State of Connecticut

REPORT

OF

The Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

ON

FOOD PRODUCTS AND DRUGS 1921,

BEING

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Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

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BEING THE

Twenty-Sixth Report

ON

Food Products

AND

Fourteenth Report on Drug Products.

By E. M. BAILEY.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

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January, 1922

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The Twenty-sixth Report on Food Products and the Fourteenth Report on Drug Products, 1921.

By E. M. Bailey.

This report summarizes examinations of foods, drugs and miscellaneous materials which have been made in this laboratory during the past year. Much of the time of the department is necessarily occupied with control work required by statutes relating to fertilizers and feeding stuffs and with other analytical work in connection with field experiments as well as with human foods and drugs. However, as much time as can be spared is devoted to the study of methods and the investigation of special subjects.

Practically all of the food and drug control work done in the past year has been upon samples submitted by the Dairy and Food Commissioner. Soft drinks, market milk, ice cream and drugs listed in the Pharmacopoeia or National Formulary have been the items of chief importance. A new law regulating the manufacture and sale of beverages of the soda water type prohibits the use of saccharin in these products and it has resulted in greatly diminishing the occurrence of this artificial sweetener which heretofore has been rather widely used in this state.

An investigation of the cryoscopy of milk has been made, involving analyses and freezing point determinations of authentic milk from individual cows and herds for the purpose of establishing the freezing point range of normal milk to serve as a basis for the detection of added water in market milk. This has been done in collaboration with Dr. Hortvet of the Minnesota State Dairy and Food Department, who is the author of the freezing point method we have used, and with Dr. Menge of the Milk Products Department of the Libby, McNeill and Libby Company. The data secured have been included in a report of the writer as associate referee on this subject to the Association of Official Agricultural Chemists and an abstract of the same is published here. The writer has also collaborated with the Council on Pharmacy and Chemistry of the American Medical Association upon questions pertaining to diabetic and other special foods and has prepared and submitted to the Council tentative standards for dietetic casein and calcium caseinate.

Mr. Andrew has served during the year as referee on tea for the Association of Official Agricultural Chemists and has submitted a report to the Association an abstract of which is given in this bulletin. He has also collaborated in the study of methods for the assay of certain drugs.

Three educational exhibits have been arranged. One of these was a part of the general exhibit of this Station at the Farmers' Week Fair at Hartford in January and the others were made jointly with the Biochemical laboratory at the meeting of the American Medical Association at Boston in June and at the meeting of the American Child Hygiene Association at New Haven in November.

During the last few years the volume of work required by the department of the Dairy and Food Commissioner has greatly increased. Charged as we are with analytical work required by other branches of control and investigation, our time and facilities often would be seriously overtaxed were it not for the generous efforts of the Commissioner and his staff to correlate the work of his department with that of ours, so far as it is possible to do so, and we appreciate this coöperation. Under this plan the work of both departments proceeds with an efficiency that otherwise would not be possible.

Acknowledgment is made to the chemists of this laboratory, Messrs. Andrew, Shepard, Edmond, Nolan, Fisher and Merwin, to whom credit for the analytical work herein reported is due, for their efficient coöperation; and to Miss Moss for her valuable assistance in the compilation of data and the preparation of reports and bulletins.

I. FOODS.

CARBONATED BEVERAGES, ETC.

One hundred and fifty-three samples of beverages of the soda water type have been examined for saccharin and of that number twenty-one, representing products of fourteen manufacturers, were found to be adulterated for the reason that they contained that substance. A recent act of the Legislature[1] expressly prohibits the use of saccharin in non-alcoholic beverages and a previous act[2] likewise prohibits its use in ice cream. These are the only instances of specific legislation against this artificial sweetener, which, however, has heretofore been regarded as an adulterant under the provisions of the general food and drug law and by rules and regulations[3] pertaining thereto, made jointly by the Director of this station and the Dairy and Food Commissioner.

In the inspection made in 1920, 40.5 per cent. of the samples examined contained saccharin, as compared with 13.7 per cent. found in the inspection of 1921. There is reason to believe that an even smaller percentage would be found at the present time.

Saccharin was found in the following samples:

[1] Public Acts 1921, Chap. 159, Sec. 3.
[2] Public Acts 1919, Chap. 260.
[3] Regulation 7.

D. C. No.	Brand.	City or Town	Manufacturer or Dealer.
20662	Cherry Soda.	*Ansonia:*	L. Yolin.
18172	Cherry Soda.	*East Norwalk:*	Morris Sopshin.
20033	Strawberry Soda.		Morris Sopshin.
20030	Birch Soda.		Morris Sopshin.
20045	Cherry Soda.	*Greenwich:*	Barney Tunick.
20772	Strawberry Soda.	*Jewett City:*	Jewett City Bottling Works
20674	Strawberry Soda.	*New Britain:*	Peerless Bottling Works.
18178	Lemon Soda.	*New Canaan:*	Gray Bros.
20027	Lemon Soda.		Gray Bros.
18179	Peach Soda.		Gray Bros.
20028	Peach Soda.		Gray Bros.
20679	Cherry Soda.	*New Haven:*	New Haven Bottling Works.
20682	Cherry Soda.		D. Chiaramonte.
19871	Strawberry Soda.	*New London:*	Benj. Manoff.
20666	Cream Soda.	*Shelton:*	Derby Bottling Works.
18529	Cream Soda.	*Stamford:*	Isaac Silver.
18530	Strawberry Soda.		Isaac Silver.
18531	Strawberry Soda.		Morris Alterwitz.
18532	Creme Soda.		Morris Alterwitz.
19878	Strawberry Soda.	*Thompsonville:*	Thompsonville Bottling Works.
20651	Cherry Soda.	*Waterbury:*	C. Mascola Bottling Works.

CASEIN AND CALCIUM CASEINATE.

A number of preparations of casein and calcium caseinate, designed for clinical purposes, have been examined for the Council on Pharmacy and Chemistry of the American Medical Association and tentative standards for these products suggested.

Dietetic casein is the purified protein separated from milk by the action of acids or of enzymes. It finds limited use in the feeding of infants, in the nutrition of convalescents and undernourished individuals and in the dietotherapy of diabetes. It should contain not less than 15 per cent. of nitrogen, on the moisture-free basis, with other specifications as will appear in New and Non-Official Remedies.[1] The proximate composition of casein prepared by various commercial and laboratory methods is shown by data published from the Forest Products laboratory[2] and by analyses of a number of pure preparations made in the Biochemical laboratory of this station and used by Doctors Osborne, Mendel and Wakeman in studies on nutrition. Analyses of these last named preparations are given in Table I.

Calcium caseinate is also used in medicine for such disorders as can be treated by dietetic measures.

Five preparations of calcium caseinate including three commercial products and one natural preparation made in the Biochemical laboratory of this station have been analyzed and the results are given in Table II.

[1] Published by the Am. Med. Assoc., 1922.
[1] Jour. Ind. Eng. Chem., 11, 11, 1029, 1919.

TABLE I. PROXIMATE ANALYSES OF CASEIN.

Sample No.	1 %	2 %	3 %	5 %	6 %	7 %
Moisture	7.89	7.75	8.86	6.40	9.68	6.23
Ash	0.55	0.61	0.52	0.38	0.60	1.30
Fat	0.80	0.40	0.23	1.00	0.50	0.75
Nitrogen	14.08	14.08	13.84	14.36	13.82	14.34
Casein (N x 6.38)	89.83	89.84	88.30	91.60	88.16	91.48
M. F. A.—free material[1]	90.76	91.24	90.39	92.22	89.22	91.72
Diff. between Casein and M. F. A.—free material	0.93	1.40	2.09	0.62	1.06	0.24
Lactose	none	none	none	none	none	none
Undetermined	0.93	1.40	2.09	0.62	1.06	0.24
Acidity, cc. N/10 alk. per gm. original material	10.0	10.5	11.4	10.4	10.0	6.7
Acidity, cc. N/10 alk. per gm. M. F. A.-free material	11.0	11.5	12.6	11.2	11.2	7.3

[1] Moisture, fat and ash-free material.

TABLE II. ANALYSES OF CALCIUM CASEINATE.

		Moisture %	Nitrogen %	Protein (Nx6.38) %	CaO. %	P_2O_5 %	Fat %	Moisture-free Nitrogen %	Moisture-free Protein %
17029	No. 4 T. B. O.	9.75	13.68	87.28	1.65	1.95	0.43	15.16	96.71
17030	Larosan	10.38	13.06	83.31	2.37	1.69	2.36	14.58	93.02
17031	Larosan	9.87	13.12	83.71	2.16	1.65	2.57	14.56	92.89
17024	Protolac	8.90	12.72	81.15	2.66	1.80	0.75	13.96	89.07
17025	Casec	7.60	12.48	79.62	1.50	1.54	2.40	13.50	86.13

CIDER.

Four samples of cider were submitted by the Dairy and Food Commissioner. Three of these, **20358, 20359** and **20920**, were so-called sweet cider. They contained 5.75 per cent., 5.93 per cent. and 4.16 per cent. of alcohol respectively showing in all cases an advanced stage of fermentation which marked them as hard ciders. One sample, **19414**, Veribest, made by Armour & Co., contained only a trace of alcohol and was free from saccharin, and salicylic, benzoic and sulphurous acids.

COCOA.

Three samples have been submitted by the Dairy and Food Commissioner and two by the New Haven County Farm Bureau. The samples were D. C. Nos. **19874**, Hershey's, **19875**, Van Houten's, **19876**, Lowney's and Sta. Nos. **15963** and **15964**, brands unknown, but sold by D. M. Welch and The Mohican Company, New Haven, respectively.

Partial analyses were made as follows:

D. C. or Sta. No.	19874 %	19875 %	19876 %	15963 %	15964 %
Moisture	5.80	5.95	4.80	6.22	5.05
Ash, total	7.12	4.60	4.60	5.10	5.10
insol. in water	1.78	2.90	2.65	3.15	2.85
Nitrogen	3.50	3.50	3.49	3.74	3.74
Crude Fiber	.....	.....	.....	5.38	5.35
Fat	24.24	24.58	25.08	21.23	21.06

COFFEE.

One sample of coffee substitute and one of modified coffee have been examined. The brands were Delisco, **16373**, prepared by the Delisco Corporation Ltd., Boston, and Kaffee Hag, **15682**, made by the Kaffee Hag Corporation of Cleveland, Ohio.

Our analysis of the coffee substitute is as follows:

Moisture 5.08 per cent; ash 4.25 per cent; ash soluble in water 3.01 per cent; phosphoric acid (P_2O_5) in insoluble ash 0.49 per cent, in soluble ash 0.43 per cent; alkalinity of ash 3.15 cc N/10 acid per gram; nitrogen 2.25 per cent; soluble solids 27.95 per cent; fat (ether extract) 9.13 per cent; fiber 12.43 per cent; caffeine by weight 0.76 per cent, from nitrogen 0.72 per cent.

This product is declared by the manufacturers to be a combination of cereals and other vegetable substances with a percentage of the finest coffee. Assuming 1.25 per cent.. caffeine as an average for pure coffee this product contains about 60 per cent. of coffee.

Kaffee Hag was examined for caffeine only and was found to contain 0.09 per cent. of caffeine by weight and 0.05 per cent. calculated from nitrogen. This product has been examined by us on two previous occasions when 0.03 per cent. and 0.10 per cent. of caffeine were found. Data submitted by the manufacturers show a range over a considerable control period of from 0.03 per cent. to 0.08 per cent; our range for the three market samples examined is from 0.03 per cent to 0.10 per cent.

DIABETIC, SPECIAL AND MISCELLANEOUS FOODS.

Sixty-four samples of diabetic, special and miscellaneous foods have been examined. Some of these were submitted by manufacturers or distributors at our request and some have been referred to us by physicians or others interested.

Three samples of gluten bread made by the American System of Bakeries, Hartford, Conn., were submitted by Dr. W. R. Miller and by Mr. W. J. Hardie.

Two samples, Cassava Breakfast Food and Cassava Cakes, both said to be starchless, were submitted by Arnaud, Inc., New York.

One sample of gluten bread made by Brusson Jeune, Villimur, France and distributed in this country by Gustave Müller, 18 South William St., New York, was sent by John Gilbert and Son, New Haven.

To determine the efficiency of the washing method of preparing washed bran two samples of bran, one unwashed and one washed, were submitted by J. G. Dilworth, Nurse-in-charge, Clifton Springs Sanitarium, Clifton Springs, New York.

For experimental purposes three samples of bread were made in this laboratory using cottonseed, almond and soybean flours respectively.

A sample of gluten bread, **17687,** made by the Howland Co., Bridgeport, was submitted by Mrs. F. A. Doolittle, Bridgeport.

Three samples of Croustils, **16491, 16492** and **16493** made by Laporte and Gauthier, Somerset, Manitoba, distributed by Charles Horstmann, Clifton, N. J., were referred to us by the American Medical Association.

One sample of Allison flour, **17910,** made by the Schulenburg Oil Mill, Schulenburg, Texas, was also submitted by the American Medical Association.

Eleven samples of Ch. Heudebert products made by La Societé L'Aliment "Essentiel," Nanterre, France, distributed by Park and Tilford, New York, were sent by the distributors with the exception of **16277** which was submitted by the American Medical Association.

Dr. B. H. Ragle, Boston, submitted products of the Woman's Baking Co., Boston. A number of similar products were examined in this laboratory last year.

A sample of Passover Bread, **16255,** said to be made from Duggan gluten flour, was submitted by Mr. Samuel Lapides, New Haven. Further information regarding the manufacturer of the gluten flour could not be furnished us.

The Diaprotein Company, Columbus, Ohio, submitted fourteen samples "Dieta Brand" specially prepared canned fruits and vegetables.

Seven samples of Ch. Heudebert products recommended for infants, invalids and convalescents were submitted by the distributors, Park and Tilford, New York.

A sample of India Peas, **16485,** was referred to us by Dr. E. P. Joslin, Boston, for analysis.

A sample of dahlia bulbs, **18640,** grown and submitted by Mr. F. C. Sheldon of this laboratory, was examined.

Analyses of these products are given in Table III.

The three samples of gluten bread made by the American System of Bakeries show reasonable uniformity in composition and a substantial reduction in carbohydrates as compared with ordinary wheat bread. It requires 124 parts of sample **15449,** for example, to equal 100 parts of ordinary bread according to Janney's method of comparison and 173 parts are required according to von Noorden's method. The success of this, or any other diabetic bread, will depend entirely upon the patient's carbohydrate tolerance.

Cassava Breakfast Food and Cassava Cakes, made by Arnaud, Inc., are not labeled as diabetic foods but are labeled "starchless" which is certain to attract the interest of the diabetic patient. Each product contains about 70 per cent. of available carbohydrate a large portion (over 90 per cent.), of which is starch and shows the microscopic characteristics of cassava starch. The labeling of this product is utterly deceptive.

The composition of Brusson Jeune gluten bread is substantially the same as shown by previous analyses made in this laboratory[1] indicating a very uniform product.

Sample **16078** represents a commercial hygienic bran and sample **16336** the same bran after thoroughly washing with water to remove starch. Comparison shows that the readily available carbohydrates i. e., starch and soluble reducing materials, have been reduced from 12 per cent. to 2 per cent., approximately, by this method of treatment.

Breads made from cottonseed-wheat, almond-gluten and soybean flours for our own experimental purposes were made according to recipes suggested by others and do not represent in any way specific suggestions on our part for diabetic dietaries. The soybean bread was, however, particularly palatable and the analysis shows a low content of available carbohydrate. The glucose yield of soybean protein in metabolism has not been determined so far as we know, but assuming it to be equal to that of wheat protein it would require about 2 parts of this bread to yield the same amount of glucose in metabolism as 1 part of ordinary wheat bread according to Janney's method of comparison.

Of the three samples of Croustils made by Laporte and Gauthier it appears from the advertising literature that only the "glutenized" form is recommended or prescribed for diabetic patients. Our analyses show that glutenized croustils, **16493**, contain more protein and less starch than other forms yet this product contains about 50 per cent. of starch and soluble reducing sugars as dextrose combined.

Allison cottonseed flour conforms to the substance and quality shown by our earlier analyses.[2]

The three samples of Heudebert "Essentiel" gluten bread, submitted from different sources and at different times, show a satisfactory degree of uniformity in composition. Our analysis of

[1] Conn. Exp. Sta. Bull. 220, p. 318.
[2] Conn. Exp. Sta. Bull. 220, p. 311.

TABLE III. ANALYSES OF DIABETIC,

No.	Manufacturer and Product
	FLOUR, BRAN, BAKED PRODUCTS, ETC.
	American System of Bakeries, Hartford
15449	Gluten Bread
15933	Gluten Bread A
15934	Gluten Bread B
	Arnaud Inc., New York
17908	Starchless Breakfast Food
17909	Cassava Cakes
	Brusson Jeune, Villimur, France
17609	Gluten Bread
	Experimental
16078	Bran, unwashed
16336	Bran, washed
16112	Cottonseed-Wheat Bread
16114	Almond-Gluten Bread
16113	Soybean Bread
	Howland Co., Bridgeport
17687	Gluten Bread
	Laporte and Gauthier, Somerset, Manitoba
16491	Croustils, Dechloridized
16492	Croustils, Simple
16493	Croustils, Glutenized
	Schulenburg Oil Mill, Schulenburg, Texas
17910	Allison Flour (Cotton Seed)
	La Societe L'Aliment "Essentiel," Nanterre, France
17612	Heudebert, Bread of Gluten
16250	Heudebert, Bread of Gluten
16277	Heudebert, Bread of Gluten
16252	Heudebert, Aleurone Bread
17610	Heudebert, Aleurone Bread
.....	Guaranty
16251	Heudebert, Special Diabetic Bread
17611	Heudebert, Special Diabetic Bread
.....	Guaranty
16253	Heudebert, Rolls with Gluten
16254	Heudebert, Rusks of Gluten
16266	Heudebert, Surazotized Gluten Flour
16267	Heudebert, Gluten Flour with Cacao

SPECIAL AND MISCELLANEOUS FOODS.

No.	Moisture	Ash	Nitrogen	Protein		Fiber	Nitrogen-free Extract			Ether Extract
				N x 6.25	N x 5.70		Starch	Sugar as Dextrose	Other N-free Extract	
	%	%	%	%	%	%	%	%	%	%
15449	35.29	1.65	6.52	.....	26.16	0.30	22.78	1.01	6.84	5.97
15933	30.43	1.79	6.60	.....	27.75	0.41	25.25	2.33	6.12	5.92
15934	30.85	1.60	6.81	.....	28.54	0.43	25.56	1.93	5.65	5.44
17908	10.39	2.06	0.32	2.00	.....	4.16	64.13	6.72	10.33	0.21
17909	10.42	2.16	0.28	1.75	.....	4.83	66.77	2.76	11.08	0.23
17609	10.31	0.71	5.93	.....	33.80	0.15	35.63	9.32	0.38	3.77
16078	6.05	6.31	2.62	16.38	.....	6.05	9.02	3.19	46.86	6.14
16336	.....	.....	.....	.....	.....	.....	1.43	0.86	.....	.....
16112	42.22	2.23	3.10	11.63	.....	0.95	31.52	1.74	8.08	1.63
16114	25.58	6.70	5.81	27.98	.....	0.92	11.43	1.74	8.26	17.39
16113	37.70	5.88	5.38	21.75	.....	0.88	3.70	2.52	9.53	18.04
17687	31.74	2.25	5.80	.....	23.51	0.41	32.28	1.88	7.01	0.92
16491	7.55	1.25	2.66	16.63	.....	0.44	54.45	10.30	3.32	6.06
16492	7.62	1.67	2.74	17.13	.....	0.38	60.36	5.68	3.75	3.41
16493	7.88	1.50	4.84	30.25	.....	0.46	44.55	5.36	3.29	6.71
17910	6.65	6.20	8.07	50.44	.....	4.83	0.56	8.25	15.18	7.89
17612	10.11	2.71	10.78	.....	61.45	0.51	9.96	1.24	8.04	5.98
16250	6.83	2.62	10.82	.....	61.67	0.31	13.59	1.10	7.03	6.85
16277	6.33	2.66	10.94	.....	62.36	0.32	14.32	0.93	7.40	5.68
16252	7.00	2.81	12.07	.....	68.80	0.21	6.51	0.15	8.23	6.19
17610	9.82	3.19	10.39	.....	59.22	0.76	13.56	2.72	6.73	4.00
.....	.....	.....	.....	.....	61.73	.....	10.50		.....	1.62
16251	7.01	2.91	10.48	.....	59.74	0.57	16.12	1.52	5.38	6.75
17611	11.19	3.04	9.01	.....	51.36	0.41	18.76	2.36	7.79	5.09
.....	.....	.....	.....	.....	62.00	.....	30.00		.....	0.50
16253	7.51	2.32	1.70	.....	9.69	0.43	59.12	6.98	5.20	8.75
16254	6.56	1.62	1.90	.....	10.84	0.44	58.05	9.30	5.56	7.63
16266	7.79	3.36	10.75	.....	61.28	0.30	12.71	1.32	10.94	2.30
16267	7.46	3.63	9.40	.....	53.58	1.00	12.30	1.46	14.73	5.84

TABLE III. ANALYSES OF DIABETIC,

No.	Manufacturer and Product
	FLOUR, BRAN, BAKED PRODUCTS, ETC.—(*Continued*).
	Woman's Baking Co., Boston, Mass.
17555	Washed Bran
17552	Bran Cookies, Anice
17550	Bran Cookies, Caraway
15320[1]	Bran Cookies, Caraway
17551	Bran Cookies, Cocoa Nib
15315[1]	Bran Cookies, Cocoa Nib
17553	Bran Cookies, Spice
15316[1]	Bran Cookies, Spice
17556	Bran Muffins
15257[1]	Bran Muffins
17554	Cellu Biscuit
15319[1]	Cellu Biscuit
15258[1]	Cellu Cookies, Caraway
17548	Cellu Cookies, Lemon
15259[1]	Cellu Cookies, Lemon
17544	Cellu Cookies, Vanilla
15317[1]	Cellu Cookies, Vanilla
15260[1]	Cellu Kisses
17557	Cellu Muffins
15256[1]	Cellu Muffins
15314[1]	Cellu Nuts
17549	Cellu Soup Wafers
15318[1]	Cellu Soup Wafers
	Unknown
16676	Passover Bread
	FRUITS AND VEGETABLES, CANNED.
	The Diaprotein Co., Columbus, Ohio
16385	Apple Sauce
16394	Blackberries
16388	Cherries, Red, Pitted
16387	Cherries, White[2]
16395	Peaches, Yellow
16397	Pears, Bartlett
16392	Raspberries, Red
16389	Strawberries
16393	Beans, Cut, Wax
16391	Beans, Refugee, Green

[1] Analysis of 1920.
[2] Analysis of edible portion.

