largely used sedimentary media, in which only the coarser food particles have been filtered off. That his use of filtered media does not explain his partial success in imperfect oöspore production seems apparent, since we failed in our previous experiments to obtain oöspores under conditions employed by him, so far as the use of stab cultures in a filtered, potato juice gelatine goes. So it must be some other factor than this that gave him oögonia where we failed to obtain them. In fact, we have found with our oat juice agar that the sediment in the medium favors rather than retards oöspore production.

On several occasions we have placed a batch of hot oat agar in a centrifuge and whirled it in the machine for ten to fifteen minutes, until it hardened, when we have been able to cut off the upper perfectly clear portion from the lower portion containing the extra sediment. Comparative cultures made in tubes of the clear and sedimentary portions have always shown that the fungus makes a much weaker growth in the former, and so far no signs of oöspore formation have been found in it, while in the sedimentary tubes the mycelial growth and oöspore

production remain about the same as in our ordinary tubes, from which they differ only in a little more sediment. Tubes made from oats in which none of the coarse sediment is removed also act about the same as our ordinary tubes with only the finer sediment present. Since it might be that the clear tubes were very deficient in soluble food matter, we have made cultures in which the ground oats were soaked over night in water, protected from bacterial action by chloroform, and then used this for making the oat juice agar. The clear and sedimentary portions of such a medium, separated in a similar manner in the centrifuge, showed no different results than before on inoculation with the fungus. It seems from these experiments quite evident that the fungus gets from the solid food particles in the sediment something favorable not only for more vigorous mycelial development, but also for inciting moderate oöspore production. Whether or not it is the fat, which might be held in greater amount in the sediment, we have not determined.

Variability of Oöspore Production. Despite the fact that oat juice agar will usually produce oöspores with most of our strains, while Lima bean juice agar practically fails to do so, there still remains much to be desired in stability and productiveness of oöspore formation in this favorable medium. In fact, we are never sure even now when we make a culture from a very good tube as regards oöspores that its descendant tube will be equally good. While our success in obtaining oöspores to-day is much greater than it was over a year ago, when they first began to appear, it is only in looking back over this long period that we notice improvement, since cultures made a month or two ago may have been even better than those of recent date.

Variability in the Same Tube. Just what causes this variability of oöspore production we do not know, since it manifests itself even in the same tube. We have mentioned before that ordinarily we are more likely to find the oöspores at the top of the culture than anywhere else. We may take out for microscopic examination small pieces of the medium from several different places, and find no oöspores, or only a few, and then we may strike a spot where they are rather common. This may be due to the fact that localized portions of the mycelium are concerned in their production, and that these are scattered. We have some evidence in favor of this view in the oöspore production of *P. Phaseoli,* where we find oöspores more abundant in some places than in others, and occasionally we find them developed in more or less luxuriant bands, so evident as to be detected by the naked eye. Yet with this species it is rare that they do not occur very abundantly in every slide made from the surface of an oat agar tube; while the opposite condition is more likely to be true of the potato blight. Perhaps this restriction and scarcity in the case of the potato blight is due to their development in certain spots where the available food, especially in the sediment, is most abundant.

Variability in Different Tubes. We have also found that cultures made from the same source into tubes of the same batch of the medium may vary considerably. Perhaps variation in different batches of the same medium might be accounted for by some very slight variation in the manner of making, but we would hardly expect this to hold true in the same batch unless it was some variation in the settling of the sediment, too slight to be detected by the eye.

We have tried to increase oöspore production by propagating from tubes showing the greatest luxuriance in their development. While there seems to be something in this, still on the whole we have no very clear proof of it. Perhaps one difficulty in the way is that in these renewals we are never sure that we have used a portion of the culture that was richest in oöspore production, since it is usually impossible to detect their presence with a hand lens in our uncleared media. With Jones' cleared gelatine media, however, this method of renewal was more feasible, as the oöspore groups were quite evident with a hand lens, and this may account for such success as he has attained by his continued use of these oögonial groups.

Age of Cultures as Regards Oöspore Production. As a usual thing, with our oat juice agar cultures we can find immature oöspores in the tubes, if such appear at all, two weeks after inoculation. With *P. Phaseoli* mature oöspores are usually quite abundant by this time. In order to be sure, however, we have usually examined the tubes again about a month after inoculation, as the oöspores are then frequently more mature and abundant. One of the very best tubes produced showed about a hundred oöspores, in different stages of development, on a single slide from it. Ordinarily, however, the number of

oöspores does not run over from six to twenty on a slide, and most of these are imperfect. A slide that will give two or three oögonia from which mature oöspores can be crushed out is considered a good one. Most of the oögonia fail entirely to mature, apparently through lack of fertilization. Those that reach maturity with a perfect oöspore usually have attached a well-developed antheridium. Whether or not we can develop oöspore production to the luxuriance which is the usual thing with *P. Phaseoli* in both Lima bean and oat juice agar, time only will tell. What we are sure of so far is that we have produced perfectly matured oögonia with normal and apparently functional antheridia, and that the oögonia in such cases have often contained mature and apparently functional oöspores. As yet we have not germinated these oöspores, but this is equally true of those of *P. Phaseoli,* as it apparently takes an exposure to winter conditions to bring about germination.

Microscopic Characters of the Oöspores. We have not been able to follow the different steps in the development of these oöspores as closely as in the bean *Phytophthora* because of their comparative scarcity. In general the oögonium develops as a much more prominent factor than the antheridium, since the latter is so frequently missing. Then, too, the oögonium seems to be able to attain a much more advanced stage of development independent of any fertilization than does *P. Phaseoli,* if we can judge by the size and condition of the oögonium in the latter when the antheridium first appears. The oögonia of the potato fungus (see Plate XXXVIII) first made their appearance in our cultures as swollen terminal threads, cut off from the normal mycelium by a septum. Not infrequently, by bifucation of the mycelial thread, there were two of these swollen bodies together. The terminal portion of these swollen threads gradually assumes a globular shape and is cut off from the rest of the thread. In the meantime the swollen thread, especially its spherical tip, becomes more or less deeply tinted. The wall is thickened by the deposition on the outside of the original coat of a more or less irregular, thick, reddish-brown coat (see Plate XXXVIII J). The protoplasmic contents of the oögonium may now begin to contract into the oösphere. If no antheridium is present, however, this seems to be as far as the development toward an oöspore proceeds, and this is the fate of most of the oögonia.

When an antheridium is present (see Plate XXXIX), it is very similar to those of *P. Phaseoli*. We have not yet been able to detect antheridia in their younger stages, having seen them only when they were practically mature, and the oögonium is then well along in its development. With *P. Phaseoli* we found that the antheridium was matured, as to size and general appearance at least, when the oögonium was just beginning to develop. (See Report, 1908, Plate LXXIV E.) Perhaps a similar condition would exist with the potato fungus if the antheridia were produced as abundantly. The presence of the antheridium further stimulates, apparently through fertilization, the protoplasmic contents into forming a definite spherical oöspore with a thin limiting cell wall, which gradually thickens until there is formed a perfectly normal oöspore. Plate XXXIX F shows an oögonium crushed open to reveal more plainly its enclosed oöspore, well filled with protoplasmic contents. In this case the oögonium, antheridium and oöspore are certainly as perfect as any of those ever produced by *P. Phaseoli* (see Plate XL A-C).

The thick, colored, outer wall of the oögonium sometimes becomes so opaque (see Plate XXXIX D) as to hide all signs of its oöspore. This outer coat is also quite variable in thickness and in the irregularity of its markings. Apparently the medium in which it is grown has some effect on the irregularity of the markings as Jones got some apparently quite abnormal sculpturing on those grown in his potato gelatine medium. Then, too, the outer wall is somewhat brittle, and, when slightly crushed under a slide, the thick walled oögonia appear more irregular than they really are. If these oögonia were produced in the plant tissues we doubt if the outer wall would be as thick, or present as great irregularities of surface as it does in the artificial cultures. Some of the oögonia, however, are very nearly smooth, and some have rather thin walls or thin places.

The oöspores have a medium to rather thick wall when mature. This wall is smooth and hyaline, though in some cases we have seen a slight tint and some unevenness of surface. Those we have measured vary from 24 to 35 μ in diameter. The oögonia vary from 34 μ to 50 μ, mostly 38 to 42 μ, depending somewhat on the thickness and irregularity of their outer coat. The antheridia are usually somewhat irregular-oval in shape, vary

in size usually from $14 - 25 \times 12 - 18\ \mu$, and, like *P. Phaseoli*, often show the superimposed oögonial thread (see Plate XXXIX D-F). We have not been able to trace the point of origin of antheridium and oögonium, but they seem to come from separate threads, and perhaps it is the contact of these threads that stimulates the beginning of their development, as seems to be the case with *P. Phaseoli*.

Hybrids. In our Report for 1908, page 900, we described attempts to produce hybrid oöspores of *P. infestans* and *P. Phaseoli* by inoculating a tube of Lima bean juice agar above with the former and below with the latter fungus. At first we were inclined to believe that such a hybrid resulted, as in, around, and below the *P. infestans* colony there were developed numerous oöspores. As these did not differ essentially from those of *P. Phaseoli*, however, we finally came to the conclusion that they all belonged to the latter fungus.

When, however, in our present work we tried this same crossing on oat juice agar, the results were entirely different, since we obtained oögonia, usually only in the vicinity of the *P. infestans* colony, which were entirely different from the normal oögonia of *P. Phaseoli* that were produced abundantly all through the culture. These different *oögonia were of the P. infestans type*, which at that time we were just beginning to get in a small way in our pure cultures of *P. infestans* on oat juice agar, and they differed in that they usually *produced mature oöspores, and were far more abundant than we have ever obtained them in pure cultures of P. infestans*. Plate XL shows, in the upper row, the oögonia of *P. Phaseoli* as grown in Lima bean juice agar; the second row shows these *P. Phaseoli* oögonia as grown in a cross culture in oat juice agar with *P. infestans;* while the two lower rows show the hybrid *P. infestans* oögonia as appearing in the same culture with those of *P. Phaseoli* shown in the row above. These photomicrographs easily convince one that the hybrid oögonia are of an entirely different type from those of *P. Phaseoli*, and that they closely resemble those of *P. infestans*, as shown in Plate XXXIX A-F.

As stated before, they differ from those of *P. infestans* in their greater abundance and more perfect development, especially of the oöspores. They also differ, perhaps, in not being so deeply tinted, and there are some that seem to grade into

P. Phaseoli, or at least are not very different from those of that species, as the oögonial walls are only slightly tinted and thickened. In one of these cross cultures we measured fifteen oögonia and oöspores each of *P. Phaseoli* and the hybrid *P. infestans,* and found that in the former the oögonia varied from 24 to 34 μ, averaging 29 μ, and the oöspores from 18 to 26 μ averaging 22.5 μ, while the oögonia of the latter varied from 34 to 47 μ, averaging 40 μ, and the oöspores from 25 to 35 μ, averaging 30 μ. These hybrids, then, are about the same size as the uncrossed oögonia and oöspores of *P. infestans* when fully matured.

We have crossed most of the strains of *P. infestans* with *P. Phaseoli* on two different occasions. Some of these cross cultures have been much better than others as regards production of the hybrid oöspores. We have continued these hybrids in renewal cultures in some cases through six generations. Plate XL, L, shows one of these oöspores in the fifth renewal from the original cross. It does not look essentially different from the original hybrids, as its lighter color is not lighter than some that were produced in the original crosses. Now in these renewal cultures from the original cross, the oöspores are not descendants of the hybrid oöspores, since these never germinate in the cultures, but apparently are merely new crosses each time, and so are produced only by the conveyance of the mycelia of both species, which became closely mixed in the original culture. All of the renewal cultures produce an abundance of the normal oöspores of *P. Phaseoli,* and those cultures which produce few or none of the hybrid oöspores are therefore ones in which the *P. infestans* mycelium has been largely or entirely crowded out by that of *P. Phaseoli.*

Of course there are those who may think that these oöspores are not hybrids, but true oöspores of *P. infestans* which have been stimulated to oöspore production in some way by the presence of *P. Phaseoli,* just as the oat juice agar has stimulated this production to a less degree. We do not believe this to be the case, however. The potato blight has evidently lost its power of antheridial development much more completely than it has its oögonial development. The history of all our cultures shows this to be so. In these cross cultures, the antheridia of *P. Phaseoli* take the place of the missing ones of

P. infestans when situated more favorably to the potato oögonia or oögonial threads than they are to their own. Naturally they are more favorably situated on the whole to their own than they are to those of the potato, and so the hybrids are much fewer in number.

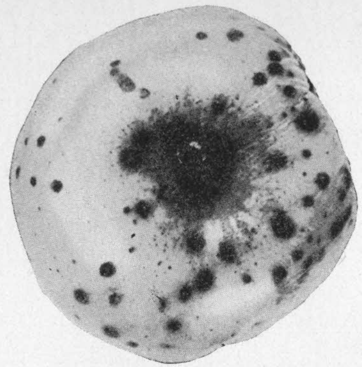
Not only has *P. infestans* been crossed with *P. Phaseoli,* but also with *P. cactorum.* Our results in crossing with the latter, however, have not been nearly so satisfactory, as comparatively few hybrids were found in the cultures, and only where the B and the D strains were used. We think that this is probably due as much to mechanical difficulties in having the antheridia of *P. cactorum* free to fertilize the oögonia of *P. infestans,* as to physiological incompatibility. Our cultures of *P. cactorum* on oat juice agar run almost entirely to oöspore production, with little or no aërial growth of mycelium and conidiophores. This makes it probable that the antheridia are much more favorably situated to fertilize their own oögonia than those of *P. infestans,* so that the chances of crossing are thereby greatly lessened. Those hybrids that were formed were of the potato type, but were not nearly so deeply tinted as those obtained with the bean *Phytophthora,* being more of a golden than a chestnut brown. Photomicrographs of the normal oöspores of *P. cactorum* in a cross culture with *P. infestans* are shown in Plate XXXIX J while K of the same plate shows one of the hybrid oöspores. Four of the hybrids had oögonia varying from 35 to 40 μ, and oöspores from 25 to 28 μ, while the variation of *P. cactorum* in the same culture was 20 to 35 μ for the oögonia and 18 to 28 μ for the oöspores. The oögonia and oöspores of *P. cactorum* are very similar to those of *P. Phaseoli,* being hyaline, smooth, and moderately thin-walled. Sometimes the oögonia of both these species become slightly tinted.

Theories. At one time we suggested as a reason for the absence of the oöspores of potato blight in nature and cultures that there might be male and female mycelial strains and that oöspore production could therefore take place only when these occurred together. So far as our culture work has gone with both *P. Phaseoli* and *P. infestans,* this theory does not seem to hold good, as we explained in our last Report.

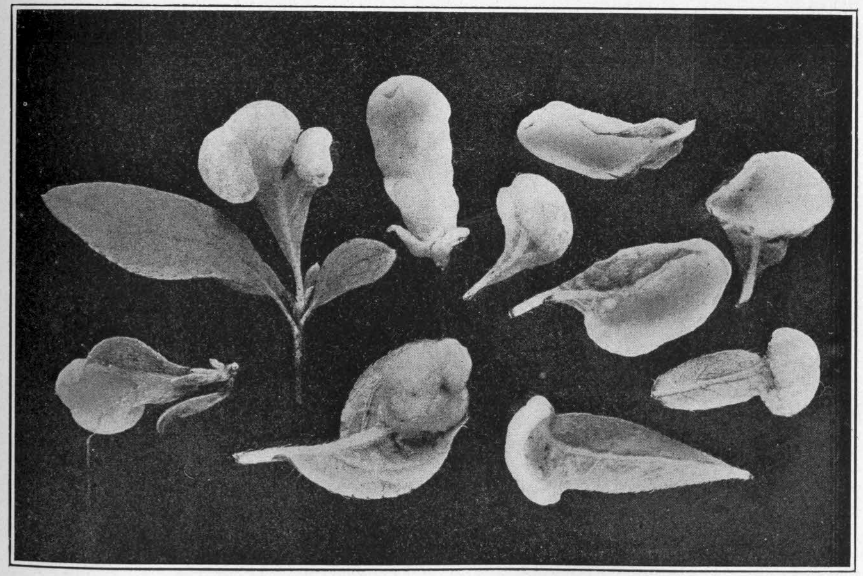
The more probable theory is that the potato blight fungus has, at least in most instances, lost its power of sexual reproduction to a large degree. This is shown by failure to produce oöspores in media in which both *P. Phaseoli* and *P. cactorum* produce them abundantly. It is further shown by oat juice agar stimulating the production of oögonia in varying degrees from imperfect to fully matured specimens, and by the varying response of different strains of the fungus to this favorable medium.

