TABLE II. ANALYSES OF SPECIAL FOODS—*Continued.*

Date of analysis	Manufacturer and Brand	Water	Ash	Nitrogen	Protein	Fiber	Carbohydrate (other than fiber): Starch	Carbohydrate (other than fiber): Undetermined carbohydrate	Fat	Calories per 100 gms.
	Hard Breads and Bakery Products—Cont.									
	Loeb's Diabetic Food Bakery, New York City.	%	%	%	%	%	%	%	%	
1923	Aerated Bread	5.53	1.60	8.73	49.76	0.34	23.59[1]	7.00	12.18	431
1919	Aerated Gluten Bread	9.17	1.78	8.04	47.83	0.18	26.78	3.18	11.08	411
1914	Diabetic Almond Macaroons	3.22	2.98	7.44	46.50	1.53	0.64	7.36	37.77	558
1916	Diabetic Almond Macaroons	4.55	4.01	5.48	34.25	1.72	trace	10.46	45.01	584
1919	Diabetic Almond Macaroons	5.90	4.39	4.86	30.38	1.93	0.59	10.48	46.33	713
1914	Diabetic Bread Sticks	8.72	2.28	8.07	50.44	0.60	24.64	9.88	3.44	371
1916	Diabetic Bread Sticks	8.15	2.87	7.41	46.31	0.19	35.92	7.17	0.29	339
1919	Diabetic Bread Sticks	9.14	2.67	6.69	41.81	0.20	35.44	6.93	3.81	331
1919	Diabetic Bread Sticks	7.99	3.87	6.72	42.00	0.15	35.23	10.32	0.44	314
1919	Diabetic Bread Sticks, Almond	7.93	2.00	6.30	39.38	0.70	31.22	7.08	11.69	416
1916	Diabetic Butter Cookies	6.14	2.22	6.29	39.31	0.15	32.18	5.07	14.93	471
1916	Diabetic Butter Cookies	4.07	2.86	5.02	31.38	0.35	30.66	8.39	22.29	482
1919	Diabetic Butter Cookies	8.85	3.06	5.84	36.50	0.13	31.05	8.38	12.03	412
1914	Diabetic Lady Fingers	6.01	2.75	9.05	56.56	0.35	1.81	4.23	28.29	505
1916	Diabetic Lady Fingers	5.97	3.46	7.68	48.00	0.07	2.14	7.57	32.79	527
1919	Diabetic Lady Fingers	8.33	4.41	7.64	47.75	0.05	1.91	3.50	34.05	519
1914	Diabetic Sponge Cookies	6.92	2.75	8.75	54.69	0.55	1.24	3.74	30.11	510
1916	Diabetic Sponge Cookies	5.82	3.49	7.14	44.63	0.23	1.91	6.75	37.17	548
1919	Diabetic Sponge Cookies	8.66	4.45	7.95	49.69	0.11	1.91	1.41	33.77	516
1919	Gluten Bread	7.85	1.80	7.46	42.52	0.22	27.71	8.76	11.14	416
1914	Gluten Luft Bread	5.68	2.05	8.38	47.77	0.63	22.89	7.74	13.24	433
1916	Gluten Luft Bread	7.05	1.20	7.12	40.58	0.18	29.93	11.28	9.78	415
1916	Gluten Zwieback	8.27	2.34	7.27	41.44	0.20	35.72	9.64	2.39	369
1915	Gluten Zwieback	8.39	1.45	7.47	42.58	0.18	23.43	10.52	13.45	427
1919	Gluten Zwieback	9.61	1.91	6.78	38.65	0.14	36.06	10.64	2.99	368
	Loeb's Diabetic Food Bakery, New York City—Concluded.									
1915	Gluten Almond Zwieback	7.84	2.38	6.81	42.56	0.60	19.13	6.90	20.59	460
1916	Gluten Almond Zwieback	8.04	1.97	7.04	44.00	0.33	33.10	6.46	6.10	389
1919	Gluten Almond Zwieback	8.91	1.94	6.60	41.25	0.58	32.57	6.97	7.78	392
	Gustav Müller & Co., Agent, New York City.									
1913	Charasse Biscuits Croquettes au Gluten	7.30	0.50	5.49	31.30	0.20	30.60	14.70	5.40	395
1913	Charasse Biscottes Lucullus	7.50	1.80	1.82	11.40	0.20	59.20	14.20	5.70	391
1913	Charasse Gluten Exquis Biscuits aux Amandes	5.30	1.60	2.90	16.50	0.60	25.50	26.70	23.80	489
1913	Charasse Gluten Fleur de Neige Pain	6.10	2.30	5.74	32.70	0.40	25.10	20.90	12.50	427
1913	Charasse Mignonettes au Gluten	8.20	2.10	6.42	36.60	0.30	27.30	19.80	5.70	386
1913	Charasse Pain de Gluten	8.10	2.10	6.53	37.20	0.20	27.20	19.90	5.30	385
1913	Charasse Tranches Grilles pour Potage	7.70	2.30	6.50	40.60	0.30	28.80	16.70	3.60	377
	Nasmith's Ltd., Toronto.									
1916	Diabetic Bread	8.15	1.75	1.82	11.38	....	63.71	13.77	1.24	331
	Nutrivoid Diabetic Flour Co., Brooklyn, N. Y.									
1925	Nutrivoid Bran Wafers	4.98	6.33	0.92	5.75	8.68	4.20[2]	38.98	31.08	...
	Pure Gluten Food Co., New York City.									
1914	No. 1 Dainty Fluffs	7.04	0.75	12.79	79.94	0.45	10.74	0.54	0.54	370
1914	No. 2 Dainty Fluffs	7.45	0.68	10.60	66.25	0.28	21.85	3.02	0.47	369
1916	Dainty Fluffs	7.15	1.25	12.81	80.04	0.12	7.65	2.97	0.82	370
1913	Gum Gluten Biscuit Crisps	5.30	1.70	6.86	39.10	0.90	39.30	13.00	0.70	372
1914	Gum Gluten Biscuit Crisps	5.97	1.70	8.43	48.05	1.08	31.22	11.46	0.52	368
	Rademann's Nährmittelfabrik, Frankfurt.									
1893	Diabetiker-Biscuits	2.90	3.50	7.06	44.10	....	10.00	9.70	29.80	523
1913	Diabetiker-Biscuits	5.00	1.10	4.74	29.60	0.20	25.90	18.60	19.60	473
1913	Diabetiker-Bretzel	6.80	3.00	5.02	31.40	0.20	40.70	9.40	8.50	402
1910	Diabetiker-Cakes	....	....	2.02	12.60	....	39.80		....	...
1913	Diabetiker-Cakes	6.50	3.00	4.74	29.60	0.20	39.10	8.10	13.50	429
1893	Diabetiker-Chokolade-Biskuits	1.80	3.80	7.18	44.90	....	11.80	10.10	27.60	516
1913	Diabetiker-Dessert-Gebäck	4.30	2.50	3.55	22.20	1.10	5.90	21.60	42.40	580

[1] Includes 2.83 per cent water-soluble carbohydrates.

[2] All water-soluble carbohydrates.