SPECIAL AND MISCELLANEOUS FOODS—(*Continued*).

No.	Moisture	Ash	Nitrogen	Protein		Fiber	Nitrogen-free Extract			Ether Extract
				N x 6.25	N x 5.70		Starch	Sugar as Dextrose	Other N-free Extract	
	%	%	%	%	%	%	%	%	%	%
17555	9.13	.....	1.79	11.19	.....	.....	4.59		.....	7.39
17552	16.12	.....	1.18	7.39	.....	.....	1.72	3.47	.....	25.87
17550	15.29	.....	1.30	8.13	.....	.....	3.48		.....	23.36
15320[1]	12.24	6.90	1.30	8.13	.....	2.62	3.15	3.34	38.61	25.01
17551	13.41	.....	1.30	8.13	.....	.....	2.41	3.73	.....	27.80
15315[1]	14.87	6.30	1.33	8.33	.....	6.05	6.19	5.05	29.17	24.04
17553	15.04	.....	0.98	6.11	.....	.....	2.21	4.11	.....	26.75
15316[1]	16.31	6.43	1.12	6.99	.....	6.90	4.44	7.77	32.48	18.68
17556	28.41	.....	1.33	8.33	.....	.....	4.76		.....	6.11
15257[1]	41.51	6.50	1.00	6.26	.....	6.72	1.54	4.83	27.03	5.61
17554	29.31	.....	0.48	3.00	.....	.....	4.76		.....	11.81
15319[1]	32.81	6.33	0.53	3.34	.....	14.26	1.60	1.41	25.65	14.60
15258[1]	14.16	5.48	0.89	5.58	.....	16.53	1.51	2.33	31.95	22.46
17548	12.28	.....	0.65	4.10	.....	.....	3.12		.....	27.35
15259[1]	12.94	5.22	0.69	4.32	.....	17.43	trace	4.62	34.10	21.37
17544	14.13	.....	0.66	4.11	.....	.....	4.39		.....	23.35
15317[1]	17.16	5.69	0.71	4.45	.....	16.98	1.58	2.22	32.61	19.31
15260[1]	17.85	4.09	3.68	23.00	.....	27.12	1.29	1.20	25.22	0.23
17557	23.62	.....	0.61	3.84	.....	.....	3.38		.....	14.33
15256[1]	29.08	5.37	0.59	3.66	.....	18.23	1.61	2.10	27.02	12.93
15314[1]	15.91	5.71	0.86	5.38	.....	16.80	1.07	2.57	23.82	28.74
17549	15.96	.....	0.53	3.32	.....	.....	4.25		.....	27.66
15318[1]	14.22	6.66	0.64	4.01	.....	14.97	1.69	2.43	31.39	24.63
16676	7.04	0.60	2.38	14.88	.....	0.38	70.46	.....	6.64	0.37
16385	88.69	0.58	0.03	0.18	.....	0.47	5.75		3.72	0.61
16394	91.80	0.29	0.11	0.67	.....	1.76	2.57		2.41	0.50
16388	90.39	0.34	0.08	0.50	.....	0.13	5.14		3.36	0.14
16387	91.26	0.45	0.11	0.71	.....	0.18	3.79		3.47	0.14
16395	93.38	0.31	0.08	0.47	.....	0.38	2.88		2.52	0.06
16397	93.57	0.17	0.05	0.28	.....	0.62	2.54		2.72	0.10
16392	88.34	0.47	0.14	0.88	.....	2.67	3.00		3.96	0.68
16389	93.58	0.32	0.09	0.57	.....	0.82	1.95		2.40	0.36
16393	96.20	0.27	0.13	0.83	.....	0.99	1.15		0.51	0.05
16391	94.43	1.36[3]	0.11	1.04	.....	0.88	1.43		0.80	0.06

[3] 1.04 per cent salt (NaCl calc. from chlorine).

TABLE III. ANALYSES OF DIABETIC,

No.	Manufacturer and Product
	FRUITS AND VEGETABLES, CANNED—*Concluded*
16390	Peas, Green
16386	Rhubarb
16396	Spinach
16384	Tomatoes
	SPECIAL PREPARATIONS.
	La Societe L'Aliment "Essentiel," Nanterre, France
16255	Lacteous Flour
16265	"Essential" Flour
16268	"Roburol" with Cacao
16269	"Essential" Food, Cacao Flavor
16279	Cacao and Oat Cakes
16270	"Regimette" Dessert Cake
16278	Vegetable Broth
	MISCELLANEOUS.
16485	India Peas, dried
18640	Dahlia Tubers, dried
17545	Whiskey
17546	Vermouth

sample **17612** however does not agree with the one which is given on the package which states protein 72 per cent., fat 0.8 per cent. and carbohydrate plus starch 20 per cent. We find considerably less protein and more fat. Two samples of Aleurone bread, **16252** and **17610**, are not in so close agreement between themselves and the guaranty of the last named, protein 61.7, fat 1.6 and carbohydrate 10.5, is not in accord with our findings as regards carbohydrate and fat. It is not entirely clear to us what is referred to as carbohydrate in the guaranty but we interpret it to be comparable with total nitrogen-free extract. Special Diabetic breads, samples **16251** and **17611** are stated to contain protein 62 per cent., fat 0.5 per cent. and carbohydrate plus starch 30 per cent. Our analyses confirm the protein guaranty in one case, the carbohydrate guaranty in the other and the fat guaranty in neither case. As regards fat, however, it should be said that when determined by the usual continuous extraction methods figures reasonably approximating the guaranties in each case were obtained, but by

SPECIAL AND MISCELLANEOUS FOODS—(*Concluded*).

No.	Moisture	Ash	Nitrogen	Protein		Fiber	Nitrogen-free Extract			Ether Extract
				N x 6.25	N x 5.70		Starch	Sugar as Dextrose	Other N-free Extract	
	%	%	%	%	%	%	%	%	%	%
16390	88.74	0.37	0.51	3.19	.....	1.27	3.	92	2.15	0.36
16386	96.35	0.51	0.07	0.41	.....	0.54	0.	27	1.88	0.04
16396	91.46	2.39[4]	0.49	3.08	.....	0.93	0.	56	0.98	0.60
16384	95.07	0.53	0.17	1.04	.....	0.32	1.	48	1.34	0.22
16255	4.80	2.02	1.38	8.63	.....	0.32	31.22	40.96	8.48	3.57
16265	7.89	1.58	3.14	19.63	.....	0.27	49.13	9.30	9.24	2.96
16268	4.70	3.16	3.26	20.38	.....	0.75	19.76	26.80	20.34	4.11
16269	4.62	1.48	1.47	9.19	.....	0.78	27.83	35.47	16.21	4.42
16279	6.90	2.81	2.25	14.06	.....	1.98	37.03	7.23	17.72	12.27
16270	3.68	1.27	1.10	6.88	.....	0.37	47.00	20.90	8.35	11.55
16278	8.40	3.17	2.10	13.13	.....	3.41	37.52	14.68	18.51	1.18
16485	9.00	3.18	4.00	25.00	.....	4.15	37.91	6.76	12.93	1.07
18640	2.13	7.97	3.12	19.50	.....	8.55		60.50[5]		1.35
17545	.....	.....	.....	.....	.....	.....	.....	trace	.....	.....
17546	.....	.....	.....	.....	.....	.....	.....	4.02[6]	.....	.....

[4] 1.00 per cent salt (NaCl calc. from chlorine).
[5] For distribution of this group of constituents see page 245.
[6] Grams per 100cc.

the more approved method[1] for baked products much higher results were secured. It would appear from the guaranties of Aleurone, "Essentiel" gluten and Special Diabetic breads that they are designed to represent three classes of carbohydrate tolerance viz. 10, 20 and 30 per cent. in the order named. Our results in the main justify such classification except that Aleurone bread contained 15 to 20 per cent carbohydrate instead of 10 per cent. Samples **16253**, Rolls with gluten and **16254**, Rusks of gluten, both contain over 65 per cent. of available carbohydrate and are no more suitable for the diabetic than ordinary wheat bread. Surazotized Gluten flour, **16266** and Gluten flour with cacao, **16267**, contain from 20 to 25 per cent. total carbohydrate with about one half of that amount probably available.

The products of the Woman's Baking Company are prepared from washed bran or cellu-flour as the basic constituent. These

[1] Conn. Exp. Sta. Bull. 220, p. 273.

products were examined in this laboratory last year[1] and the further examination of them this year has been chiefly to determine the nature of the fat or oil present. The Cellu Products Company has suggested a number of recipes for making non-nutritive "foods" in which the fatty constituent is mineral oil and the Woman's Baking Company, adopting this idea or conceiving a similar one, has used a non-nutritive oil in its products. The nature of the ether extract was not determined in our previous analyses but the low or negligible saponification values of the ether extracts obtained in our recent examinations indicate that only a small amount of saponifiable oil is present, derived probably from the bran, spices, etc. The saponification numbers of the cellu products examined ranged from 3.2 to 10.5 and the bran products from 8.0 to 12.8. The ether extracts from bran muffins gave a value of 90.1 while that of washed bran itself had a value of 152.7. Mineral oil is not saponifiable, or, in other words, it has a saponification value of zero.

In our previous discussion[2] of these products attention was called to the difficulties of estimating their caloric values due chiefly to the uncertainty regarding the availability of the carbohydrates present. The conventional method of calculating caloric yield was finally followed with the reservation noted. It is now evident that the ether extract should be practically disregarded as a source of available energy in most of these products. Probably as close an approximation of energy yield as can be made will be obtained by including in the formula for calculating calories the nitrogen expressed as protein, carbohydrates represented by starch and soluble reducing sugars and not over 10 per cent. of the fat, except in case of bran muffins where 60 per cent. might be included. Calculated in this way the energy values range approximately from 50 to 100 calories per 100 grams. Including all the nitrogen-free extract in the calculation in the conventional way these values are increased by 100 to 150 calories.

Passover bread, **16676**, was said to be made from Duggan gluten flour but no further information regarding the flour could be obtained. The bread, which was in the form of a hard bread or cracker, contained as much starch as ordinary wheat bread.

Products of the Diaprotein Company, canned fruit and vegetables, were submitted by them at our request. These goods are specially selected by the packers and prepared without added sugar or salt, for clinical purposes. Partial analyses of the various products were submitted by the company which our analytical results substantially confirm. The claims as regards added sugar appear to be substantiated and mineral matter is less than 1 per cent. except in Refugee beans and spinach where the

[1] Conn. Exp. Sta. Bull. 227, p. 231.
[2] Conn. Exp. Sta., Bull. 227, p. 232.

normal ash appears to be enhanced by 1.04 per cent. and 1.00 per cent, respectively, of salt calculated from the chlorine content of the ash. Variations in composition of fruits and vegetables due to seasonal conditions, degree of ripeness, etc., are, of course, recognized.

The special Heudebert products are indicated for the feeding of infants, invalids or convalescents and recommended, in some instances, as of particular value in specific disorders. None of them are suggested for the use of diabetics and they do not belong in the category of diabetic foods. The claims made, however, are very extravagant. Thus, for example, Ruborol "is especially recommended for troubles of the stomach and the intestines, anaemia, convalescence of infectious sickness, tuberculosis, neurasthenia, and intellectual overwork." "Essential" Food, "is much more digestive than chocolate and kindred products; . . . It is also good for Bright's disease owing to the theobromine it contains and for persons in good health." The physician and the critical dietitian will require convincing evidence on these points before accepting these conclusions.

The sample of India peas closely resembles our common garden peas in composition. They contain about 58 per cent. of nitrogen-free extract about 3/5 of which is in the form of starch and soluble carbohydrate.

An analysis of dahlia tuber **18640** was made after the tuber had been washed free from adhering dirt, sliced thin, and air dried. The proximate analysis is given in Table III. A further distribution of the nitrogen-free extract was made as follows:

Soluble in hot water, before hydrolysis, as levulose .	1.68 per cent.
after hydrolysis, as inulin[1]	49.18
Direct acid hydrolysis of water-insoluble residue, as dextrose	4.92
Total nitrogen-free extract (Table III.)	60.50
Undetermined nitrogen-free extract	4.72

[1] Calculated from levulose assuming the factor 0.9.

Thus inulin constitutes about 80 per cent. of the total nitrogen-free extract. The reducing power of the water solution before hydrolysis may be due to performed reducing substances or to levulose derived from partial hydrolysis of inulin by hot water.

Inulin occurs as a reserve carbohydrate in the underground parts of plants, particularly dahlia, artichoke, elecampane, burdock and similar plants. Unlike starch, it is somewhat soluble in water, readily soluble in hot water, gives no blue color with iodine, is not attacked by animal or vegetable amylases and hydrolyzes with dilute acid to levulose instead of dextrose. Plants which store up reserve material in the form of inulin have the mechanism (inulase), for its conversion to utilizable form, as do also certain

fungi, but there are no enzymes in the several digestive juices of the body capable of converting inulin into sugar. Human fecal extracts have been shown to contain an enzyme which attacks inulin with the formation of reducing sugars.[1] The acidity of the gastric juice is sufficient to hydrolyze inulin but the extent to which this proceeds will depend upon the conditions in the stomach. In the length of time which food ordinarily remains in the stomach, i.e., 2 to 3 hours, extensive hydrolysis does not take place.

Early observations that inulin fed to diabetics resulted in no conspicuous elimination of inulin, as such, in the feces and no glucose output in the urine led to the conclusion that it was utilized in the organism. The studies of Neubauer,[2] Lewis,[3] Frankel[4] and others indicate, however, that the failure of sugar to appear in the urine is due to the fact that no sugar is formed to be excreted; and the failure to recover inulin, as such, in conspicuous amounts in the feces is due to the decomposition of inulin by intestinal bacteria. The mechanism of inulin transformation in the intestine is obscure, but it does not result in recoverable sugar. The presence of inulase in the intestinal contents and excessive gas production which is observed after inulin feeding suggest that sugar may be an intermediate product in the transformation and that the sugar thus formed is immediately destroyed by fermentation. Whether or not inulin is excreted in the feces will therefore depend upon the length of time it remains in the intestine and the opportunity bacteria have had to act upon it; under some conditions a considerable amount may be eliminated unchanged.

The apparent utilization and tolerance of inulin in the body has led to its use to some extent in the diet of diabetics. Thus Teyxeira[5] suggested adding inulin to gluten of wheat. White[6] recommended that dahlia tubers be cooked and eaten as a vegetable by diabetics. Persia[7] reported favorable results from the use of inulin in diabetic treatment and remarks that the inulin was "well digested and assimilated." Strauss[8] likewise reports favorably on its use.

The assumption that levulose is better tolerated than other sugars has, perhaps, been based upon these earlier experiences with inulin when it was supposed that levulose resulted from it in metabolism. The facts appear to be, however, that inulin has little, if any, nutritive value and that from it no significant amounts of levulose are derived. Whatever levulose may arise from the action of the acid gastric juice upon inulin will behave in diabetic metabolism just as does levulose from any other source.

[1] Okey, J. Biol. **39**, 149, (1919)
[2] München. med. Wchnschr., p. 1525, 1905.
[3] Jour. Am. Med. Assoc., **58**, 1176, 1912.
[4] Jour. Biol. Chem., **17**, 365, 1914.
[5] Boll. Chim. Farm., **43**, 605-6; Jahresb. Tierchem., **35**, 822, 1905.
[6] Allbutt and Rolleston; System of Medicine, III, 204.
[7] Jahresb. Tierchem., **25**, 822, 1905.
[8] Therapie der Gegenwart, **52**, 337, 1911.

FATS AND OILS.

Olive Oil.

An unofficial sample of pure Spanish olive oil, **17918**, was submitted by the Dairy and Food Commissioner. The sample had been referred to his department by the H. J. Heinz Co. who remarked that the oil responded to the tests for sesame oil as generally applied. Our examination showed that the oil responded positively to the Baudouin and Villavecchia tests, the red color darkening in a short time, finally becoming almost black. These tests when applied to the liquid fatty acids, however, gave only very faint pink colors which should he regarded as negative. This experience indicates the necessity of checking positive tests for sesame obtained in the regular way by tests made upon the liquid fatty acids.

Cooking Fats.

Seven samples of shortening materials were examined for the Dairy and Food Commissioner. They were **18112**, Flake White; **18113**, Peerless Puff Paste; **18121**, Selex; **18122** Cottolene; **18123** Snowdrift; **18124**, Puff Paste.

The samples were examined chiefly with reference to the presence of beef stearin by Belfield's test, samples of hardened cottonseed oil and known mixtures of cottonseed oil and beef stearin being examined as controls. Evidence of beef stearin seemed positive in cases of **18113** and **18124** but negative or inconclusive in the other samples. Positive tests were obtained for cottonseed oil in all cases except in **18121**, but it is recognized that heated or hydrogenated cottonseed oil does not respond to the Halphen test.

Butter.

Ten samples sold for butter were submitted by the Dairy and Food Commissioner and five were examined for purchasers. One sample, D. C. No. **19184**, sold by Morris Gold, New Haven, was found to be renovated butter.

Of five samples submitted by purchasers one, **16468**, was so-called "wavy" or "mottled" butter, the effect being due probably to unequal distribution of water and brine or to incomplete removal of buttermilk or both.[1]

[1] Jour. Dairy Science, **3**, 2, p. 27.

TABLE IV. INSPECTION OF ICE CREAM.

Town	No. of Samples	Fat Content		
		Range		Average
		%	%	%
Ansonia	6	9.2	11.2	9.7
Beacon Falls	1	....	....	9.6
Branford	2	9.4	13.0	11.2
Bridgeport	20	6.4	15.0	10.4
Bristol	7	7.2	15.2	12.8
Brookfield	2	7.6	8.2	7.9
Centerbrook	1	....	....	7.6
Compounce	1	....	....	11.8
Danbury	12	8.4	15.6	10.2
Danielson	5	5.6	11.0	8.1
Dayville	1	....	....	10.6
Deep River	1	....	....	13.3
Derby	1	....	....	4.8
Devon	1	....	....	7.1
East Haven	1	....	....	9.2
Forestville	7	8.0	14 0	10.8
Greenwich	9	5.6	17.2	10.1
Guilford	1	....	....	13.2
Hartford	12	7.6	17.6	11.6
Hazardville	1	....	....	10.1
Jewett City	4	4.5	14.0	9.6
Meriden	6	12.2	15.6	14.3
Mianus	2	8.2	9.6	8.9
Middletown	8	11.4	23.2	15.5
Milldale	1	....	....	8.0
Moosup	2	10.0	11.2	10.6
Naugatuck	8	8.0	13.2	10.8
New Britain	9	8.2	15.0	12.3
New Haven	31	6.0	17.0	10.7
New London	18	8.8	19.8	13.8
New Milford	10	7.1	20.0	12.2
North Haven	1	....	....	10.0
Norwalk	6	9.0	14.4	11.5
Norwich	10	8.4	18.6	11.8
Old Lyme	1	....	....	9.4
Plainfield	4	9.2	18.2	13.5
Plantsville	3	8.8	9.8	9.3
Pomfret	1	....	....	23.0
Portland	1	....	....	15.2
Putnam	6	8.4	19.2	12.4
Ridgefield	2	7.2	9.4	8.3
Rockville	4	3.6	15.4	8.7
Saybrook	3	8.0	15.8	11.1
Somerville	1	....	....	11.2
South Manchester	7	7.6	16.0	10.2
South Norwalk	3	13.2	16.0	14.4
Southington	4	8.0	13.0	10.8
Stafford Springs	4	9.0	15.6	12.4
Stamford	10	9.0	13.0	11.0
Stratford	4	7.8	9.6	8.7
Suffield	2	8.0	10.6	9.3
Terryville	1	....	....	9.2

TABLE IV. INSPECTION OF ICE CREAM—(*Concluded.*)

Town	No. of Samples	Fat Content		
		Range		Average
		%	%	%
Thomaston	3	14.0	14.8	14.5
Thompsonville	3	8.6	12.2	10.1
Torrington	8	8.0	15.6	11.7
Unionville	4	7.6	10.4	8.3
Wallingford	6	8.8	15.4	11.6
Wauregan	2	6.4	7.6	7.0
Waterbury	14	8.0	20.0	11.4
Westbrook	1	....	....	9.4
West Haven	1	....	....	6.8
Willimantic	4	13.6	17.0	15.8
Windsor Locks	5	2.3	10.8	6.5
Winsted	7	5.8	10.2	8.3
Not Given	1	....	....	13.2
Not Given	1	....	....	13.6

OLEOMARGARINE.