That the absense of oöspore production is due more largely to the absense or loss of vigor of the male than the female factor, is shown by the appearance of oögonia in cultures more frequently than of antheridia, their evident attempt to form oöspores in the absence of the latter, and their success when normal antheridia do appear. Likewise, the ease with which *P. infestans* crosses with *P. Phaseoli* seems to be due to the vigorous antheridia of the latter species.

It is perhaps idle to speculate as to how this loss of sexual vigor came about, though it may be due to the same cause that has induced the decline of sexual reproduction in the potato itself. Very rarely do the blossoms of the potato set seeds, apparently due largely to the sterility of the pollen. Varieties long propagated seem to have lost the power of seed production more completely than those recently originated, especially if the latter are from a cross with a species nearer the wild condition. This loss of sexual vigor is explained, at least in part, by the continued propagation of our cultivated varieties by the asexual tubers. As the potato blight, so far as is known in nature, carries over from one season to another only through the vegetative mycelium in the tubers, it may be that continued asexual propagation of the fungus in this manner has also resulted in its loss of sexual vigor, especially of the antheridia.

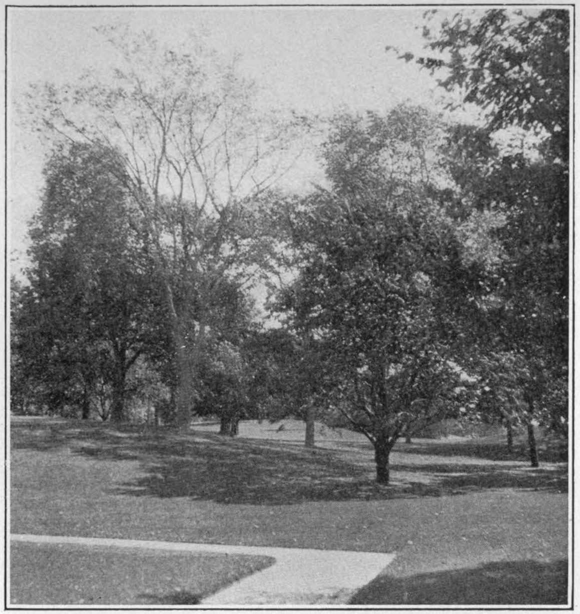


a. Fruit Spot of Apple, p. 723.

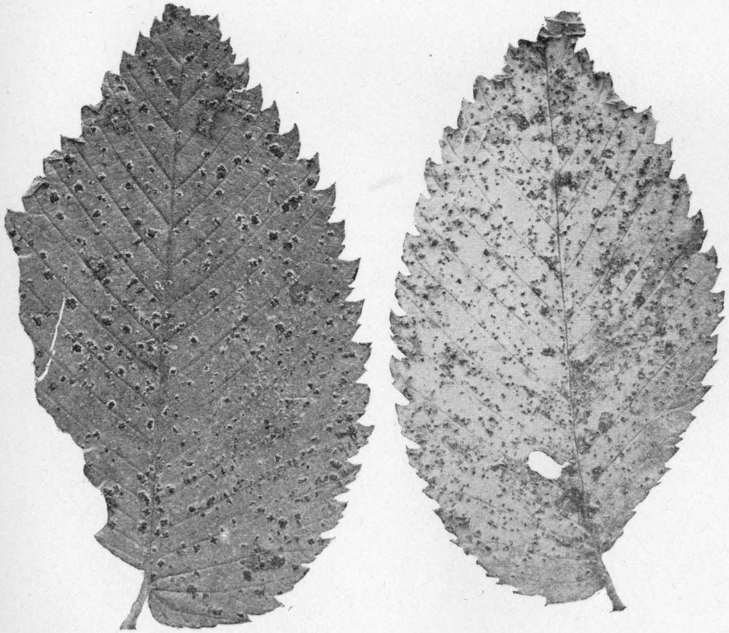


b. Pocket Curl of Azalea, p. 724.

FUNGI OF APPLE AND AZALEA.



a. Showing an elm defoliated in mid-summer.



b. Appearance of fungus on the leaves.

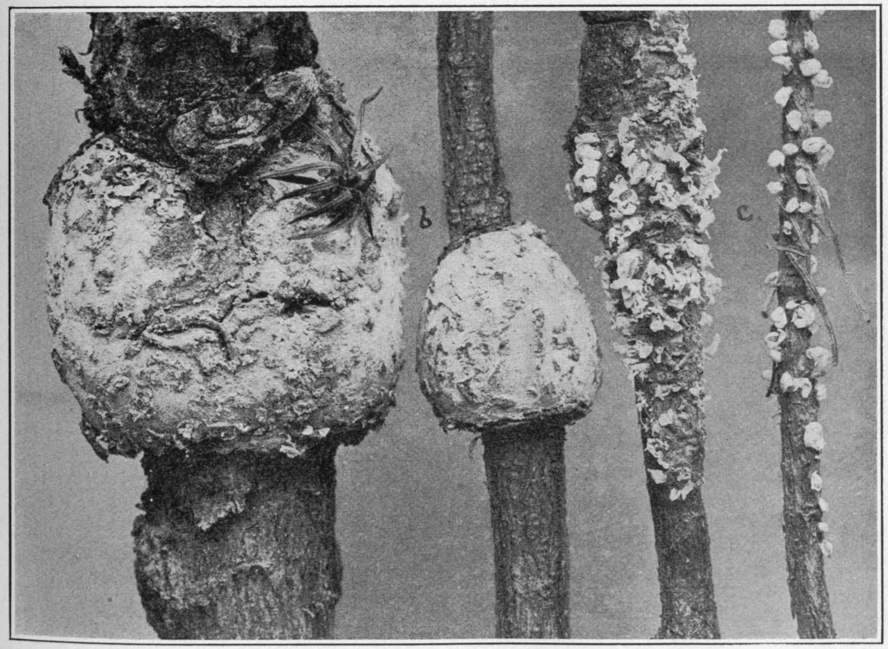
LEAF SPOT OF ELM, p. 717.

a. Drought injury, followed by fungus, p. 729.

b. Frost injury, p. 730. Healthy.

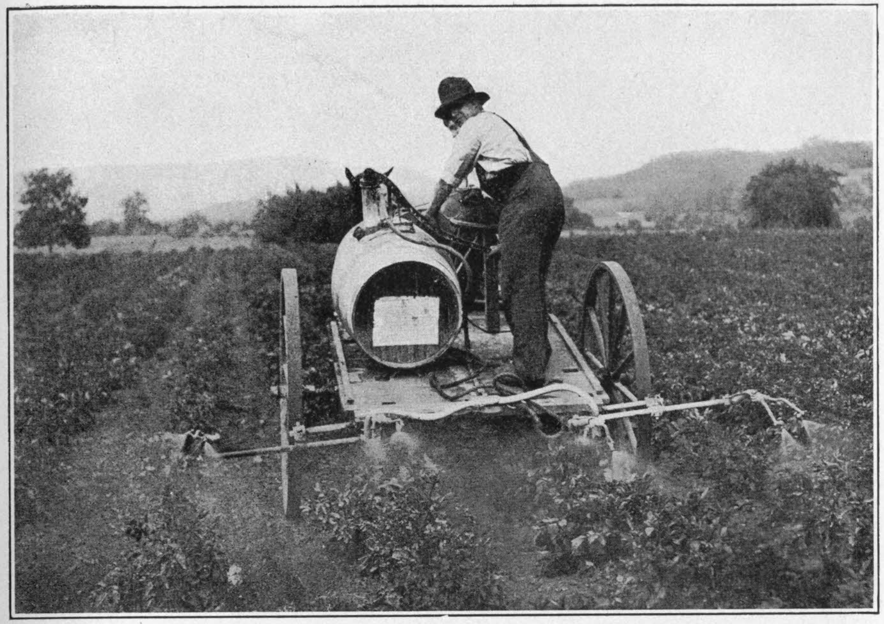
INJURIES OF WHITE PINE SEEDLINGS.

a. Pine-Currant Rust, p. 730.

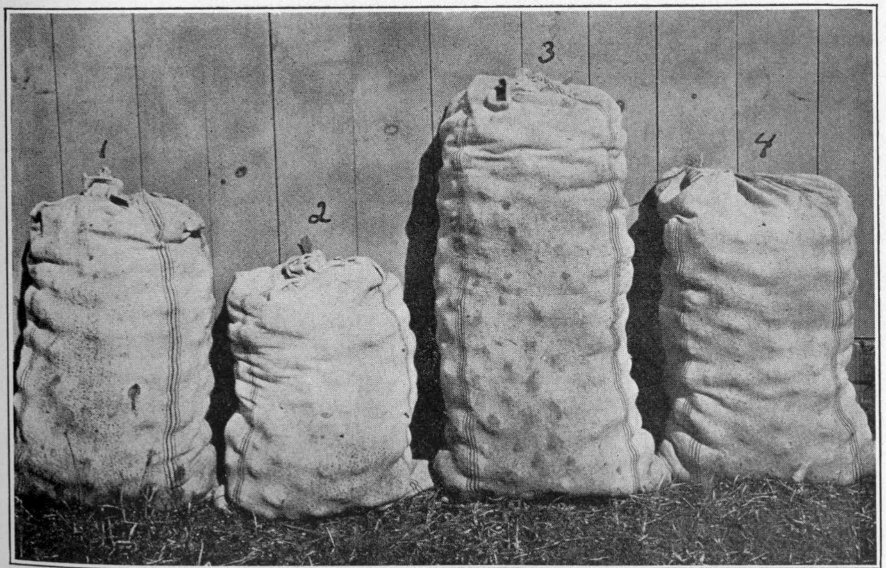


b. Pine-Oak Rust, p. 728. c. Pine-Sweetfern Rust, p. 729.

STEM RUSTS OF PINES.

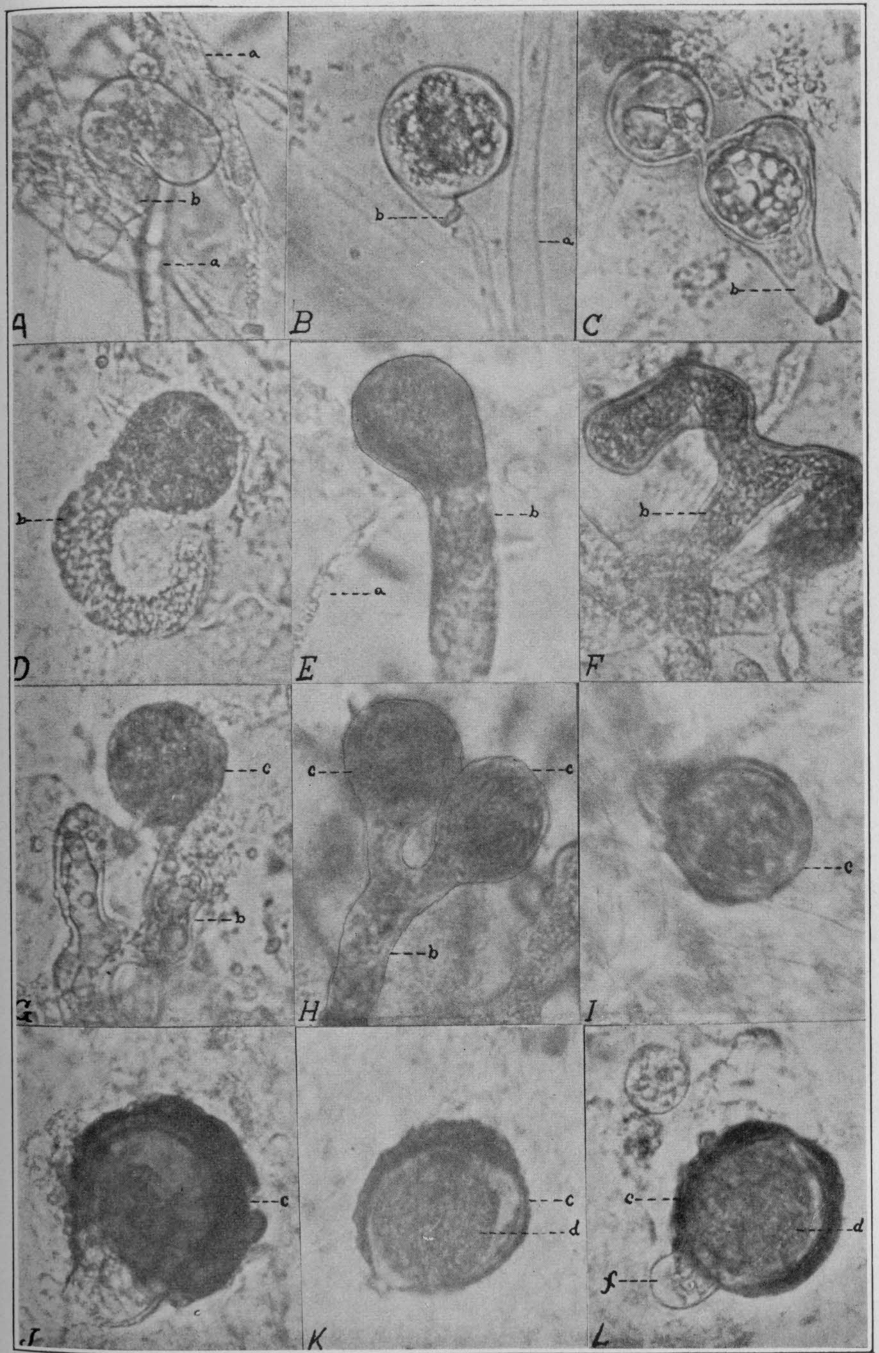


a. Spraying by hand with stationary nozzels.



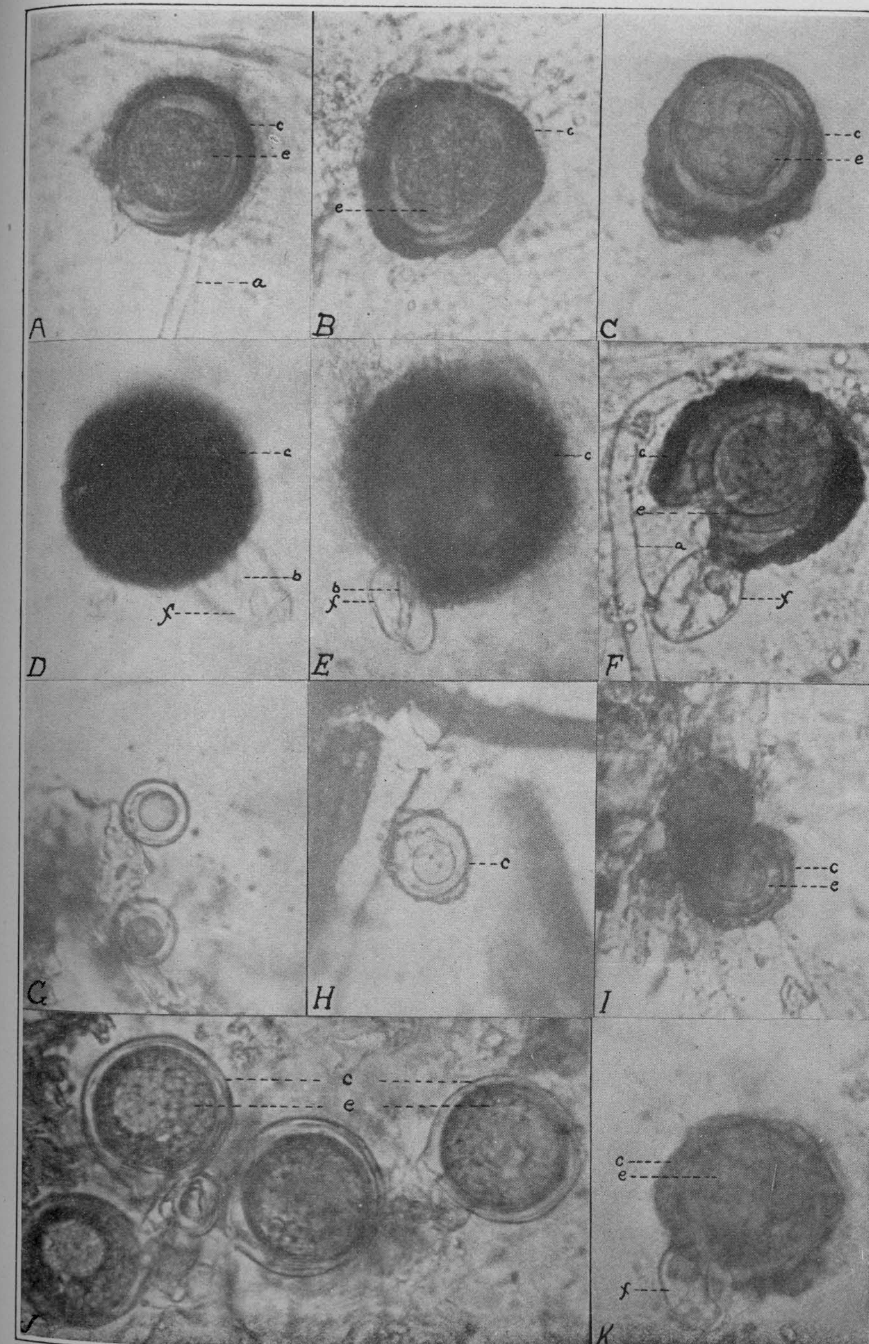
b. Comparative yields from sprayed (1, 3) and unsprayed (2, 4) vines, p. 741.