TABLE II. ANALYSES OF SPECIAL FOODS—*Continued.*

Date of analysis	Manufacturer and Brand	Water	Ash	Nitrogen	Protein	Fiber	Carbohydrate (other than fiber)		Fat	Calories per 100 gms.
							Starch	Undetermined carbohydrate		
	Hard Breads and Bakery Products—Cont.									
	Rademann's Nährmittelfabrik, Frankfurt—Concl.	%	%	%	%	%	%	%	%	
1910	Diabetiker-Makronen	....	....	1.97	12.30	....	11.30		....	...
1910	Diabetiker-Makronen	4.50	3.20	3.57	22.30	1.10	8.80	12.10	48.00	605
1913	Diabetiker-Makronen	4.00	3.00	3.71	23.20	1.20	3.00	17.60	48.00	607
1910	Diabetiker-Stangen	....	....	3.63	22.70	....	17.00		....	...
1910	Diabetiker-Stangen	10.50	2.10	4.77	29.80	....	24.60[1]		33.00	515
1913	Diabetiker-Stangen	4.50	3.60	2.83	17.70	0.50	21.40	8.10	44.20	586
1910	Diabetiker-Zwieback	....	....	2.62	16.40	....	37.60		....	...
1910	Diabetiker-Zwieback	9.40	2.20	4.03	25.20	....	47.00	4.30[1]	11.90	413
1893	Erdnuss-Biskuits	1.90	2.70	5.57	34.80	....	9.00	30.10	21.50	489
1910	Käsestangen	6.90	2.20	1.79	11.20	....	50.49[1]		29.30	511
1913	Käsastangen	6.70	3.80	1.49	9.30	0.10	38.00	8.40	33.70	524
1910	Sanitätszwieback	....	....	2.80	17.50	....	58.40		....	...
	Schelle, Braunschweig.									
1897	Aleuronat-Kakes	4.90	1.30	3.18	18.10	....	64.90[1]		10.80	429
	R. M. Scott, Ipswich, England.									
1923	Gluten and Almond Biscuits	5.93	2.24	3.80	23.75	0.50	44.49[2]	3.18	19.91	465
	Seidl, München.									
1910	Kleberzwieback	6.30	....	2.37	13.50	....	67.90		7.80	396
	La Societe L'Alimen' "Essential," Nanterre, France.									
1921	Cacao and Oat Cakes	6.90	2.81	2.25	14.06	1.98	44.26[3]	17.72	12.27	475
1921	Heudebert, Aleurone Bread	7.00	2.81	12.07	68.80	0.21	6.66[4]	8.23	6.19	390
1921	Heudebert, Aleurone Bread	9.82	3.19	10.39	59.22	0.76	16.28[5]	6.73	4.00	365
1921	Heudebert, Bread of Gluten	10.11	2.71	10.78	61.45	0.51	11.20[6]	8.04	5.98	377
1921	Heudebert, Bread of Gluten	6.83	2.62	10.82	61.67	0.31	14.69[7]	7.03	6.85	395
1921	Heudebert, Bread of Gluten	6.33	2.66	10.94	62.36	0.32	15.25[8]	7.40	5.68	391
1921	Heudebert, Rolls with Gluten	7.51	2.32	1.70	9.69	0.43	66.10[9]	5.20	8.75	403
1921	Heudebert, Rusks of Gluten	6.56	1.62	1.90	10.84	0.44	67.35[10]	5.56	7.63	404
1921	Heudebert, Special Diabetic Bread	7.01	2.91	10.48	59.74	0.57	17.64[11]	5.38	6.75	392
1921	Heudebert, Special Diabetic Bread	11.19	3.04	9.01	51.36	0.41	21.12[12]	7.79	5.09	367
1921	"Regimette" Dessert Cake	3.68	1.27	1.10	6.88	0.37	67.90[13]	8.35	11.55	436
	James Strachen.									
1916	Gluten Bread	6.20	2.20	2.96	16.87	0.10	52.74	21.29	0.60	369
	Therapeutic Food Co., Inc., New York and London.									
1924	Aleurone Bread	9.89	3.16	10.88	62.02	0.27	15.42[14]	7.54	1.67	355
1924	Bread of Gluten	9.03	3.80	12.56	71.59	0.07	6.29[15]	7.73	1.49	356
1924	Brusson Jeune Gluten Bread	10.01	0.72	6.89	39.27	0.14	12.83[16]	36.04	0.99	361
1923	Dr. Charrasse Gluten Bread	7.83	2.25	7.49	42.69	0.16	35.99[17]	5.25	5.83	388
1923	Dr. Charrasse Gluto-Kola Bread	8.51	2.17	7.34	45.88	0.16	37.26[18]	0.00	6.02	387
1923	Dr. Charrasse Gluto-Soja Bread	8.11	2.20	7.77	48.56	0.26	33.30[19]	0.69	6.88	392
1923	Dr. Charrasse Supreme Bread	8.21	2.45	7.30	45.63	0.22	35.93[20]	0.64	6.92	370
1923	Energen New Natural Gluten Bread	7.05	0.97	5.80	33.06	0.59	44.04[21]	4.23	10.06	416
1925	Gluten Bread	5.67	4.59	12.81	73.02	0.26	5.93[22]	6.85	3.68	376
1924	Special Diabetic Bread	9.44	2.86	11.06	63.04	0.14	15.01[23]	8.43	1.08	356
	Roman Uhl, Carlsbad.									
1913	Carlsbad-Water Biscuits, "Sprudel" Brand	8.10	1.70	1.60	10.00	0.20	55.60	19.20	5.20	386
	G. Van Abbott & Sons, London.									
1913	Caraway Biscuits for Diabetics	6.70	3.60	5.70	35.60	0.70	8.60	7.30	37.50	544
1913	Diabetic Rusks for Diabetics	10.80	1.20	11.34	70.90	0.30	12.60	3.40	0.80	355

[1] Includes fiber.
[2] Includes 3.76 per cent water-soluble carbohydrates.
[3] Includes 7.23 per cent water-soluble carbohydrates.
[4] Includes 0.15 per cent water-soluble carbohydrates.
[5] Includes 2.72 per cent water-soluble carbohydrates.
[6] Includes 1.24 per cent water-soluble carbohydrates.
[7] Includes 1.10 per cent water-soluble carbohydrates.
[8] Includes 0.93 per cent water-soluble carbohydrates.
[9] Includes 6.98 per cent water-soluble carbohydrates.
[10] Includes 9.30 per cent water-soluble carbohydrates.
[11] Includes 1.52 per cent water-soluble carbohydrates.
[12] Includes 2.36 per cent water-soluble carbohydrates.
[13] Includes 20.90 per cent water-soluble carbohydrates.
[14] Includes 2.03 per cent water-soluble carbohydrates.
[15] Includes 0.40 per cent water-soluble carbohydrates.
[16] Includes 3.83 per cent water-soluble carbohydrates.
[17] Includes 3.73 per cent water-soluble carbohydrates.
[18] Includes 4.50 per cent water-soluble carbohydrates.
[19] Includes 3.26 per cent water-soluble carbohydrates.
[20] Includes 3.33 per cent water-soluble carbohydrates.
[21] Includes 8.60 per cent water-soluble carbohydrates.
[22] Includes 1.26 per cent water-soluble carbohydrates.
[23] Includes 0.96 per cent water-soluble carbohydrates.