Five samples were examined, one being submitted by the Dairy and Food Commissioner and four by the Connecticut School for Boys. Analyses of the four last named are as follows:

No.	16125	16126	16127	16128
	%	%	%	%
Moisture	9.66	7.86	9.33	10.94
Fat	85.01	89.30	84.25	83.54
Salt, curd, etc.	5.33	2.84	6.42	5.52
Refraction of fat, butyro-refract. at 25° C.	59.2	58.2	56.48	56.25
Reichert-Meissel No.	2.02	4.21	4.90	7.37

On the basis of the Reichert Meissel number sample **16128** contains the greatest amount of butter or milk fat. From the standpoint of caloric value there is no great difference among the several products but milk fat enhances the food value by reason of the peculiar diet factors which it contains.

ICE CREAM.

During the past summer an extensive inspection of ice cream has been conducted by the Dairy and Food Commissioner. The samples submitted to us do not adequately represent the scope of the work since some of the samples collected were tested by inspectors of his department who are licensed milk testers and who have followed methods approved by this laboratory. All doubtful cases have been resampled and referred to us for final judgment.

Three hundred and twenty-nine samples have been tested here. The distribution of these by towns, the range in fat content and the average are given in Table IV.

TABLE V. ICE CREAM BELOW STANDARD.

No.	Dealer	Manufacturer	Flavor	Fat.
	BRIDGEPORT			%
20268	Frank Cuneo	Own make	Vanilla	7.3
20266	G. Monaco	Own make	Vanilla	7.7
	BROOKFIELD			
18189	Mrs. E. Calkins	Int'l Ice Cream Co.	Vanilla	7.6
	DANIELSON			
20293	Mary E. Salotti	Own make	Chocolate	5.6
	DERBY			
20596	Debarbiere & Musante	Own make	Vanilla	4.8
	DEVON			
20276	Ideal Confectionery Co	R. Kostopoulas	Vanilla	7.1
	GREENWICH			
20072	A. B. Libano & Co	Own make	Strawberry	5.6
	HARTFORD			
20006	Soda Shop	New Haven Dairy	Coffee	7.6
	JEWETT CITY			
20793	Dennis Sullivan	Own make	Chocolate	6.8
20792	Dennis Sullivan	Own make	Maple Walnut	4.5
	NEW HAVEN			
20025	Sweetland Bros.	Own make	Chocolate	7.6
20563	Union Confectionery Co	Own make	Lemon	7.6
20783	J. Basil	Own make	Chocolate	7.6
	NEW MILFORD			
18200	Noble, Lynch & Noble	Int'l Ice Cream Co.	Vanilla	7.2
18193	Hipp's Ice Cream Co	Own make	Chocolate	7.1
	ROCKVILLE			
19958	John E. Gawtrey	Own make	Vanilla	3.6
19959	John E. Gawtrey	Own make	Coffee	3.7
	SOUTH MANCHESTER			
19956	Manchester Dairy Ice Cream Co.	Own make	Chocolate	7.8
19954	Joseph Sardella	Own make	Vanilla	7.6
	UNIONVILLE			
20000	Chas. Hackney		Vanilla	7.6
	WAUREGAN			
20295	H. J. Fournin	Own make	Vanilla	7.6
	WINDSOR LOCKS			
19192	Vito Colapietro	Own make	Vanilla	2.3
19195	Leon Colapietro	Own make	Vanilla	2.6
19183	Louis Molinari	Peter Fossa	Chocolate	7.0
	WINSTED			
20634	John Nubarek	Int'l Ice Cream Co.	Vanilla	7.8
20639	Manchester Dairy Co.	Own make	Vanilla	7.6
20640	T. Lentin	Manchester Dairy Co	Strawberry	5.8

Samples found below standard, viz., 8 per cent. for plain cream and 6 per cent. for fruit and nut creams, are reported in more detail in Table V.

It is of interest to classify the samples on the basis of milk fat as we have done in other years. Such a comparison is given in Table VI.

TABLE VI. CLASSIFICATION OF ICE CREAM ON THE BASIS OF FAT CONTENT.

Range of Fat, per cent.	1919 Samples	1919 Per cent.	1920 Samples	1920 Per cent.	1921 Samples	1921 Per cent.
8.0 to 9.9	25	30.5	134	33.5	94	28.5
10.0 to 11.9	26	31.7	83	20.8	71	21.6
12.0 and above	28	34.1	125	31.2	123	37.4
Below 8	3	3.7	58[1]	14.5	41[2]	12.5
Total	82	100.0	400	100.0	329	100 0

[1] Includes 11 fruit ice creams of legal standard viz., 6 per cent.
[2] Includes 14 fruit ice creams of legal standard viz., 6 per cent.

As noted in our report last year[1] the true average quality of the market product of the state is not shown by these figures since we have no knowledge of the gross production of the several grades. It is quite probable that the production of ice cream testing between 8 and 10 per cent. exceeds that of grades testing higher. It is evident however that our statute legalizing 8 per cent. ice cream has not caused grades richer in fat to disappear.

Fifteen samples were examined for individuals. Of these only three, **17668, 17669** and **17670,** require notice. These were the top, middle and bottom portions of a gallon can of vanilla cream submitted by the Semon Ice Cream Company of New Haven for study of uniformity of fat distribution. The can was heated gently to permit removal of the contents as a whole and cross sections were taken at the top, middle and bottom. Each of the three sections tested 10 per cent. fat showing a very even fat distribution.

Three similar experiments made in this laboratory on another occasion[2] showed satisfactory uniformity in two of the trials but in the third case the product had evidently stratified either by reason of imperfect mixing originally or, more probably, because of partial melting or "weakening" subsequently.

MILK AND MILK PRODUCTS.

CRYOSCOPY OF MILK.[3]

Methods for the detection of adulteration in milk have been greatly improved in recent years. Twenty-years ago the analyst was obliged to base his judgment of milk samples submitted for

[1] Conn. Exp. Sta. Bull. 227, p. 249.
[2] Conn. Exp. Sta. Bull. 219, pp. 215-216.
[3] The data and much of the discussion on this subject is taken from the report of the writer as associate referee to the Association of Official Agricultural Chemists at the meeting at Washington in October, 1921.

examination entirely upon the analysis of the sample. If the specific gravity, fat and non-fatty solids were low, added water was suspected; if the specific gravity and non-fatty solids were high and the fat low, skimming was indicated. In either case it was obviously difficult to pass certain judgment unless the samples were well outside the limits of reasonable composition, and a combination of both of the forms of sophistication mentioned further complicated the task of diagnosis. As a result of careful study of analyses of whole milk certain relationships between its several proximate constituents have been postulated and it is largely upon such ratios that the identification of skimmed milk still depends. The introduction of the immersion refractometer facilitated the solution of a number of analytical problems, not the least of which was that of the more certain detection of watered milk. Exhaustive observations upon the sera of authentic milks from cows in various periods of lactation, upon varied rations and in different seasons of the year, etc., showed that the refraction of the serum is a factor which varies within comparatively narrow limits and that it is possible to choose, from the large amount of data collected, a figure below which milk will not refract provided it is undiluted with water. Thus, for the copper method of preparing the serum, a refraction of 36 is the lowest recorded value for milk of known purity and a reading of less than this figure is regarded as indicative of added water. It is recognized that this method has its limitations and that 10 per cent. dilution, or even in some cases considerably more, may escape detection, but taken in conjunction with deductions drawn from the chemical analysis it is still an invaluable aid in deciding the presence of added water.

More recently a method has been devised whereby milk containing extraneous water can be detected and the amount thereof estimated with a degree of delicacy not heretofore possible. The method is based upon the freezing point of milk which is a physiological constant varying within very narrow limits, viz., -0.530° C. to -0.566° C. according to the studies herein reported which is the best information available at this time. Obviously as milk is diluted with water its freezing point approaches that of water and depressions less than -0.530° will be observed. By comparing the freezing point depression of milk which has been diluted with water with the minimum or the accepted average depression observed for whole milk of known purity the percentage of water added can be very closely approximated.

The theory and practice of freezing point determinations as applied to milk together with a critical review of the literature dealing with cryosocopic investigations of blood serum, bile, gastric juice, etc. have been very adequately set forth in a paper by Hortvet[1]

[1] Jour. Ind. Eng. Chem., 13, 3, p. 198, 1921.

who has outlined a carefully standardized method of procedure for the determination of freezing points. The practical application of this method to the detection and estimation of added water in milk is necessarily based upon a knowledge of the range in freezing point depressions which may be shown by normal milk and this further necessitates a study of milk obtained in different localities from normal individual cows and herds and from animals under varying conditions of daily routine and general health. Dr. Hortvet, as referee on dairy products for the Association of Official Agricultural Chemists, has continued the study of this subject during the past year and the writer, as associate referee for the same Association, has collaborated with him with special reference to the definition of the freezing point range for normal milk and the depressions which may be observed in milk from cows under abnormal conditions. We discuss here only that part of the work which comes within the scope of the writer's part in the program.

Collaboration.

Generous coöperation was received from the Libby, McNeill and Libby Laboratories, Morrison, Ill. through Dr. G. A. Menge who has reported results credit for which is due to Messrs. R. T. Beardsley and W. H. Tucker. Further data were supplied from the State Dairy and Food Department, St. Paul, Minn., through the collaboration of Messrs. Henry Hoffman, Otto Kneffner and C. S. Carl. Credit for data submitted from this Station is due to Mr. R. E. Andrew, collaborator, assisted by Mr. R. T. Merwin. Samples examined here were taken under the supervision of Mr. G. T. Fowler of the Dairy and Food Commissioner's Department and Mr. C. E. Shepard of this laboratory.

Classification of Results.

Two hundred and sixteen samples are represented in the combined reports of collaborators. Partial or complete analyses with freezing point determinations, the latter largely in duplicate, have been made and these data have been classified in appropriate groups and are discussed under titles as follows:

I. Freezing Point Depressions of Authentic Milk From Normal Individual Cows.

II. Freezing Point Depressions of Authentic Milk From Normal Herds.

III. Freezing Point Depressions of Authentic Milk From Healthy Cows but Under Abnormal Conditions of Daily Routine or Environment.

IV. Freezing Point Depressions of Authentic Milk From Cows which are Diseased or Otherwise Abnormal Physically.

TABLE VII. ANALYSES AND FREEZING POINT DEPRESSIONS OF AUTHENTIC MILK, NORMAL INDIVIDUAL COWS.

Herd	Indiv. Cow No. Sample No.	Breed	Date 1921	Sp. Gr. 15.6° C.	Fat	S-N-F.	Lactose	Ash	Acidity	Freezing Point —0° C.	
			(Collaborator, Libby, McNeill and Libby)								
H. T.	5 B	Holstein	9/14 P.M.	1.0306	3.3	8.30	4.64	0.639	0.145	0.532	0.531
H. A.	4 B	Holstein	9/14 P.M.	1.0310	3.6	8.47	3.71	0.799	0.147	0.551	0.551
H. A.	7 B	Holstein	9/14 P.M.	1.0380	3.8	10.26	3.65	0.805	0.155	0.566	0.566
B. J. F.	6 B	Holstein	9/14 P.M.	1.0300	3.3	8.15	4.39	0.660	0.140	0.533	0.533
	1	Holstein, Gr'd	9/18 P.M.	1.0260	6.3	7.76	3.41	0.664	0.120	0.548	0.549
	7	Holstein, Gr'd	9/18 P.M.	1.0303	4.9	8.55	4.45	0.697	0.170	0.548	0.546
	8	Holstein, Gr'd	9/18 P.M.	1.0264	3.0	7.20	4.29	0.770	0.103	0.548	0.548
	9	Holstein, Gr'd	9/18 P.M.	1.0303	3.8	8.34	4.37	0.678	0.165	0.538	0.537
	11	Holstein, Gr'd	9/18 P.M.	1.0288	4.7	8.14	4.16	0.728	0.153	0.549	0.548
B. J. F.	....	Holstein, Pure	9/14 P.M.	1.0300	2.2	7.90	4.38	0.693	0.140	0.535	0.535
B. V.	....	Holstein, Gr'd	9/16 P.M.	1.0287	0.9[1]	7.36	4.15	0.719	0.100	0.538	0.537
A. H.	....	Holstein, Gr'd	9/21 P.M.	1.0357	3.3	10.01	4.17	0.784	0.190	0.548	0.548
J. N.	....	Holstein, Gr'd	9/21 P.M.	1.0316	3.7	8.63	4.34	0.707	0.153	0.551	0 550
B. F. H.	....	Holstein, Gr'd	9/21 P.M.	1.0338	4.1	9.26	4.15	0.770	0.165	0.549	0.548
E. K.	....	Jersey, Gr'd	9/21 P.M.	1.0328	4.3	9.05	4.68	0.730	0.165	0.542	0.540
J. H.	....	Jersey, Gr'd	9/26 A.M.	1.0326	3.1	8.77	5.03	0.628	0.115	0.560	0.560
			9.26 P.M.	1.0320	2.8	8.57	4.78	0.622	0.118	0.546	0.545
.....	5	Br. Swiss	9/18 P.M.	1.0256	5.3	7.46	3.65	0.647	0.145	0.549	0.548
A. M.	....	Durham	9/16 P.M.	1.0310	3.5	8.44	4.55	0.661	0.145	0.533	0.533
A. S.	....	Durham, Gr'd	9/16 P.M.	1.0328	4.0	8.99	4.61	0.676	0.160	0.545	0.547
G. T.	....	Durham, Gr'd	9/26 A.M.	1.0318	4.0	8.74	3.75	0.782	0.110	0.548	0.549
			9/26 P.M.	1.0310	4.3	8.60	3.56	0.797	0.120	0.541	0.540
A. D.	....	Dur.-S. Horn	9/26 A.M.	1.0340	4.9	9.48	4.63	0.829	0.135	0.550	0.550
			9/26 P.M.	1.0340	4.4	9.37	4.52	0.832	0.123	0.548	0.547
O. R....	....	S. Horn-Hol.	9/26 A.M.	1.0325	4.6	9.05	3.63	0.636	0.083	0.540	0.539
			9/26 P.M.	1.0326	4.2	8.96	3.43	0.661	0.080	0.540	0.540
F. F.	....	Red Pole	9/23 A.M.	1.0304	5.5	8.94	4.53	0.695	0.138	0.551	0.551

[1] A.M. sample following day tested 1.6% fat.

TABLE VII. ANALYSES AND FREEZING POINT DEPRESSIONS OF AUTHENTIC MILK, NORMAL INDIVIDUAL COWS—(*Continued*).

Herd	Indiv. Cow No. Sample No.	Breed	Date 1921	Sp. Gr. 15.6° C.	Fat %	S-N-F. %	Lactose %	Ash %	Acidity %	Freezing Point —0° C.	
			(Collaborator, State Dairy & Food Dept., St. Paul, Minn.)								
.....	1 H.	Holstein, Reg.	5/9	1.0295	4.7	8.47	....	.....	.....	0.560	.....
.....	2 H.	Holstein, Reg.	5/9	1.0281	4.2	8.02	....	.....	.....	0.554	.....
.....	3 H.	Holstein, Reg.	5/9	1.0312	3.4	8.63	....	.....	.....	0.550	.....
.....	4 H.	Holstein, Reg.	5/9	1.0313	2.9	8.54	....	.....	.....	0.542	.....
.....	5 H.	Holstein, Reg.	5/9	1.0310	2.3	8.34	....	.....	.....	0.540	.....
.....	6230	Holstein	5/14	1.0305	3.3	8.57	....	.....	.....	0.544	.....
.....	6231	Holstein	5/14	1.0310	2.6	8.24	....	.....	.....	0.541	.....
.....	6232	Holstein	5/14	1.0310	2.8	8.48	....	.....	.....	0.543	.....
.....	6233	Holstein	5/14	1.0320	2.4	8.60	....	.....	.....	0.540	.....
.....	6234	Holstein	5/14	1.0330	2.8	8.95	....	.....	.....	0.554	.....
.....	6235	Holstein	5/14	1.0310	2.6	8.43	....	.....	.....	0.556	.....
.....	6236	Holstein	5/14	1.0315	4.9	9.07	....	.....	.....	0.552	.....
.....	6237	Holstein	5/14	1.0330	3.3	9.05	....	.....	.....	0.540	.....
.....	6238	Holstein	5/14	1.0310	4.4	8.78	....	.....	.....	0.545	.....
.....	6250	Holstein	5/17	1.0290	3.7	9.25	....	.....	.....	0.546	.....
.....	7022	Durham	9/7	1.0323	4.4	9.10	....	.....	.....	0.554	.....
St. L. P.	....	.....	8/25	1.0315	3.8	8.80	....	.....	.....	0.551	.....
			(Collaborator, Agricultural Experiment Station, New Haven, Conn.)								
Y	1	Holstein	4/5 A.M.	1.0323	3.6	8.80	....	.....	0.17	0.573	0.574[2]
			4/13 A.M.	1.0317	3.2	8.58	....	.....	0.15	0.558	0.559
			4/15 A.M.	1.0330	3.3	8.92	....	.....	0.16	0.565	0 566
			4/15 A.M.	1.0330	3.3	8.92	....	.....	0.15	0.565	0.565
			4/16 A.M.	1.0322	3.4	8.74	....	.....	0.16	0.565	0 565
			4/20 A.M.	1.0315	3.3	8.55	....	.....	0.15	0.562	0.562
			4/20 P.M.	1.0305	3.3	8.30	....	.....	0.14	0.542	0.542
			5/20 P.M.	1.0299	3.4	8.17	....	.....	0.14	0.536	0.537
	2	Holstein	4/6 A.M.	1.0320	4.3	8.88	....	.....	0.14	0.572	0.572[2]

[2] See discussion.

TABLE VII. ANALYSES AND FREEZING POINT DEPRESSIONS OF AUTHENTIC MILK, NORMAL INDIVIDUAL COWS—(*Continued*).

Herd	Indiv. Cow No. Sample No.	Breed	Date 1921	Sp. Gr. 15.6° C.	Fat %	S-N-F. %	Lactose %	Ash %	Acidity %	Freezing Point —0° C.	
(Collaborator, Agricultural Experiment Station, New Haven, Conn.—Continued)											
Y	2	Holstein	4/13 A.M.	1.0311	3.4	8.46	....	.....	0.15	0.544	0.544
			4/16 A.M.	1.0317	4.1	8.76	....	.....	0.14	0.562	0.562
			4/20 A.M.	1.0317	3.6	8.67	....	.....	0.13	0.553	0.554
			4/26 P.M.	1.0307	3.8	8.46	....	.....	0.15	0.547	0.546
			5/18 P.M.	1.0309	4.3	8.60	....	.....	0.13	0.551	0.552
	3	Holstein	4/7 A.M.	1.0337	5.4	9.54	....	.....	0.15	0.572	0.572[2]
			4/13 A.M.	1.0321	4.7	8.98	....	.....	0.15	0.557	0.557
			4/20 A.M.	1.0330	5.1	9.29	....	.....	0.15	0.562	0.563
			4/26 P.M.	1.0325	5.0	9.14	....	.....	0.14	0.547	0.547
			5/20 P.M.	1.0332	5.0	9.31	....	.....	0.15	0.549	0.550
	4	Holstein	4/9 A.M.	1.0308	4.4	8.60	....	.....	0.12	0.560	0.560
			4/20 A.M.	1.0320	3.6	8.73	....	.....	0.14	0.562	0.562
			4/9 P.M.	1.0299	4.4	8.37	....	.....	0.12	0.552	0.550
			4/26 P.M.	1.0308	3.1	8.34	....	.....	0.15	0.543	0.543
			5/26 P.M.	1.0315	3.3	8.85	....	.....	0.13	0.543	0.543
	5	Holstein	4/8 A.M.	1.0333	3.7	9.07	....	.....	0.15	0.552	0.552
	6	Holstein	4/16 A.M.	1.0326	3.3	8.82	....	.....	0.12	0.571	0.571[2]
			4/22 A.M.	1.0313	3.5	8.52	....	.....	0.11	0.571	0.571[2]
			4/26 P.M.	1.0309	3.7	8.48	....	.....	0.10	0.544	0.545
			4/25 P.M.	1.0301	3.1	8.15	....	.....	0.11	0.533	0.534
	7	Holstein	4/22 A.M.	1.0322	4.0	8.85	....	.....	0.12	0.571	0.571[2]
			4/25 P.M.	1.0312	4.0	8.60	....	.....	0.11	0.545	0.546
			5/26 P.M.	1.0326	4.3	9.03	....	.....	0.12	0.553	0.553
	8	Holstein	4/22 A.M.	1.0342	4.6	9.48	....	.....	0.13	0.580	0.580[2]
			4/25 P.M.	1.0333	4.0	9.13	....	.....	0.12	0.542	0.542
			5/18 P.M.	1.0343	5.0	9.58	....	.....	0.11	0.552	0.553
	9	Holstein	4/22 A.M.	1.0340	3.8	9.28	....	.....	0.15	0.571	0.571[2]
			4/25 P.M.	1.0317	4.7	8.90	....	.....	0.12	0.543	0.544
			5/18 P.M.	1.0318	4.6	8.94	....	.....	0.12	0.551	0.552

TABLE VII. ANALYSES AND FREEZING POINT DEPRESSIONS OF AUTHENTIC MILK, NORMAL INDIVIDUAL COWS—(*Continued*).