SPRAYING EXPERIMENTS WITH POTATOES.



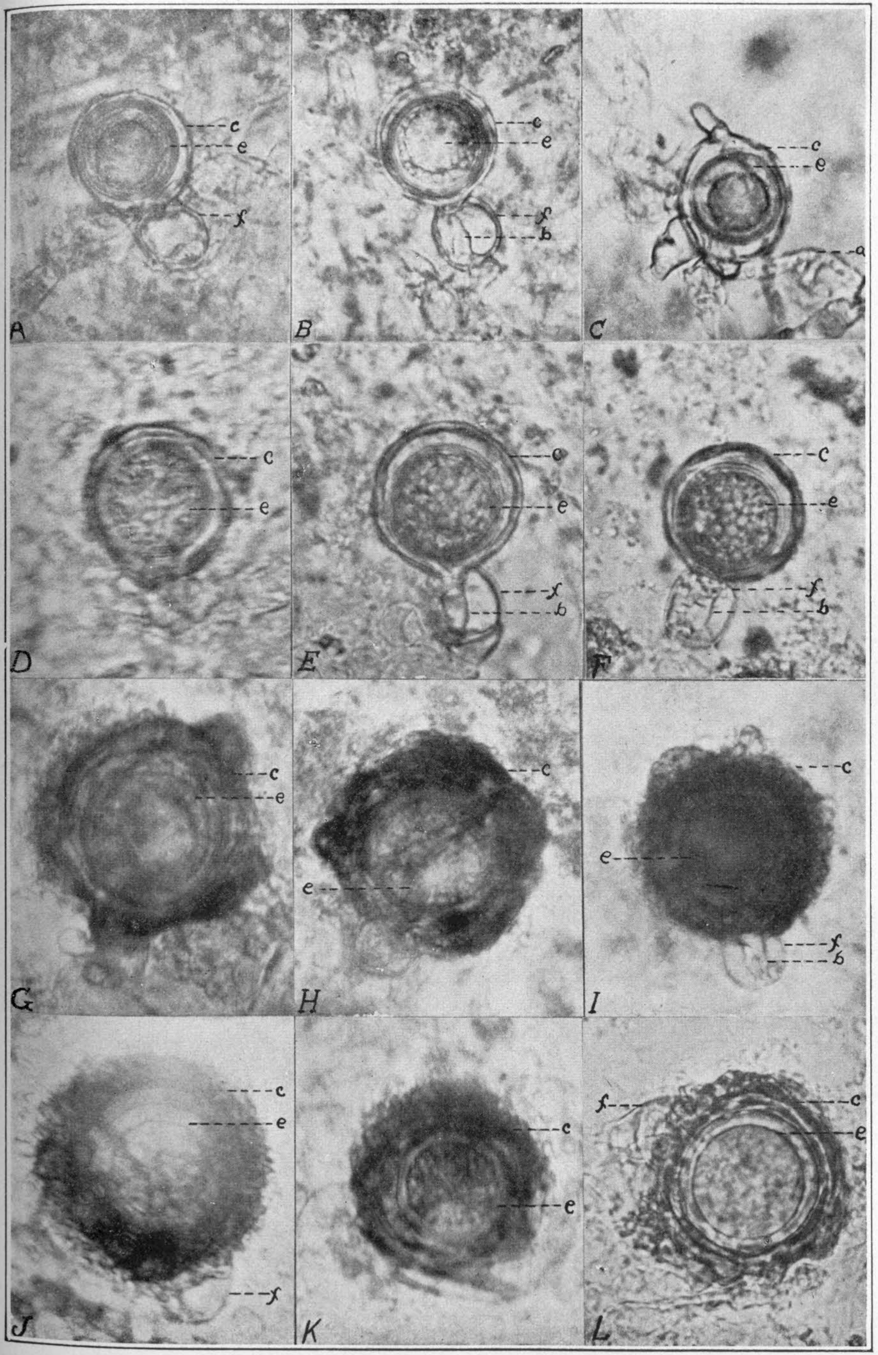
a. mycelium ; b. oögonial thread ; c. oögonium ; d. oösphere ; e. oöspore ; f. antheridium.

DEVELOPMENT OF OÖGONIA OF PHYTOPHTHORA INFESTANS, p. 769.



A–F. Mature oögonia, oöspores and antheridia of *P. infestans*, p. 770.
G–I. Oögonia-like bodies found in blighted leaves and tubers of potatoes, p. 756.
J. Oögonia of *P. cactorum* and K, hybrid of this and *P. infestans*, p. 773.

OÖGONIA, OÖSPORES, ANTHERIDIA OF PHYTOPHTHORA sps, etc.



A–C, *P. Phaseoli* grown in Lima bean agar. D–F, *P. Phaseoli* grown in same tube of oat agar with *P. infestans*. G–L, Hybrids produced by fertilizing *P. infestans* oögonia with antheridia of *P. Phaseoli*, p. 771.

OÖGONIA, OÖSPORES, ANTHERIDIA OF PHYTOPHTHORA sps.

PART XI.

Forestry Publication No. 6.

REPORT OF THE STATE FORESTER

SAMUEL N. SPRING, M.F.

INTRODUCTION.

There are three important phases of forestry in Connecticut: (1) Protection of woodland and cut-over lands from fire; (2) Application of methods to improve conditions of the forest so as to increase the yield and to grow a better quality of timber; (3) Forest planting of waste lands.

The improvement of forests by thinnings is being demonstrated in the State Forests and in private woodland, under the advice and supervision of the State Forester. Considerable forest planting has been done on open areas in the State Forests. Progress of state forest work and results of special studies of the treatment of woodland will be given in separate publications, or in subsequent reports of the State Forester.

Since 1901 annual plantings of forest trees, chiefly pines, have been made on a tract of land near Rainbow, in the northern part of the town of Windsor, until the Agricultural Station now has 100 acres of experiment forests there. In 1908 the Station purchased a small portion of the Shaker white pine plantation in Enfield and special experiments in thinnings were made in this forest. Further thinnings will be made periodically and results recorded every five years.

A progress report of forest planting at the Rainbow experimental tract and by private owners elsewhere in Connecticut was published in 1908.* Preliminary results of experiments and con-

*Part IV, Report of the Connecticut Agricultural Experiment Station for the year 1907.

clusions will again be reported at the close of the second five-year period ending in 1911.

From the beginning of forestry in this state the persons holding the office of State Forester have recognized the primary importance of protecting forests from fire. Unless they are effectively protected, the development of forestry is seriously hindered. Owners hesitate to make improvement thinnings, plant waste land with trees or practice forestry in any form if fires are likely to ruin the results of their work. Without fire protection such an investment is not an attractive one.

The present State Forester has, therefore, given much time and attention to this subject, in order to supplement previous work of organizing a service to provide adequate forest protection.

This report deals wholly with the subject of forest fires, especially with those of 1910.

Fire Warden Service.

The State Forester is *ex-officio* State Forest Fire Warden. He has supervision of the town and district fire wardens, who are responsible in their respective towns for the protection of woodland from fires. This protective service, established by law in 1905, has become more efficient each year in the control and prevention of forest fires. In 1905 there were only 44 town fire wardens appointed, and the next year there were 119. Up to July 1, 1907, appointments to this position had been made by 140 towns and these town wardens had in turn appointed 270 district fire wardens. The record for 1910 is 160 town fire wardens, with 445 district wardens in 135 of these towns. Of the remainder, five are principal cities, the limits of which are coterminous with the town boundaries. In these cases the chief of the fire department is, according to law, in charge of whatever forest protection is needed. The other three towns have arranged for appointment of a warden (February, 1911).

This, then, practically completes putting the system into operation, but there still remains to be secured a more effective organization of the work in individual towns, arranging fire districts, weeding out men of less efficiency and, of special importance, introducing more effective methods for fighting fires and preventing fires.

The total force in 1910 was 605 fire wardens. Assuming the area of woodland to cover approximately one-half the state, say 1½ million acres, there would be an average of 2,480 acres per man, if the area were uniformly apportioned. The arrangement of districts and the area to be watched by a single warden depends, however, on several things, such as topography of the region, location of the warden's home, etc. District wardens are needed in several towns not now districted and in a few cases an unnecessarily large number were appointed. On the whole, the organization has been brought to a much higher state of development. It is of the greatest importance that selectmen should reappoint efficient town fire wardens, not making changes for political reasons, and where new appointments are necessary, a thoroughly capable man should be selected.

Statistics of Forest Fires.

From the beginning of organized work of forest protection in the state, reports of each fire extinguished have been required from the wardens. All the information needed for this purpose can usually be secured by the local warden as soon as he has put out the fire, and his report is required by the State Fire Warden within two weeks afterward. Accurate reporting of fires has been specially emphasized, and more complete records are being secured, although some towns still fail to report.

The following is the printed form used for this purpose.

FORM C. (APRIL 1, 1911)

REPORT OF FOREST FIRE BY TOWN FIRE WARDEN.

(REPORT ONE FIRE ONLY ON THIS SHEET)

To be sent to State Forest Fire Warden, New Haven, Conn., within two weeks after a fire.

Name of town.......................... Fire District........................
Date of fire.......................... Warden in charge..................

Number of acres burned over { Merchantable timber land................. / Second growth, not yet merchantable....... / Other land (grass land, bushes, etc.).........

Total acres........

Estimated damage to standing timber and sprouts $...............................
Number of buildings burned............Damage $...... Insurance $......
Stacked timber burned..............feet, Value $...... Insurance $......
Piled cordwood burned ....cords, Value $...... Insurance $......
Cause of fire..
....

Underline the methods used in putting out fire. *Bucket pumps; chemical extinguishers; wet brooms and bags; beating; shovels and dirt; back firing*......
Number of men employed........... Bill to town for this fire $............
Additional information ....
....
....
....
....
....
....

Signed..............................
TOWN FIRE WARDEN.

Date.................... P. O. Address...............................

If no fires occur during the year return blank saying so on December 31.

These reports are compiled annually and the summaries by towns, counties and for the state make it possible to gain a comprehensive understanding of conditions. The value of summaries has been to some extent lessened by lack of reports from towns having no wardens, or whose wardens fail to realize the full importance of reporting. Until such time as complete reports are secured annually from every town, there will be an apparent increase in number of fires, area burned and losses incurred. In 1909 and 1910 the reports from the towns were nearly com-

plete and probably represent quite closely the actual number of fires. The following table is presented to show, primarily, the development of the fire warden service, and also to give a preliminary understanding of the forest fire problem in Connecticut. Any comparison of these figures by years should take into consideration the number of towns not reporting.

TABLE I.—SUMMARY OF FOREST FIRES.

Year.	Number of wardens.	*Number of towns not reporting.	Number of fires reported.	Area burned. (Acres.)	Average area per fire. (Acres.)	Cost of fighting.	Average cost per fire.
1905	44	126	---	†8,000	---	--------	-----
1906	119	94	125	4,036	32.3	--------	-----
1907	140	76	109	4,387	40.2	$1,286.46	$11.80
1908	152	64	283	18,430	65.1	3,646.66	6.88
1909	157	18	339	14,779	43.6	2,755.46	8.13
1910	160	19	834	47,443	56.9	10,024.76	12.02

*Includes five principal cities whose limits are coterminous with those of the town.
† Estimated at end of year.

The development of a new system, such as the forest fire warden service, was necessarily slow. In 1906, 90 per cent. of the towns had appointed wardens, but reports were received from only 60 per cent. This indicates a marked advance in putting the system into operation, but relatively slow progress in efficiency, as represented by reports of work done. (See columns two and three, Table I.) In 1910 95 per cent. of the towns had fire wardens and approximately 90 per cent. of the towns returned reports of fires to the State Fire Warden. The unusually long period of drought in the early spring of 1910 and also in the fall made conditions especially favorable for the occurrence and rapid spread of forest fires. More complete returns from wardens also increase the number of fires recorded and the area burned as compared to that of previous years. Complete reports in 1908 would probably have given 25,000 to 30,000 acres burned as compared to 18,430 in the summary given above for that year. Weather conditions in the dangerous season of 1908 favored the occurrence of forest fires, but there was not so great a degree of drought as was experienced in 1910.

Conditions in 1909 were perhaps midway between those of 1908 and 1910.

The record of 1910 is probably near to the maximum that may be expected any one year and serves to show the necessity of organized effort to prevent and extinguish fires. That the warden service is efficient was shown beyond doubt during the past year. Losses would have been many times greater if fighting fires had been no one's special duty in each town.

In the future a reduction may be expected in the acreage burned; first, through increased efficiency of our wardens and by retaining capable, experienced men in this position; second, by adopting further preventive measures and by using improved methods of fighting fires. Climatic conditions cannot be controlled, but even in periods of extreme drought, as in the present dry years, preventive measures and active work of wardens will keep down the losses greatly if not the total number of fires.

TABLE II.—SUMMARY OF FOREST FIRES, 1909.

(Compiled from reports of 140 towns.)

County.	Causes.				Acres burned.	Estimated damage to standing timber.	Estimated damage to products and buildings.	Cost of fighting.	Miscellaneous cost.
	Total No. fires.	Unknown.	Railroad.	Careless, including brush burning.					
Fairfield	33	18	7	8	1,380	$1,005.00	$ 990.00	$202.79	$ 5.35
Hartford	91	39	26	26	5,546	4,922.00	6,415.00	649.97	17.60
Litchfield	52	24	16	12	2,233	747.00	771.00	530.99	----
Middlesex	39	11	20	8	495	312.00	1,505.00	154.78	----
New Haven	52	33	4	15	1,786	4,495.00	300.00	320.72	----
New London	11	7	--	4	703	1,515.00	2,125.00	168.95	----
Tolland	28	16	8	4	792	1,750.00	600.00	192.90	3.00
Windham	33	12	14	7	1,844	975.00	10.00	334.36	----
Totals	339	160	95	84	14,779	$15,721.00	$12,716.00	$2,555.46	$25.95

Of the 1909 fires the cause of nearly one-half (47.2 per cent.) was unknown, 28 per cent. were attributed to the railroad and the rest of the fires was divided among several causes, such as brush burning, carelessness of hunters, fishermen, and others in setting fires. Approximately one per cent. of the woodland area of the state was burned over, with a total loss of $28,437.00. The total cost of the fire warden service for the year, including the State Fire Warden's expenses, was slightly less than $3,000.00.

FOREST FIRES OF 1910.

The following compilation, Table III, gives statistics, by counties, of forest fires of 1910. A detailed record by towns will be found at the end of this report.

TABLE III.—SUMMARY OF FOREST FIRES, 1910.

(Compiled from reports of 141 towns.)