TABLE II. ANALYSES OF SPECIAL FOODS—*Continued.*

Date of analysis	Manufacturer and Brand	Water	Ash	Nitrogen	Protein	Fiber	Carbohydrate (other than fiber) Starch	Carbohydrate (other than fiber) Undetermined carbohydrate	Fat	Calories per 100 gms.
	Hard Breads and Bakery Products—Concl.									
	G. Van Abbott & Sons, London—Concluded.	%	%	%	%	%	%	%	%	
1913	Euthenia Biscuits	5.50	3.40	5.73	35.80	1.40	6.90	6.30	40.70	562
1913	Gluten Biscottes or Rolls	10.50	2.40	8.26	47.10	0.20	29.80	7.70	2.30	359
1913	Gluten Bread or Slices	10.60	2.00	8.66	49.40	0.20	27.40	8.20	2.20	361
1913	Gluten Butter Biscuits for Diabetics	6.10	3.00	7.06	40.20	0.90	9.00	7.60	33.20	526
1913	Ginger Biscuits for Diabetics	4.10	3.40	5.54	34.60	1.80	10.90	5.80	39.40	560
1913	Midolia Biscuits	6.00	4.30	2.82	17.60	4.10	13.40	18.20	36.40	524
1913	Walnut Biscuits for Diabetics	4.40	2.90	3.34	20.90	2.30	trace	12.30	57.20	648
1923	Soya Biscuits	4.85	5.52	6.27	39.19	2.20	11.44[1]	11.82	24.98	475
	Waukesha Health Products Co., Waukesha, Wis.									
1919	Hepco Dodgers	8.73	5.68	6.79	42.44	3.85	1.01	21.56	16.73	411
	Weston's Bakery, Boston, Mass.									
1915	Gluten Cookies	....	....	4.86	27.70	....	19.59	....	....	...
	Woman's Baking Co., Boston, Mass.									
1921	Bran Cookies, Anice	16.12	....	1.18	7.39	....	5.19[2]	....	25.87[3]	...
1921	Bran Cookies, Caraway	15.29	....	1.30	8.13	....	3.48[2]	....	23.36[3]	...
1920	Bran Cookies, Caraway	12.24	6.90	1.30	8.13	2.62	6.49[2]	38.61	25.01[3]	...
1921	Bran Cookies, Cocoa Nib	13.41	....	1.30	8.13	....	6.14[2]	....	27.80[3]	...
1920	Bran Cookies, Cocoa Nib	14.87	6.30	1.33	8.33	6.05	11.24[2]	29.17	24.04[3]	...
1921	Bran Cookies, Spice	15.04	....	0.98	6.11	....	6.32[2]	....	26.75[3]	...
1920	Bran Cookies, Spice	16.31	6.43	1.12	6.99	6.90	12.21[2]	32.48	18.68[3]	...
1921	Bran Muffins	28.41	....	1.33	8.33	....	4.76[2]	....	6.11[3]	...
1920	Bran Muffins	41.51	6.50	1.00	6.26	6.72	6.37[2]	27.03	5.61[3]	...
1921	Cellu Biscuit	29.31	....	0.48	3.00	....	4.76[2]	....	11.81[3]	...

1920	Cellu Biscuit	32.81	6.33	0.53	3.34	14.26	3.01[2]	25.65[4]	14.60[3]	...
1920	Cellu Cookies, Caraway	14.16	5.48	0.89	5.58	16.53	3.84[2]	31.95[4]	22.46[3]	...
1921	Cellu Cookies, Lemon	12.28	....	0.65	4.10	....	3.12[2]	....	27.35[3]	...
1920	Cellu Cookies, Lemon	12.94	5.22	0.69	4.32	17.43	4.62[2]	34.10[4]	21.37[3]	...
1921	Cellu Cookies, Vanilla	14.13	....	0.66	4.11	....	4.39[2]	....	23.35[3]	...
1920	Cellu Cookies, Vanilla	17.16	5.69	9.71	4.45	16.98	3.80[2]	32.61[4]	19.31[3]	...
1920	Cellu Kisses	17.85	4.09	3.68	23.00	27.12	2.49[2]	25.22[4]	0.23[3]	...
1921	Cellu Muffins	23.62	....	0.61	3.84	....	3.38[2]	....	14.33[3]	...
1920	Cellu Muffins	29.08	5.71	0.59	3.66	18.23	3.71[2]	27.02[4]	12.93[3]	...
1920	Cellu Nuts	15.91	5.71	0.86	5.38	16.80	3.64[2]	23.82[4]	28.74[3]	...
1921	Cellu Soup Wafers	15.96	....	0.53	3.32	....	4.25[2]	....	27.66[3]	...
1920	Cellu Soup Wafers	14.22	6.66	0.64	4.01	14.97	4.12[2]	31.39[4]	24.63[3]	...
	Miscellaneous.									
1921	Passover Bread	7.04	0.60	2.38	14.88	0.38	70.46	6.64	0.37	371
	Breakfast Foods.									
	Arnaud, Inc., New York City.									
1921	Starchless Breakfast Food	10.39	2.06	0.32	2.00	4.16	70.85[5]	10.32	0.21	335
	Brusson Jeune, Villemur, France.									
1913	Farine au Gluten	10.90	0.60	5.42	30.90	0.20	48.80	8.00	0.60	356
1910	Gluten Semolina	9.70	0.70	2.75	15.70	0.30	64.90	8.20	0.50	360
	Curdolac Food Co., Waukesha, Wis.									
1924	Krinkles	8.52	4.40	1.73	10.81	11.53	4.77[6]	45.53	14.44	374
	Dieto Food Co., New York City.									
1914	Dieto Nut Cereal	5.00	1.95	3.46	21.63	1.22	39.54	12.28	18.38	459
1914	Wheat and Barley Cereal	6.77	1.68	1.86	11.63	2.00	61.42	14.35	2.15	359
	Efficiency Products Co., Somerville, N. J.									
1926	Ecmo Breakfast Food	10.81	1.89	1.02	6.38	8.16	2.56[7]	69.12[4]	1.08	...
1924	Nut Flakes	9.56	1.04	0.70	4.38	5.61	2.78[7]	75.59[4]	1.04	...

[1] Includes 8.94 per cent water-soluble carbohydrates.
[2] Includes water-soluble carbohydrates.
[3] Largely mineral oil.
[4] Largely unassimilable.
[5] Includes 6.72 per cent water-soluble carbohydrates.
[6] Includes 3.90 per cent water-soluble carbohydrates.
[7] All water-soluble carbohydrates.

TABLE II. ANALYSES OF SPECIAL FOODS—*Continued.*

Date of analysis	Manufacturer and Brand	Water	Ash	Nitrogen	Protein	Fiber	Carbohydrate (other than fiber)		Fat	Calories per 100 gms.
							Starch	Undetermined carbohydrate		
	Breakfast Foods—Continued.									
	Farwell & Rhines, Watertown, N. Y.	%	%	%	%	%	%	%	%	
1913	Barley Crystals	9.90	1.20	1.84	11.50	0.90	62.70	12.50	1.30	359
1913	Cresco Grits	11.10	0.60	2.85	17.80	0.50	54.10	14.50	1.40	358
	William Hazard Co., New York City.									
1908	Hazard's Wheat Protein Breakfast Food	8.50	0.70	6.42	36.60	....	53.20[1]		1.00	368
	Health Food Co., New York City.									
1913	Manana	10.20	2.40	6.02	37.60	1.10	31.00	15.80	1.90	355
1914	Manana Gluten Breakfast Food	7.56	2.53	6.82	38.87	1.73	29.87	17.45	1.99	363
1919	Manana Gluten Breakfast Food	8.49	2.47	7.86	44.80	1.09	21.99	12.47	8.69	396
1919	Protosoy (Cereal)	7.65	5.39	6.42	40.13	3.78	trace	24.88	18.17	424
	Jireh Diabetic Food Co., New York City.									
1913	Whole Wheat Farina	6.20	1.80	2.06	11.70	2.20	59.50	16.30	2.30	371
1913	Frumenty	6.20	1.40	1.97	12.30	1.10	65.40	11.90	1.70	374
	Kellogg Food Co., Battle Creek, Mich.									
1911	Granola	6.10	2.30	2.22	13.90	0.60	45.20	31.10	0.80	368
	Kellogg's Toasted Corn Flake Co., Battle Creek, Mich.									
1923	Kellogg's Bran Cooked and Krumbled	5.05	6.30	2.31	14.41	....	68.53[1]	....	3.40	362
	Kramer Surgical Stores, New York City.									
1926	Breakfast Cereal	5.64	4.02	5.25	32.81	5.76	3.54[2]	46.98	1.25	345
	Lister Bros., Inc., New York City.									
1924	Starch-free Bran	8.16	4.30	2.62	16.38	21.14	1.63[3]	44.37	4.02	286
1924	Starch-free Bran	5.65	5.72	2.80	17.50	18.88	5.73[4]	40.97	5.55	307
	Loeb's Diabetic Food Bakery, New York City.									
1919	Caseine Breakfast Cereal	4.52	4.61	5.86	36.63	....	0.70	11.02[1]	42.52	576
1919	Gluten Breakfast Cereal	4.38	2.73	5.12	29.18	1.04	25.51	17.78	19.38	464
	S. S. Pierce Co., Boston, Mass.									
1926	Deshell Starchless Agar Flakes	10.50	3.96	0.30	1.88	0.25	none	83.26[5]	0.15	...
	Plasmon, Ltd., London.									
1923	Plasmon Oats	9.02	1.80	2.77	17.31	0.53	57.39[6]	5.86	8.09	395
	Pure Gluten Food Co., New York City.									
1919	Gluten Breakfast Food	9.17	1.32	7.16	40.75	0.10	35.70	12.28	0.68	361
1904	Gum Gluten Breakfast Food	9.50	0.90	8.70	49.60	0.50	30.40	8.30	0.80	360
1906	Gum Gluten Breakfast Food	9.10	1.10	8.54	48.70	0.30	31.00[7]	8.20	1.60	366
1911	Gum Gluten Breakfast Food	7.50	1.20	6.05	34.40	0.40	37.90	17.30	1.30	370
1911	Gum Gluten Granules	7.50	1.50	7.28	41.50	0.30	32.30	15.30	1.60	371
1916	Gum Gluten Granules	6.95	0.80	6.90	39.33	0.08	40.50	11.42	0.92	363
1914	Hoyt's Gum Gluten Breakfast Food	6.48	0.60	7.26	41.38	0.28	39.21	11.19	0.86	375
1914	Hoyt's Gum Gluten Granules	6.64	0.73	6.83	38.93	0.45	41.93	10.63	0.69	372
1901	Pure Gluten Breakfast Cereal	9.30	0.70	6.99	39.80	0.30	48.30		1.60	367
1923	Hoyt's Gluten Flakes	8.18	3.55	7.84	44.69	3.89	16.48[8]	18.86	4.35	359
1924	Hoyt's Gluten Flakes	....	....	7.52	42.86	....	....	....	....	...
1924	Hoyt's Gluten Flakes	5.94	3.78	7.77	44.29	5.93	12.83[9]	22.05	5.18	363
1924	Hoyt's Gluten Flakes	7.45	4.14	7.14	40.70	4.73	16.57[10]	24.18	2.23	346
1924	Hoyt's Special Gluten Flakes	8.64	1.01	13.00	74.10	0.31	5.91[11]	8.09	1.94	370
1924	Hoyt's Protein Cereal	5.95	0.98	13.93	79.40	0.38	2.85[12]	8.89	1.55	379