Herd	Indiv. Cow No. Sample No.	Breed	Date 1921	Sp. Gr. 15.6° C.	Fat %	S-N-F. %	Lactose %	Ash %	Acidity %	Freezing Point —0° C.	
(Collaborator, Agricultural Experiment Station, New Haven, Conn.—Continued)											
Y	10	Holstein	4/22 A.M.	1.0320	4.1	8.83	....	.....	0.15	0.572	0.572[2]
			5/18 P.M.	1.0301	4.0	8.33	....	.....	0.12	0.542	0.542
	11	Holstein	4/22 A.M.	1.0320	3.7	8.75	....	.....	0.15	0.562	0.562
			5/18 P.M.	1.0303	3.9	8.35	....	.....	0.15	.....	0.543
	12	Holstein	4/23 A.M.	1.0301	6.8	8.88	....	.....	0.16	0.572	0.572[2]
			5/18 P.M.	1.0327	6.5	9.47	....	.....	0.15	0.551	.....
	13	Holstein	4/23 A.M.	1.0304	3.8	8.37	....	.....	0.12	0.540	0.540
			5/26 P.M.	1.0316	4.6	8.84	....	.....	0.12	.....	0.542
	14	Holstein	4/23 A.M.	1.0319	3.8	8.75	....	.....	0.16	0.549	0.549
			5/20 P.M.	1.0320	4.0	8.81	....	.....	0.16	0.539	0.538
	15	Holstein	4/27 A.M.	1.0317	3.5	8.65	....	.....	0.11	0.561	0.561
			4/25 P.M.	1.0298	3.0	8.76	....	.....	0.13	0.523	0.523[2]
			4/26 P.M.	1.0305	3.3	8.30	....	.....	0.14	0.532	0.532
			4/27 P.M.	1.0301	3.2	8.17	....	.....	0.13	0.536	0.537
			5/20 P.M.	1.0312	3.4	8.48	....	.....	0.13	0.544	0.545
	16	Holstein	4/26 P.M.	1.0302	4.5	8.45	....	.....	0.16	0.540	0.541
			5/20 P.M.	1.0317	4.6	8.87	....	.....	0.16	.....	0.542
	17	Holstein	4/26 P.M.	1.0294	3.5	8.06	....	.....	0.13	0.541	0.541
			5/20 P.M.	1.0291	3.5	7.98	....	.....	0.12	.....	0.542
F	1	Holstein	4/16 A.M.	1.0310	3.2	8.40	....	.....	0.14	0.542	0.542
			5/6 P.M.	1.0304	3.1	8.23	....	.....	0.14	0.541	0.541
	2	Holstein	4/18 A.M.	1.0313	2.8	8.38	....	.....	0.15	0.542	0.542
			5/5 P.M.	1.0295	...	....	....	.....	0.14	0.543	0.544
	3	Holstein	4/18 A.M.	1.0329	...	....	....	.....	0.14	0.550	0.551
			5/5 P.M.	1.0296	3.2	8.05	....	.....	0.14	0.532	0.533
	4	Holstein	4/18 A.M.	1.0308	3.1	8.34	....	.....	0.15	0.542	0.543
			5/5 P.M.	1.0301	3.2	8.17	....	.....	0.15	0.529	0.530
	5	Holstein	4/18 A.M.	1.0318	3.4	8.64	....	.....	0.16	0.543	0.543
			5/5 P.M.	1.0317	3.5	8.64	....	.....	0.16	0.542	0.540

TABLE VII. ANALYSES AND FREEZING POINT DEPRESSIONS OF AUTHENTIC MILK, NORMAL INDIVIDUAL COWS—(*Concluded*).

Herd	Indiv. Cow No. Sample No.	Breed	Date 1921	Sp. Gr. 15.6° C.	Fat %	S-N-F. %	Lactose %	Ash %	Acidity %	Freezing Point —° C.	
(Collaborator, Agricultural Experiment Station, New Haven, Conn.—Concluded)											
F	6	Holstein	4/19 A.M.	1.0280	4.0	7.81	....	.....	0.11	0.545	0.546
			5/5 P.M.	1.0307	4.0	8.50	....	.....	0.13	0.541	0.542
	7	Holstein	4/19 A.M.	1.0325	4.1	8.90	....	.....	0.14	0.552	0.552
			5/6 P.M.	.....	3.5	....	....	.....	0.11	0.542	0.542
	8	Holstein	4/19 A.M.	1.0335	4.8	9.35	....	.....	0.14	0.548	0.549
			5/6 P.M.	1.0310	2.9	8.33	....	.....	0.16	0.536	0.536
	9	Holstein	4/19 A.M.	1.0298	3.8	8.23	....	.....	0.15	0.542	0.542
			5/6 P.M.	1.0305	3.8	8.40	....	.....	0.14	0.534	0.534
	10	Holstein	4/19 A.M.	1.0309	3.8	8.50	....	.....	0.13	0.547	0.547
			5/6 P.M.	1.0310	5.1	8.79	....	.....	0.12	0.543	0.543
	11	Holstein	4/19 A.M.	1.0301	3.5	8.23	....	.....	0.16	0.542	0.542
			5/6 P.M.	1.0303	2.7	8.10	....	.....	0.17	0.535	0.535
S	1	Jersey	4/29 A.M.	1.0336	6.0	9.63	....	.....	0.17	0.542	0.543
	2	Ayrshire	4/29 A.M.	1.0309	4.1	8.56	....	.....	0.18	0.531	0.532
	3	Guernsey	4/29 A.M.	1.0309	5.1	8.77	....	.....	0.20	0.549	0.549
P	5	.....	5/11 P.M.	1.0320	3.7	8.75	....	.....	0.16	0.532	0.533
			7/6 P.M.	1.0303	4.7	8.53	....	.....	0.14	0.535	0.536
	6	.....	5/11 P.M.	1.0309	...	....	....	.....	0.09	0.542	0.542
			7/6 P.M.	1.0271	3.8	7.55	....	.....	0.09	0.535	0.535

FREEZING POINT DEPRESSIONS OF AUTHENTIC MILK FROM I, NORMAL INDIVIDUAL COWS AND II, NORMAL HERDS.

The data obtained upon normal individual cows and normal herds are given in Tables VII and VIII respectively.

The term "normal" as applied to an individual cow or herd is used in this report to refer to animals which in the judgment of the ordinary observer or dairyman would be classed as healthy and which are fed and kept with ordinary care. It does not refer to animals which have been subjected to clinical tests and pronounced sound by expert authority. The milk from animals which conform to this interpretation of the term is presumed to be normal milk. While from a purely scientific standpoint it would be of interest to define the limits of freezing point depression for the milk of only such individuals as had been judged healthy by expert examination and clinical tests, yet that would be beside the immediate purpose of this study which is to define such limits as will serve for safely judging the substance and quality of market milk.

UNCORROBORATED RESULTS.

Before taking up the discussion of freezing point range as shown by the combined data, attention is called to certain extreme results which lie outside the experience of the collaborators as a whole. This refers to results below -0.570° C. found for a number of morning samples and to one extremely high figure, -0.523° C. observed in one case of evening milk.

These results are summarized from Table VII as follows:

TABLE VII, A. RESULTS REQUIRING FURTHER CORROBORATION.

Herd	Cow No.	Breed.	Date.	Freezing Point—o°C.	
Y	1	Holstein	4/5 A. M.	0.573	0.574
	2	Holstein	4/6 A. M.	0.572	0.572
	3	Holstein	4/7 A. M.	0.572	0.572
	6	Holstein	4/16 A. M.	0.571	0.571
			4/22 A. M.	0.571	0.571
	7	Holstein	4/22 A. M.	0.571	0.571
	8	Holstein	4/22 A. M.	0.580	0.580
	9	Holstein	4/22 A. M.	0.571	0.571
	10	Holstein	4/22 A. M.	0.572	0.572
	12	Holstein	4/23 A. M.	0.572	0.572
	15	Holstein	4/25 P. M.	0.523	0.523

All these results were obtained in the laboratory of the writer who can vouch for the care with which the freezing point observations were made and who can obtain no information of any abnormal conditions prevailing in this herd at the time the samples were taken. So far as this herd is concerned the low figures seem

TABLE VIII. ANALYSES AND FREEZING POINT DEPRESSIONS OF AUTHENTIC MILK, NORMAL HERDS.

Herd	No. of Cows	Breed	Date 1921	Sp. Gr. 15.6° C.	Fat	S-N-F.	Lactose	Ash	Acidity	Freezing Point —0° C.	
			(Collaborator, Libby, McNeill & Libby.)								
E. M.	4	Holstein, Gr'd	4/1 P.M.	1.0314	3.6	8.56	....	.....	0.145	0.535	0.534
W. T.	12	Holstein, Gr'd	4/1 P.M.	1.0305	2.8	8.17	....	.....	0.145	0.530	0.531
	13	Holstein, Gr'd	6/22 P.M.	1.0300	3.1	8.13	4.46	.....	0.140	0.541	0.541
	15	Holstein, Gr'd	7/14 P.M.	1.0304	3.3	8.26	....	.....	0.135	0.538	0.538
G. H.	13	Holstein, Gr'd	3/29 P.M.	1.0290	3.6	7.98	....	.....	0.135	0.532	0.532
			7/14 P.M.	1.0295	3.3	8.03	4.58	.....	0.135	0.541	0.541
W. B.	6	Holstein, Gr'd	4/1 P.M.	1.0324	2.7	8.63	....	.....	0.150	0.529	0.530
	13	Holstein, Gr'd and Pure	6/22 P.M.	1.0310	3.0	8.36	4.72	.....	0.135	0.539	0.537
			7/14 P.M.	1.0295	3.2	8.01	....	.....	0.130	0.533	0.532
A. G.	15	Holstein, Pure	8/2 P.M.	1.0294	3.4	8.02	....	.....	0.135	0.538	0.537
M. B.	16	Holstein, Gr'd	9/16 P.M.	1.0313	3.5	8.53	4.44	0.722	0.150	0.547	0.548
H. W.	11	Holstein, Gr'd	9/21 P.M.	1.0323	3.2	8.72	4.18	0.734	0.143	0.552	0.552
O. R.	10	Holstein, Gr'd	9/26 A.M.	1.0292	4.3	8.16	4.29	0.678	0.123	0.534	0.532
			9/26 P.M.	1.0285	4.3	7.98	3.69	0.710	0.110	0.532	0.533
G. P.	6	Holstein, Gr'd	9/21 P.M.	1.0313	3.5	8.53	4.23	0.696	0.133	0.551	0.551
D. F. M. 1 B.	3	Holstein, Pure	9/14 P.M.	1.0336	3.4	9.08	4.53	0.693	0.145	0.550	0.550
B. J. F. 3 B.	2	Holstein, Pure	9/14 P.M.	1.0300	2.7	8.05	4.39	0.676	0.145	0.535	0.535
S. W.	2	Hol.-Jersey	9/16 P.M.	1.0313	3.7	8.57	4.61	0.684	0.155	0.549	0.548
B. V.	11	Hol. 10, Jersey 1	9/16 P.M.	1.0301	3.1	8.15	4.47	0.686	0.145	0.550	0.549
A. P. T.	10	Hol. 4, Jersey 1, Bk. Pole 1, Dur. 2, Hereford 1, Guernsey 1	9/21 P.M.	1.0319	3.5	8.68	4.42	0.710	0.140	0.546	0.545
E. K.	12	Holstein 2, Jer. 10	9/21 P.M.	1.0320	3.8	8.76	4.52	0.704	0.148	0.543	0.542

TABLE VIII. ANALYSES AND FREEZING POINT DEPRESSIONS OF AUTHENTIC MILK, NORMAL HERDS—(*Concluded*).

Herd	No. of Cows	Breed	Date 1921	Sp. Gr. 15.6° C.	Fat %	S-N-F. %	Lactose %	Ash %	Acidity %	Freezing Point -0° C.	
			(Collaborator, Libby, McNeill & Libby.—*Concluded.*)								
F. F.	9	Holstein 7, Red Pole 1, Jersey 1	9/23 A.M.	1.0309	4.2	8.56	4.59	0.666	0.148	0.547	0.545
D. L.	2	Jersey, Gr'd	6/22 P.M.	1.0329	5.4	9.30	4.92	.....	0.142	0.550	0.549
J. J. R.	2	Jersey, Gr'd	8/1 P.M.	1.0316	3.3	8.56	4.82	.....	0.130	0.551	0.551
R. N.	6	Jersey 1, S. Horn 5	9/21 P.M.	1.0316	3.8	8.66	4.67	0.672	0.150	0.550	0.550
B	10	Durham, Gr'd	3/29 P.M.	1.0321	3.8	8.77	....	.....	0.143	0.542	0.541
A. D.	6	Dur.-S. Horn	9/26 A.M.	1.0325	4.6	9.05	4.52	0.687	0.105	0.540	0.539
			9/26 P.M.	1.0325	4.2	8.96	4.50	0.700	0.123	0.540	0.540
P. W.	7	Reds, Gr'd	6/20 P.M.	1.0322	3.9	8.83	4.68	.....	0.157	0.531	0.531
			7/14 P.M.	1.0324	3.7	8.84	....	.....	0.130	0.534	0.533
B. L.	4	S. Horn, Gr'd	9/23 A.M.	1.0314	3.6	8.57	4.48	0.706	0.150	0.557	0.556
B. W.	16	Mixed, Gr'd	6/20 P.M.	1.0326	3.7	8.98	4.45	.....	0.152	0.536	0.537
J. H.	11	Mixed, Gr'd	9/26 A.M.	1.0318	4.0	8.74	4.68	0.696	0.118	0.548	0.549
			9/26 P.M.	1.0310	4.3	8.60	4.55	0.698	0.120	0.541	0.540
G. T.	5	Mixed, Gr'd	9/26 A.M.	1.0313	4.5	8.73	4.29	0.719	0.128	0.552	0.553
			9/26 P.M.	1.0313	4.1	8.65	4.14	0.750	0.125	0.552	0.553
Factory Sample	2300	Mixed	9/23 A.M. & P.M.	1.0310	3.7	8.49	4.45	0.704	0.145	0.541	0.540
			(Collaborator, Agricultural Experiment Station, New Haven, Conn.)								
Y	17	Holstein	4/27 A.M.	1.0317	4.1	8.77	....	.....	0.13	0.553	0.553
			4/27 P.M.	1.0309	3.5	8.44	....	.....	0.14	0.539	0.540
F	11	Holstein	5/2 A.M.	1.0312	3.3	8.46	....	.....	0.16	0.559	0.560
			4/13 P.M.	1.0313	3.7	8.56	....	.....	0.15	0.535	0.535
			4/18 P.M.	1.0309	3.7	8.48	....	.....	0.16	0.539	0.540
			4/19 P.M.	1.0310	3.4	8.44	....	.....	0.15	0.540	0.540
			5/2 P.M.	1.0305	3.7	8.38	....	.....	0.14	0.540	0.540
S	7	Holstein	4/18	.....	3.4	....	....	.....	0.13	0.542	0.542
B	7	Holstein	4/18	.....	3.5	....	....	.....	0.13	0.550	0.550

to be substantiated by their occurrence in so many different individuals, at intervals of from one to eighteen days, and in one case recurrence in the same individual after an interval of six days, nevertheless, except in the instance just mentioned, they were not duplicated or very closely approximated in any other samples from the same cows. Similarly, the very high figure obtained in sample from No. 15 was not again observed although three other samples were examined. There is no information upon which these samples can be declared abnormal in the sense of the term herein defined yet for the reason that the figures have all been obtained from one herd, and because they have not been duplicated by the experience of any other collaborator nor satisfactorily substantiated in the laboratory where they were obtained they are recorded here with the provision that they require further corroboration and are classed accordingly.

VARIATIONS BETWEEN MORNING AND EVENING MILK WITH REFERENCE TO THE FREEZING POINT DEPRESSION.

A considerable amount of data have been obtained to show the relation between morning and evening milk both of individual cows and of herds as regards freezing point depressions. The data have been submitted chiefly by one collaborator so that no adequate comparison upon this point can be made of the experiences of collaborators as a whole. The results reported from this station show quite consistently greater depressions in the case of morning samples, whether from individuals or herds.

The results reported from the laboratory of Libby, McNeill and Libby do not confirm this experience but the data are not complete enough to successfully contradict it.

The comparisons are shown in the following summary based upon Tables VII and VIII.

The extreme figures which were discussed and disposed of in the preceding table are included in this tabulation merely to show that the differences, without reference to their magnitude, are in the same general direction as the majority of other differences.

The last four observations in each group are from the Libby, McNeill and Libby laboratories. In the case of individual cows their data harmonize with those reported from this station but in the case of herds they do not. However taking the six observations as they stand the average freezing point depression is 0.007° greater in the morning milk which is a magnitude well beyond the limit of experimental error and may therefore be regarded as a real value.

TABLE VII-VIII, A. VARIATION IN FREEZING POINT DEPRESSIONS OF MORNING AND EVENING MILK.

INDIVIDUAL COWS.

Herd and Cow No.	No. of Samples A. M.	No. of Samples P. M.	A. M. Freezing Pt. Average — o°C.	P. M. Freezing Pt. Average — o°C.	A. M. Freezing Pt. lower (+) or higher (—) than P. M. — o°C.
Y 1	5	2	0.563	0.539	+ 0.024
2	3	2	0.553	0.549	+ 0.004
3	2	2	0.560	0.548	+ 0.012
4	2	3	0.561	0.546	+ 0.015
6	2	2	0.571	0.539	.....
7	1	2	0.571	0.550	.....
8	1	2	0.580	0.547	.....
9	1	2	0.571	0.548	.....
10	1	1	0.572	0.542	.....
11	1	1	0.562	0.543	+ 0.019
12	1	1	0.572	0.551	.....
13	1	1	0.540	0.542	— 0.002
14	1	1	0.549	0.538	+ 0.011
15	1	3	0.561	0.538	+ 0.023
F 1	1	1	0.542	0.541	+ 0.001
2	1	1	0.542	0.544	— 0.002
3	1	1	0.551	0.533	+ 0.018
4	1	1	0.543	0.530	+ 0.013
5	1	1	0.543	0.541	+ 0.002
6	1	1	0.546	0.542	+ 0.004
7	1	1	0.552	0.542	+ 0.010
8	1	1	0.549	0.536	+ 0.013
9	1	1	0.542	0.534	+ 0.008
10	1	1	0.547	0.543	+ 0.004
11	1	1	0.542	0.535	+ 0.007
J. H.	1	1	0.560	0.546	+ 0.014
G. T.	1	1	0.549	0.541	+ 0.008
A. D.	1	1	0.550	0.548	+ 0.002
O. R.	1	1	0.540	0.540	± 0.000
HERDS.					
Y	1	1	0.553	0.540	+ 0.013
F	1	4	0.560	0.539	+ 0.021
J. H.	1	1	0.549	0.541	+ 0.008
G. T.	1	1	0.553	0.553	± 0.000
A. D.	1	1	0.540	0.540	± 0.000
O. R.	1	1	0.533	0.533	± 0.000

VARIATION IN FREEZING POINT DEPRESSIONS OBSERVED IN MILK FROM THE SAME INDIVIDUAL COW OR THE SAME HERD AT DIFFERENT INTERVALS.

In a few instances a sufficient number of samples have been taken from the same cow or herd to indicate what the variation in freezing point depression may be from day to day. While the data are not extensive enough to be conclusive they indicate that the

variation between the morning and evening milk is greater than the variation between morning samples or evening samples from day to day.

The following summary illustrates this point:

TABLE VII-VIII, B. VARIATION IN FREEZING POINT DEPRESSIONS OF MILK FROM THE SAME COW OR HERD.

Herd and Cow No.	No. of Samples. A. M.	P. M.	Freezing Point Variation A. M. —o°C.	P. M. —o°C.	Extreme Range A. M. and P. M. —o°C.
			INDIVIDUAL COWS.		
Y 1	5	2	0.007	0.006	0.029
2	3	2	0.018	0.005	0.018
3	2	2	0.006	0.003	0.016
4	2	3	0.002	0.008	0.019
6	2	2	0.000	0.011	.....
7	1	2	.....	0.007	.....
8	1	2	.....	0.011	.....
9	1	2	.....	0.008	.....
15	1	3	.....	0.013	0.029
			HERDS.		
F	1	4	.....	0.005	0.025

THE RANGE IN FREEZING POINT DEPRESSIONS OBSERVED IN MILK FROM NORMAL COWS.

Hortvet has reported[1] summaries covering his experience with reference to the range in freezing point depressions for milk from 60 normal individual cows and from 15 normal herds. It is of interest and, indeed the chief purpose of this study, to compare his data with that obtained from the wider observations of the several collaborators this year, and our combined experience is shown in condensed form in the following summary, Table VII-VIII, C.

From this condensed summary it appears that the tentative limits suggested by Hortvet are not substantially changed by the further observations made in collaborative study. For individual cows the minimum depression of -0.530° and maximum depression -0.566° are recorded as compared with -0.534° and -0.562° reported a year ago. For herd milk the new high figure of -0.530° has been found but no new low figure established. The average for individual cows as reported last year (-0.547°), remains practically unchanged, -0.545°, while the average for herd milk is raised from -0.551° to -0.544°. The minimum depression observed for normal individual cows is -0.530° and the same figure obtains also for herd milk.

[1] Report of Minnesota State Dairy and Food Commissioner, 1920, p. 111.

TABLE VII-VIII, C. RANGE IN FREEZING POINT DEPRESSIONS IN NORMAL MILK.