County.	Causes.						Acres burned.	Estimated damage to standing timber.	Estimated damage to forest products and buildings.	Cost of fighting.	Cost of protection.
	Total No. fires.	Unknown.	Railroad.	Careless.	Brush burning.	Incendiary.					
Fairfield	154	86	23	21	19	5	4,481	$11,397.00	$1,894.00	$1,436.77	$ 266.41
Hartford	178	78	57	25	17	1	12,795	44,431.00	7,318.00	2,381.13	450.69
Litchfield	116	55	43	6	11	1	7,521	25,697.00	7,388.00	1,479.07	94.36
Middlesex	75	23	34	11	7	0	4,553	10,995.00	254.50	805.43	340.15
New Haven	78	56	9	6	3	4	3,609	8,410.00	1,270.00	790.29	33.10
New London	54	40	7	5	2	0	7,966	28,195.00	2,451.00	696.88	4.66
Tolland	58	23	25	3	6	1	1,811	4,659.00	103.00	433.38	23.86
Windham	121	54	50	7	7	3	4,707	14,816.00	7,343.00	2,001.81	30.66
Totals	834	415	248	84	72	15	47,443	$148,600.00	$28,021.50	$10,024.76	$1,243.89

Weather Conditions and Number of Fires.

Woodland and brush fires are most likely to occur in the spring before vegetation starts and in the fall after the leaves drop from the trees. Disregarding for the moment all other factors, the number and severity of fires depend upon weather conditions during these two seasons. The following table gives for each county the record of fires by months.

TABLE IV.—NUMBER OF FOREST FIRES, 1910.

County.	Total number.	March.	April.	May.	June.	July.	Sept.	Oct.	Nov.
Fairfield	154	41	52	9	--	--	3	42	7
Hartford	178	61	66	4	--	1	--	29	17
Litchfield	116	41	51	7	1	6	--	8	2
Middlesex	75	37	18	3	--	--	--	13	4
New Haven	78	31	29	7	--	--	--	8	3
New London	54	19	18	7	--	--	--	6	4
Tolland	58	24	18	1	1	1	--	11	2
Windham	121	31	53	7	--	1	3	24	2
Totals	834	285	305	45	2	9	6	141	41

March weather in 1910 was abnormally warm and dry. In temperature the average in Connecticut for March, 1909, was 34° Fahr.; for March, 1910, 40.3°, a difference of 6.3° warmer for the latter year. On March 25 it was above 80° in some places in Connecticut. For this month in 1909 there was an average of 4.03 inches rainfall, for 1910 only 1.41 inches rainfall. Precipitation was lower for this month than in years and high winds prevailed. Conditions could scarcely have been worse at this time, when fires are likely to occur.

April was also warmer than usual, although rainfall was more nearly normal. The quantity and distribution through the month, however, were such as to relieve the situation for a few days only. The 285 fires in March occurred in the last half of the month, hence it was proportionately worse than April, when there were 305. In April alone the total number of fires for 1909 was nearly equalled. It was not until May that the conditions were improved. Several fires in dried-out swamps occurred in July which were difficult to fight and could not be controlled for days, since they ate their way beneath the surface. Drought occurred in the last half of September and continued during October. In parts of Connecticut it was reported as the worst in fifty years and many streams, springs, ponds and wells went dry, or were unusually low. Here, again, the effect is apparent, there being a total of 141 forest fires in October.

Such weather conditions, while extraordinary, occur at irregular intervals and emphasize the necessity of well-organized fire warden service, prepared especially to meet these unusual conditions, as well as for the control and prevention of such forest fires as may occur during years which are more nearly normal.

Area Burned Over.

In case of prolonged drought and adverse weather conditions, as in 1910, fires are not only likely to be more numerous, but burn with greater rapidity. If they gain headway before fighting can be begun, or escape from control, large areas are sure to be burned. In very dry seasons it is much more difficult to gain control of a fire and extinguish it before it has covered considerable ground. This is due to the fact that logs, brush, dead grass and other fuel for the flames is so thoroughly dry

that sparks carried by the wind readily set new fires, unless the whole line can be effectively watched.

A total of 834 fires in 1910 burned 47,400 acres, or an average of 57.4 acres per fire. This average is less than 1908 and more than the other years recorded in Table I.

A classification of figures of the acreage burned by forest fires of 1910 shows the effective work of the wardens and is given in the following table.

TABLE V.—NUMBER AND AREA OF FIRES.

	All fires.	Fires less than 100 acres in extent.	Fires 100 acres or more in extent.
Number	834	707	127
Total acreage burned	47,400	11,670	36,230
Average acreage per fire	57.4	16.5	286.8

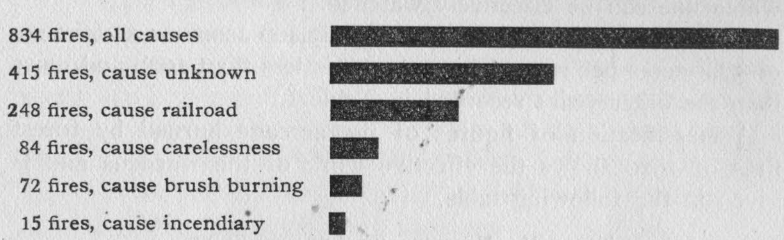
Of the 834 fires, 707, or 85 per cent., were less than 100 acres in extent. The average per fire was 16½ acres and the total area burned was 11,670 acres. This shows that in the majority of cases the fires were fought promptly and extinguished before they covered much ground. The remaining 127 fires, or 15 per cent. of the total number, averaged 286.8 acres per fire and burned over three times as much ground as the 707 fires. Most of these larger fires occurred in the spring. Fast Day, March 25, holds the record as the worst day for fires in many years. Sixty-three fires started and burned more than 10,000 acres. Twenty of these fires burned more than 100 acres each. Three were the largest fires of the year, one in Glastonbury, 3,500 acres, another in Southington covering 2,000 acres, and the third in New Milford 1,500 acres. Losses from these three aggregated $33,000. Most of the fires on Fast Day originated from careless burning of brush or the thoughtless setting of fires by people in the woods on this holiday. The unusual heat and windiness of the day and great dryness of the surface caused rapid spreading of the flames.

During the year there were but eleven fires which exceeded 500 acres in size.

Causes and Damage.

The following diagram shows the number of forest fires classified according to cause.

NUMBER AND CAUSES FOREST FIRES, 1910.



It is practically impossible for wardens to ascertain the causes of all fires and in cases of any uncertainty they almost invariably report the cause as unknown. At first glance at the diagram it is natural to conclude that the fires of unknown cause may be classified in the same relative proportion, according to cause, as those of known source. This would not necessarily be correct. The railroad heads the list, according to the diagram given above, and if causes of all fires were known it might still be at the top, or second compared with all the others together, as a source of forest fires. However, there are several facts easily ascertained that lead to attributing the source of a fire to the railroad; for example, a fire near the railroad, starting immediately after the passing of a heavy freight or passenger train on an up grade, the line of the fire extending out directly from a point on the right of way, etc. Thus it is probable that nearly all railroad fires were reported as such. No such plain facts point to the source of other fires, except perhaps those originating from burning out fence rows and by burning brush piles near woodland. The inference is that the majority of fires whose cause is stated as unknown are not chargeable to the railroad. They are more than likely due to the carelessness of hunters, fishermen, smokers, and to persons setting fire to clean up cut-over land or brushy pasture. Not a few of these fires are started by lighted matches, cigar or cigarette butts thrown down by travelers on the highway, or persons passing through woodland.

Compilation of the causes of forest fires and a study of conditions in the state which favor the occurrence of fires are of great value in determining measures of control and prevention. A statement of the progress along these lines and measures

recently put into effect will be found on page 786, under "Measures of Control and Prevention of Forest Fires."

In order to ascertain the relative losses according to cause, the table given below was compiled from data of forest fires furnished by wardens in 1910.

TABLE VI.—LOSSES IN RELATION TO CAUSE.

Cause.	Number.	Per cent.	Acres burned.	Per cent.	Damage to Timber.	Per cent.
Unknown	415	50	28,000	59	$94,000	63
Railroad	248	30	10,000	21	33,000	22
Carelessness	84	10	2,400	5	10,200	7
Brush Burning	72	8	4,200	9	9,900	7
Incendiary	15	2	2,800	6	1,500	1
Totals	834	100	47,400	100	$148,600	100

From this table it will be seen that the railroads, for example, are responsible for 30 per cent. of all fires in Connecticut in 1910, 21 per cent. of all the area burned, and 22 per cent. of the losses incurred.

It is apparent that we have relatively little loss from fires deliberately set with criminal intent and that our chief sources of danger are the railroads and the failure of the majority of our citizens to realize the importance of the utmost care during the dangerous spring and fall seasons.

Cost of Fighting Fires.

The total cost of extinguishing 834 fires in 1910 was $10,024.-76, or an average cost of $12.02 per fire. The cost of posting warning notices, issuing permits required under Chap. 128, Sec. 4, Public Acts of 1909, etc., was $1,243.39, making a total of $11,268.15. According to the law one-half of the expense is borne by the towns concerned, one-quarter by the county, and one-quarter by the state. The amount spent by the State Forest Fire Warden for the year was $695.91, of which $130.00 were spent to replace supplies lost in a fire on January 10, 1910, which destroyed the building where the State Forester's office was located. Expenses of the office comprise clerk and stenographer's services, postage and stationery, printing of laws and instructions, report and permit forms, cloth warning notices, etc., and the traveling expenses of the State Forester in performing his duties under the law as State Forest Fire Warden. The grand total of expense for 1910 was $11,964.06, which in all probability is the maximum for any one year. This expenditure represents a little less than one cent an acre for protection of the woodland of the state. In preceding years, during which there was greater rainfall and less adverse conditions than in 1910, the cost of protection was approximately ⅓ to ½ of a cent per acre. The expenditure of less than one cent per acre per year is a very reasonable amount for protection in consideration of the value of our standing timber and the prospective values in our young growth that is not yet merchantable and which suffers worst if it is burned over.

Measures of Control and Prevention of Forest Fires.

A reduction in the number of fires, the area burned and the amount of damage can be secured through efforts along several lines at the same time.

Local Organization:

In putting the fire warden system into operation, the chief effort at the outset has been to have reliable men appointed as wardens and to secure prompt, energetic, honest work in extinguishing every woodland fire which starts. A good measure of success has been attained in this respect, as indicated by the statistics for 1910. In some few towns the organization of the service and the fighting of fires has been of the highest grade. In such towns the fire warden has intelligently divided the town into fire districts under the charge of capable men, has thoroughly posted the town with cloth warning notices, has held a meeting of the wardens to plan systematic work and has adopted improved methods for fighting fires. Such organization of work within towns is essential to successful protection of woodland from fires and their prompt extinguishment.

Coöperation between Towns:

Only in rare instances have wardens in any towns arranged special coöperation with wardens of adjacent towns. Coöperation between towns is highly important and is easily carried out by use of the telephone. The arrangement in many cases need be only the mutual understanding between wardens and others on either side of the town line that if fires are seen they will be reported by telephone at once to the nearest warden of the town concerned. A plan is now being arranged to make a trial of this in the towns of Union, Woodstock, Ashford, Eastford and Stafford, by the establishment of a lookout. This lookout will be located on Ochepetuck Mountain, locally called Bald Hill, in the town of Union. This is to be a central point for the receipt and sending of messages by telephone concerning fires.

The person living on this hill will keep a lookout for fires each day during the dry season of 1911, will ascertain the nature and definite location of a fire by means of the telephone and be guided by a large map on which are entered the location, name and telephone number of coöperating parties in the five towns. The lookout, after receiving definite information, will notify the nearest warden and give instructions. Such a system, worked out in detail, will save time and money for the towns concerned, causing fires to be quickly extinguished.

Fire Fighting.

In the actual work of fire fighting much advantage is gained in cases where the fire warden acts as foreman of the fighters and directs the work, going from point to point. In one town the warden carries a signal whistle and when help is needed immediately on the fire at another point he summons a part of his force by whistle signals. Each town fire warden has to study conditions in his town and determine the most effective means of extinguishing fires and the sources from which men can be secured quickly to fight fires in a given locality.

In several towns coöperation has been secured with manufacturing companies and large owners, by which in case of a forest fire a telephone message to them will bring a gang of laborers at once to assist the warden in extinguishing it. In some instances the outside foreman of a company has been appointed a district warden, and has permission to use the company's men as required at forest fires.

The common methods of fighting fires have been beating with brush or wet bags, smothering with dirt by use of shovel and hoe, and backfiring. Small attention has been given by towns to the furnishing of wardens with a good equipment and to testing apparatus useful for extinguishing woodland fires. Massachusetts has emphasized this matter greatly and many towns have fire wagons, well equipped with chemical extinguishers, tools, etc. Some Connecticut towns have provided wardens with small chemical extinguishers and with ordinary tools for fighting fires. In one case the question of procuring a wagon specially constructed and similar to Massachusetts wagons is under consideration.

At Simsbury the bucket spray pump has been adopted for use in fighting fires and has proved very effective. Every warden is supplied with one. In its use for fire fighting the pump is attached to a galvanized iron pail, the top of which is covered with burlap. A fire nozzle is substituted for the usual spray nozzle. The cover of burlap permits the use of water from any stream or swamp without clogging the pump. With a fire nozzle a stream may be thrown with decided force.

Wherever water is available or can advantageously be hauled this method surpasses all others. It is useful also in controlling a back fire. In practice the man with the pump is followed by two or three men with hoes and shovels, who complete the extinguishing and throw back into the burned area inflammable material that lies across the line of the fire. The other laborers are chiefly engaged in bringing water. One bucketfull will put out 150 to 200 feet of fire. Fire on brush land or rocky land, ordinarily very difficult to extinguish except by backfire, is effectively handled with the bucket pump. So valuable has the method proven that the Simsbury warden and the State Fire Warden have designed the two-man pump shown in Plate XLI. The water capacity of the tank is eight gallons. It may be equipped with a larger tank if desirable. It is designed to be carried by two men, the one in front holding one handle and directing the stream, the one behind holding the other handle and pumping. Tests of this model have proven satisfactory.

Every town should take up the subject of equipment for wardens and purchase at once a supply of the ordinary tools and some apparatus for a test of the best methods to meet local conditions. A small amount thus spent means a large saving in the cost of putting out fires.

Effective organization of the fire warden service, hearty coöperation between landowners and wardens, watchfulness followed by prompt action when fires are seen, and use of the best methods must tend to lessen the area burned annually. Back of all this are the causes of fires. All fires cannot be prevented, but a very large proportion need never occur at all.

Prevention of Railroad Fires.

Railroad fires start chiefly from locomotive sparks, occasionally from fire escaping from piles of old ties which are being burned by section gangs. The proper condition of the engines is important. Railroad officials state that all engines are provided with spark arresters, and railroad orders are said to be strict in reference to maintaining the screens in good condition. No spark arrester thus far invented, however, prevents emission of all sparks, but the number is greatly reduced by the use of an arrester, and by keeping it in repair.

The condition of the right of way is of primary importance. The practice of the railroads has been to cut vegetation in the summer just before the weeds begin to seed. Subsequent clearing of inflammable material later in the year has not been systematically done each year. Clearing by burning in the late fall and winter was more effectively carried out in December, 1910, and January, 1911, than in previous years. It should be made the practice to burn dry grass on the right of way annually wherever the railroads pass through woodland, brushland or grassland adjoining woodland. This is especially important at points where the grade of the road is heavy and sharp curves occur. If the right of way is in proper condition, sparks dropping on it die out and fire will not be communicated to adjoining land by this means. Many fires, however, start from sparks falling outside the right of way in leaves, dry grass or other inflammable material. Clearing such materials by burning a strip a hundred feet from the edge of the location of the right of way will greatly lessen the danger of fires from this source. In case of woodland, little injury to the trees results if leaves and twigs are raked away from the base of the trunks before the burning is begun on the strip to be cleared. A bucket pump and water should be kept on hand, to control the fire at any moment and prevent its escape.

Massachusetts and New Jersey laws provide that the railroad shall carry out, at its own expense, protective clearing on private land outside the right of way without liability of trespass. Such work is a great measure of prevention of railroad fires, insures protection to the abutting property owners and lessens the amount of damages for which the railroad is annually liable. Such a preventive measure should be enacted into law in Connecticut. Experiments along this line have been tried on the State Forest at Simsbury. Where the strip has been cleared and burned, no fires have spread on that side from the railroad which passes through the state land. Planted forest is thriving on this land, which has previously been burned over so frequently by fires started by passing trains as to be considered by the owners as worthless for any purpose. On the South side of the railroad, where no plantations had been set and no protective strip established, a fire set by an engine spark occurred in 1910 which killed valuable seed trees. Even with the protection afforded by work as indicated above, fires may start from railroad causes if the season be very dry and windy. Under such conditions only one way remains to prevent such fires, or reduce their number, and that is to establish a patrol. Such a patrol was put into operation in Simsbury along a dangerous stretch of the railroad in 1908. It was maintained for six weeks in early spring and prevented all fire damage. Thirty-five fires were seen and extinguished. The cost was borne equally by the town of Simsbury and the C. N. E. railroad. Such a patrol at danger points on the railroad is necessary in prolonged periods of spring or fall drought. Any work along this line by the track-walker or the section gangs has either been wholly lacking or ineffective. Nearly always these fires occur immediately after the passing of certain regular trains on an up grade. Undoubtedly the following up of these trains along the most dangerous stretches where the road passes through woodland and up grade would prevent a very large number of fires. At the present time there are hundreds of acres of unimproved land along the railroad in this state which have been rendered valueless and on which profitable forest cannot be maintained because of railroad fires.