[1] Includes fiber.
[2] Includes 1.46 per cent water-soluble carbohydrates.
[3] Includes 0.76 per cent water-soluble carbohydrates.
[4] Includes 2.86 per cent water-soluble carbohydrates.
[5] Largely unassimilable.
[6] Includes 2.94 per cent water-soluble carbohydrates.
[7] Includes water-soluble carbohydrates.
[8] Includes 11.98 per cent water-soluble carbohydrates.
[9] Includes 9.96 per cent water-soluble carbohydrates.
[10] Includes 11.84 per cent water-soluble carbohydrates.
[11] Includes 0.67 per cent water-soluble carbohydrates.
[12] Includes 0.80 per cent water-soluble carbohydrates.

TABLE II. ANALYSES OF SPECIAL FOODS—*Continued.*

Date of analysis	Manufacturer and Brand	Water	Ash	Nitrogen	Protein	Fiber	Carbohydrate (other than fiber)		Fat	Calories per 100 gms.
							Starch	Undetermined carbohydrate		
	Breakfast Foods—Concluded.									
	Pure Gluten Food Co., Columbus, Ohio.	%	%	%	%	%	%	%	%	
1919	Hoyt's Gluten Breakfast Food, 40% Protein ..	9.23	0.93	8.07	46.00	0.51	31.39	10.15	1.79	366
1919	Hoyt's Gluten Granules, over 40% Protein ...	9.75	0.97	7.68	43.78	0.68	32.15	10.08	2.59	327
	Gerda H. Wagner, Brooklyn, N. Y.									
1924	Diabetic Cereal	7.45	4.47	1.61	10.06	13.28	1.35[1]	58.82	4.57	322
	Waukesha Health Products Co., Waukesha, Wis.									
1919	Hepco Grits	8.88	5.51	6.44	40.25	4.19	0.87	23.91	16.39	408
	Macaroni, Noodles, etc.									
	Brusson Jeune, Villemur, France.									
1910	Pâtes aux Oeufs Macaroni	8.80	0.70	2.22	13.90	trace	69.20	7.00	0.40	364
1910	Pâtes aux Oeufs Nouillettes	8.70	0.70	2.30	14.40	trace	68.90	6.80	0.50	365
1913	Petites Pâtes au Gluten	9.00	0.80	2.98	17.00	0.20	61.20	10.80	1.00	365
1910	Vermicelle au Gluten	8.00	0.80	2.94	16.80	trace	65.80	8.20	0.40	367
	Callard & Co., London.									
1923	Casoid Flakes (Macaroni Paste)	9.63	7.41	12.56	78.50	0.22	1.16[2]	0.01	3.07	346
1923	Casoid Vermicelli	9.33	7.31	12.80	80.00	0.13	0.50[2]	0.00	2.73	347
	The Dieto Food Co., New York City.									
1914	Whole Wheat Brand Macaroni	9.81	0.90	2.22	13.88	0.57	58.72	14.98	1.14	361
	Jireh Diabetic Food Co., New York City.									
1913	Macaroni	8.80	1.10	2.70	16.90	0.90	58.80	12.60	0.90	361
	Kramer Surgical Stores, New York City.									
1926	Macaroni	5.50	6.48	6.68	41.75	3.99	4.51[3]	32.93	4.84	360
1926	Broad Noodles	5.05	6.45	6.61	41.31	2.61	5.60[4]	33.84	5.14	369
1926	Fine Noodles	4.75	6.63	6.67	41.69	2.58	4.66[5]	34.56	5.13	370
	Eugene Loeb, New York City.									
1913	Home Made Noodles	9.80	1.00	6.69	41.80	0.20	36.70	5.00	5.50	384
	Loeb's Diabetic Food Bakery, New York City.									
1916	Gluten Noodles	9.25	0.69	7.23	41.21	0.15	33.19	14.48	1.03	365
1919	Gluten Noodles	10.23	1.63	6.54	37.28	0.15	36.84	10.28	3.59	370
	The Marvelli Co., Detroit, Mich.									
1901	Macaroni	13.40	0.50	3.31	20.70	....	64.80[6]		0.60	347
1912	Spaghetti	....	....	2.48	15.50	....	....	....	....	...
	Pure Gluten Food Co., New York City.									
1906	Gum Gluten Macaroni	10.30	0.70	6.62	37.70	0.30	46.20[2]	3.80	1.00	360
1911	Gum Gluten Noodles	8.30	1.10	5.86	33.40	0.20	42.00	12.60	2.40	374
1914	Hoyt's Gum Gluten Noodles	8.21	0.65	6.48	36.93	0.33	41.82	10.83	1.23	369
	Nuts and Nut Preparations.									
	Dieto Food Co., New York City.									
1914	Pine Nuts	2.23	4.55	6.35	39.69	0.75	none	2.76	50.02	620
	Chas. Lawrence Co., Boston, Mass. (sold by).									
1913	California Paper Shell Almonds, edible portion	3.50	3.50	2.94	18.40	3.00	none	16.30	55.30	637
	Christian National Food Co., Kenilworth, N. J.									
1916	Christian's Protoid Nuts	4.23	4.27	6.02	37.63	....	trace	5.65[6]	48.22	607
	Jireh Diabetic Food Co., New York City.									
1913	Diabetic Pine Nuts (Pignolias)	2.00	4.60	6.35	39.70	0.90	none	3.40	49.40	617

[1] All water-soluble carbohydrates.
[2] Includes water-soluble carbohydrates.
[3] Includes 2.48 per cent water-soluble carbohydrates.
[4] Includes 2.70 per cent water-soluble carbohydrates.
[5] Includes 2.66 per cent water-soluble carbohydrates.
[6] Includes fiber.