	Sp. Gr.	Fat. %	S-N-F. %	Freezing Point —o°C.
		INDIVIDUAL COWS.		
State Dairy and Food Dept., St. Paul, Minn.—1919-1920 (60 samples).				
Maximum	1.0350	7.30	10.15	0.562
Minimum	1.0262	2.20	7.37	0.534
Average	1.0319	3.94	8.90	0.547
			—*1921 (17 samples).*	
Maximum	1.0330	4.9	9.25	0.560
Minimum	1.0281	2.4	8.02	0.540
Average	1.0311	3.4	8.67	0.547
Libby, McNeill and Libby.—1921 (27 samples).				
Maximum	1.0380	6.3	10.26	0.563
Minimum	1.0256	0.9	7.20	0.532
Average	1.0313	3.9	6.2	0.546
Agricultural Experiment Station, New Haven, Conn.—1921 (75 samples).				
Maximum	1.0343	6.8	9.63	0.566
Minimum	1.0271	2.7	8.17	0.530
Average	1.0313	4.0	8.64	0.543
		HERDS.		
State Dairy and Food Dept., St. Paul, Minn.—1919-1920 (15 samples).				
Maximum	1.0330	5.50	9.27	0.562
Minimum	1.0305	3.10	8.48	0.545
Average	1.0319	4.15	8.95	0.551
Libby, McNeill and Libby—1921 (37 samples).				
Maximum	1.0336	5.4	9.30	0.553
Minimum	1.0285	2.7	7.98	0.530
Average	1.0312	3.7	8.45	0.542
Agricultural Experiment Station, New Haven, Conn.—1921 (9 samples).				
Maximum	1.0317	4.1	8.77	0.560
Minimum	1.0305	3.3	8.38	0.535
Average	1.0311	3.6	8.50	0.544
Combined results of all collaborators.				
		INDIVIDUAL COWS (179 SAMPLES)		
Maximum	1.0380	7.3	10.26	0.566
Minimum	1.0256	0.9	7.20	0.530
Average	1.0315	3.8	8.71	0.545
		HERDS (61 SAMPLES).		
Maximum	1.0336	5.5	9.30	0.562
Minimum	1.0285	2.7	7.98	0.530
Average	1.0313	3.8	8.58	0.544

TABLE IX. ANALYSES AND FREEZING POINT DEPRESSIONS OF AUTHENTIC MILK.
Healthy Cows Under Abnormal Conditions of Daily Routine or Environment.

Herd	Date of milking, 1921	Description	Sp. Gr. 15.6° C.	Fat %	S-N-F. %	Lactose %	Ash %	Acidity %	Freezing Point —0° C.	
		(Collaborator, Libby, McNeill & Libby)								
		INDIVIDUAL COWS.								
A. M. 2A.	8/30 P.M.	Pure Jersey, driven 4 blocks to Fair, milking delayed 1 hour	1.0327	7.6	9.69	4.29	0.817	(1)	0.563	0.563
2B.	9/14 P.M.	Same cow, normal conditions	1.0398	7.0	11.34	1.80	0.874	0.160	0.562	0.563
H. T. 4A.	8/30 P.M.	Pure Holstein, driven 6 miles to Fair, milking delayed 3½ hours	1.0294	4.1	8.18	4.52	0.666	(1)	0.547	0.546
4B.	9/14 P.M.	Same cow, normal conditions	1.0306	3.3	8.30	4.64	0.639	0.145	0.532	0.531
H. A. 5A.	8/31 P.M.	Pure Holstein, milking delayed 10½ hours	1.0322	3.9	8.84	4.00	0.815	(1)	0.578	0.577
5B.	9/14 P.M.	Same cow, normal conditions	1.0310	3.6	8.47	3.71	0.799	0.147	0.551	0.551
H. A. 6A.	8/31 P.M.	Pure Holstein, milking delayed 10½ hours	1.0358	5.5	10.05	4.25	0.808	(1)	0.563	0.562
6B.	9/14 P.M.	Same cow, normal conditions	1.0380	3.8	10.26	3.65	0.805	0.155	0.566	0.566
J. F. 7A.	8/31 P.M.	Pure Holstein, milking delayed 9½ hours	1.0270	3.8	7.51	3.67	0.732	(1)	0.537	0.537
7B.	9/14 P.M.	Same cow, normal conditions	1.0300	3.3	8.15	4.39	0.660	0.140	0.533	0.533
		HERDS.								
F. M. 1A.	8/30 P.M.	Three pure Holsteins, driven 6 miles to Fair arriving 7.30 A.M. Sample taken from evening milk	1.0318	5.48	9.95	4.59	0.762	(1)	0.571	0.571
1B.	9/14 P.M.	Same herd, normal conditions	1.0336	3.40	9.08	4.53	0.693	0.145	0.550	0.550
J. F. 3A.	8/30 P.M.	Two pure Holsteins, driven 5 miles to Fair arriving 7.30 A.M. Sample taken from evening milk	1.0316	3.3	8.55	4.59	0.700	(1)	0.561	0.560
3B.	9/14 P.M.	Same herd, normal conditions	1.0300	2.7	8.05	4.39	0.676	0.145	0.535	0.535

[1] Freezing point observed same evening that samples were taken.

III. FREEZING POINT DEPRESSIONS OF AUTHENTIC MILK FROM HEALTHY COWS UNDER ABNORMAL CONDITIONS OF DAILY ROUTINE OR ENVIRONMENT.

An interesting group of data was submitted by one of the collaborators showing the effect upon the freezing point of milk when the animals had been subjected to slight exercise, severe exercise or strain, or to delayed milkings.

The data appear in Table IX.

Apparently long delayed milking may or may not influence the freezing point depression. Of three cases where milkings were delayed from 9½ to 10½ hours, in one there was a conspicuous increase in depression but in the other two the changes were very slight, one of them being a decreased depression. There appears to be no evidence that moderately delayed milking e.g., 1 to 3 hours, produces any effect upon the freezing point.

Moderate exercise, such as a walk of four blocks, was without effect. In cases of severe exercise, strain or fatigue, such as walks of 5 or 6 miles, the freezing point was very materially lowered both for individuals and herds, the variations from normal being from 0.015° to 0.026°. The comparisons between the normal and abnormal are true since the observations were made on the evening milk in both cases. In point of magnitude certain of these abnormal figures e.g., -0.571 and -0.578, are at first glance suggestively coincident with the extremely low depressions observed in a number of morning samples discussed elsewhere in this report, but they offer no valid explanation of them first, because a delay of 10½ hours in milking does not occur in ordinary practice and second, morning milk is drawn after a period of rest.

IV. FREEZING POINT DEPRESSIONS OF AUTHENTIC MILK FROM COWS WHICH ARE DISEASED OR OTHERWISE ABNORMAL PHYSICALLY.

The observation that cows which to all outward appearances are sound and healthy may yet prove to be tubercular as judged by the tuberculin test is not uncommon. This suggested the desirability of studying the freezing point depressions of milk obtained from tubercular reactors and animals otherwise physically abnormal, and the data obtained in this investigation are given in Table X. Over 80% of the results reported by collaborators were within the limits observed for normal individuals and herds, but in 5 cases out of 33 unusually high freezing points were obtained which ranged from -0.520° to -0.523°. The evidence in 3 of these 5 cases is, however, somewhat contradictory for the reason that samples drawn from the same cows after an interval of 2 months gave

TABLE X. ANALYSES AND FREEZING POINT DEPRESSIONS OF AUTHENTIC MILK.
Cows Diseased or Otherwise Abnormal Physically.

Herd or No.	Date of milking, 1921	Description	Sp. Gr. 15.6° C.	Fat %	S-N-F. %	Lactose %	Ash %	Acidity %	Freezing Point —0° C.	
		(Collaborator, Libby, McNeill & Libby)								
		INDIVIDUAL COWS.								
2	9/18 P.M.	Pure Holstein, tubercular reactor	1.0263	4.0	7.38	3.10	0.763	0.137	0.550	0.549
3	9/19 A.M.	Grade Holstein, tubercular reactor, not milked evening of previous day	1.0265	3.3	7.28	2.41	0.790	0.100	0.555	0.556
6	9/18 P.M.	Grade Holstein, tubercular reactor	1.0298	3.4	8.13	2.41	0.731	0.130	0.560	0.560
12	9/18 P.M.	Grade Holstein, tubercular reactor	1.0286	4.5	8.05	4.04	0.698	0.170	0.544	0.543
13	9/18 P.M.	Pure Holstein, tubercular reactor	1.0280	4.6	7.92	4.17	0.661	0.155	0.550	0.550
14	9/18 P.M.	Pure Holstein, tubercular reactor	1.0240	3.2	6.64	3.12	0.697	0.090	0.536	0.535
15	9/19 A.M.	Pure Holstein, tubercular reactor	1.0364	3.7	7.34	2.80	0.782	0.100	0.551	0.549
4	9/18 P.M.	Guernsey-Holstein, tubercular reactor	1.0299	4.7	8.42	2.67	0.714	0.145	0.550	0.552
10	9/18 P.M.	Grade Guernsey, tubercular reactor	1.0270	4.6	7.67	2.96	0.767	0.136	0.542	0.543
SC	7/13 A.M.	Grade Jersey, poor physical condition	1.0286	3.6	7.91	....	.....	0.123	0.522	0.523
	7/14 A.M.	Symptoms of tuberculosis	.....	...	....	....	.....	0.132	0.523	0.523
A. M. 2B.	9/14 P.M.	Jersey, colostrum milk	1.0398	7.0	11.34	1.80	0.874	0.160	0.562	0.563
		HERDS.								
	9/18 P.M.	14 cows, mixed breeds, 8 tubercular	1.0272	4.2	7.64	3.65	0.716	0.133	0.548	0.548
		(Collaborator, Agricultural Experiment Station, New Haven, Conn.)								
P 1	5/11 P.M.	Holstein, tubercular	1.0300	3.7	8.25	....	.....	0.14	0.522	0.522
	7/6 P.M.		1.0272	4.4	7.69	....	.....	0.12	0.537	0.538
P 2	5/11 P.M.	Holstein, tubercular	1.0304	2.0	8.00	....	.....	0.14	0.519	0.520
	7/6 P.M.		1.0215	9.5	7.38	....	.....	0.13	0.534	0.535
P 3	5/11 P.M.	Holstein, tubercular	1.0287	...	....	....	.....	0.12	0.522	0.522
	7/6 P.M.		1.0286	4.0	7.96	....	.....	0.18	0.550	0.552
P 4	5/11 P.M.	Holstein, tubercular	1.0304	4.0	8.41	....	.....	0.15	0.537	0.538
	7/6 P.M.		1.1277	4.2	7.78	....	.....	0.13	0.541	0.541

TABLE X. ANALYSES AND FREEZING POINT DEPRESSIONS OF AUTHENTIC MILK.—(*Concluded*).
Cows Diseased or Otherwise Abnormal Physically.

Herd or No.	Date of milking, 1921	Description	Sp. Gr. 15.6° C.	Fat %	S-N-F. %	Lactose %	Ash %	Acidity %	Freezing Point —0° C.	
		(Collaborator, State Dairy & Food Department, St. Paul, Minn.)								
517	9/22	Heifer, 2 years old, in heat, tubercular reactor	1.0301	3.4	8.35	....	.....	.....	0.551	.....
518	9/22	Tubercular reactor, 10 years old	1.0285	2.9	7.84	....	.....	.....	0.541	.....
519	9/22	Heifer, 3 years old, tubercular reactor	1.0284	3.8	8.00	....	.....	.....	0.548	.....
520	9/22	Tubercular reactor	1.0295	3.6	8.23	....	.....	.....	0.544	.....
521	9/22	Tubercular reactor, wild cow, one eye blind	1.0328	3.6	9.05	....	.....	.....	0.547	.....
522	9/22	Tubercular reactor, produced 30 lbs. 80% butter in 7 consecutive days	1.0293	3.1	8.08	....	.....	.....	0.543	.....
523	9/22	Tubercular reactor	1.0303	4.4	8.60	....	.....	.....	0.543	.....
524	9/22	Tubercular reactor	1.0328	3.3	9.00	....	.....	.....	0.534	.....
525	9/22	Tubercular cow with infected udder	1.0254	0.5	6.59	....	.....	.....	0.586	.....
526	9/22	Tubercular reactor	1.0290	3.7	8.23	....	.....	.....	0.540	.....
513	9/17	Holstein, calved 7 days previous to sampling, infected, still discharges pus	1.0294	4.5	8.40	....	.....	.....	0.554	.....
514	9/17	Guernsey, abortion 11 days previous to sampling	1.0341	4.3	9.53	....	.....	.....	0.538	.....

freezing points within the limits for normal milk. On the basis of these data therefore it would appear that while in many cases tuberculosis and other pathological conditions may not necessarily be reflected in the freezing point depression of the milk, nevertheless, a few exceptionally high freezing points have been observed which should be borne in mind when deciding the significance of depressions less than -0.530° in the case of milk from individual cows.

It has not been possible to include in this report any adequate review of the literature dealing with the effect of pathological conditions upon the freezing points of secretions. Tieken[1] has shown comparisons between the freezing point of the blood and of various body fluids for a number of diseases in man. In the several cases of tuberculosis reported the freezing point of the blood remained normal, (-0.56° C.), with the other fluids under observation closely corresponding. When conspicuous departures from normal were observed in the blood e.g., in uremic coma, they were in the direction of *increased* depressions (-0.58° to -0.68°). Marked increase in depression in freezing point of the blood has been observed by some investigators in carcinoma, excessive amounts of protein decomposition products being regarded as the cause, but this experience has been questioned by others who found no such increase.[2] Koestler[3] has investigated the detection of milk altered by secretion disturbances and finds that pathological disturbances increase the serum nitrogen, chlorine and sodium and decrease the lactose, potassium and phosphorus. It is said that the altered milk showed normal lowering of freezing point; and that this determination is a valuable check in cases where the general analytical results indicate added water. Further examination of this and other literature on the subject must be reserved for future study.

Conclusions.

The complete data now represent the examination of 291 samples distributed as follows:

Normal individual cows	179
Normal herds	61
Diseased or otherwise abnormal:	
individual cows	37
herds	3
Unclassified, requiring further corroboration	11
Total	291

The results indicate:

[1] Wells, Chem. Pathol. p. 324.
[2] Wells, Chem. Pathol. p. 461.
[3] Chem. Abs. **15**, 10, 1581.

(1). That there is an appreciable, and may be a conspicuous, difference in freezing point depression between morning and evening milk. This morning-evening variation is greater than that observed between morning samples or evening samples from day to day.

(2). The minimum freezing point depression of -0.530° and maximum of -0.566° for milk from normal individual cows and the minimum of -0.530° and maximum of -0.562° for milk from normal herds is reasonably substantiated by the experience of all collaborators.

(3). According to the data here reported moderate exercise or moderately delayed milkings are not reflected in the freezing point depressions of the milk. Long delayed milkings, 9½ to 10½ hours, may or may not be followed by depressions varying from normal. Severe exercise, strain or fatigue are followed by materially increased depressions.

(4). The milk from tubercular cows or those otherwise in poor or abnormal physical condition has generally fallen within the limits for normal milk as regards freezing point. The few exceptions noted have been in the direction of decreased depressions.

(5). Extremely low freezing points observed in certain samples of morning milk suggest a fuller investigation of this point. The study also of the effect of pathological conditions upon the freezing point may well be continued. The effect of increased acidity upon the freezing point depression with a view to corroborating or modifying the correction factor suggested by Kiester[1] should be studied.

Market Milk.

Nine hundred and sixty-seven samples of market milk have been submitted by the Dairy and Food Commissioner classified as follows:

Not found adulterated	593	61.3%
Adulterated by dilution with water	78	8.0
Adulterated by skimming	30	3.1
Adulterated by skimming and dilution with water	1	0.1
Adulterated by reason of being:		
below standard in solids and solids-not-fat	139	14.4
below standard in solids and fat	21	2.2
below standard in solids, fat and solids-not-fat	105	10.9
Total	967	100.0

There is reason to believe that the general quality of market milk available in this state is better than the data just given would indicate since, as we have stated in previous reports on this subject, the majority of samples received by us are submitted upon the suspicion of inferiority or adulteration. Many samples are tested

[1] Jour. Ind. Eng. Chem., **9**, p. 862.

TABLE XI. ADULTERATED MILK.

No.	Dealer	Solids	Fat
	Containing Added Water.		
	AVON.		
21102	Wm. Thompson & T. B. Edgerly	10.93	3.8
21103	Wm. Thompson & T. B. Edgerly	7.98	2.8
	BARKHAMSTED.		
20719	Ralph Bradley	10.81	3.3
20713	Chas. H. Segeyt	11.55	3.7
20720	John J. Wright	9.88	2.9
	BECKLEY.		
19156	Thomas Boncek	4.19	1.1
19157	Thomas Bodcek	5.17	0.7
19159	Alex. Kokoski	7.56	2.8
	BERLIN.		
19160	James Balfye	10.90	3.5
17389	Alexander Bruce	11.35	3.7
17390	Alexander Bruce	9.99	3.1
17391	Alexander Bruce	10.41	3.2
	BETHANY.		
20532	Kasloski & Nero	10.64	3.6
	BETHEL.		
19388	E. H. Converse	10.94	3.7
	BLOOMFIELD.		
20916	T. Ballai	10.63	3.2
20393	Thomas Seathem	11.48	4.2
20394	Thomas Seathem	11.16	3.9
	BRANFORD.		
21320	Nick. Dubiago	10.86	3.7
19594	Angello Mongello	11.15	3.5
	BRIDGEPORT.		
20442	Beebe Dairy	9.51	2.9
20523	Beebe Dairy	10.38	2.9
	BRISTOL.		
20801	A. Alklis	10.73	3.3
	CANTON.		
20943	M. Basha	10.89	3.5
18328	Mike Mishi	11.89	4.1
	Containing Added Water —continued		
	COLLINSVILLE.		
20939	W. J. Humphrey	10.97	3.5
	DANBURY.		
19378	Geo. Waltz	9.76	2.3
19379	Geo. Waltz	10.47	3.1
	FORESTVILLE.		
21105	Weintz Zwarville	10.95	3.4
	GUILFORD.		
19558	Wm. Hinnes	10.30	3.0
19555	C. Woruncke	11.20	3.6
19556	C. Woruncke	12.19	4.9
	HAWLEYVILLE.		
19368	S. Bonderank	8.62	2.7
19369	S. Bonderank	9.12	2.5
18543	John Oshavett	10.12	3.1
	KENSINGTON.		
20747	Walter Rudnick	10.42	3.4
	MERIDEN.		
21006	Belmont Lunch, T. Chamis	9.69	2.7
17382	D. Marcellino	10.86	3.2
17395	D. Marcellino	10.58	3.3
	MILFORD.		
19410	Chris. Anderson	9.79	2.6
19411	Chris. Anderson	9.93	2.8
	NEW MILFORD.		
19331	John Anderson	10.46	3.3
19308	J. Prucknik	10.73	3.3
	NORWALK.		
18537	Peter O'Haro	11.63	4.1
18353	M. Roberts	8.18	2.9
18354	M. Roberts	8.15	2.6
	NORWICH.		
21190	George Anderson	10.92	3.6
	RIDGEFIELD.		
18563	Jacob Baker	12.29	4.4

TABLE XI. ADULTERATED MILK—(*Continued*).

No.	Dealer	Solids	Fat
	Containing Added Water —continued		
	ROCKY HILL.		
20362	J. Anulewicz	10.34	3.1
20363	J. Anulewicz	11.35	3.6
20364	J. Anulewicz	10.90	3.2
20365	J. Anulewicz	11.04	3.6
20366	J. Anulewicz	10.82	3.5
20367	J. Anulewicz	11.14	3.6
20374	Toney Russell	10.97	3.5
	SHELTON.		
20426	Joseph Carson	10.83	3.3
20427	Joseph Carson	11.09	3.5
20428	James Facendo	11.07	3.4
	STEPNEY DEPOT.		
19415	Mnozinski	11.04	3.7
19416	Mnozinski	10.38	3.3
19417	Mnozinski	10.07	3.2
	UNIONVILLE.		
21101	Edward Sailing	11.20	3.6
	WATERBURY.		
20805	Exchange Lunch	10.91	3.3
20807	Puritan Ice Cream Parlor	10.24	2.7
	WATERFORD.		
19265	Joe Verito	10.46	3.2
	WETHERSFIELD.		
20378	Gerrent Bros.	11.11	3.4
20395	H. W. Wells	10.08	3.4
20396	H. W. Wells	10.85	3.5
20397	H. W. Wells	10.10	3.0
20398	H. W. Wells	9.62	3.0
	WEST HARTFORD.		
18304	A. J. Back	11.71	4.0
18305	A. J. Back	10.62	3.0
18306	A. J. Back	10.32	3.2
18307	A. J. Back	11.11	3.5
20985	C. F. Crosson	6.72	1.6
	WILLIMANTIC.		
21017	Walo Andryshawki	11.32	3.7
	WOODBRIDGE.		
20534	I. Setlow	10.27	2.5
20538	I. Setlow	10.15	2.5
	Containing Added Water —concluded		
	WOODBURY.		
20353	F. H. Shaw	10.78	3.4
20356	F. H. Shaw	10.59	3.2
	Skimmed Milk.		
	BRIDGEPORT.		
20436	Beebe Dairy	10.91	2.0
	BRISTOL.		
21104	Presto Lunch, Peter Blanos	11.19	2.4
	DANIELSON.		
21150	Harry Evergates	10.99	2.6
21088	J. W. Gallup	11.47	2.8
	EAST GRANBY.		
20902	M. C. Griffin	11.14	2.6
20903	M. C. Griffin	11.16	2.6
	GOSHEN.		
19080	S. Oviatt	11.34	2.7
	HARTFORD.		
20687	Vermont Lunch	10.50	2.0
	KENSINGTON.		
20743	Louis Prey	12.04	2.9
	MERIDEN.		
21003	Jack Barkowitz	11.31	2.5
21005	Frank E. Packard	10.82	2.2
	NEW BRITAIN.		
20731	James Chimoridis	9.90	1.6
20735	Hudson Lunch	12.04	2.9
20739	Welgner Bros., Hotel Beloin	11.01	2.4
	NEW LONDON.		
18825	Far East Lunch	11.07	2.4
	ROCKY HILL.		
20373	Toney Russell	10.71	2.3
20360	Fred Suppe	10.97	2.6
	STAFFORD SPRINGS.		
21275	Rand Bros.	11.26	2.5
	SUFFIELD.		
20961	A. G. Bissell	11.34	2.5

TABLE XI. ADULTERATED MILK—(*Concluded*).