Enforcement of Forest Laws.

Public opinion in regard to forest fires has changed greatly in the past decade. This is reflected in legislation and in the

enforcement of the laws. Both legislation and earnest efforts to have the law properly enforced are traceable to citizens who have foreseen the necessity of developing our forest lands just as our crops and orchards have been improved by intensive scientific methods. To bring about this development, adequate protection from fire was seen to be essential. The Connecticut Forestry Association, a body of representative Connecticut citizens, has been greatly influential in securing progressive legislation to further the prevention and control of forest fires. The Assembly of 1909 passed the so-called "brush permit law," the full text of which is as follows:

PUBLIC ACTS OF 1909, CHAPTER 128.

SEC. 3. Every person who shall kindle or authorize another to kindle, at any time, a fire in the open air, which fire occasions an injury to another, shall be fined not more than two hundred dollars, or imprisoned not more than six months, or both.

SEC. 4. Every person, except as hereinafter provided, who shall kindle or authorize another to kindle a fire in the open air, outside the limits of any city, borough, or land controlled by any railroad company, for the purpose of burning bushes, weeds, grass, or rubbish of any kind, between the fifteenth day of March and the first day of June, and the fifteenth day of September and the fifteenth day of November, in any year, without first obtaining from the fire warden of the district written permission stating when and where such fire may be kindled, shall be fined not more than two hundred dollars, or imprisoned not more than six months, or both.

SEC. 5. Whenever the state fire warden shall deem that the public safety of any town of this state does not require the protection provided by section four of this act, and the town so votes, he may cause the town fire warden of any such town to post notices to that effect in conspicuous places, not less than five in each town, or two in each fire district. Whenever such notices have been posted, each town so affected shall be exempt from the operation of the provisions of section four of this act until the fifteenth day of March of the next succeeding year.

In 1910 only one town applied for exemption, and this was not given, since action by the town was not taken until about two weeks before the fall season ended and there was insufficient time for the State Fire Warden to make the necessary investigation before taking action.

At the outset, before the law was fully understood, it was criticised severely, but later received the approval and hearty commendation of nearly everyone. It was directed toward lessening the number of fires due to carelessness in burning brush, rubbish, etc., on land adjoining woodland. A permit in itself in no way prevents a woodland fire. However, if a person applies for and receives a permit he accepts a certain responsibility in the matter, can be warned to be careful, can be required to adopt measures to prevent the fire spreading, and so on. In time of prolonged drought fire wardens have withheld issuing permits until abundant rainfall occurred.

This law was enforced in a very reasonable way, in the spirit of educating people to use much greater care and with the desire not to make it a hardship in any way to secure necessary permission. Few complaints were heard as to its enforcement, and none in those towns having an efficient town fire warden and a sufficient number of district wardens, to any of whom citizens could apply for a permit.

The law was a little too broad, since its provision covered cases of fires in village streets, gardens, etc., not adjoining woodland. For this reason an amendment was proposed and submitted to the 1911 Assembly as follows:

> Provided, however, that such permits shall not be necessary for kindling a fire in a ploughed field, garden or public highway at a distance of not less than two hundred feet from any woodland, brushland, or field containing dry grass or other inflammable material.

In cases of malicious act or criminal carelessness in kindling fires it is necessary to prosecute in order to give an object lesson.

The following is a list of cases prosecuted in 1910:

PROSECUTIONS UNDER FOREST LAWS.

Name of town.	Number of persons prosecuted.	Laws violated.	Results.
Bristol	1	Chap. 128, §3,* Pub. Acts 1909 " 43, §1221,† " " 1907	10 days in jail and costs ($13.90).
Huntington	1	" 128, §4,* " " 1909	Costs ($5.87). Fine remitted.
	1	" 128, §4, " " 1909	$6.00 and costs, amounting to $20.42.
Milford	1	------	Costs ($14.24).
Montville	1	" 128, §4, " " 1909	Nolled.
Norfolk	1	" 128, §4, " " 1909	$1.00 and costs.
Southington	1	" 128, §3, " " 1909	$5.00 and costs ($11.21).
	1	" 128, §4, " " 1909	$25.00 and costs ($8.96).
Stamford	1	" 128, §4, " " 1909	Not convicted.
	1	" 128, §4, " " 1909	$10.00 and costs.
Stratford	1	" 128, §4, " " 1909	$7.00 and costs, amounting to $22.71.
Wolcott	1	" 128, §4, " " 1909	$1.00 and costs.
Woodstock	2	" 128, §4, " " 1909	$1.00 and costs in each case.

* Chapter 128, sections 3 and 4, will be found on p. 791 of this report.
† Forbids kindling fire in woodland without first removing combustible materials for 20 feet surrounding; fire must be extinguished before leaving, or safely covered.

These prosecutions show clearly the growth of public sentiment, and the determination to enforce the law and by that and other means reduce the losses by forest fires. There is, however, a tendency on the part of people whose forest has been burned over by some one through criminal carelessness to withhold testimony or reluctantly bear witness against the party, perhaps a neighbor, who is charged with the crime. Coöperation and assistance of the prosecuting officer along these lines is extremely essential for the public good.

Economic Results of Forest Fires.

People in general deplore losses by forest fires; few realize the economic results. Light surface fires repeatedly burning over woodland mean steady deterioration of the forest, resulting finally in a worthless stand. Trees become weakened through fire injury and are subject to attacks by insects and fungi. This has been found especially true in observing the increase in damage from the chestnut bark disease. Fire damage is great in young stands of timber not yet merchantable and in young sprout growth following cutting. Our future supplies of forest products depend especially upon the protection and care of cut-over lands.

In the case of very hot fires, all the trees are killed. Sprouting from the stumps of broadleaf deciduous trees in burned land may be lacking or weak. The dead stems, unless removed, form a hindrance to renewal of the stand and at the best the next crop of trees will be inferior. An area annually destroyed such as was burned in 1910, is equal to cutting over the whole woodland of Connecticut in fifty or sixty years. The present supply cannot equal future demands under our present methods of handling woodland. It is, therefore, of the greatest importance that losses by fire be reduced to the minimum through intelligent work of an organized fire warden service, enforcement of the laws, special measures of prevention, and the coöperation of every citizen in the state.

FOREST FIRES OF 1910 IN DETAIL.

Name of Town.	No. of Fires.	Causes.					Acres Burned.	Estimated Damage.	Cost of Fighting.
		Unknown.	Railroad.	Careless-ness.	Burning Brush.	Incen-diary.			
Fairfield County.									
Bethel	8	5	1	----	1	1	190	$ 231.	$ 94.47
Bridgeport	----	No	Re	port	----	----	------	---------	---------
Brookfield	5	----	3	1	1	----	170	85.	7.60
Danbury	10	8	----	1	1	----	377	1030.	139.90
Darien	11	7	----	2	----	2	81	---------	76.35
Easton	7	4	----	1	2	----	195	435.	18.80
Fairfield	1	1	----	----	----	----	100	---------	27.50
Greenwich	0	----	----	----	----	----	------	---------	---------
Huntington	15	11	2	----	2	----	835	3398.	195.20
Monroe	8	2	5	1	----	----	67	125.	16.10
New Canaan	11	7	----	----	4	----	40	67.	16.56
New Fairfield	3	2	----	1	----	----	23	---------	55.43
Newtown	4	2	2	----	----	----	120	435.	---------
Norwalk	4	1	----	1	2	----	68	50.	19.40
Redding	5	4	----	----	----	1	435	630.	61.10
Ridgefield	2	2	----	----	----	----	60	300.	29.40
Sherman	2	1	----	----	1	----	110	1005.	101.35
Stamford	18	10	----	4	4	----	860	3253.	420.66
Stratford	9	3	----	4	1	1	94	910.	44.10
Trumbull	15	13	1	1	----	----	233	385.	30.15
Weston	0	----	----	----	----	----	------	---------	---------
Westport	1	1	----	----	----	----	50	25.	8.00
Wilton	15	2	9	4	---	----	373	907.	74.70
Totals	154	86	23	21	19	5	4481	$13291.	$1436.77

FOREST FIRES OF 1910 IN DETAIL—*Continued.*

Name of Town.	No. of Fires.	Causes. Unknown.	Railroad.	Careless-ness.	Burning Brush.	Incen-diary.	Acres Burned.	Estimated Damage.	Cost of Fighting.
Hartford County.									
Avon	5	2	2	1	----	----	162	$ 90.	$ 43.93
Berlin	5	2	----	3	----	----	407	1758.	138.65
Bloomfield	----	No	Re	port	----	----	----	----	----
Bristol	25	7	8	8	2	----	402	3875.	190.93
Burlington	0	----	----	----	----	----	----	----	----
Canton	3	----	3	----	----	----	70	300.	24.23
East Granby	2	1	----	1	----	----	140	100.	21.45
East Hartford	3	3	----	----	----	----	287	----	50.20
East Windsor	17	2	15	----	----	----	558	12757.	59.30
Enfield	19	11	4	2	2	----	445	2630.	265.57
Farmington	14	7	7	----	----	----	311	685.	154.51
Glastonbury	15	12	----	1	2	----	4348	6995.	518.76
Granby	1	----	----	1	----	----	6	300.	----
Hartford	----	No	Re	port	----	----	----	----	----
Hartland	0	----	----	----	----	----	----	----	----
Manchester	11	9	1	----	1	----	336	2745.	104.45
Marlborough	1	1	----	----	----	----	150	150.	57.00
New Britain	0	----	----	----	----	----	----	----	----
Newington	0	----	----	----	----	----	----	----	----
Plainville	5	----	2	2	1	----	952	1350.	61.05
Rocky Hill	2	2	----	----	----	----	70	150.	9.75
Simsbury	18	2	10	4	2	----	442	594.	262.56
Southington	14	7	----	2	4	1	2370	12095.	216.59
South Windsor	10	2	5	----	3	----	1140	4510.	124.15
Suffield	0	----	----	----	----	----	----	----	----
West Hartford	1	1	----	----	----	----	1	----	1.20
Wethersfield	----	No	Re	port	----	----	----	----	----
Windsor	----	No	Re	port	----	----	----	----	----
Windsor Locks	7	7	----	----	----	----	198	665.	76.85
Totals	178	78	57	25	17	1	12795	$51749.	$2381.13

FOREST FIRES OF 1910 IN DETAIL—*Continued.*

Name of Town.	No. of Fires.	Causes. Unknown.	Railroad.	Careless-ness.	Burning Brush.	Incen-diary.	Acres Burned.	Estimated Damage.	Cost of Fighting
Litchfield County.									
Barkhamsted	2	----	2	----	----	----	222	$ 2000.	$ 10.00
Bethlehem	----	No	Re	port	----	----	----	----	----
Bridgewater	2	2	----	----	----	----	42	43.	17.40
Canaan	----	No	Re	port	----	----	----	----	----
Colebrook	1	----	----	1	----	----	----	----	3.65
Cornwall	8	1	6	----	1	----	471	715.	46.32
Goshen	1	----	----	----	1	----	150	340.	10.50
Harwinton	4	1	----	1	2	----	145	898.	59.75
Kent	1	1	----	----	----	----	25	50.	24.50
Litchfield	7	3	4	----	----	----	571	50.	157.73
Morris	5	----	5	----	----	----	180	902.	60.77
New Hartford	4	1	2	1	----	----	142	2140.	29.05
New Milford	2	1	1	----	----	----	1502	9525.	101.60
Norfolk	3	----	1	----	2	----	182	300.	69.30
North Canaan	7	----	7	----	----	----	189	750.	23.50
Plymouth	12	7	3	2	----	----	570	1655.	74.88
Roxbury	5	1	3	----	1	----	891	3779.	79.75
Salisbury	0	----	----	----	----	----	----	----	----
Sharon	2	2	----	----	----	----	275	2830.	53.10
Thomaston	7	6	1	----	----	----	151	6.	105.20
Torrington	10	10	----	----	----	----	568	2870.	254.90
Warren	1	1	----	----	----	----	2	----	2.90
Washington	6	1	5	----	----	----	389	324.	78.92
Watertown	5	3	----	----	1	1	599	3025.	48.90
Winchester	15	10	3	----	2	----	176	798.	116.75
Woodbury	6	4	----	1	1	----	72	85.	49.70
Totals	116	55	43	6	11	1	7521	$33085.	$1479.07

FOREST FIRES OF 1910 IN DETAIL—*Continued.*

Name of Town.	No. of Fires	Causes. Unknown.	Railroad.	Careless-ness.	Burning Brush.	Incen-diary.	Acres Burned.	Estimated Damage.	Cost of Fighting.
Middlesex County.									
Chatham	3			2	1		143	$ 211.	$ 41.05
Chester	3	3					540	1285.	31.30
Clinton	3	1		1	1		1240	2520.	58.68
Cromwell	2	2					150	100.	29.70
Durham	3	2		1			24	525.	14.15
East Haddam	1	1					300	100.	38.45
Essex	14		10	2	2		27	200.	35.88
Haddam	3	2	1				950	3100.	88.15
Killingworth	2	2					700	1200.	105.55
Middlefield		No	Re	port					
Middletown	21	5	9	4	3		271	1548.	303.60
Old Saybrook	15	2	13				89	135.	19.19
Portland	2	1		1			100	200.	27.90
Saybrook		No	Re	port					
Westbrook	3	2	1				19	125.	11.83
Totals	75	23	34	11	7	0	4553	$11249.	$805.43

FOREST FIRES OF 1910 IN DETAIL—*Continued.*

Name of Town.	No. of Fires.	Causes. Unknown.	Railroad.	Careless-ness.	Burning Brush.	Incen-diary.	Acres Burned.	Estimated Damage.	Cost of Fighting.
New Haven County.									
Ansonia	1			1			100	$ 150.	$ 19.65
Beacon Falls	2		2				55	200.	135.25
Bethany	3	2		1			76	245.	36.25
Branford	14	11		3			211	180.	131.59
Cheshire	9	7	2				164	1090.	51.65
Derby	4	3				1	29	10.	7.00
East Haven		No	Re	port					
Guilford	4	3		1			24	145.	32.10
Hamden	4	3			1		535	650.	63.55
Madison		No	Re	port					
Meriden	1	1					20	10.	8.00
Middlebury	1	1					10	10.	
Milford		No	Re	port					
Naugatuck	12	8			1	3	342	443.	99.75
New Haven		No	Re	port					
North Branford	0								
North Haven	0								
Orange	3	3					52	90.	7.25
Oxford	7	5	2				660	2067.	113.50
Prospect	3	1	1		1		230	265.	11.68
Seymour	1	1					4	10.	12.80
Southbury	2		2				600	600.	2.00
Wallingford	1	1					5	5.	2.25
Waterbury		No	Re	port					
Wolcott	5	5					472	3510.	52.57
Woodbridge	1	1					20		3.45
Totals	78	56	9	6	3	4	3609	$9680.	$790.29