TABLE II. ANALYSES OF SPECIAL FOODS—*Continued.*

Date of analysis	Manufacturer and Brand	Water	Ash	Nitrogen	Protein	Fiber	Carbohydrate (other than fiber)		Fat	Calories per 100 gms.
							Starch	Undetermined carbohydrate		
	Nuts and Nut Preparations—Concluded.									
	The Kellogg Food Co., Battle Creek, Mich.	%	%	%	%	%	%	%	%	
1906	Almond Butter (Sanitas)	0.90	2.90	3.62	22.60	3.90	3.70[1]	4.50	61.50	677
1908	Almond Butter (Sanitas)	2.30	3.00	3.47	21.70	....	11.50[2]		61.50	686
1901	Malted Nuts	2.60	2.20	3.79	23.70	....	43.90[2]		27.60	519
1913	Nut Bromose (Meltose and Nuts)	14.00	1.50	2.73	17.10	1.20	3.20	36.20	26.80	467
1906	Nut Butter (Sanitas)	0.20	2.90	4.61	28.80	3.70	9.10[1]	4.80	50.50	625
1906	Nut Meal	3.00	2.20	4.64	29.00	2.00	8.90[1]	3.20	51.70	630
1906	Nuttolene	55.20	2.20	2.03	12.70	1.80	6.30		21.80	272
1913	Pine Nuts	2.60	4.50	6.08	38.00	1.10	4.20		49.60	615
1906	Protose	62.20	1.50	3.62	22.60	0.90	3.60		9.20	188
	Nashville Sanitarium-Food Co., Nashville, Tenn.									
1913	Malted Nut Food	3.40	1.70	3.95	24.70	....	3.40	24.10[2]	42.70	593
1913	Nut Butter	1.90	2.90	4.48	28.00	1.60	3.80	9.20	52.60	637
1913	Nutcysa	57.00	1.80	2.06	12.90	1.00	trace	6.30	21.00	266
1913	Nutfoda	62.30	1.60	3.33	20.80	0.50	trace	6.80	8.00	182
	Chocolate and Chocolate Preparations.									
	Brusson, Jeune, Villemur, France.									
1913	Chocolate with Added Gluten à la Vanille	2.60	3.20	2.54	15.90	2.20	9.20	17.20	49.70	617
	Callard, Stewart & Watt, London.									
1913	Casoid Chocolate Almonds	3.50	3.10	3.57	22.30	3.20	trace	16.10	51.80	620
	Callard & Co., London.									
1923	Casoid Chocolates	5.54	3.14	3.67	22.94	1.54	5.01[1]	23.02	38.81	553
1925	Casoid Chocolate Creams	11.80	2.77	3.48	21.75	1.58	4.75[1]	35.80	21.55	443
1925	Casoid Chocolate Peppermints	12.98	2.66	3.57	22.31	1.48	4.06[1]	36.03	20.48	434
1925	Casoid Chocolate Truffles	5.90	3.43	4.44	27.75	1.78	5.19[1]	9.25	46.70	589
1923	Casoid Dessert Chocolate	3.83	3.95	3.98	24.88	2.13	7.87[1]	11.26	46.08	591
1925	Casoid Marzipan Chocolate	7.50	3.44	3.96	24.75	1.70	4.19[1]	21.24	37.18	535
1923	Casoid Nut Chocolate	3.66	3.88	3.82	23.88	2.22	8.64[1]	11.28	46.44	593
1923	Sugarless Chocolate	2.81	4.28	2.24	14.00	3.16	13.99[1]	17.33	44.34	580
	Fritz, Vienna.									
1924	Plain Chocolate Bars and Cakes	3.22	2.90	2.41	15.06	1.77	6.97[3]	15.28	54.80	642
1924	Nut Chocolate	3.39	2.96	3.07	19.19	2.17	4.90[4]	12.99	54.40	638
1924	Ferment-Schokolade	1.08	1.21	1.00	6.25	0.83	26.74[5]	15.11	48.78	631
1924	Saccharin Schokolade	3.46	3.42	2.77	17.31	2.45	12.70[6]	17.98	42.68	576
1924	Dr. Fromm's Conglutin Schokolade	3.87	7.11	2.91	18.19	0.93	19.41[7]	13.81	36.68	536
1924	Cakes with Chocolate Icing	4.92	2.25	3.99	24.94	1.55	25.58[8]	9.49	31.27	521
	Fromm & Co., Dresden.									
1913	Conglutin-Diabetiker-Schokolade	4.00	5.40	2 82	17.60	1.20	4.30	28.40	39.10	553
	Karl Goldscheider, Carlsbad.									
1914	Feinste Dessert-Schokolade für Diabetiker, "9.98% carbohydrates"	2.17	1.80	1.82	11.38	1.68	4.98	20.44	57.55	665
1914	Feinste Mocca-Schokolade für Diabetiker, "10.26% carbohydrates"	2.20	2.25	1.63	10.19	1.65	4.11	19.38	60.22	677
1914	Feinste Nuss-Schokolade für Diabetiker, "11.32% carbohydrates"	3.37	2.65	2.34	14.63	1.70	6.86	16.44	54.35	641
1914	Feinste Orange-Schokolade für Diabetiker, "9.98% carbohydrates"	2.38	2.20	1.83	11.44	1.43	4.98	19.93	57.64	664
	Groetzsch, Frankfurt.									
1910	Esschokolade (Orange)	4.60	2.30	1.73	10.80	4.40	12.00	5.20	60.70	658
1910	Kochschokolade	10.90	6.70	4.05	25.30	5.90	15.90	20.20	25.10	432
	Hygienic Food Co., New York City. (Laboratoire E. Storage, Marseilles, France.)									
1924	Pastilles de Chocolat	4.50	4.75	3.36	21.00	1.20	30.70[1]	11.95	25.90	488
1924	Croquettes de Chocolat Sucre	4.88	4.90	3.53	22.06	1.28	29.88[1]	10.55	26.45	488

[1] Includes water-soluble carbohydrates.
[2] Includes fiber.
[3] Includes 2.36 per cent water-soluble carbohydrates.
[4] Includes 1.64 per cent water-soluble carbohydrates.
[5] Includes 23.76 per cent water-soluble carbohydrates.
[6] Includes 6.96 per cent water-soluble carbohydrates.
[7] Includes 15.58 per cent water-soluble carbohydrates.
[8] Includes 21.30 per cent water-soluble carbohydrates.