No.	Dealer	Solids	Fat	No.	Dealer	Solids	Fat
	Skimmed Milk—continued				*Skimmed Milk—concluded*		
	THOMPSONVILLE.				WINDSOR LOCKS.		
20975	Geo. Thomas	10.89	2.3	20956	Gregory Apostol	10.99	2.3
20969	Peter Tenerowicz	10.59	2.2	21125	Bridgeview Rest., Thos. Zaccheo	12.10	3.1
	WATERFORD.						
19277	John W. Worral	10.95	1.9		WOODBURY.		
	WEST HARTFORD.			18585	Joe Baltz	12.32	2.7
20989	E. W. Downs	10.39	1.3	21010	Unknown	11.25	2.6
20996	W. E. Johnson	11.19	2.4				
20990	R. B. White	10.90	2.2		*Watered and Skimmed.*		
	WINDSOR.				SHELTON.		
20979	I. W. Hemphill	11.28	2.1	20544	Alex. Emory	9.54	2.1

by inspectors attached to the Dairy and Food Commissioner's Department who have qualified for licenses to test milk and cream. In this way we are often saved the necessity of testing milk of good quality.

Samples found adulterated by reason of watering or skimming or both are summarized in Table XI.

Ninety-eight samples have been submitted by purchasers or producers of which number three were found to be watered.

CREAM.

Twenty-two samples of cream have been examined for purchasers or producers and four to check candidates for tester's license.

CONDENSED MILK AND OTHER MILK PRODUCTS.

Eight samples of various milk products have been examined.

Three samples of condensed milk were found to be of average composition and require no comment.

Two samples of condensed skimmed milk D. C. Nos. **20160** and **20204** were mouldy and unfit for food.

A sample of malted milk, **15976**, submitted by Crary Brokerage Co., Waukesha, Wis. was examined as follows:

Moisture 1.90 per cent.; ash 3.78 per cent.; nitrogen 1.42 per cent.; fat 7.60 per cent.; acidity as lactic acid 0.86 per cent.

A sample of milk powder, **16272**, contained moisture 4.34 per cent. and fat 3.45 per cent.

Protein milk, **17957**, and Modified Buttermilk, **17958**, both made by the Beebe Laboratories Inc., St. Paul, Minn. were examined as follows:

No.	17957	17958
Water	86.39%	90.02%
Ash	0.99	0.93
Protein (N x 6.38)	6.20	3.40
Fat	2.78	0.43
Carbohydrates (by diff.)	2.92	4.62[1]
Acidity, calc. as lactic acid.	0.72	0.60

[1] Starch conversion products present.

Protein Milk, **17957**, is stated to be prepared by the formula of Finkelstein and Meyer and to be relatively low in carbohydrate and mineral matter and comparatively high in protein. It is directed to make the contents of the can, 20 ozs., up to 1 quart, hence the composition of the diluted material will be approximately, solids 8.5 per cent., protein 3.9 per cent., fat 1.7 per cent., carbohydrate 1.8 per cent., ash 0.6 per cent. and lactic acid 0.5 per cent. This shows rather more protein and less fat than the diluted material is stated to contain but agrees with the statement as regards lactic acid and carbohydrates. As compared with average whole milk the product is higher in protein and much lower in sugar, as claimed. Mineral matter (ash), is higher than in average whole milk.

Modified Buttermilk, **17958**, is stated to be freshly prepared buttermilk combined with carbohydrates consisting of starch and resultant dextrins. This preparation as well as Protein Milk are intended for infant and invalid feeding and both the quantity to be fed and the frequency of feeding are left to the discretion of the physician.

HUMAN MILK.

Thirty samples of human milk have been examined for physicians or for the Visiting Nurse Association. Nurses should bear in mind the necessity of obtaining a representative sample for examination because the fractional parts of the secretion vary in composition. The variation is chiefly with respect to fat so that no adequate idea of the "richness" of breast milk will be obtained unless the entire supply is drawn and well mixed.[1]

The composition of milk varies with the species, with individuals of the same species and with the same individual under varied conditions. The average composition of cow's milk can be stated with rather more accuracy than that of human milk on account of the difficulties, in many cases, of obtaining adequate and repre-

[1] Conn. Exp. Sta. Bull. *227*, p. 255.

sentative samples of the last named. Authorities will differ as to the exact figures which should be chosen to represent the average composition of the milk of these two species but the following comparison may be taken as illustrating their essential differences.

TABLE XII. AVERAGE COMPOSITION OF COW'S MILK AND HUMAN MILK.

	No. of analyses	Water	Solids	Protein	Fat	Sugar	Ash
		%	%	%	%	%	%
Cow's milk[1]	...	87.4	12.6	3.8	3.6	4.5	0.7
Human milk	200[2]	87.4	12.6	2.3	3.8	6.2	0.3
	94[3]	88.2	11.8	1.5	3.3	6.8	0.2

[1] As stated by S. M. Babcock.
[2] From König's Chemie der mens. Nahr. u. Genuss., Leach 2d Ed., p. 127.
[3] From Richmond, Dairy Chem., London, Leach 4th Ed., p. 113.

It is evident that cow's milk contains more tissue building material, protein and mineral matter, than human milk which is in harmony with the peculiar needs of the first named species, the young of which are born in a relatively more advanced stage of development than is the human being.

Analyses of the samples submitted during the past year are given in Table XIII.

OYSTERS.

Three samples were examined for the Dairy and Food Commissioner. Two of these, **18545** and **18546,** were taken from the Thomas Oyster Co. and one, **18547,** from the J. P. McNeil Estate, both of New Haven. Sample **18545** had been aerated by means of a mechanical blower, evidently in water of less salt content than that of the original oyster liquor. Samples **18546** and **18547** were shucked oysters not so treated. It is illegal in this state to "sell oysters or other shell-fish which have been subjected to 'floating' or 'drinking' in brackish water, or water containing less salt than that in which they are grown."[1]

Analyses are given in Table XIV.

Solids, ash and salt in the drained oysters are distinctly less in **18545** than in the others and the salt content of the liquor is only a small fraction of that found in the original liquor.

TEA.

DETERMINATION OF CAFFEINE.

According to the plan indicated in our report[2] last year a method for the determination of caffeine in tea, which was devised in this

[1] Conn. Regulation 14.
[2] Conn. Exp. Sta. Bull. 227, p. 256.

TABLE XIII. ANALYSES OF HUMAN MILK.

No.	Solids %	Protein %	Fat %	Sugar %	Ash %
15843	10.50	1.37	1.20	7.69	0.24
15872	12.76	1.28	3.40	7.84	0.24
15937	.....	....	3.00	....	....
16301	.....	1.46	1.50	....	....
16304	.....	1.40	3.60	....	....
16379	.....	1.50	2.20	....	....
16807	.....	....	2.80	....	....
16854	9.48	....	1.00	....	0.17
16876	.....	1.21	2.60	....	....
16916	14.17	1.60	5.50	6.83	0.24
16917	.....	1.72	4.60	....	....
16990	.....	1.28	3.40	....	....
17038	14.10	1.28	6.20	6.38	0.24
17039	15.14	1.28	7.40	6.31	0.15
17055	10.43	1.08	2.60	6.61	0.14
17093	.....	1.28	3.40	....	....
17124	9.60	1.25	1.20	6.95	0.20
17514	11.36	0.92	2.80	7.64	0.15
17542	12.60	1.31	3.80	7.28	0.21
17607	12.28	1.32	3.20	7.54	0.22
17614	11.91	1.03	3.40	7.26	0.22
17623	15.60	1.33	5.30	....	....
17644	13.42	....	4.20	8.97[1]	0.25
17627	13.95	....	4.80	8.82[1]	0.33
17650	11.71	1.34	2.20	7.95	0.22
17732	12.15	1.46	5.00	5.43	0.26
17758	11.45	1.79	2.20	7.19	0.27
17767	11.95	....	2.66	9.16[1]	0.13
17920	.....	1.27	3.80	....	....
17922	11.06	1.28	2.20	7.31	0.27

[1] Protein included.

TABLE XIV. ANALYSES OF OYSTERS.

D. C. No.	**18545**	**18546**	**18547**
Net weight of sample, grams	463.8	474.4	478.0
Weight of liquor, grams	34.7	128.7	110.5
Weight of drained oysters, grams	429.1	345.7	367.5
Loss on boiling drained oysters, per cent	49.79	40.93	43.30
Solids in drained oysters, per cent	16.10	22.13	20.65
Ash in drained oysters, per cent	1.06	2.41	2.24
Solids in liquor, per cent	4.15	5.22	5.16
Ash in liquor, per cent	0.60	2.48	2.32
Salt (NaCl) in oysters, per cent	0.05	0.68	0.73
Salt (NaCl) in liquor, per cent	0.24	1.92	1.81

laboratory, has been studied collaboratively and the results have been summarized elsewhere by Mr. Andrew.[1] An abstract of his report is given here.

[1] Report of R. E. Andrew, Referee on Tea, Assoc. Official Agricultural Chemists, Washington, Oct., 1921.

COLLABORATION.

Samples were sent to ten different chemists who expressed their willingness to coöperate. Reports were received from Mr. Henry Lepper, Bureau of Chemistry; Mr. W. S. Hubbard, who reported analyses by Mr. Charles A. Herrmann, Bureau of Chemistry, New York Station; Dr. I. K. Phelps, Food Control Laboratory, Bureau of Chemistry, who reported analyses by Miss Dorothy B. Scott, Miss Lillian Offutt and Mr. J. I. Palmore; Mr. L. E. Walter, Laramie, Wyoming, who reported results obtained by Mr. Harold R. Baker, Asst. State Chemist.

INSTRUCTIONS TO COLLABORATORS.

Three samples were used, viz., I Green Tea, II Black Tea, III Mixture of Green and Black Teas. Each sample was finely ground and well mixed. Sub-samples were sent to each collaborator with the following instructions:

Determine caffeine in each of the samples by the following methods:—

MODIFIED STAHLSCHMIDT METHOD.

Weigh 3.125 grams of the finely powdered sample into a 500 cc. flask, add 225 cc. of water (this volume will be reduced to about 200 cc. by boiling), attach a reflux condenser and boil for 2 hours. Add 2 grams of dry basic lead acetate and boil 10 minutes. Cool, transfer to a 250 cc. graduated flask, fill to the mark, filter through a dry filter, measure 200 cc. of the filtrate into a 250 cc. graduated flask and pass hydrogen sulphid through to remove the excess of lead. Make the solution up to the mark and filter through a dry filter. Measure 200 cc. of this filtrate into an evaporating dish and concentrate to about 40 cc. Wash the concentrated solution with as little water as possible into a small separatory funnel and shake out six times with chloroform, using 25, 20, 15, 10, 10, 10 cc., respectively, combining the several extracts in a second separatory funnel. Treat the combined extracts with 5 cc. of 1 per cent. potassium hydroxide, allow the liquids to separate and draw off the chloroform. Wash the aqueous solution in the separatory with chloroform, in two portions of 10 cc. each adding these washings to the main extract. Distill off most of the solvent, transfer to a small tared flask, evaporate, dry at 100° C. and weigh. Test the purity of the residue by determining nitrogen therein and calculate caffeine by the factor 3.464.

POWER-CHESNUT METHOD.

Extract 10 grams of material for 8 hours in a Soxhlet apparatus with hot 95 per cent. alcohol. Add the alcoholic extract to a suspension of 10 grams of heavy magnesium oxide in 100 cc. of water, rinse the flask with a little hot water and add rinsings to the mixture. Allow the mixture to evaporate slowly on a boiling water bath, with frequent stirring, until the alcohol is removed and a nearly dry, powdery mass is obtained. Transfer the mass to a smooth filter by means of a sufficient amount of hot water, cleaning the container thoroughly. Wash the material on the filter with

successive portions of hot water until the filtrate measures 250 cc. Add 10 cc. of 10 per cent. sulphuric acid to the filtrate contained in a flask of suitable size, place a funnel in the neck of the flask, boil cautiously until danger of frothing is passed and continue active boiling for one half hour. Allow the solution to cool and filter into a separatory funnel through a double moistened filter and wash the flask and filter with small portions of 0.5 per cent. sulphuric acid. Shake the clear acid filtrate with 6 successive 25 cc. portions of chloroform, collecting the several extracts in a second separatory funnel. Treat the combined chloroform extracts with 5 cc. of 1 per cent. solution of potassium hydroxide and allow the chloroform to completely subside. Draw off the chloroform into a suitable flask, filtering through a dry paper or pledget of cotton inserted in the stem of the separatory funnel. Wash the alkaline liquid remaining in the separatory with two portions of chloroform, also washing the filter if used, and unite the washings with the main bulk of chloroform solution. Distill the solvent to small volume, transfer to a tared beaker, evaporate to dryness, further dry for one hour at 100° C., cool and weigh.

To test the purity of the residue determine nitrogen therein and calculate caffeine by the factor 3.464.

PROPOSED METHOD.

To 5 grams of material in a 500 cc. graduated flask add 10 grams of heavy magnesium oxide and 200 cc. of distilled water. Boil gently over a low flame for two hours using a small bore glass tube 30 inches long as a condenser. Cool, dilute to volume and filter through a dry paper. Take an aliquot of 300 cc., equivalent to 3 grams of original material, in an Erlenmeyer flask of 1000 cc. capacity, add 10 cc. of 10 per cent. solution of sulphuric acid and boil until the volume is reduced to about 100 cc. Filter into a separatory funnel, washing the flask with small portions of 1 per cent. sulphuric acid and shake out six times with chloroform using 25, 20, 15, 10, 10, 10 cc. portions. Treat the combined extracts with 5 cc. of a 1 per cent. solution of potassium hydroxide. When the liquids have completely separated draw off the chloroform layer into a suitable flask or beaker. Wash the alkaline solution in the separatory with two portions of chloroform of 10 cc. each and unite the washings with the main bulk, transfer to a tared flask, evaporate to dryness and further dry in a water oven at 100° C. to constant weight.

If desired, transfer the residue thus obtained to a digestion flask with successive small portions of sulphuric acid and determine nitrogen by the Kjeldahl method. Calculate caffeine from nitrogen by the factor 3.464.

NOTES ON METHODS.

Results for caffeine *by weight* and *from nitrogen* are desired.

In the Power-Chesnut method extraction should be continued until the extract is colorless. The heavy magnesium oxide used should meet the United States Pharmacopoeia requirements.

Evaporation of the last portion of solvent from the caffeine should be done carefully to prevent loss by spattering.

If the results by all methods outlined cannot be obtained those by the Modified Stahlschmidt and proposed methods are particularly desired.

RESULTS OF COLLABORATIVE WORK.

The results obtained by the various collaborators are given in Table XV.

TABLE XV. CAFFEINE IN TEA.

Sample I.

Analyst	Modified Stahlschmidt Method. Caffeine by weight.	from N.	Power-Chesnut Method. Caffeine by weight.	from N.	Proposed Method. Caffeine by weight.	from N.
Henry A. Lepper,	1.97	1.97	2.09	1.98	2.10	1.92
Bureau of Chemistry	....	....	2.05	1.99	2.11	1.92
Dorothy Scott,						
Food Control Laboratory,	2.30	1.60	2.09	1.93	2.38	2.05
Bureau of Chemistry.	2.02	1.65	1.85R	1.79	2.14	1.96
Lillian Offutt,						
Food Control Laboratory,	2.10	1.63	2.36	2.09	2.08	1.65
Bureau of Chemistry.	2.00	1.55	2.34K	2.15	2.00	1.85
J. I. Palmore,						
Food Control Laboratory,	2.33	1.94	2.15	....	2.20	2.02
Bureau of Chemistry.	2.19	1.81	2.16S	....	2.29	2.02
Harold R. Baker,	2.63	1.73	....	....	1.96	1.63
Asst. State Chemist,	2.32	1.73	....	....	2.15	1.68
Laramie, Wyoming.	2.17	1.82	....	....	2.33	1.73
Charles A. Herrmann, Bureau of Chemistry, New York Station.	2.23	2.25	....	....	2.34	2.25
R. E. Andrew,	2.18	2.08	2.33	2.25	2.20	2.16
Agricultural Exp. Station,	2.19	2.08	2.34	2.26	2.25	2.17
New Haven, Conn.	....	....	....	....	2.20	2.15
	....	....	....	....	2.20	2.15

Sample II.

Henry A. Lepper,	2.25	2.16	2.15	2.06	2.29	2.10
Bureau of Chemistry.	....	....	2.24	2.17	2.31	2.16
Dorothy Scott,						
Food Control Laboratory,	2.17	1.65	2.49R	2.32	2.35	2.14
Bureau of Chemistry.	2.03	1.75	....	....	2.19	2.15
Lillian Offutt,						
Food Control Laboratory,	2.16	1.75	2.55	....	....	....
Bureau of Chemistry.	2.10	1.58	2.37K	2.21	2.20	2.13
J. I. Palmore,	2.56	1.99	2.32	2.20	2.37	2.22
Food Control Laboratory,	2.39	2.02	2.33S	2.21	2.28	2.12
Bureau of Chemistry.	....	....	2.38	2.21	2.22	2.05
	....	....	2.35R	2.20	2.50	2.23
Harold R. Baker,	2.28	1.78	....	....	2.36	1.97
Asst. State Chemist,	2.29	1.68	....	....	2.39	....
Laramie, Wyoming.	2.28	1.92	....	....	2.40	1.97
R. E. Andrew,	2.28	2.25	2.52	2.42	2.38	....
Agricultural Exp. Station,	2.29	2.22	2.46	2.37	2.40	2.30
New Haven, Conn.	....	....	....	....	2.39	2.33
	....	....	....	....	2.40	2.33

TABLE XV. CAFFEINE IN TEA.--(*Concluded*).

Sample III.

Analyst	Modified Stahlschmidt Method. Caffeine by weight.	from N.	Power-Chesnut Method. Caffeine by weight.	from N.	Proposed Method. Caffeine by weight.	from N.
Charles A. Herrmann, Bureau of Chemistry, New York Station.	2.45	2.42	....	....	2.56	2.54
R. E. Andrew,						
Agricultural Exp. Station,	2.43	2.37	2.49	2.44	2.53	2.51
New Haven, Conn.	2.43	2.39	2.39	2.32	2.53	2.52

K Modified Knorr Extractor used.
R Rask Extractor used.
S Soxhlet Extractor used.

DISCUSSION OF RESULTS.

The experience with these three methods was summarized by the referee[1] last year as follows:

"The results obtained by the proposed method are in close agreement with those obtained by the other two methods and the caffeine residues are of an equal degree of purity. The time required is very much less than in either of the other procedures." The average difference between results for caffeine by weight and from nitrogen was considerably under 0.1 per cent. and practically the same in all methods.

The results this year show satisfactory agreement as regards results for caffeine by weight but too wide discrepancies between these figures and the corresponding results estimated from nitrogen. The trouble quite evidently lies in the determination of caffeine nitrogen, but why this should be at all troublesome, or why it should be more so in case of the Stahlschmidt method than in the other methods, is difficult to understand. An allowance of 0.1 per cent. for experimental error in determining nitrogen (equivalent to 0.35 per cent. caffeine), is a very liberal tolerance and about twice as great as is generally necessary; nevertheless, excluding only those figures for caffeine from nitrogen which vary from caffeine by weight by more than 0.35 per cent. the averages for the three samples become as follows:

[1] Report of the Referee on Tea to the A. O. A. C., 1920.

TABLE XVI. SUMMARY OF CAFFEINE DETERMINATIONS IN TEA.

Sample No.	Modified Stahlschmidt Method.		Power-Chesnut Method.		Proposed Method.	
	Caffeine by weight.	from N.	Caffeine by weight.	from N.	Caffeine by weight	from N.
	%	%	%	%	%	%
I	2.20	2.04	2.18	2.06	2.18	2.02
II	2.26	2.10	2.38	2.24	2.34	2.19
III	2.44	2.39	2.44	2.38	2.54	2.53

In computing this summary no figures reported by the Power-Chesnut method have been excluded. Of results reported by the proposed procedure only five have been excluded. It was necessary to exclude sixteen of the 28 results reported by collaborators by the Stahlschmidt method, as it is manifestly unfair in this case to recognize results which vary from the results by weight to the extent of from 0.5 to nearly 1 per cent. since it is evident that the results by weight are in satisfactory accord with the other two methods and there are ample data to show that the method will yield a caffeine residue of equal purity. The summary given is reasonably fair to all methods although it will be noted that the Power-Chesnut method gains by the fact that reports are less complete by that method than by the other two. If all figures reported had been included in the averages reported in the summary the only conspicuous change would occur in the results for caffeine from nitrogen in samples I and II by the Stahlschmidt method.

The accumulated data of the past two years show that the proposed method compares satisfactorily with the other two methods both as regards the gross amount of caffeine obtained and the degree of purity of the caffeine residues. In the opinion of all collaborators it is simpler to manipulate, requires less time than the Stahlschmidt method, and in the opinion of some it is superior to the Power-Chesnut method. The referee, however, made the second recommendation that the Power-Chesnut method as herein described, except that in line 10 the wording be changed to read 20 cc. of 10 per cent. sulphuric acid instead of 10 cc. of 10 per cent. sulphuric acid, be made official for the determination of caffeine in tea; and made a first recommendation that the proposed method for the same determination also be made official. Both recommendations were adopted.