FOREST FIRES OF 1910 IN DETAIL—*Continued.*

Name of Town.	No. of Fires.	Causes. Unknown.	Railroad.	Careless-ness.	Burning Brush.	Incen-diary.	Acres Burned.	Estimated Damage.	Cost of Fighting.
New London County.									
Bozrah	----	No	Re	port	----	----	----	--------	--------
Colchester	2	2	----	----	----	----	175	$ 350.	$ 13.70
East Lyme	1	1	----	----	----	----	100	50.	17.60
Franklin	3	3	----	----	----	----	218	455.	19.20
Griswold	4	4	----	----	----	----	1890	10725.	111.00
Groton	7	5	----	2	----	----	985	3375.	120.50
Lebanon	2	1	1	----	----	----	104	110.	34.15
Ledyard	7	6	----	----	1	----	823	2125.	86.70
Lisbon	8	3	5	----	----	----	300	600.	46.01
Lyme	2	1	----	1	----	----	21	10.	12.42
Montville	4	3	----	1	----	----	60	30.	21.85
New London	----	No	Re	port	----	----	----	--------	--------
North Stonington	1	1	----	----	----	----	1000	5000.	7.70
Norwich	3	3	----	----	----	----	1230	2680.	28.30
Old Lyme	4	2	1	----	1	----	300	1076.	63.55
Preston	0	----	----	----	----	----	----	--------	--------
Salem	0	----	----	----	----	----	----	--------	--------
Sprague	----	No	Re	port	----	----	----	--------	--------
Stonington	2	1	----	1	----	----	65	100.	--------
Voluntown	2	2	----	----	----	----	625	3400.	114.20
Waterford	2	2	----	----	----	----	70	560.	--------
Totals	54	40	7	5	2	0	7966	$30646.	$696.88

FOREST FIRES OF 1910 IN DETAIL—*Continued.*

Name of Town.	No. of Fires.	Causes. Unknown.	Railroad.	Careless-ness.	Burning Brush.	Incen-diary.	Acres Burned.	Estimated Damages.	Cost of Fighting.
Tolland County.									
Andover	2	----	----	----	2	----	175	$ 90.	$ 3.75
Bolton	21	4	13	3	1	----	287	1486.	25.60
Columbia	2	1	----	----	1	----	265	25.	9.25
Coventry	2	1	1	----	----	----	157	1035.	34.45
Ellington	1	----	----	----	1	----	15	--------	2.00
Hebron	3	1	2	----	----	----	256	152.	3.40
Mansfield	5	2	2	----	----	1	268	690.	16.47
Somers	1	1	----	----	----	----	25	--------	7.55
Stafford	----	No	Re	port	----	----	----	--------	--------
Tolland	----	No	Re	port	----	----	----	--------	--------
Union	2	2	----	----	----	----	45	187.	126.00
Vernon	18	11	7	----	----	----	316	1097.	204.91
Willington	1	----	----	----	1	----	2	--------	--------
Totals	58	23	25	3	6	1	1811	$4762.	$433.38

Name of Town.	No. of Fires.	Causes. Unknown.	Railroad.	Careless-ness.	Burning Brush.	Incen-diary.	Acres Burned.	Estimated Damages.	Cost of Fighting.
Windham County.									
Ashford	5	3	----	2	----	----	206	$1700.	$ 59.45
Brooklyn	2	2	----	----	----	----	----	--------	14.60
Canterbury	3	1	2	----	----	----	184	600.	13.40
Chaplin	1	1	----	----	----	----	25	--------	14.00
Eastford	1	1	----	----	----	----	100	--------	7.45
Hampton	1	----	1	----	----	----	8	50.	--------
Killingly	7	4	3	----	----	----	134	450.	176.12
Plainfield	10	2	3	2	2	1	1005	2245.	106.79
Pomfret	4	1	3	----	----	----	110	1400.	85.81
Putnam	16	4	11	1	----	----	157	3330.	163.23
Scotland	1	----	----	----	1	----	10	10.	6.50
Sterling	13	8	5	----	----	----	1247	4085.	164.52
Thompson	37	23	12	----	----	2	704	5224.	820.16
Windham	14	1	10	1	2	----	318	1065.	130.98
Woodstock	6	3	----	1	2	----	499	2000.	238.80
Totals	121	54	50	7	7	3	4707	$22159.	$2001.81

TOWN FIRE WARDENS 1911.

Town	Name of Warden	Address
Andover	Edwin H. Cook	Andover
*Ansonia		
Ashford	Edward F. Bassett	Warrenville
Avon	F. J. Distin	Unionville
Barkhamsted	Harold P. Birden	Barkhamsted
Beacon Falls	Milton Carrington	Seymour
Berlin	Wm. J. Ritchie	Kensington
Bethany	Arthur H. Doolittle	Bethany, R. F. D. No. 3
Bethel	Henry F. Kyle	Bethel
Bethlehem	Albert E. Johnson	Bethlehem
Bloomfield	Melville H. Barnard	Bloomfield
Bolton	Waldo E. Rice	Bolton Notch
Bozrah	John H. Miner	Yantic, R. F. D. No. 1
Branford	Chester W. Prann	Branford
*Bridgeport		
Bridgewater	Reuben J. Keeler	Bridgewater
Bristol	George A. Rowe	Bristol
Brookfield	Eugene Elwood	Danbury, R. F. D. No. 18
Brooklyn	Henry M. Evans	Brooklyn
Burlington	Frank A. Barnes	Collinsville, R. F. D. No. 2
Canaan	M. C. Dean	Falls Village
Canterbury	A. Hale Bennett	South Canterbury
Canton	Burton N. Bristol	Collinsville
Chaplin	William J. Lee	Chaplin
Chatham	F. J. Dunham	East Hampton
Cheshire	Alfred S. Bennett	Cheshire
Chester	L. A. Kelsey	Chester
Clinton	Holcomb N. Jones	Clinton
Colchester	H. P. Buell	Colchester
Colebrook	Horace W. White	Colebrook
Columbia	George H. Champlin	Leonard's Bridge
Cornwall	Henry J. Bouteiller	Litchfield, R. F. D., E. Cornwall
Coventry	Geo. H. Robertson	South Coventry
Cromwell	John W. Gardner	Cromwell
Danbury	Morris Meyers	Danbury
Darien	Abel Dance	Darien
Derby	Geo. L. Curtis	Derby
Durham	James P. Hull	Durham Center
Eastford	Chas. E. Buell	North Ashford
East Granby	Frank H. Dibble	East Granby
East Haddam	W. S. Hungerford	East Haddam
East Hartford	John T. O'Neill	Glastonbury, R. F. D. No. 2
East Haven	Irving Hoxsey	East Haven
East Lyme	William R. Proctor	Niantic
Easton	Chas. G. Keller	Long Hill, R. F. D. No. 9
East Windsor	John J. O'Melia	Broad Brook
Ellington	A. U. Charter	Rockville, R. F. D. No. 4
Enfield	William Wilson	Hazardville
Essex	Everett W. Doane	Essex
Fairfield	John C. Lobdell	Fairfield, R. F. D. No. 9
Farmington	F. A. Cadwell	Farmington
Franklin	Frank I. Date	North Franklin
Glastonbury	Jefferson J. Weir	Glastonbury, R. F. D. No. 1
Goshen	E. H. Johnson	Torrington, Star Route
Granby	F. E. Rice	Granby
Greenwich	John Hvolbeck	Port Chester, N. Y., R. F. D.

* City Fire Chief in charge of whatever forest protection is necessary.

TOWN FIRE WARDENS 1911—*Continued.*

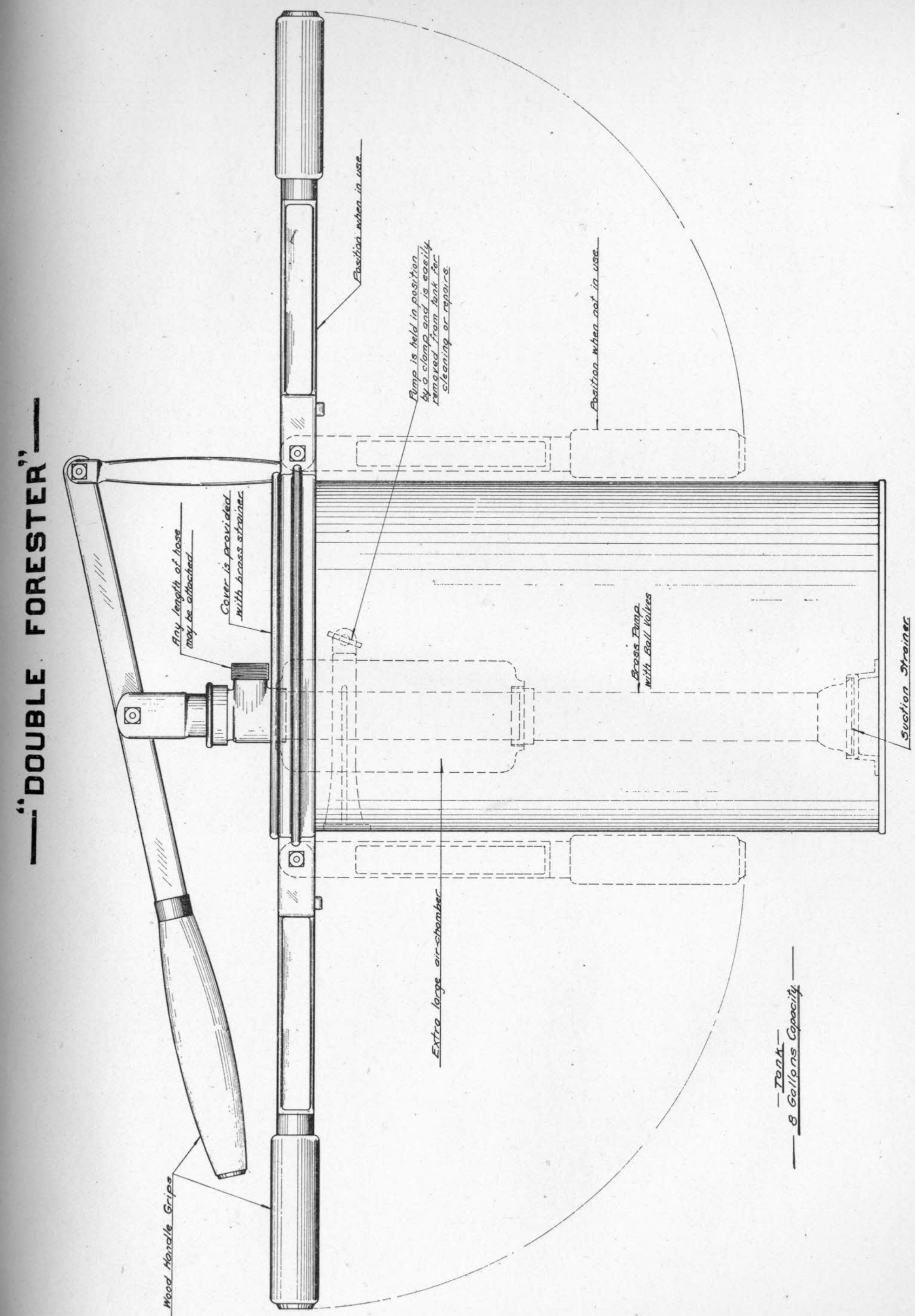
Town	Name of Warden	Address
Griswold	Irving O. Burdick	Norwich, R. F. D. No. 5
Groton	Daniel Chesebro	Mystic, R. F. D. No. 1
Guilford	Burton W. Bishop	Guilford, R. F. D. No. 2
Haddam	Ephraim P. Arnold	Haddam
Hamden	Samuel A. Flight	Highwood
Hampton	William S. Ford	Hampton
*Hartford		
Hartland	Edw. E. Emmons	East Hartland
Harwinton	James P. Hogan	Torrington, R. F. D. No. 2
Hebron	T. R. Prentice	Turnerville
Huntington	H. L. Bowles	Shelton
Kent	John H. Finn	Kent
Killingly	Sidney Bastow	East Killingly
Killingworth	H. R. Blatchley	Clinton, R. F. D. No. 2
Lebanon	M. M. Hazen	Leonard Bridge
Ledyard	Frederick W. Burton	Mystic, R. F. D.
Lisbon	Frank E. Hyde	Norwich, R. F. D. No. 4
Litchfield	Geo. H. Hunt	Litchfield, R. F. D. No. 4
Lyme	James E. Beebe	Hamburgh
Madison	Walter E. Clark	Madison
Manchester	John S. Risley	So. Manchester, R. F. D. No. 2
Mansfield	James C. Green	Eagleville, R. F. D. No. 2
Marlborough	Byron S. Lord	East Hampton, R. F. D. No. 2
Meriden	William C. Lucas	Meriden
Middlebury	D. L. Wheeler	Waterbury, R. F. D. No. 3
Middlefield	Luther W. Fowler	Middlefield
Middletown	†P. J. Kennedy	Middletown
Milford	George J. Smith	Milford
Monroe	Myron S. Clark	Stepney Depot, R. F. D. No. 14
Montville	John J. Driscoll	Montville
Morris	Clark H. Emmons	West Morris
Naugatuck	Wilson F. Clark	Naugatuck
*New Britain		
New Canaan	George T. Smith	New Canaan
New Fairfield	Edward Jennings	New Fairfield, R. F. D. No. 54
New Hartford	Riley M. Olmsted	New Hartford, R. F. D. No. 2
*New Haven		
Newington	Robert Dart	Newington
*New London		
New Milford	Walter L. Erwin	New Milford
Newtown	Frederick B. Lake	Hawleyville
Norfolk	Thomas P. Higgins	Norfolk
North Branford	Edmund M. Field	Northford, R. F. D. No. 1
North Canaan	Charles H. Sage	East Canaan
North Haven	Lawrence Bruce	North Haven
North Stonington	Jas. Frank Brown, Jr.	North Stonington, R. F. D.
Norwalk	George W. Mills	Norwalk, Broad River, R. F. D.
Norwich	C. P. Bushnell	Norwich, R. F. D. No. 4
Old Lyme	George Griswold	Lyme
Old Saybrook	James U. Dibble	Old Saybrook
Orange	Charles S. Clark	Orange
Oxford	F. W. Hubbell	Seymour, R. F. D.
Plainfield	A. B. Mathewson	Plainfield
Plainville	Wm. J. Simpson	Plainville
Plymouth	Ard Welton	Terryville, R. F. D. No. 2

* City Fire Chief in charge of whatever forest protection is necessary.
† Resigned June 1, 1911.

TOWN FIRE WARDENS 1911—*Continued.*

Town	Name of Warden	Address
Pomfret	Seymour Peal	Abington
Portland	Joseph P. Synnott	Portland, R. F. D.
Preston	E. P. Barnes	Norwich, R. F. D. No. 3
Prospect	Chas. S. Fenn	Prospect, R. F. D. No. 2
Putnam	B. K. Smith	Putnam
Redding	Daniel R. Warner	Bethel, R. F. D. No. 24
Ridgefield	George H. Beeker	Ridgefield
Rocky Hill	Ira E. Holmes	Rocky Hill
Roxbury	Henry L. Smith	Roxbury
Salem	Charles I. Beebe	Colchester, R. F. D. No. 3
Salisbury	John S. Perkins	Lakeville
Saybrook	James A. Jones	Deep River
Scotland	Frank E. Allen	Baltic, R. F. D.
Seymour	Walter B. Johnson	Seymour
Sharon	Louis Miller	Sharon
Sherman	David D. Gray	Sherman
Simsbury	James M. Stocking	Weatogue
Somers	John Hunt	Somers
Southbury	Elmer A. Lewis	Southbury, R. F. D.
Southington	C. F. Hamlin	Plantsville
South Windsor	John C. Stoughton	Wapping
Sprague	Arthur Dobbron	Baltic
Stafford	John M. Larned	Stafford Springs
Stamford	F. V. Stevens, Jr.	Stamford
Sterling	Henry R. Brown	Sterling
Stonington	E. Everett Watrous	Westerly, R. I., R. F. D.
Stratford	W. J. Williamson	Stratford
Suffield	Ernest N. Austin	Suffield
Thomaston	William Johnston	Thomaston
Thompson	Thomas Ryan	Thompson
Tolland	Oscar Leonard	Rockville
Torrington	F. H. Baldwin	Torrington
Trumbull	Burr F. Beach	Trumbull
Union	Eugene Walker	Southbridge, Mass., R.F.D. No. 2
Vernon	Chas. W. Bradley	Rockville
Voluntown	Walter C. Tanner	Voluntown
Wallingford	William B. Ives	Wallingford, R. F. D. No. 3
Warren	Henry S. Morrow	New Preston
Washington	John A. Winterburn	West Morris
*Waterbury		
Waterford	Park B. Smith	Waterford
Watertown	Simeon M. Jones	Watertown, R. F. D. No. 2
Westbrook	Lewis N. Stevens	Westbrook
West Hartford	W. E. Johnson	West Hartford
Weston	Chas. E. Lockwood	Georgetown
Westport	Stanley B. Fillow	Westport
Wethersfield	Herbert W. Wells	Wethersfield
Willington	E. C. Eldredge	South Willington
Wilton	E. S. Jennings	Wilton
Winchester	Elliott B. Bronson	Winsted
Windham	James D. Wilson	Willimantic, R. F. D. No. 2
Windsor	M. W. Gilligan	Windsor
Windsor Locks	Willis H. Birge	Windsor Locks
Wolcott	E. M. Upson	Terryville, R. F. D.
Woodbridge	Elmer E. Little	Westville
Woodbury	David L. Somers	Woodbury
Woodstock	Charles M. Perrin	North Woodstock

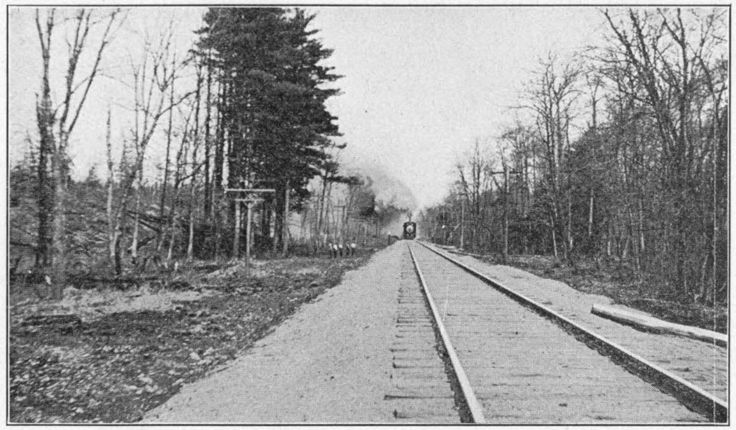
* City Fire Chief in charge of whatever forest protection is necessary.