TABLE II. ANALYSES OF SPECIAL FOODS—*Continued.*

Date of analysis	Manufacturer and Brand	Water	Ash	Nitrogen	Protein	Fiber	Carbohydrate (other than fiber): Starch	Carbohydrate (other than fiber): Undetermined carbohydrate	Fat	Calories per 100 gms.
	Chocolate and Chocolate Preparations—Concl.									
	Loeb's Diabetic Food Bakery, New York City.									
1914	Almond Chocolate Bars	2.88	3.77	2.60	16.25	4.32	5.74	26.04	41.00	561
1914	Diabetic Chocolates	1.98	3.85	2.38	14.88	4.90	6.92	16.05	51.42	614
1919	Almond Chocolate Bars	4.76	3.43	2.38	14.88	2.81	5.34	15.55	53.23	622
1919	Diabetic Chocolate	4.72	3.45	2.35	14.69	2.62	7.26	15.52	51.74	716
	Plasmon Co., London.									
1901	Plasmon Chocolate	....	....	3.38	21.10	....	....	....	....	...
1903	Plasmon Chocolate	3.50	2.50	3.23	20.20	0.70	trace	48.00	25.10	499
1923	Plasmon Chocolate	1.76	1.74	2.20	13.75	0.47	38.52[1]	14.40	29.36	531
	Rademann's Nährmittelfabrik, Frankfurt.									
1910	Diabetiker-Chokolade	....	....	2.58	16.10	....	9.60		....	...
1913	Diabetiker-Chokolade	2.50	3.20	2.80	17.50	2.30	3.80	13.10	57.60	656
	Troponwerke, Mülheim.									
1898	Tropon-Chokolade	1.70	1.60	2.91	18.20	2.70	49.90		25.90	506
1899	Tropon-Chokolade	1.80	....	2.94	18.40	....	....	....	....	...
	Cocoa.									
	Callard & Co., London.									
1923	Biogene Cocoa	8.25	7.50	5.29	33.06	2.41	11.05[2]	19.82	17.91	417
	Cheltine Foods Co., Cheltenham, England.									
1923	Cheltine Milk Cocoa	7.75	5.14	7.53	47.06	2.11	8.91[2]	13.12	15.91	420
	The Dieto Food Co., New York City.									
1914	Dieto Cocoa	4.29	5.40	3.77	23.56	4.87	12.38	26.57	22.93	456
1924	*H. and R. Diabetic Foods, Bronx, N. Y.* Cellu Cocoa Nibs	3.80	2.79	1.32	8.25	8.00	4.23[2]	42.83	30.10	492
	Jireh Diabetic Food Co., New York City.									
1906	Diabetic Cocoa	3.10	4.30	3.30	20.60	3.60	32.60[2]	18.00	17.80	445
1906	Diabetic Cocoa	7.30	3.90	3.06	19.10	3.40	29.00[2]	18.90	18.40	434
	Loeb's Diabetic Food Bakery, New York City.									
1923	Diabetic Cocoa	4.98	5.47	5.29	33.06	3.62	12.64[2]	22.34	17.89	433
1923	Diabetic Cocoa	4.90	5.80	4.07	25.44	3.83	16.03[2]	23.09	20.91	446
	Gustav Müller, New York City (Agent).									
1913	Charrasse Gluto-Cacao	6.40	6.70	3.44	21.50	3.10	16.30	23.80	22.20	446
	Plasmon Co., London.									
1903	Plasmon Cocoa	8.90	6.60	8.45	52.80	....	5.10	15.80[3]	10.80	392
1921	Plasmon Cocoa	9.82	7.74	8.07	50.44	1.33	6.01[2]	13.07	11.59	382
	Rademann's Nährmittelfabrik, Frankfurt									
1913	Diabetiker-Cacao	5.20	5.90	2.82	17.60	3.00	10.70	34.00	23.60	462
	Miscellaneous Products.									
	Callard & Co., London.									
1923	Cibrola	11.31	10.86	11.94	76.18	0.00	0.19[4]	1.06	0.40	313
1923	Ponos Cocoanut Ice[5]	7.85	1.29	1.38	....	1.19	3.12[2]	....	36.18	338
1923	Sugarless Jujubes (peppermint)[6]	21.70	0.40	3.01	....	none	trace[2]	....	....	...
1923	Sugarless Jujubes (pineapple)[6]	19.76	0.35	2.89	...:	none	trace[2]	....	....	...
1923	Sugarless Table Jelly[7]	8.68	0.42	4.50	....	none	trace[2]	....	....	...
	Dieto Food Co., New York City.									
1914	Dieto Baking Powder	....	....	....	....	....	12.94	....	....	...
1914	Dieto Barley Coffee	3.42	3.08	2.11	13.19	9.14	17.72	46.15	7.30	374
	Manual Freres.									
1917	Longuets de Lausanne	10.78	3.04	2.27	14.19	0.44	49.16	16.86	5.53	370

[1] Includes 36.52 per cent water-soluble carbohydrates.
[2] Includes water-soluble carbohydrates.
[3] Includes fiber.
[4] Lactose.
[5] Saccharin present; glycerine indicated.
[6] Glycerine present; gelatin indicated.
[7] Saccharin present; gelatin indicated.

TABLE II. ANALYSES OF SPECIAL FOODS—*Continued.*

Date of analysis	Manufacturer and Brand	Water	Ash	Nitrogen	Protein	Fiber	Carbohydrate (other than fiber): Starch	Carbohydrate (other than fiber): Undetermined carbohydrate	Fat	Calories per 100 gms.
	Miscellaneous Products—Concluded.									
	Health Food Co., New York City.	%	%	%	%	%	%	%	%	
1913	Kaffeebrod	4.50	2.20	2.06	12.90	6.40	10.10	62.40	1.50	355
	Genevieve Jackson, Los Angeles, Calif.									
1919	Dia-Biskit	6.08	6.13	2.82	17.63	11.99	6.13[1]	47.21	4.83	328
	The Kellogg Food Co., Battle Creek, Mich.									
1911	Sanitas Meltose	26.80	0.50	0.10	0.60	....	....	72.10[2]	....	291
	Lister Bros., Inc., New York City.									
1923	Lister's Sugar-free Candy[3]	9.44	1.41	3.67	....	none	trace[4]	....	....	...
	Mansfield Laboratories, Mansfield, Mass.									
1923	No Name (square)	9.34	5.53	4.72	29.50	0.43	34.26	13.53	7.41	376
1914	No Name (hexagonal)	8.65	4.84	4.06	25.38	0.47	31.16	14.33	15.17	420
	Gustav Müller & Co., New York City.									
1913	Dr. Bouma Sugar-free Milk	91.80	0.50	0.38	2.40	....	....	....	5.30	57
	S. S. Pierce Co., Boston, Mass. (prepared for).									
1919	Svea Wafers	10.58	2.85	1.04	6.50	0.13	53.72	25.53	0.69	349
1900	Diabetes Milch, 5%, *Rose's*	92.50	0.20	0.18	1.10	....	....	1.20	5.00	54
1900	Diabetes Milch, 10%, *Rose's*	86.30	0.20	0.37	2.30	....	....	1.20	10.00	104
	La Societie L'Aliment "Essentiel," Nanterre, France.									
1921	"Essentiel" Food, Cacao Flavor	4.62	1.48	1.47	9.19	0.78	63.30[5]	16.21	4.42	395
1921	"Roburol" with Cacao	4.70	3.16	3.26	20.38	0.75	46.56[6]	20.34	4.11	386
	D. Whiting & Sons, Boston, Mass.									
1913	Sugar-free Milk (ave. 3 analyses)	86.40	0.70	0.91	5.70	....	....	trace	7.20	88
1919	Sugar-free Milk	83.30	0.76	1.01	6.43	....	....	0.22[7]	9.34	111
1922	Sugar-free Milk	83.51	0.76	....	6.62[8]	....	....	0.55[7]	8.56	106
	Fruits and Vegetables (Canned).									
	Callard & Co., London.									
1925	Cranberries, Callard's Sugarless Fruit	82.24	0.14	0.05	0.31	1.00	1.33[9]	(10)	....	...
1925	Plums, Callard's Sugarless Fruit	76.44	0.17	0.04	0.25	0.28	1.46[9]	(10)	....	...
	The Diaprotein Co., Columbus, Ohio.									
1921	Apple Sauce	88.69	0.58	0.03	0.18	0.47	5.75[4]	3.72	0.61	44
1921	Blackberries	91.80	0.29	0.11	0.67	1.76	2.57[4]	2.41	0.50	27
1921	Cherries, Red, Pitted	90.39	0.34	0.08	0.50	0.13	5.14[4]	3.36	0.14	37
1921	Cherries, White	91.26	0.45	0.11	0.71	0.18	3.79[4]	3.47	0.14	33
1921	Peaches, Yellow	93.38	0.31	0.08	0.47	0.38	2.88[4]	2.52	0.06	24
1921	Pears, Bartlett	93.57	0.17	0.05	0.28	0.62	2.54[4]	2.72	0.10	51
1921	Raspberries, Red	88.34	0.47	0.14	0.88	2.67	3.00[4]	3.96	0.68	37
1921	Strawberries	93.58	0.32	0.09	0.57	0.82	1.95[4]	2.40	0.36	23
1921	Beans, Cut, Wax	96.20	0.27	0.13	0.83	0.99	1.15[4]	0.51	0.05	10
1921	Beans, Refugee, Green	94.43	1.36[11]	0.11	1.04	0.88	1.43[4]	0.80	0.06	14
1921	Peas, Green	88.74	0.37	0.51	3.19	1.27	3.92[4]	2.15	0.36	40
1921	Rhubarb	96.35	0.51	0.07	0.41	0.54	0.27[4]	1.88	0.04	11
1921	Spinach	91.46	2.39[12]	0.49	3.08	0.93	0.56[4]	0.98	0.60	24
1921	Tomatoes	95.07	0.53	0.17	1.04	0.32	1.48[4]	1.34	0.22	17
	The Poms Co., Sarasota, Fla.									
1924	Poms (Canned Grapefruit)	90.54	0.36	....	0.49	0.17	4.24[9]	4.09	0.11	36
	John Sexton & Co., Chicago.									
1924	Edelweiss Apricots	90.50	0.46	....	0.39	0.35	4.38[9]	3.81	0.11	35
1924	Pride of the West Apricots	90.58	0.48	....	0.37	0.34	4.81[9]	3.32	0.10	35
1924	Alp Rose Blackberries	85.33	0.33	....	0.96	2.29	5.59[9]	4.84	0.66	52
1924	Alp Rose Blueberries	85.89	0.25	....	0.44	0.95	7.60[9]	4.53	0.34	53