VINEGAR.

Thirteen samples were submitted by the Dairy and Food Commissioner, four of which failed to meet the legal requirements. Three samples, **20777, 20778** and **20778A,** were sent for examination in connection with a peculiar growth which formed on the top of pickles in which this vinegar had been used. The growth was referred to the Department of Botany of this station and found to be a dense growth of bacteria zoogloea. The infection is thought to have come from the pickles but experimental inoculations of this and other vinegars indicated that this particular vinegar offered especially favorable conditions for growth, the exact cause of which has not been determined.

Of eight samples sent by individuals three were found to be below the standard required in this state.

MISCELLANEOUS MATERIALS.

FOODS, ETC.

Twenty samples of this class have been examined for individuals and for the Dairy and Food Commissioner. They require no particular comment.

D. C. No. 20161. *Baked Beans, Diamond Brand,* were found wholesome and fit for food as far as organoleptic tests could discover.

17473. *Blackberry Preserves,* showed gas formation, had a sour taste and were judged unwholesome.

16313. *Cherries, Maraschino,* were analyzed as follows:

Solids 52.63 per cent.; invert sugar 11.48 per cent.; sucrose 38.22 per cent.; ash 0.17 per cent.; undetermined 2.67 per cent.

The liquor and drained cherries were analyzed separately and the above composite analysis calculated. The cherries were colored with a permitted dye, erythrosin, and no alcohol, saccharin, salicylic or benzoic acids or sulphites were found.

16294. *Crullers,* sugared, were analyzed as follows:

Moisture 21.80 per cent.; ash 1.42 per cent.; protein (N x 6.25) 5.88 per cent.; fat 21.23 per cent.; carbohydrates, by difference, 49.67 per cent.

16757. *Les Fruits.* This is a fruit paste to be used as a laxative food. It contained:

Moisture 31.41 per cent.; ash 3.11 per cent.; protein (N x 6.25) 3.12 per cent.; ether extract (crude fat) 2.26 per cent.; total sugars, as invert sugar 48.40 per cent.; undetermined nitrogen-free extract 6.99 per cent. Emodin-bearing drugs present.

D. C. No. 20205. *Peaches,* canned, were found to be wholesome and fit for food. Another sample **17470,** V-W Brand, was fermented and the can sprung by gas pressure.

16302. *Purslain,* canned, prepared by Mrs. John Haberle, New Haven was examined as follows:

Moisture 91.68 per cent.; ash 1.76 per cent.; protein (N x 6.25) 1.12 per cent.; fiber 1.19 per cent.; ether extract 0.35 per cent.; nitrogen-free extract, by difference 3.90 per cent.

Chemical analysis alone is not very illuminating. The product is said to possess antiscorbutic properties, which, of course, no chemical analysis can demonstrate.

Other samples include sugar, flour, canned spinach, canned peas, wine, beer, whiskey and water and require no particular comment.

Materials Examined for Poisons, etc.

Thirty-one samples were examined for poisonous, injurious or illegal substances as follows:

No. of samples.	Kind of Material.	Remarks.
1	Bread.	Moulds present.
8	Candy.	No poisons detected. Alcohol 0.4 per cent. in one sample.
1	Canning compound.	Borax present.
4	Chicks, viscera of	No poison detected.
1	Corn.	No poison detected.
1	Coffee.	No poison detected.
1	Deposit in engine.	Aluminum powder.
1	Ginger extract.	Capsicum present.
1	Goose, viscera of	Pins, nails, staple, bits of brass in gizzard.
1	Lumps in flour.	Not identified.
2	Soils.	No poison detected.
5	Stomach contents.	No poison detected.
3	Urine, for lead.	No lead detected.
1	Wine.	Traces of tin and zinc.

II. DRUGS.

PROPRIETARY REMEDIES, ETC.

Five preparations of this class have been examined.

15668. *Dr. True's Elixer,* a family laxative and worm expeller, made by Dr. J. F. True & Co., Auburn, Me. and Knowlton, Que.

Examination and analysis showed the following composition:

Alcohol 7.90 per cent. by volume; solids 45.0 grams per 100 cc.; flavor wintergreen; santonin none; spigelia indicated; emodin-bearing drugs present, aloes identified.

This is a syrup containing vegetable laxatives. A previous examination[1] of this remedy showed the presence of santonin which has apparently been replaced by spigelia.

15670. *Russell Emulsion,* made by the Standard Emulsion Co., New York. This preparation is said to be made of equal parts of

[1] Conn. Exp. Sta. Report 1914, p. 254.

beef suet, cocoanut, peanut and cottonseed oils with clove oil to flavor and less than ¾ of 1 per cent. of sodium borate as a preservative.

Examination and analysis showed the following composition:

Solids 47.45 per cent.; ash 1.74 per cent.; fats 39.11 per cent.; constants of fat, refractive index 1.4613, Riechert-Meissel No. 9.4; cottonseed oil present; boric acid 0.32 per cent.; oil of cloves present.

The declared composition is practically substantiated by the analysis. No test was made for peanut oil but cottonseed and cocoanut oils are indicated. Sodium borate is illegal when used as a preservative in foods[1] but its use in drugs is probably within the law.

15669. *Milks Emulsion,* made by the Milks Emulsion Co., Terre Haute, Ind.

Examination and analysis showed the following composition:

Solids 95-43 per cent.; fat, unsaponifiable, 94.00 per cent.; glycerin, small amount indicated; wild cherry not identified; oil of wintergreen present.

This analysis essentially confirms advertising literature which states that the product is composed of about 95 per cent. of petroleum oil with vegetable oils, glycerin and wild cherry syrup.

D. C. No. 18396. *Medicine* submitted by the Dairy and Food Commissioner. It is not sold as a proprietary remedy and there is no advertising literature available. The medicine was purchased as a cure for tuberculosis and the purchaser claims that a cure was effected. The preparation was a syrup containing alcohol, chloroform and unidentified vegetable extractives. Opium alkaloids and emodin-bearing drugs were not detected. The label bore no claim of curative properties.

D. C. No. 16330. Phosphorated Iron, distributed by the Iron Remedy Co., Fort Wayne, Ind. These were sugar-coated pills in which iron and phosphates were the only medicaments detected.

UNITED STATES PHARMACOPOEIA OR NATIONAL FORMULARY PREPARATIONS.

All samples discussed in this section were submitted by the Dairy and Food Commissioner unless otherwise stated.

Bay Rum.

Bay Rum, or Spirit of Myrcia, was formerly an official preparation of the United States Pharmacopoeia. These names are used synonymously in the 3d edition of the National Formulary but in the 4th edition the title Compound Spirit of Myrcia appears and the name Bay Rum has been dropped. The formula, however,

[1] Regulation 7.

remains substantially the same, the finished product containing about 58 per cent. of alcohol by volume. The preparation is held to be fit for beverage purposes under Federal Prohibition Regulations[1] and for this reason we find many samples marked to indicate that they have been medicated with tarter emetic or otherwise to make them non-drinkable.

Twenty-four samples were examined. The inspection was made primarily with reference to the possible presence of wood alcohol but that substance was not found in any case. A large proportion of the samples were deficient in grain alcohol, nineteen falling short of the standard or declared alcohol content by more than 10 per cent.

Tincture of Belladonna Leaves.

This preparation should contain in 100 mils not less than 0.027 gram nor more than 0.033 gram of the total alkaloids of belladonna leaves.[2]

Nine samples were examined. All were found to be of standard strength or within reasonable limits thereof.

Table XVII. Assays of Tincture of Belladonna.

D. C. No.	City or Town	Dealer	Alkaloids of belladonna, gm. per 100 cc.
19428	*Derby*	Prudy Drug Co.	0.025
20134	*Hartford*	Sisson Drug Co.	0.027
20126	*Middletown*	Hartman Drug Co.	0.029
19700	*New Britain*	L. K. Liggett Co.	0.027
20210	*New Haven*	Est. of J. A. Hodgson	0.025
19715	*Thompsonville*	Geo. R. Steele, Est	0.026
20185	*Unionville*	Paul Flynn	0.025
20170	*Waterbury*	Apothecaries Hall Co.	0.035
20111	*Willimantic*	Cartier, The Druggist	0.032

Belladonna Leaves (Powder).

Belladonna leaves should yield not less than 0.3 per cent. of total alkaloids and not over 20 per cent. of ash.[3]

One sample, **19641**, was examined which was not excessive in ash but was deficient in alkaloids, containing only 0.17 per cent. or 56.6 per cent. of the required amount.

Milk of Bismuth.

The official preparation of Bismuth Magma contains not less than 5.6 per cent. nor more than 6.2 per cent. of bismuth trioxide, Bi_2O_3.[1]

Ten samples were submitted which assayed as shown in Table XVIII.

[1] Bureau of Int. Rev., Regulations 60, p. 36.
[2] U.S.P. IX, p. 448.
[3] U.S.P. IX, p. 72.

Table XVIII. Assays of Milk of Bismuth.

D. C. No.	City or Town	Dealer or Manufacturer	Per cent. Bi_2O_3, min. required or declared	Bi_2O_3, found
20179	*Meriden*	Louis Liggett (Park Davis)	5.6	6.6
19421	*Naugatuck*	Carl G. Olson (Park Davis)	5.6	6.8
19702	*New Britain*	L. K. Liggett Co. (Park Davis)	5.6	6.8
20494	*New London*	James' Drug Store	5.6	6.4
19432	*Shelton*	E. J. Barden (Lilly)	5.6	3.7
19621	*So. Manchester*	J. H. Quinn & Co. (Lilly)	3.35	3.8
19631	*Stafford Springs*	D. H. McCormick (Park Davis)	5.6	6.9
19717	*Thompsonville*	Geo. R. Steele, Est. (Lilly)	3.35	3.8
20188	*Unionville*	Albert C. Roby (Lilly)	5.6	3.7
20106	*Willimantic*	Bay State Drug Co. (Park Davis)	5.6	6.0

The products examined are not of the druggists' own manufacture except possibly in one case, and the amount of bismuth present is somewhat in excess of the maximum amount named in the official specifications in most cases. Two of the Lilly products are stated to contain 3.35 per cent. bismuth trioxide and it is probable that the other samples of this make are intended to be of the same strength, but the samples as sold have no declaration of the fact and were therefore presumed to be of standard quality, hence arises what is probably only an apparent deficiency.

Solution of Calcium Hydroxide (Lime Water).

This preparation is a solution containing not less than 0.14 per cent. of calcium hydroxide, $Ca(OH)_2$, at 25° C.[2]

Sixty-nine samples were examined and twelve were found to be deficient by substantial amounts. Assays are given in Table XIX.

Tincture of Colchicum Seed.

One hundred mils of this tincture are required to contain not less than 0.036 gram nor more than 0.044 gram of colchicine.[3]

Two samples, **19438**, from Goulden's Pharmacy, Stamford, and **19430**, from F. G. Stanford, Shelton, contained 0.03 gram and 0.04 gram of colchicine respectively.

[1] U.S.P. IX, p. 260.
[2] U.S.P. IX, p. 239.
[3] U.S.P. IX, p. 453.

TABLE XIX. ASSAYS OF LIME WATER.

D.C.No.	City or Town	Dealer	Calcium Hydroxide per cent,
20479	*Bethel*	English's Drug Store	0.06
20218	*Branford*	Branford Pharmacy	0.13
20215		Spalding Co.	0.03
20412	*Bridgeport*	Kaesmann Drug Store	0.16
19743	*Bristol*	Madden Drug Store	0.15
19745		Rickman's Economy Drug Store	0.15
19740		Leroy P. Tucker	0.17
20323	*Central Village*	H. Elmer Lewis	0.16
20128	*Cromwell*	Geo. F. Chapin Est.	0.16
20464	*Danbury*	Burns' Drug Store	0.16
20474		Doran's Drug Store	0.16
20468		Kenner & Benjamin	0.12
20319	*Danielson*	Burrough's Drug Store	0.17
20316	*Dayville*	Wm. E. LaBelle	0.14
19734	*East Hartford*	O'Connell Drug Co.	0.17
20483	*Fairfield*	The Boyle Pharmacy	0.10
20486		Randall's Pharmacy	0.17
20158	*Hartford*	Frank L. Palmer	0.17
20140		Sisson Drug Co.	0.15
20184	*Meriden*	M. P. Forcier	0.15
20176		Louis Liggett	0.16
20182		Pinks Pharmacy	0.13
20122	*Middletown*	Lincoln's Drug Store	0.16
20239	*Milford*	J. H. Barnes	0.05
20240		John Howes	0.14
20305	*Mystic*	Mystic Pharmacy	0.17
20487	*New Haven*	Coburn's Drug Store	0.16
20195		T. P. Gillespie & Co.	0.05
20203		Horowich & Son	0.21
20222		Deegan-Hope Drug Co.	0.17
20199		Spalding Drug Co.	0.14
20207		Taft Pharmacy	0.16
20225		Visel & Kennedy	0.16
20219		Wood's Drug Store	0.04
20496	*New London*	L. P. Desmarais	0.16
20491		Starr Bros.	0.01
20235	*New Milford*	Albert Evitts	0.03
20232		W. N. Noble	0.17
20300	*Noank*	Wm. M. Hill, M.D.	0.05
20480	*Norwalk*	Devine & Hardwick Co., Inc.	0.16
20482		H. Glendening & Co.	0.16
20332	*Norwich*	Smith Pharmacy	0.15
20325	*Plainfield*	Edmond Mercier	0.16
20102	*Plainville*	Geo. R. Byington	0.15
20119	*Portland*	C. E. Blodgett	0.16
20310	*Putnam*	Edward H. Burt	0.17
20313		James F. Donahue	0.12
20311		Geo. E. Dresser	0.13
19644	*Rockville*	Thomas' Pharmacy	0.14
19747	*Southington*	Chafee's Drug Store	0.16
20462	*South Norwalk*	L. K. Liggett Co.	0.13
20458		H. A. Mead	0.16
20301	*Stonington*	Burch's Drug Store	0.15
20247	*Stratford*	F. B. Brill	0.16
20243		Wm. H. St. John & Co.	0.14
20155	*Thomaston*	Pickett Drug Co.	0.16
20148	*Torrington*	Claxton's Pharmacy	0.16
20150		Collins & Collins	0.15
20187	*Unionville*	Paul Flynn	0.09

TABLE XIX. ASSAYS OF LIME WATER—(*Concluded*).

D.C.No.	City or Town	Dealer	Calcium Hydroxide, per cent.
19726	*Wallingford*	Wallingford Drug Co., Inc.	0.16
20169	*Waterbury*	Apothecaries Hall Co.	0.04
20162		H. W. Lake Drug Co.	0.15
20191	*West Hartford*	Allen B. Judd Co.	0.13
20418	*West Haven*	Home Drug Store	0.16
19441	*Westport*	Westport Drug Co.	0.19
20131	*Wethersfield*	W. T. Eagan	0.16
20117	*Willimantic*	Wilson Drug Co.	0.01
20115		Chas. de Villers	0.17
20142	*Winsted*	John A. Williams	0.16

TINCTURE OF FERRIC CHLORIDE.

This preparation is required to contain not less than 4.48 per cent. of iron (Fe).[1]

Eighteen samples were submitted and all were found to be of standard quality or within reasonable limits thereof.

TABLE XX. ASSAYS OF TINCTURE OF FERRIC CHLORIDE.

D. C. No.	City or Town	Dealer	Iron (Fe), per cent.
20216	*Branford*	Spalding Co.	4.65
19444	*Bridgeport*	Hindle's Drug Store	4.38
20402	*Clinton*	Chas. B. Hull	4 78
20467	*Danbury*	Kenner & Benjamin	4.75
20308	*Groton*	C. S. Woodhull Davis	5.11
20489	*New Haven*	Coburn's Drug Store	4.76
20211		Est. J. A. Hodgson	6.52
20209		Taft Pharmacy	4.42
20221		Visel & Kennedy	4.35
20498	*New London*	Nichols & Harris Co.	4.76
20230	*New Milford*	Park Pharmacy	4.54
20236		Albert Evitts	4.76
20334	*Norwich*	James C. Mara	4.26
20461	*South Norwalk*	L. K. Liggett	4.32
20450		Plaisted Drug Store	5.45
20248	*Stratford*	F. B. Brill	4.53
20244		H. H. St. John & Co.	4.32
20302	*Stonington*	C. T. Brayton & Co.	4.90

SYRUP OF FERROUS IODIDE.

The official preparation is a syrupy liquid containing not less than 4.75 per cent. nor more than 5.25 per cent. of ferrous iodide (FeI_2).[2]

Six samples were examined two of which were somewhat less than the minimum strength required but the deficiency was less than 10 per cent.

[1] U.S.P. IX, p. 454.
[2] U.S.P. IX, p. 429.

TABLE XXI. ASSAYS OF FERROUS IODIDE.

D. C. No.	City or Town	Dealer	FeI_2, per cent.
19443	*Bridgeport*	John Clampet Drug Store	5.30
20409		Laity Bros.	4.41
20208	*New Haven*	Taft Pharmacy	4.38
20229	*New Milford*	Park Pharmacy	4.79
20338	*Norwich*	Lee & Osgood	5.19
20452	*South Norwalk*	Plaisted Drug Store	4.84

SYRUP OF HYDRIODIC ACID.

One hundred mils of this preparation are required to contain not less than 1.3 grams nor more than 1.45 grams hydriodic acid (HI).[1] The solution when fresh is colorless or straw-colored; solutions which are orange colored or darker have deteriorated.

Sixteen samples have been examined. Three were deficient, one conspicuously so being only 59.2 per cent. of the minimum requirement, while the other two were 91 per cent. and 86 per cent. of minimum standard strength.

TABLE XXII. ASSAYS OF SYRUP OF HYDRIODIC ACID.

D. C. No.	City or Town	Dealer	HI, gram per 100 cc.
19426	*Ansonia*	E. B. Schoonmaker	1.43
20473	*Danbury*	Doran's Drug Store	1.52
20157	*Hartford*	Frank L. Palmer	1.18
20124	*Middletown*	Hartmann Drug Co.	1.28
19649	*New Britain*	L. K. Liggett Co.	1.50
20223	*New Haven*	Deegan-Hope Drug Co.	1.12
20206		Taft Pharmacy	1.43
20495	*New London*	James' Drug Store	1.50
20226	*New Milford*	Park Pharmacy	1.52
19642	*Rockville*	Thomas' Pharmacy	1.47
19622	*So. Manchester*	J. H. Quinn & Co.	1.49
19630	*Stafford Springs*	D. H. McCormick	1.47
19635		Ethel H. Wikes	1.41
19435	*Stamford*	Sherwood Drug Store	1.47
19716	*Thompsonville*	Geo. R. Steele Est.	1.48
19721	*Wallingford*	Wallingford Drug Co., Inc.	0.77

TINCTURE OF IODINE.

The official tincture contains in 100 mils not less than 6.5 grams nor more than 7.5 grams of iodine and not less than 4.5 grams nor more than 5.5 grams of potassium iodide.[2]

Thirty-five samples were examined and all were satisfactory except one sample, **20407**, which was about 14 per cent. too low in iodine and contained 18 per cent. too much potassium iodide indicating careless preparation.

[1] U.S.P. IX, p. 427.
[2] U.S.P. IX, p. 457.

TABLE XXIII. ASSAYS OF TINCTURE OF IODINE.

D. C. No.	City or Town	Dealer	Grams per 100 cc. I	Grams per 100 cc. KI
20213	*Branford*	T. D. Williams	7.0	5.0
20413	*Bridgeport*	European Pharmacy	6.7	5.1
20407		H. A. Scalton	5.6	6.5
20410		Wolf-Heiman	6.8	4.9
19746	*Bristol*	Rickman's Economy Drug Store	6.9	5.3
19739		Leroy P. Tucker	6.6	4.8
20471	*Danbury*	Northrop's Drug Store	7.1	5.1
20322	*Danielson*	Woodward's Drug Store	7.5	5.3
19736	*East Hartford*	W. B. Noble	6 8	4.5
19733		O'Connell Drug Co.	7.2	5.1
19729	*Glastonbury*	People's Pharmacy	6.9	4.8
20159	*Hartford*	Frank L. Palmer	6.5	4.6
20138		Sisson Drug Co.	6.9	5.4
20327	*Jewett City*	Chas. R. Carey	7.3	5.3
20328		J. P. Gorman	7.3	5.3
20121	*Middletown*	Lincoln's Drug Store	6.8	5.4
20488	*New Haven*	Coburn's Drug Store	7.4	5.1
20201		Spalding Drug Co.	6.9	5.0
20492	*New London*	United Chemists	7.2	5.3
20237	*New Milford*	Albert Evitts	6.9	5.0
20233		W. N. Noble	6.8	5.1
20329	*Norwich*	G. G. Engler	7.5	5.6
20455	*South Norwalk*	Harold A. Mead	6.6	4.7
20245	*Stratford*	Wm. H. St. John & Co.	7.4	5.2
20154	*Thomaston*	Pickett Drug Store	7.8	4.6
20189	*Unionville*	Albert Roby, Druggist	7.1	5.1
19725	*Wallingford*	Wallingford Drug Co.	7.3	5.5
20164	*Waterbury*	H. W. Lake Drug Co.	7.4	4.2
20401	*Westbrook*	J. W. Neidlinger	7.1	5.2
20417	*West Haven*	Silver Drug Corp.	6.6	4.5
19440	*Westport*	Bridge Pharmacy	7.0	5.1
20109	*Willimantic*	Bay State Drug Co.	6.9	6.6
20113		Cartier, The Druggist	7.2	5.5
20144	*Winsted*	Bannon's Drug Store	6.8	4.0
20143		John A. Williams	6.8	5.1

IPECAC.