Putting out a grass fire with ordinary bucket pump specially adapted to the purpose. Town of Simsbury. p. 788.

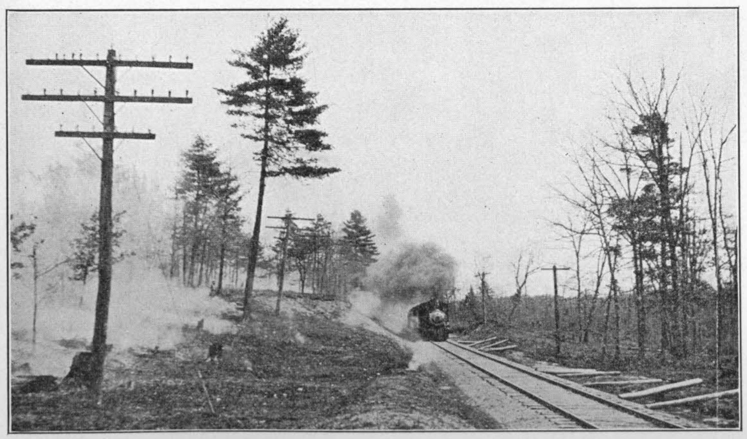
Testing first model of two-man pump at fire on cut-over land. p. 788.

Fighting a hot fire in grass and brush with two-man pump. p. 788.



Railroad right of way through State land where fires formerly did great damage. p. 789.

Fire wardens of Simsbury and their equipment. 100 ft. strip outside of right of way being cleared by burning. p. 790.



Train on heavy grade throwing out sparks. Danger of forest fires greatly lessened by burning over right of way. p. 790.

PART XII.

GARDEN AND FIELD SEEDS SOLD IN CONNECTICUT IN 1910-11

BY MARY H. JAGGER AND E. H. JENKINS *

During the time covered by this report 1034 examinations of seeds have been made, in the interest of the seed growers and farmers of this state.

No farmer can afford to lay down land with any grain or with clover or grass seed without assuring himself in some way that his seed will germinate under proper conditions, that it is true to name and that it is fairly clean and free from noxious weeds. This assurance he may often get by personal inspection of the seed and by a germinating test made at home.

A pinch or two of a grass or clover seed, or a hundred kernels of oats, wheat or rye, spread carefully on a thick damp woolen cloth over which another is laid, rolled together and kept in a damp warm place a week, will show fairly well whether the tested seed will "come" or not in the field.

The "look" of the seed is often very deceptive. For example; quite a number of complete or partial failures of oats have come to our attention. The seed was bright and clean but it had been ruined by bleaching with burning sulphur fumes. Some samples were entirely killed, of others not more than 20 per cent. were alive.

An hour's time given to a test of sprouting the oats before sowing would have avoided the loss of the crop.

To determine certainly the genuineness of clover, alfalfa and some grasses is not easy for most farmers.

* All the tests of seeds reported in this paper and the identification of foreign seeds has been the work of Miss Jagger. The Director has assisted in preparing the work for publication.

This Station therefore undertakes, to the extent of its ability, to test seeds with reference to their purity and vitality, both for farmers and also for growers and dealers within the state, to the end that farm production may not be handicapped at the very start by inferior seed.

All such work, done at the state expense, can only be justified when it is of general interest and importance.

A state institution cannot fairly do work which has interest or value to a single individual alone.

Therefore every sample sent should have with it the facts which are of general importance; for example, the name and address of the party who sells it, the price, the name under which it is sold, whether it is claimed to be fresh and of good quality, etc. A blank form is supplied by the Station for these particulars giving also directions for sampling which should be carefully followed.

The Station spends the time of an expert and provides laboratory facilities for the work of carefully examining the sample, seed by seed.

This is time thrown away if the sample does not fairly represent the stock from which it was taken.

To fairly sample seeds is not in many cases an easy matter. To give it value to the sender and to the public alike,

1. The sample should represent stock offered for sale in the state. A small sample sent by mail from some dealer at a distance is of no value unless he guarantees that the goods shipped shall be like the sample, in which case a sample of the goods as delivered should be sent, for comparison.

2. The sample should be described on a blank which will be supplied by the Station on request.

3. The sample should be so taken as to fairly represent the stock on hand. Carelessness or inaccuracy in this particular impairs or destroys the value of the Station's work.

Instructions for Sampling Seeds.

An accurate sample can be taken by following these directions.

1. Mix well together with the hand and arm the contents of the package (bag or barrel) of seed.

2. Take out five or six small handfuls or cupfuls* from various parts of the package, mix these carefully together and take a part of this mixture for the sample.

3. Send of the smaller seeds—red top, white clover, timothy, etc., *at least* two (2) ounces; of beets, turnips, red clover, etc., four (4) ounces; of wheat and cereals, and of peas and other legumes, eight (8) ounces.

4. Samples may be sent by mail, so securely packed as to prevent leakage or loss, prepaid, *plainly labeled* with name and address of the sender, and addressed to

CONN. AGRICULTURAL EXPERIMENT STATION,
New Haven, Conn.

As the test of germinating power requires some time for its completion, a report on it cannot be ordinarily expected in less than two weeks from the time the sample is received. Usually a report as to purity can be made within a few days of the receipt of the sample.

Seeds of varieties like the different kinds of cabbage or of carrot cannot usually be distinguished from one another. Occasionally loss comes from planting an inferior variety which has been bought under the name of another and good variety.

The examination of *grass-mixtures* can only be undertaken in special cases. It requires a large outlay of time and labor which is not often justified by the results.

Here follow the results of the seed examinations recently made which prove to be of sufficient value for publication.

The tests of samples of grasses, clovers, and alfalfa are given in Table I. Those collected by the Station's agent and those sent for examination by others are separately recorded.

The Station agent bought in each case one pound of each sample, which therefore does not certainly represent the quality of the stock, but rather what the casual buyer of a small lot would receive. We have no data regarding the method of sampling followed by others than our agent.

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* A small cup may be closed with the palm of the hand, forced down to the desired place, then filled and withdrawn.

Red Clover.

The quality of the seed bought by our agent was in general good, the average purity being 95.7 per cent. and the "viability," —that is the percentage of pure seed which germinated,—88.7.

Four samples, 6110, 6112, 6117 and 6545, contain more inert matter and foreign seeds than are desirable. The larger part of the foreign seeds are long-leaved and Rugel's plantain, dock and foxtail or bottle grass. The first three are pestilent weeds.

Either field dodder or European dodder was found in samples 6095, 6108, 6112, 6117, 6122, 6148, 6028, and 6545, that is in one-quarter of the number tested. It was very abundant in 6095, 6108 and 6122.

The inert matter in 6090 and 6136 is chiefly worthless clover seeds which crumble easily. Some such seeds are also found in several other samples, being seeds ruined by the clover-seed chalcid. Dr. Britton (see page 709 of this report) states that this insect is distributed nearly all over the United States and in some localities is a serious pest. The insect lays its eggs in the clover heads in the field and the adult four-winged flies emerge from the mature seeds. Seed thus attacked of course is of no value as the embryo is entirely eaten out by the insect.

In all, about 45 species of weed seeds were found in the bought samples of red clover. The most important have been named above.

Mammoth Red Clover.

Sample 6089 contained about 5 per cent. of common sorrel.

White Clover.

The viability of this clover was considerably lower than that of red or alsike clover. More than half of the foreign seeds in 6132 were harmless, timothy and red clover; the weeds being sorrel, pepper grass, pigweed and catchfly. 6140 contains dodder, 596 seeds to the pound, and 6147 contains less than this. 6140 has over 50,000 weed seeds in the pound, most of them sorrel. In all, about 25 species of weed seeds were found in these samples.

Alsike Clover.

The samples examined were of about average quality, 6131 containing some dodder, about 125 seeds to the pound.

The foreign seed consisted chiefly of timothy and clovers. About sixteen species of weed seeds were found.

Alfalfa.

No dodder was found in any of the six samples bought by the Station and the percentage of foreign seed is very small. 6118 has a very low germination.

The average viability of the others is 84.4 per cent. which is about what standard alfalfa should have.

In the case of leguminous seeds, such as clovers and alfalfa, one third of the seeds remaining hard at the end of the germination test are counted as viable. That is, if the seed were planted it is assumed that at least one third of these hard seeds would sprout during the season.

In alfalfa seed number 6515 there was about fifty per cent. of these hard seeds at the end of the sprouting test. Such a large amount might seriously affect the character of the crop.

Of the samples reported in the table drawn by others than the Station agent, 6087 and 6159 contained dodder seed.

Alfalfa seed should have a bright yellow color. Brown seed should be avoided as the color is a sign of inferiority.

Timothy.

The eight samples of timothy examined were very pure, one of them showing 100 per cent. and none of them less than 97.4 per cent. purity.

Two of them, however, did not sprout satisfactorily.

Of the samples sent by others than the Station agent, 6013 had very low germinating power and was somewhat dirty. A part of the seed was brown and hard as if it had been heated. Such seed was entirely dead.

Red-Top.

The inert matter in red-top should consist chiefly of portions of the flower which cannot be perfectly separated from the seed, but the exceptionally large amount of foreign matter in 6123 is due to 11.1 per cent. of sand; 6113 contained much dirt, chaff and sticks.

Yarrow, and cinquefoil, *Potentilla*, are the most abundant weeds and seven of the samples also contained over 9 per cent. of timothy.

Of the samples sent in for examination 5964 had 11.6 per cent. of inert matter, 5.6 per cent. of timothy, also seeds of yarrow, pepper grass and plantain. 6015 was dirty but had few weed seeds. Number 6029 had 9.3 per cent. of timothy with some yarrow and seeds of rush, *Juncus* sp. 6508 contained over 13 per cent. of timothy.

TABLE I.—ALFALFA, GRASS AND CLOVER SEEDS EXAMINED IN 1910.

Station No.	Dealer	1000 seeds weigh, grams.	Pure seed, per cent.	Inert matter, per cent.	Foreign seed, per cent.	Pure seed germination, per cent.	Viability, per cent.
	RED CLOVER SEED.						
	Purchased by Station Agent.						
6095	W. A. Burr, West Hartford	1.56	96.4	1.5	2.1	97.0	93.5
6100	Blish Hdw. Co., So. Manchester	1.69	98.8	1.0	0.2	97.0	95.8
6102	Wheeler & Co., Bridgeport	1.62	98.8	0.7	0.5	94.5	93.3
6104	Church & Morse, Meriden	1.65	99.0	0.5	0.5	93.0	92.0
6108	Olds & Whipple, Hartford	1.54	94.8	2.6	2.6	95.0	90.0
6110	T. H. Eldridge, Norwich	1.61	88.3	4.4	7.3	90.0	79.4
6112	F. C. Benjamin & Co., Danbury	1.53	88.3	5.0	6.7	90.0	79.4
6117	G. M. Williams Co., New London	1.45	88.1	5.5	6.4	88.0	77.5
6119	F. S. Bidwell & Co., Windsor Locks	1.58	99.6	0.2	0.2	95.0	94.6
6122	F. A. Hull & Son, Danbury	1.53	97.2	1.8	1.0	94.5	91.8
6128	E. A. Buck & Co., Willimantic	1.36	97.6	1.7	0.7	93.5	91.2
6133	Farmers' Supply Co., Bridgeport	1.65	91.5	5.4	3.1	96.5	88.2
6136	Greenwich Hdw. Co., Greenwich	1.70	92.8	4.2	3.0	94.0	87.2
6137	P. Swartz, New London	1.54	94.8	2.1	3.1	90.5	85.7
6142	Cadwell & Jones, Hartford	1.74	97.8	1.2	1.0	94.0	91.9
6148	Spencer Bro., Suffield	1.61	99.1	0.5	0.4	95.5	94.6
6150	F. S. Platt Co., New Haven	1.55	94.4	2.7	2.9	87.0	82.1
	Sent by interested persons.						
5589	Wilcox & Co., Simsbury	1.64	99.5	0.5*	--	90.5	90.0
5612	D. L. Dickinson & Son, Waterbury	1.69	99.2	0.8*	--	95.5	94.7
5959	E. W. Conklin & Son, New York	1.70	98.8	1.2*	--	93.0	91.8
5989	F. S. Platt Co., New Haven	1.68	97.1	2.9*	--	81.0	78.6
6012	Wm. Segar & Co., Westerly, R. I.	1.67	97.7	2.3*	--	88.0	85.9
6028	W. E. Barrett & Co. Providence, R. I.	1.62	98.8	1.2*	--	92.0	90.8
6090	Bash & Co., Fort Wayne, Ind.	1.58	93.6	6.4*	--	83.5	78.1
6155	Wheeler & Co., Bridgeport	1.62	94.4	5.6*	--	93.5	88.2
6156	" " "	1.73	97.1	2.9*	--	93.0	90.3
6439	Cadwell & Jones, Hartford	1.47	99.0	1.0*	--	93.5	92.5
6501		1.58	98.2	1.8*	--	94.0	92.3
6512		1.55	97.5	2.5*	--	97.0	94.5
6545	Brower & Malone, Norwalk	1.83	91.6	3.6	4.8	91.0	83.2

* Includes foreign seeds.