[1] Includes some reducing material derived from agar-agar.
[2] Includes fiber.
[3] Gums, saccharin, glycerine and gelatin present.
[4] Includes water-soluble carbohydrates.
[5] Includes 35.47 per cent water-soluble carbohydrates.
[6] Includes 26.80 per cent water-soluble carbohydrates.
[7] Lactose.
[8] Includes 0.37 per cent gelatin.
[9] All water-soluble carbohydrates; no starch.
[10] Packed with glycerine; manufacturer's statement.
[11] Includes 1.04 per cent salt.
[12] Includes 1.00 per cent salt.

TABLE II. ANALYSES OF SPECIAL FOODS—*Concluded.*

Date of analysis	Manufacturer and Brand	Water	Ash	Nitrogen	Protein	Fiber	Carbohydrate (other than fiber)		Fat	Calories per 100 gms.
							Starch	Undetermined carbohydrate		
	Fruits and Vegetables (Canned)—Concluded.									
	John Sexton & Co., Chicago—Concluded.	%	%	%	%	%	%	%	%	
1924	Edelweiss Cherries	89.71	0.32	....	0.64	0.14	4.24[1]	4.86	0.09	40
1924	Pride of the West Cherries	88.76	0.32	....	0.57	0.12	4.88[1]	5.24	0.11	44
1925	Alp Rose Black Cherries	82.60	0.40	0.09	0.56	0.19	9.95[1]	6.04	0.26	69
1925	Alp Rose Red Pitted Cherries	86.76	0.34	0.08	0.51	0.19	6.99[1]	4.94	0.27	52
1924	Alp Rose Royal Ann Cherries	86.18	0.36	....	0.63	0.15	7.58[1]	5.05	0.05	14
1924	Alp Rose Grapefruit	90.49	0.43	....	0.69	0.17	4.87[1]	3.30	0.05	36
1924	Alp Rose Logan Berries	85.43	0.34	....	1.04	1.82	5.60[1]	5.09	0.68	53
1924	Edelweiss Peaches	91.73	0.31	....	0.37	0.26	4.04[1]	3.24	0.05	31
1924	Pride of the West Peaches	91.72	0.31	....	0.38	0.24	4.76[1]	2.55	0.04	31
1924	Alp Rose Bartlett Pears	89.17	0.21	....	0.26	0.61	4.31[1]	5.34	0.10	41
1924	Edelweiss Pears	90.35	0.23	....	0.24	0.56	3.70[1]	4.82	0.10	36
1924	Pride of the West Pears	90.52	0.20	....	0.24	0.63	3.60[1]	4.72	0.09	35
1924	Alp Rose Pineapple, Hawaiian Sliced	85.81	0.35	....	0.36	0.27	8.49[1]	4.61	0.11	55
1924	Pride of the West Pineapple	86.17	0.30	....	0.38	0.28	9.65[1]	3.17	0.05	53
1924	Alp Rose Japan Plums	93.33	0.27	....	0.29	0.29	2.83[1]	2.93	0.06	25
1924	Alp Rose Prune Plums	88.63	0.33	....	0.33	0.21	6.92[1]	3.50	0.08	44
1924	Pride of the West Prune Plums	88.88	0.30	....	0.39	0.21	4.83[1]	5.27	0.12	43
1925	Alp Rose Black Raspberries	87.98	0.39	0.13	0.81	2.58	3.34[1]	3.83	1.07	42
1924	Alp Rose Red Raspberries	89.02	0.31	....	0.67	1.69	4.81[1]	3.00	0.50	34
1925	Alp Rose Strawberries	93.83	0.30	0.07	0.43	0.72	2.03[1]	2.37	0.32	22
1924	Alp Rose Peeled White Asparagus	95.76	0.35	....	1.20	0.34	1.49[1]	0.80	0.06	15
1924	Alp Rose White Asparagus Tips	94.81	0.43	....	1.65	0.42	1.63[1]	0.97	0.09	18
1925	Alp Rose Refugee Beans (small green)	95.26	0.33	0.17	1.03	0.48	1.44[2]	1.41	0.05	16
1925	Alp Rose Beets (small)	84.17	0.48	0.20	1.28	1.04	8.39[2]	4.59	0.05	57
1925	Alp Rose Peas (sifted Early June)	90.16	0.32	0.42	2.64	1.06	4.17[2]	1.45	0.20	35
1925	Edelweiss Sauer Kraut	93.60	1.77[3]	0.18	1.10	0.66	0.41[2]	2.31	0.15	17
1925	Alp Rose Spinach	91.94	1.17[4]	0.46	2.87	0.65	0.99[2]	1.92	0.46	27
1925	Alp Rose Sweet Corn	83.23	0.53[5]	0.34	2.11	0.31	10.27[2]	2.46	1.09	69
	Washington County Co., Dennysville, Me.									
1925	Aunty's Mountain Cranberries	82.76	0.24	0.08	0.48	1.01	3.28[2]	11.39	0.84	68
1925	Aunty's Blueberries	81.35	0.28	0.10	0.66	1.53	8.04[2]	7.21	0.93	69
	Preserves, etc.									
	Callard & Co., London.									
1925	Sugarless Jam (Apricot)	61.62	0.43	0.71	3.94[6]	0.30	3.34[1]	(7)	....	...
1925	Sugarless Jam (Green Gage Plum)	60.68	0.39	0.90	5.00[6]	0.29	2.75[1]	(7)	....	...
1925	Sugarless Marmalade (Orange)	59.64	0.37	1.04	5.77[6]	0.55	1.15[1]	(7)	....	...
1925	Sugarless Jelly (Pineapple)	80.44	0.28	1.23	6.83[6]	none	none[2]	(7)	....	...
1925	Sugarless Jam (Plum)	67.42	0.33	0.90	5.00[6]	0.28	1.68[1]	(7)	....	...

[1] All water-soluble carbohydrates; no starch.
[2] Includes water-soluble carbohydrates.
[3] Includes 1.29 per cent salt.
[4] Includes 0.06 per cent salt.
[5] Includes 0.04 per cent salt.
[6] Calculated as gelatin.
[7] Packed with glycerine; manufacturer's statement.

Connecticut Agricultural Experiment Station
New Haven, Connecticut

The Thirty-First Report on FOOD PRODUCTS and the Nineteenth Report on DRUG PRODUCTS

1926

Part II

Food and Drug Inspection

By
E. M. BAILEY

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as of

May, 1927

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THE TUTTLE, MOREHOUSE & TAYLOR COMPANY

CONTENTS AND SUMMARY.

[1] Includes 148 below standard only.

The Thirty-first Report on Food Products and the Nineteenth Report on Drug Products

PART II

Food and Drug Inspection and Analysis

By E. M. BAILEY

This part of the annual report on foods and drugs summarizes the work done in the calendar year of 1926, chiefly for purposes of inspection and control as required by the Dairy and Food Commissioner.