The official dried root contains not less than 1.75 per cent. of the ether-soluble alkaloids of ipecac.[1]

Four samples were examined and found to conform substantially to the required standard.

TABLE XXIV. ASSAYS OF IPECAC.

D. C. No.	City or Town	Dealer	Ether-soluble alkaloids, per cent.
19429	*Derby*	Alfonso Indocci	1.63
19640	*Rockville*	Thomas' Pharmacy	1.92
19623	*So. Manchester*	J. H. Quinn & Co.	2.07
19632	*Stafford Springs*	D. H. McCormick	1.73

[1] U. S. P. IX, p. 229.

Chlorinated Lime.

(Chloride of Lime).

This product is made by treating calcium hydroxide with chlorine and should contain not less than 30 per cent. of available chlorine.[1] It is directed to be preserved in air-tight containers and kept in a cool, dry place.

Eight samples were examined representing, however, but three brands. None were found to be of standard strength. Four were approximately one-half strength, two were about two-thirds strength and two were three-fourths strength. It is probable that, as first packed, the products contained the full amount of available chlorine but it is well known that they will deteriorate with access of air. The samples were obtained in original containers none of which could be said to be air-tight, but sealed by means of circular covers fitted into the cans by pressure. The general use of this material as a disinfectant makes it the more important that it should be used as fresh as possible and the purchaser should understand that, once opened, the contents does not remain efficient indefinitely.

The samples were assayed by the method as described in the Pharmacopoeia. To gain some idea of the rate of deterioration duplicate assays were made about 7 weeks subsequent to the first examination with the results shown in Table XXV.

Table XXV. Assays of Chlorinated Lime.

D. C. No.	City or Town	Dealer	Brand	Available Chlorine per cent. First assay	Second assay (7 weeks later)
19425	*Ansonia*	Bristol Drug Co	Acme	13.9	11.0
20190	*Farmington*	S. J. Adgate	Acme	23.2	21.8
19645	*New Britain*	L. K. Liggett Co	Hudson	14.5	14.1
19616	*So. Manchester*	J. H. Quinn & Co	Acme	15.8	13.4
19627	*Stafford Spgs*	D. H. McCormick	Acme	15.1	13.8
19711	*Thompsonville*	Geo. R. Steele Est.	Acme	21.0	19.5
19707		Thompsonville Drug Co.	Wander's.	19.2	17.6
20104	*Willimantic*	Bay State Drug Co	Wander's.	23.1	20.8

Linseed Oil.

The official oil of the Pharmacopoeia is raw oil, i.e., not boiled.[2] Among other specifications, the specific gravity should be between 0.925 and 0.935 at 25° C. and the oil should be free from mineral and rosin oils. The refractive index[3] at 25° C. is between 1.4790 and 1.4805.

[1] U. S. P. IX, p. 96.
[2] U. S. P. IX, p. 295.
[3] Canada Inland Rev. Bull. 430, 1919.

Fifteen samples were examined and all found to conform essentially to the requirements of the Pharmacopoeia for raw oil and no adulterants were detected.

One sample, **17628**, submitted by the Department of Entomology of this station, conformed also to the usual requirements.

Milk of Magnesia.

Magnesia Magma yields not less than 6.5 per cent nor more than 7.5 per cent. of magnesium hydroxide, $Mg(OH)_2$.[1]

One sample, **20100**, contained 7.4 per cent. of magnesium hydroxide and was of standard quality.

Mercurial Ointment.

The official ointment will contain about 50.5 per cent. mercury on the basis of the formula given in the Pharmacopoeia. It should assay not less than 49 per cent. nor more than 51 per cent. of mercury.[2]

Diluted mercurial ointment, otherwise known as blue ointment, contains 60 per cent. of mercurial ointment of official strength and should assay from 29 per cent. to 31 per cent. of mercury.[3]

Only one sample, **20133**, of the full strength preparation was examined. It was said to be made by Powers and Weightman and was sold by the Sisson Drug Co., Hartford. It contained 45.9 per cent. of mercury which is about 94 per cent. of official strength.

Fifteen samples of diluted ointment were examined. Three of these, **19434**, **19442**, and **19713**, were not so marked and would therefore be presumed to be of full strength while **20153**, marked dilute, contained an excess of mercury for the dilute article. The assays are given in Table XXVI.

Tincture of Nux Vomica.

One hundred mils of this preparation yields not less than 0.237 gram nor more than 0.263 gram of the alkaloids of nux vomica.[4]

The single sample, **19643**, assayed was purchased at Thomas' Pharmacy, Rockville and contained 0.291 gram of the alkaloid which is about 10 per cent. in excess of the maximum limit.

[1] U. S. P. IX, p. 261.
[2] U. S. P. IX, p. 479.
[3] U. S. P. IX, p. 480.
[4] U. S. P. IX, p. 461.

TABLE XXVI. ASSAYS OF DILUTED MERCURIAL OINTMENT.

D. C. No.	City or Town	Dealer and Manfr. (if known)	Mercury, per cent.
19447	*Essex*	W. H. Pond (Powers & Weightman)	28.4
19434	*Greenwich*	Greenwich Drug Store	28.4
20405	*Guilford*	J. H. Monroe	27.3
20174	*Meriden*	W. Mosher (Powers & Weightman)	26.4
19419	*Naugatuck*	Vrehoe & Leary	31.1
19701	*New Britain*	L. K. Liggett Co (United Drug Co.)	30.6
19639	*Rockville*	Thomas' Pharmacy	30.2
19442	*Southport*	L. R. Switzer Drug Store (Eimer & Amend)	26.9
20249	*Stratford*	F. B. Brill (Park, Davis & Co.)	26.6
19713	*Thompsonville*	Geo. R. Steele Est. (United Drug Co.)	30.3
19708		Thompsonville Drug Co. (Norwich Phar. Co.)	29.4
20149	*Torrington*	Claxton's Pharmacy (Mallinkrodt)	30.7
20153		Donahue's Pharmacy	36.6
19722	*Wallingford*	Wallingford Drug Co., Inc. (Merck & Co.)	29.6
20114	*Willimantic*	Chas. de Villers (Park, Davis & Co.)	26.4

SPIRIT OF PEPPERMINT.

(ESSENCE OF PEPPERMINT.)

The official preparation should contain 10 per cent. by volume of peppermint oil[1] but no method is described in the Pharmacopoeia for the determination of oil. Mitchell's precipitation method,[2] in our experience, gives low results until the solution contains about 8 per cent. of oil when they are substantially correct. Howard's modification[2] is more satisfactory but is subject to some inaccuracies due to difficulties of technique. The tentative method[3] gives results which accord with Mitchell's method, at least on solutions containing 8 to 10 per cent. of oil. In preparations containing only small amounts (less than 5 per cent.), of oil we have used an abbreviated form of the tentative method centrifuging directly after the addition of saturated salt solution.

Fifty-eight samples have been examined. Six were very low in oil and five others were deficient by amounts ranging from 12 per cent. to 20 per cent. of the standard. The results are given in Table XXVII.

OIL OF TURPENTINE.

("SPIRITS OF TURPENTINE.")

Among other specifications official oil of turpentine should have a specific gravity of from 0.860 to 0.870 at 25 °C.; 5 mils should leave not more than 0.1 gram of residue on evaporation;

[1] U. S. P. IX, p. 409.
[2] Leach, 4th. Ed., p. 431.
[3] Methods of Analysis, A. O. A. C., p. 206.

TABLE XXVII. ASSAYS OF ESSENCE OF PEPPERMINT.

D. C. No.	City or Town	Dealer	Peppermint oil, per cent.
19418	*Ansonia*	Everett McQuade	10.0
20478	*Bethel*	English's Drug Store	10.8
20214	*Branford*	Spalding Drug Co.	9.6
20217		Branford Pharmacy	10.2
20408	*Bridgeport*	A. Parsdine	9.6
20414		Frank E. Fickett	9.2
19737	*Bristol*	Leroy Tucker	9.4
19742		Madden Drug Store	5.0
19744		Rickman's Economy Drug Store	10.0
20466	*Danbury*	Simons Pharmacy	4.6
20469		Kenner & Benjamin	6.1
20472		Northrop's Drug Store	14.8
20475		Doran's Drug Store	1.9
20476		Ideal Pharmacy	9.6
20321	*Danielson*	Woodward's Drug Store	11.2
19427	*Derby*	Clarence Hotchkiss	10.0
20484	*Fairfield*	The Boyle Pharmacy	1.7
20485		Randall's Pharmacy	9.2
20307	*Groton*	C. S. Woodhull Davis	9.2
20404	*Guilford*	F. F. Donden	10.0
20137	*Hartford*	The Sisson Drug Co.	2.5
20156		F. L. Palmer, Park Drug Store	10.4
20181	*Meriden*	Pinks Pharmacy	9.2
20120	*Middletown*	Lincoln's Drug Store	8.8
20238	*Milford*	J. H. Barnes	8.6
20324	*Moosup*	Frank La Rose & Co.	9.6
20303	*Mystic*	Mystic Pharmacy	8.6
19422	*Naugatuck*	C. G. Olson	9.8
19703	*New Britain*	L. K. Liggett Co.	10.2
20194	*New Haven*	T. P. Gillespie & Co.	9.9
20202		Horowich & Son	13.6
20220		Wood's Drug Store	9.6
20224		Visel & Kennedy	10.0
20490	*New London*	Starr Bros.	10.0
20499		Nichols & Harris Co.	9.2
20231	*New Milford*	W. N. Noble	9.0
20234		Albert Evitts	9.8
20481	*Norwalk*	H. Glendening & Co.	9.8
20330	*Norwich*	G. G. Engler	11.0
20333		James C. Mara	9.8
20337		Lee & Osgood	10.2
20309	*Putnam*	Edward H. Burt	9.0
20312		James F. Donahue	9.6
19748	*Southington*	Chafee's Drug Store	8.6
19626	*So. Manchester*	J. H. Quinn & Co.	9.6
20451	*South Norwalk*	Plaisted Drug Store	9.0
20454		Harold A. Mead	16.8
19437	*Stamford*	Borg Bros.	9.8
19719	*Thompsonville*	Geo. R. Steele Est.	9.0
20147	*Torrington*	Claxton's Pharmacy	9.6
19724	*Wallingford*	Wallingford Drug Co., Inc.	10.8
20163	*Waterbury*	H. W. Lake Drug Co.	9.2
20420	*West Haven*	W. J. Coughlan	8.0
20130	*Wethersfield*	W. T. Eagan	10.0
20107	*Willimantic*	Bay State Drug Co.	9.2
20116		Chas. de Villers	11.6
20241		John T. Howes	10.0
20141	*Winsted*	John A. Williams	8.0

unpolymerized oil should not exceed 1 per cent. and the refractive index of the unpolymerized portion should not be less than 1.5 at 20° C.[1]

Twenty samples were examined. One sample, **20186**, contained 5.6 per cent. of mineral oil. It was examined as follows:

Sp. Gr. 25° C. 0.858; unpolymerized oil 5.6 per cent.; refractive index at 20° C. of unpolymerized residue 1.4613; residue on evaporation 0.144 gram per 5 cc.

The sample was purchased of Paul Flynn, Unionville, and said to have been supplied by the Hoffman Wall Paper Co., New York.

The other samples were not found to be adulterated. In a few instances unpolymerized residues exceeded 1 per cent. but the constants thereof did not indicate mineral oil.

Witch Hazel Water

Hamamelis water or witch hazel water should contain not less than 14 per cent. of alcohol by volume and certain other specifications should obtain.[2]

Four samples were submitted and since the object of the examination was the detection of wood alcohol, only alcohol was determined. No wood alcohol was indicated in any case and there were no significant deficiencies of grain alcohol the percentages of which ranged from 13.20 per cent. to 14 per cent. Only two manufacturers were represented by the four samples, viz., the E. E. Dickenson Co., Essex, and Brewer & Co., Worcester, Mass.

Ointment of Zinc Oxide.

(Zinc Ointment.)

The official preparation contains 20 per cent. of zinc oxide (ZnO).[3] No method of assay is given but direct ignition of the ointment has been shown[4] to give reliable results and this method was followed.

Thirty-four samples were examined, nearly all of which were of standard or satisfactory quality. No deficiencies greater than 10 per cent. were found except sample **20200** which contained 88 per cent. of the required amount of zinc oxide. Assays are given in Table XXVIII.

[1] U. S. P. IX, p. 302; also Bureau of Chemistry, Bull. 135, p. 31 et seq.
[2] U. S. P. IX, p. 58.
[3] U.S.P. IX, p. 483.
[4] Mass. State Board of Health, Food and Drug Report 1909, p. 53.

Table XXVIII. Assays of Zinc Ointment.

D. C. No.	City or Town	Dealer and Manufacturer	Zinc Oxide, per cent.
19738	*Bristol*	Leroy Tucker, (Meyers & Co.)	18.0
20129	*Cromwell*	Geo. F. Chapin Est., (Lilly)	20.0
20463	*Danbury*	Burn's Drug Store, (Lilly)	19.8
20318	*Danielson*	Burroughs' Drug Store	18.5
19735	*East Hartford*	W. B. Noble, (Norwich Pharmacal Co.)	20.9
19731		O'Connell Drug Co., (Sisson Drug Co.)	20.2
20132	*Hartford*	Sisson Drug Co	20.5
20183	*Meriden*	N. P. Forcier	19.5
20180		Louis Liggett, (United Drug Co.)	20.2
20175		W. Mosher, (Sharpe & Dohme)	21.3
20123	*Middletown*	The Hartman Drug Co., (Bristol & Myers)	21.0
20304	*Mystic*	Mystic Pharmacy	19.4
19420	*Naugatuck*	Pickett Drug Co	18.9
19647	*New Britain*	L. K. Liggett, (United Drug Co.)	20.0
20200	*New Haven*	Spalding Drug Co., (Apothecaries Hall Co.)	17.6
20227	*New Milford*	Park Pharmacy, (Park, Davis & Co.)	19.0
20339	*Norwich*	Lee & Osgood	19.3
20331		Smith's Pharmacy, Inc.	18.1
20118	*Portland*	C. E. Blodgett, (E. L. Patch)	20.4
19638	*Rockville*	Thomas' Pharmacy, (Crystal Chem. Co.)	21.2
20400	*Saybrook*	Saybrook Pharmacy	20.2
19618	*So. Manchester*	J. H. Quinn & Co., (The Upjohn Co.)	19.5
20460	*South Norwalk*	L. K. Liggett Co., (United Drug Co.)	19.7
20456		Harold A. Mead, (Norwich Pharmacal Co.)	20.0
19629	*Stafford Springs*	D. H. McCormick, (United Drug Co.)	19.8
19634		Ethel Wikes, (McKesson & Robbins)	20.3
19436	*Stamford*	Jones Drug Store. (Sharpe & Dohme)	20.6
19712	*Thompsonville*	Geo. R. Steele Est., (United Drug Co.)	19.7
19706		Thompsonville Drug Co., (Norwich Pharmacal Co.)	19.8
20152	*Torrington*	Donahue's Pharmacy, (Upjohn & Co.)	20.6
19720	*Wallingford*	Wallingford Drug Co., Inc., (Sharpe & Dohme)	19.1
20165	*Waterbury*	Apothecaries Hall Co.	19.8
20105	*Willimantic*	Bay State Drug Co., (Norwich Pharmacal Co.)	19.7
20110		Cartier, The Druggist, (Claflin)	19.8

Zinc Stearate.

This preparation is essentially a compound of zinc and stearic acid and should contain an amount of zinc corresponding to not

less than 13 per cent. nor more than 15.5 per cent. of zinc oxide (ZnO).[1]

All of the fourteen samples examined fell within the limits prescribed.

TABLE XXIX. ASSAYS OF ZINC STEARATE.

D. C. No.	City or Town	Dealer and Manufacturer	Zinc Oxide, per cent.
20465	*Danbury*	Simons Pharmacy, (Lilly)	14.2
19728	*Glastonbury*	Peoples' Pharmacy, (Mallinckrodt Chem. Co.)	14.2
20178	*Meriden*	Louis Liggett Co., (United Drug Co.)	14.3
19646	*New Britain*	L. K. Liggett Co., (Merck & Co.)	14.4
20228	*New Milford*	Park Pharmacy	13.5
19637	*Rockville*	Thomas' Pharmacy, (American Druggists Syn.)	14.7
19431	*Shelton*	F. G. Sanford	13.3
19617	*So. Manchester*	J. H. Quinn & Co., (Norwich Pharmacal Co.)	14.2
20459	*South Norwalk*	L. K. Liggett Co., (United Drug Co.)	14.2
20453		Plaisted Drug Store, (E. Fougera & Co.)	14.4
19628	*Stafford Springs*	D. H. McCormick, (Merck & Co.)	13.5
19633		Ethel H. Wikes, (McKesson & Robbins)	14.0
19650	*Thompsonville*	Thompsonville Drug Co., (Merck & Co.)	14.4
20166	*Waterbury*	Apothecaries Hall Co.	14.8

MISCELLANEOUS DRUGS, ETC.

Nine samples of this class have been examined, chiefly for health officers and physicians.

17658, 17659, 17660, 17661. Drugs distributed by the Direct Sales Co., Buffalo, N. Y., and submitted by Dr. S. B. Kleiner of New Haven.

Five grain *aspirin* tablets were found to contain 5.07 grains per tablet. Five grain *sodium bromide* tablets were found to contain 5.01 grains per tablet. One-fourth grain *mercury iodide* tablets were found to contain 0.223 grain of HgI. Blank tablets, examined for color only, were found to be colored with Naphthol yellow S, a harmless dye.

15891. *Unknown* powder submitted by the Department of Health, Bridgeport. The material had been seized by the local police and was found to consist of, or contain, cantharides.

16600. *Laxative* tablets submitted by Dr. A. B. Sturges, Wallingford. They were found to consist of, or contain, phenolphthalein, licorice and an unidentified bitter principle. Tests for alkaloids and emodin-bearing drugs were negative.

16599. *Eye* solution given to dilate the pupil of the eye instead

[1] U.S.P. IX, p. 493.

of which, it was claimed, contraction resulted. The prescription called for dionin and duboisine in water. It was thought that physostigmine had been substituted for one of the ingredients.

Tests for physostigmine were negative but dionin was identified and the solution further caused the pupil of a cat's eye to dilate markedly within 20 minutes.

15876 and **15877.** *Medicines,* sent by Dr. John T. Black of the State Board of Health for identification of any medicaments. Iodides were identified in both preparations and no further examination was made.

Fourteen other materials were examined which do not require extended comment. Among these were *roach powders* consisting essentially of borax, naphthalene, ammonium carbonate and probably Persian insect powder or variations of these ingredients; *tobacco dust* and various *arsenicals* for dusting purposes; *tobacco* and *sal ammoniac.* A sample of Mrs. Potter's Walnut Tint Hair Stain was made up of paraphenylene-diamine and hydrogen peroxide in separate containers; this combination has been commented upon in previous reports.[1]

[1] Conn. Exp. Sta. Bull. 227, p. 271; Report 1914, p. 289.

SUMMARY.

Materials	Sampled by, or at request of: Station Agent	Dairy and Food Commissioner	Individuals	Total	Adulterated, below standard or otherwise illegal
FOODS.					
Carbonated Beverages	....	153	....	153	21
Casein	6	....	....	6	....
Calcium Casein	5	....	....	5	....
Cider	....	4	....	4	3
Cocoa	....	3	2	5	....
Coffee	1	....	1	2	....
Diabetic Foods, etc.	39	....	25	64	....
Fats and Oils:					
Olive Oil	....	1	....	1	....
Cooking fats	....	7	....	7	....
Butter	....	10	5	15	1
Oleomargarine	....	1	4	5	....
Ice cream	....	329	15	344	27
Milk and Milk Products:					
Cryoscopic studies of milk	103	....	....	103	....
Market milk	....	967	98	1,065	377
Cream	....	4	22	26	....
Condensed milk, etc.	....	2	6	8	2
Human milk	....	....	30	30	....
Oysters	....	3	....	3	1
Tea	3	....	....	3	....
Vinegar	....	13	8	21	7
Miscellaneous Materials:					
Foods, etc.	....	3	18	21	3
Other materials	....	8	23	31	....
Total	157	1,508	257	1,922	442
DRUGS.					
Proprietary Remedies	3	2	....	5	....
U. S. P. Drugs:					
Bay Rum	....	24	....	24	19
Belladonna, Tincture of	....	9	....	9	....
Belladonna Leaves, Powder	....	1	....	1	1
Bismuth, Milk of	....	10	....	10	2
Calcium Hydroxide, Solution of	....	69	....	69	12
Colchicum Seed, Tincture of	....	2	....	2	....
Ferric Chloride, Tincture of	....	18	....	18	....
Ferrous Iodide, Syrup of	....	6	....	6	....
Hydriodic Acid, Syrup of	....	16	....	16	2
Iodine, Tincture of	....	35	....	35	1
Ipecac, Powdered	....	4	....	4	....
Lime, Chlorinated	....	8	....	8	8
Linseed Oil	....	15	1	16	....
Magnesia, Milk of	....	1	....	1	....
Mercurial Ointment	....	1	....	1	....
Mercurial Ointment, Dilute	....	15	....	15	4
Nux Vomica, Tincture of	....	1	....	1	....
Peppermint, Essence of	....	58	....	58	11
Turpentine	....	20	....	20	1
Witch Hazel	....	4	....	4	....
Zinc Ointment	....	34	....	34	1
Zinc Stearate	....	14	....	14	....
Miscellaneous Drugs, etc.	....	....	23	23	....
Total	3	367	24	394	62
Total for Foods and Drugs	160	1,875	281	2,316	504