TABLE I.—ALFALFA, GRASS AND CLOVER SEEDS EXAMINED IN 1910—*Continued*

Station No.	Dealer	1000 seeds weigh, grams.	Pure seed, per cent.	Inert matter, per cent.	Foreign seed, per cent.	Pure seed germination, per cent.	Viability, per cent.
	MAMMOTH RED CLOVER.						
	Sent by interested persons.						
5960	E. W. Conklin & Son, New York	1.63	98.4	1.6*	--	94.5	92.7
5990	F. S. Platt Co., New Haven	1.67	97.8	2.2*	--	94.0	91.9
6089	Bash & Co., Fort Wayne, Ind.	1.73	94.2	5.8*	--	76.0	71.5
	WHITE CLOVER.						
	Purchased by Station Agent.						
6132	E. A. Buck & Co., Willimantic	.63	82.7	2.9	14.4	82.0	67.8
6140	Hotchkiss & Templeton, Waterbury	.60	89.4	2.1	8.5	69.5	62.1
6147	Frank H. Smith, Middletown	.67	95.2	1.0	3.8	87.0	82.8
6149	Spencer Bros., Suffield	.54	96.8	1.0	2.2	79.5	76.9
	Sent by interested person.						
6091	Bash & Co., Fort Wayne, Ind.	.56	90.3	9.7*	--	77.0	69.5
	ALSIKE CLOVER.						
	Purchased by Station Agent.						
6131	E. A. Buck & Co., Willimantic	.70	94.2	2.1	3.7	84.0	79.1
6143	Cadwell & Jones, Hartford	.70	99.1	0.4	0.5	91.0	90.1
6145	Meriden Grain & Feed Co., Meriden	.73	94.3	0.5	5.2	88.0	82.9
6146	Frank H. Smith, Middletown	.64	93.4	1.1	5.5	86.5	80.7
6151	F. S. Platt Co., New Haven	.56	92.4	0.7	6.9	80.0	73.9
	ALFALFA.						
	Purchased by Station Agent.						
6098	Blish Hdw. Co., So. Manchester	2.03	97.3	2.1	0.6	92.0	89.5
6118	G. M. Williams Co., New London	2.07	96.9	1.9	1.2	38.5	37.3
6120	F. S. Bidwell & Co., Windsor Locks	2.03	99.3	0.3	0.3	90.5	89.8
6126	J. P. Barstow & Co., Norwich	1.87	96.9	1.4	1.7	83.5	80.9
6129	E. A. Buck & Co., Willimantic	2.08	97.4	1.7	.9	83.5	81.1
6144	Meriden Grain & Feed Co., Meriden	1.92	97.0	1.7	1.3	83.0	80.5
	Sent by interested persons.						
5596	E. W. Conklin & Son, New York	2.18	98.5	1.5*	--	88.5	87.1
6087	Whitney Noyes & Co., Buffalo, N. Y.	1.86	98.9	1.1*	--	93.5	92.4
6154	Wing Seed Co., Mechanicsburg, O.	2.00	99.0	1.0*	--	91.5	90.5
6159	F. S. Platt Co., New Haven	2.14	97.0	3.0*	--	86.0	83.4
6164	Wheeler & Co., Bridgeport	2.05	93.1	6.9*	--	74.5	69.3
6165	F. S. Platt Co., New Haven	2.02	96.8	3.2*	--	71.0	68.7
6515	A. B. Lyman, Minn.	2.07	98.8	1.2*	--	64.0	63.2
	TIMOTHY.						
	Purchased by Station Agent.						
6099	Blish Hdw. Co., So. Manchester	.417	99.4	0.3	0.3	95.5	94.9
6101	Wheeler & Co., Bridgeport	.382	99.8	0.1	0.1	91.0	90.8
6106	Olds & Whipple, Hartford	.410	99.7	0.1	0.1	97.3	97.0
6109	T. H. Eldridge, Norwich	.390	98.8	0.6	0.6	68.3	67.4
6116	Lyon & Ewald, New London	.395	98.0	0.7	1.3	80.5	78.8
6121	F. S. Bidwell & Co., Windsor Locks	.420	100.0	---	---	93.3	93.3
6125	J. P. Barstow & Co., Norwich	.350	99.7	0.2	0.1	98.3	98.0
6130	E. A. Buck & Co., Willimantic	.380	97.4	0.9	1.7	93.3	90.8

* Includes foreign seeds.

TABLE I.-ALFALFA, GRASS AND CLOVER SEEDS EXAMINED IN 1910–*Concluded*

Station No.	Dealer	1000 seeds weigh, grams.	Pure seed, per cent.	Inert matter, per cent.	Foreign seed, per cent.	Pure seed germination, per cent.	Viability, per cent.
	TIMOTHY—*Concluded.* *Sent by interested persons.*						
5586	D. L. Dickinson & Son, Waterbury	.41	99.9	0.1*	--	90.8	90.7
5590	Wilcox & Co., Simsbury	.40	99.5	0.5*	--	89.0	88.5
5961	E. W. Conklin & Son, New York	.39	99.3	0.7*	--	89.0	88.3
5962	" " " "	.33	97.7	2.3*	--	84.0	82.0
5973	" " " "	.36	98.6	1.4*	--	95.8	94.4
5974	" " " "	.41	99.5	0.5*	--	98.5	98.0
6013	Wm. Segar & Co., Westerly, R. I.	.36	96.3	3.7*	--	56.8	54.6
6030	W. E. Barrett & Co., Providence, R. I.	.34	97.2	2.8*	--	96.0	93.3
6456	E. W. Conklin & Son, Bingh'mt'n, N. Y.	.41	99.8	.2*	--	70.8	70.6
6457	" " " " "	.35	98.5	1.5*	--	86.3	85.0
6546	Brower & Malone, Norwalk	.40	99.6	.4*	--	91.8	91.4
6556	----------------	.43	98.2	1.8*	--	87.5	85.9
	RED-TOP. *Purchased by Station Agent.*						
6096	W. A. Burr, West Hartford	.087	76.7	7.1	16.2	73.8	56.6
6097	Blish Hdw. Co., So. Manchester	.085	93.7	5.5	0.8	72.0	67.4
6103	Wheeler & Co., Bridgeport	.090	94.6	4.7	0.7	88.8	84.0
6105	Church & Morse, Meriden	.085	78.0	9.1	12.9	72.3	56.3
6107	Olds & Whipple, Hartford	.097	69.0	6.7	24.3	84.0	57.9
6111	T. H. Eldridge, Norwich	.085	74.8	8.0	17.2	67.0	50.1
6113	F. C. Benjamin & Co., Danbury	.090	67.0	17.6	15.4	70.8	47.4
6114	I. W. Dennison, Mystic	.097	90.0	9.6	0.4	78.8	70.9
6123	F. A. Hull & Son, Danbury	.090	81.2	15.1	3.7	74.8	60.7
6124	J. P. Barstow & Co., Norwich	.092	89.6	8.3	2.1	84.8	75.9
6127	E. A. Buck & Co., Willimantic	.100	90.0	6.3	3.7	69.5	62.5
6134	Farmer's Supply Co., Bridgeport	.085	74.2	8.3	17.5	64.8	48.0
6135	Greenwich Hdw. Co., Greenwich	.090	93.7	5.5	0.8	72.8	68.2
6139	Hotchkiss & Templeton, Waterbury	.090	72.7	12.5	14.8	61.0	44.3
	Sent by interested persons.						
5963	E. W. Conklin & Son, New York	.09	91.4	8.6*	---	92.8	84.8
5964	" " " "	.08	78.8	21.2*	---	91.8	72.3
5972	" " " "	.08	93.2	6.8*	---	91.0	84.8
6015	Wm. Segar, Westerly, R. I.	.08	85.9	14.1*	---	86.8	74.5
6029	W. E. Barrett & Co., Providence, R. I.	.08	84.4	15.6*	---	89.8	75.7
6092	Bash & Co., Fort Wayne, Ind.	.08	91.2	8.8*	---	92.0	84.9
6508	C. D. Bushnen, Plantsville	.08	76.4	8.6	15.0	90.8	69.3

* Includes foreign seeds.

Besides the samples tabulated a considerable number of very small samples were sent by prospective buyers with inquiry as to their quality. These samples were too small to justify a full examination or, in our judgment, to fairly represent any lot of seed.

They were carefully examined as to purity and are summarized as follows:—

TESTS OF GRASS, CLOVER AND ALFALFA SEED.

	No. Tested	Clean Seed	Contained Weeds	Contained Dodder	Contained Dodder and Weeds	Contained much Dirt
Red Clover	30	13	3	..	12	2
Mammoth Clover	4	1	1	1	1	..
White Clover	4	3	1	..	..	..
Alsike Clover	8	6	2	..	..	..
Alfalfa	24	13	7	4	..	..
Timothy	23	12	11	..	..	..
Red Top	14	7	5	..	..	2
Total No. tested	107	55				

One of the samples of red clover classed as containing dodder and weeds was probably adulterated with alfalfa screenings. About twenty per cent. of this sample consisted of broken or light, shriveled seeds of red clover and alfalfa. Dodder and weed seeds were abundant, there being about four thousand dodder seeds to the pound.

The sample of mammoth clover classed as weedy contained, besides other weeds, about one per cent. of black medic, a worthless plant.

TESTS OF THE VITALITY OF VEGETABLE SEEDS SENT BY GROWERS, DEALERS OR PURCHASERS, 1909 and 1910.

Within the period above named seven hundred and ninety-six samples of field and garden seeds have been tested as to their sprouting capacity. A brief summary only of the results can here be given.

Comparison of the Vitality of Crops of Connecticut-Grown Onion Seed Less than One Year Old in the Years 1894-1910.

TABLE I.—VITALITY OF CROPS OF ONION SEED.

	No. of Samples tested	Average Percentage sprouted
In 1894	25	82.9
1895	13	85.5
1896	44	72.4
1897	39	77.9
1898	68	69.3
1899	62	89.0

	No. of Samples tested	Average Percentage sprouted
In 1900	77	88.5
1901	60	71.0
1902	60	80.6
1903	59	62.0
1904	42	80.4
1905	37	78.6
1906	62	77.2
1907	24	88.8
1908	119	74.5
1909	89	72.5
1910	57	64.3

Average for 17 consecutive years, 75.1 per cent.

The exceptionally low vitality of the 1910 seed is due to the blasting of the crop in the field.

The Sprouting Capacity of Different Varieties.

The average sprouting capacity of five varieties, of which a considerable number of samples have been tested, is as follows (only those samples are here included which were stated to be less than one year old at the time of testing and were grown in Connecticut):

TABLE II.—SPROUTING CAPACITY OF DIFFERENT VARIETIES OF ONION SEED.

	No. of Samples tested	Average Percentage of Sprouting Seed
Yellow Globe	397	73.97
Red Globe	283	77.73
White Globe	201	77.69
White Portugal	34	70.82
Wethersfield Red	15	79.07

Vitality of Onion Seed as Affected by the Age of the Seed.

Since November 1, 1896, the Station has examined 1756 samples of onion seed of the crop of 1896 and of each succeeding crop. The results are summarized in the following table:

TABLE III.—VITALITY OF ONION SEED.

	Connecticut Grown		Cal. Grown	
	No. of Samples	Per cent. sprouted	No. of Samples	Per cent. sprouted
Seed stated to be less than one year old	861	74.72	400	88.18
Seed stated to be between one and two years old	165	65.58	220	77.46
Seed stated to be between two and three years old	24	21.90	2023	57.34
Seed stated to be between three and four years old	1	59.50	1	10.00

It is quite clear that as a rule a larger percentage of California-grown onion seed germinates than of Connecticut-grown seed. It is also quite clear that, as a rule, onion seed one year old has a much lower sprouting capacity than new seed, though there are many exceptions to this. Seed from a good crop when one year old will sometimes germinate quite as well as new seed from an inferior crop.

Vitality of Sweet Corn Seed.

The following table gives the average, maximum and minimum vitality found in tests of Connecticut-grown sweet corn less than one year during the years 1904 to 1910:

	No. of Samples tested	Average Percentage by number of Seed sprouting	Maximum	Minimum
Country Gentleman	19	87.9	100.0	59.0
Early Crosby less than one year old	12	93.5	100.0	77.0
Early Crosby one to two years old	4	63.6	85.0	42.0
Early Evergreen less than one year old	3	87.8	96.0	82.0
Early Evergreen one to two years old	1	91.0	....	....
"Evergreen" less than one year old	12	88.0	....	....
"Evergreen" one to two years old	3	80.7	92.0	73.0
Acme Evergreen one to two years old	1	80.0	....	....
Hickox	4	83.2	96.0	65.0
Metropolitan	4	91.7	99.0	85.0
Old Colony less than one year old	5	84.6	100.0	57.0
Old Colony one to two years old	1	80.0	....	....
Old Colony two to three years old	1	45.0	....	....
Stowell's Evergreen less than one year old	25	86.1	100.0	48.0
Stowell's Evergreen one to two years old	8	81.7	99.0	62.5
Early Dawn	1	96.0	....	....
Ne Plus Ultra	1	72.5	....	....

In our opinion the showing of sweet corn is a poor one as regards vitality, and greater care in curing and better arrangements in the barns where the seed is dried after harvesting would considerably improve the quality of the seed.

Soil and climate give this state an exceptional chance to be the center of the sweet corn seed production. It is about the northern limit for the safe maturing of most varieties of sweet corn seed and the quality of these varieties here is generally believed to be better than when grown in a warmer climate.

The matter of proper curing has been briefly discussed in our Report for 1907-1908, p. 401.

Note on the Moulding of Seed during the Germinating Test.

Fungi of various sorts frequently grow on and about seeds set to germinate on sterilized cloth or paper in a sterilized chamber. Their spores or mycelia are therefore quite certainly on or in the seed itself. If they are within the tissues of the seed they cannot be killed by external treatment and will probably injure the plant sooner or later. If they are outside the living tissues the question arises whether conditions in the germinator favor their growth more than conditions in the soil. If so they may attack and destroy the germ before it developes and thus the germinator test may give results much lower than a field test rather than higher.

It is often assumed that a larger percentage of seed will sprout in a laboratory test than in the field, because conditions are under control and accidents less likely to occur in the laboratory. We may say in passing that considerable experience in the work makes us very skeptical of the truth of this assumption.

The following experiment was made to see whether in a special case sterilizing the exterior of the seed would increase the percentage germination. The results may be of some general interest.

Five samples of pepper seeds of the 1910 crop which had low germinating power and moulded badly during the test, were afterwards sprouted under the following conditions, in the standard germinator made by The Kny-Scheerer Company of New York.

This germinator was thoroughly cleaned and disinfected with formalin. All water used in the tests was sterilized and also the

blotters in which the seeds were placed. Ten lots of 100 seeds from each of the five samples were treated as follows:

Two lots were soaked for 10 minutes each in ¼, ½, 2 and 8 per cent. formalin solution. They were then rinsed twice with sterilized water and placed on sterile blotters in the germinator, where they remained fourteen days, counts being made five times during this period. The water tests were made as checks, the seeds not being soaked but put directly into the germinator.

The results are summarized as follows,—each figure being an average of two tests. The greatest difference between duplicates being 7 and the average difference 2.8 per cent:—

Germination Tests of Pepper Seeds.

Station No.	Water	Formaldehyde Solution ¼ per cent.	½ per cent.	2 per cent.	Average germination in ¼, ½ and 2 per cent.	8 per cent.
Per cent. sprouted in 14 days.						
6440	68.0	69.0	73.5	69.5	70.6	33.5
6441	21.5	20.0	12.5	23.5	18.6	11.5
6442	55.0	56.0	57.5	56.0	56.5	56.5
6443	24.0	18.0	16.5	21.0	18.5	12.0
6444	50.5	37.0	56.0	53.0	48.6	44.0
Average..	43.8	40.0	43.2	44.6	....	31.5
*Per cent. moulded in 14 days.**						
6440	31.0	25.5	20.0	10.0	....	3.5
6441	78.0	76.5	63.0	73.5	....	37.5
6442	42.5	28.0	28.5	14.5	....	8.0
6443	75.0	80.5	82.0	58.0	....	65.5
6444	44.0	55.0	33.0	13.0	....	19.5
Average..	54.0	53.1	45.3	33.8	....	26.8
Per cent. remaining hard at end of 14 days.†						
6440	1.0	5.5	6.5	20.5	....	63.5
6441	0.5	3.5	24.5	3.0	....	51.0
6442	2.5	16.0	14.0	29.5	....	35.5
6443	1.0	1.5	1.5	21.0	....	22.5
6444	5.5	8.0	11.0	34.0	....	36.5
Average..	2.1	6.9	11.5	21.6	....	41.8

* By mouldy seeds are meant seeds in which the embryo itself had moulded.

† By hard seeds are meant seeds which had perfect embryos at the end of the test.

These results suggest that 6441 and 6443 were much more seriously infected with moulds than the others, as shown by the much larger percentage that moulded during the test.

These two also showed practically no increase in germination following formalin treatment and relatively little decrease in mould.

In one case eight per cent. formalin did not damage the germinating power, but in four cases it did cause injury.

The limit for the safe use of it in these cases must be considerably less than eight per cent. when treated ten minutes.

Excluding from consideration 6441 and 6443 as being so deeply infected with microbe life that their germination under uniform external conditions must be very irregular, a ten minute treatment of the seed with ½ and with 2 per cent. formalin seems to have only very slightly improved germination although it reduced considerably the number of mouldy seed.

We give these figures not as in any way conclusive. It satisfied us, however, that if germination was depressed by the growth of moulds in these cases, a treatment with formalin did not kill such moulds.

The genera of fungi developed on the seed which were identified by Mr. Stoddard were, Alternaria, Penicillium, Fusarium, Rhizopus, Aspergillus, three unidentified, besides bacteria and yeasts. Treatment with formalin did not change the nature of the flora. Most of these were apparently saprophytic moulds whose spores merely adhered to the seeds.

We conclude that in these cases the microbe life which could be destroyed with formalin treatment did not seriously affect the percentage of germination.

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