Some collaborative work upon methods of analysis has been done for the Association of Official Agricultural Chemists. A unit representing the progress of food control in this State was prepared as a part of the Station's exhibit at the New Haven Progress Exposition. An index[1] to the foods and drugs examined in the department for the ten-year period ending Dec. 31st, 1925, and now published, was also a part of the year's work. The chemist in charge has served as a member of the Executive Committee and of the Committee on Recommendations of Referees of the Association of Official Agricultural Chemists; as a member of the Joint Committee of Definitions and Standards; and as a consultant to the Council on Pharmacy and Chemistry of the American Medical Association.

For the analytical work herein reported credit is due to Messrs. Andrew,[2] Shepard, Fisher, Nolan and Mathis and to Miss Bacon for assistance in preparing reports.

I. FOODS.

Baking Powder, etc.

Seven samples of baking powder were examined for available carbon dioxide and metallic impurities. Baking powder should contain not less than 12 per cent of available carbon dioxide.

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[1] Conn. Exp. Station. Bull. 284, 1927.
[2] Resigned, March, 1926.

TABLE I. ANALYSES OF BAKING POWDER.

No.	Brand	Available carbon dioxide %
31779	Davis Co., R. B. *Davis*	13.4
31767	Great A. & P. Tea Co., *Red Front*	13.4
31780	Royal Baking Powder Co., *Royal*	12.8
31781	Rumford Chemical Works, *Rumford*	12.7
31759	Slade Co., D. & L.	9.1 (total)
34769	Slade Co., D. & L.	7.2
34651	Van Dyk Co., James, *Van Dyk's*	10.5

Samples **31759** and **34769** were purchased of M. J. Babaian, 397 Capitol Ave., Hartford. Both samples were considerably below standard. No. **34651** was purchased of James Van Dyk Co., Asylum St., Hartford, and was somewhat deficient in available carbon dioxide.

None of the brands contained arsenic in excess of 1 part per million.

A sample of Cream of Tartar Substitute, **4849**, declared to contain monobasic sodium phosphate and corn starch was found to contain 30.7 per cent of starch.

BREAD.

Four samples of bread were submitted. Two, **5560, 5561,** were from the New Haven County Jail and two, **3456, 3457,** were sent by Dr. C. E. McCauley of Aberdeen, S. D.

Samples **5560, 5561** and **3457** are wheat bread. Sample **3456** is Dr. Gordon's Health Bread made from whole wheat flour and honey said to be recommended as a natural regulator and effective in reducing diets, and manufactured by the Federal System of Bakeries.

The analyses are as follows:

TABLE II. ANALYSES OF BREAD.

Number	5560	5561	3456	3457
	%	%	%	%
Moisture	37.15	35.40	31.58	29.89
Ash	1.43	1.63	3.12	1.62
Protein	9.01	8.92	10.28	9.63
Fiber	0.26	0.17	1.35	0.24
Carbohydrate:				
Starch	51.30	51.63	24.84	42.93
Soluble, as dextrose			15.88	8.78
Undetermined			8.35	3.50
Fat	0.85	2.25	4.60	3.41
Calories per 100 gms.	249.0	262.0	279.0	290.0

From a comparison of energy values the reducing effect of sample **3456** is likely to be disappointing.

CARBONATED BEVERAGES.

One hundred and seventy-nine samples of carbonated beverages were examined.

The law requires a sugar content of not less than 5 per cent in these products; saccharin is prohibited and artificial colors and flavors must be declared if used. Benzoate of soda is the only chemical preservative recognized in the regulations and its presence requires label declaration.

Recently hydrogen peroxide has been used to some extent as a preservative in bottled chocolate beverages. It is claimed that, due to the fact that this substance readily decomposes into oxygen and water, the preservative, as such, will not be found in the beverages so treated. There is evidence, however, that the peroxide may persist for some time particularly in beverages which are bottled without subsequent heating.

The apparently harmless nature of hydrogen peroxide[1] when used as a remedial agent or, according to older literature, as a preservative for certain foods, is not necessarily an argument in favor of its unrestricted use in foods, and control officials have generally adopted a conservative attitude with respect to its use for food preservation. One obvious objection to it, and to any other substance used for similar purposes, is the tendency it will have to create a disregard for those sanitary safeguards in manufacturing operations which food officials have emphasized and which manufacturers have so largely adopted. Again, commercial preparations of hydrogen peroxide are themselves preserved with mineral acids and other chemicals, and these "stabilizers," although in small amounts, are necessarily introduced into peroxide-treated beverages.

For the present no objection is raised in this State to chocolate beverages so treated provided the treatment is not in lieu of proper sanitary measures in the plant; and provided that the peroxide, as such, is not present in the finished product; and further provided that evidence of objectionable stabilizers is not found.[2]

All of the samples examined contained the required amount of sugar. Saccharin was found in seven samples but they were all the product of one manufacturer, the Washington Club Bottling Works of Norwich. Five samples of chocolate soda were tested for hydrogen peroxide; four showed no trace of the preservative and one showed the merest trace. Considerable laxity was noted in the matter of declaring artificial flavors and colors, twenty-two samples being deficient in this respect.

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[1] Rideal. Disinfection and Preservation of Food, 1903; Thresh and Porter. Preservatives in Food and Food Examination, 1900; Sollmann. Manual of Pharmacology, 1917; U. S. Dispensatory, twentieth edition.

[2] The revised rules and regulations will probably include hydrogen peroxide with those preservatives which are prohibited.

Five samples of preservative solutions (hydrogen peroxide) were examined; four were dilute (approximately 3 per cent) solutions and one was a strong solution (about 30 per cent).

Cocoa.

Two samples of cocoa being served in public schools were examined for Mrs. Weldon of Glastonbury. The chief difference between them was in the item of fat, one containing 21.8 per cent and the other 13.5 per cent.

Coffee.

One sample of coffee, **34420**, submitted by the Dairy and Food Commissioner was examined and no evidence of chicory or of other foreign substances was found.

So-called Diabetic and Special Foods.

Thirty samples of products of this class were examined but the analyses are given in Part I of this report[1] and no discussion of them is required here.

Eggs.

Forty samples of market eggs were submitted by the Dairy and Food Commissioner. By candling and determining ammoniacal nitrogen 15 samples were passed as fresh and 25 did not have the characteristics of fresh eggs.

One sample of "dipped" eggs (eggs dipped in oil) was also examined. A small quantity of oil with a refraction of about 72 at 25° C. was extracted from the shell. A sample suspected of being dipped yielded no oil when the shell was extracted. The dipped eggs showed a relatively high ammoniacal nitrogen content (2.7 mgms. per 100 gms. of egg), and the yolks were settled in the shell. Air spaces were, however, generally less than 1 inch in diameter. The eggs were wholesome and edible but did not have the characteristics of fresh eggs excepting the fairly small air spaces.

Fats and Oils.

BUTTER.

One sample of butter and four of sweet butter have been examined and all found to be genuine and to contain no excess of water (less than 15.99 per cent).

OLEOMARGARINE.

Two samples of oleomargarine were examined and no evidence of added artificial coloring matter was found.

[1] Conn. Exp. Station, Bull. 286, 1927.

Two samples of so-called cooking fats known as Danish Nut Product (Danish Packing Co., Providence, R. I.), and Nut Product, Verco Brand (Vermont Products Co., Providence, R. I.), were examined. Analyses are given in Table III.

These products are artificially colored and sold as cooking fats and not as oleomargarine. A Federal court decision has exempted one of them (Danish Nut Product), from classification as oleomargarine.[1]

Section 2449, General Statutes, defines imitation butter or oleomargarine as any article resembling butter and not made wholly from milk or any product of milk, salt and coloring excepted.

These two "cooking fats" admittedly contain no milk or milk product and analysis shows no evidence of such constituents. The compounds do resemble butter, however, by reason of their chemical composition, their appearance and taste and their other physical properties which determine their use as edible fats or for cooking purposes.

From the standpoint of composition these products bear substantially the same resemblance to butter as do certain other articles generally recognized as oleomargarines, viz., vegetable oil margarines. To classify them as cooking fats is to place them with products which they least resemble.

In appearance they resemble butter and their taste also suggests or resembles that of butter.

Cooking fats are practically 100 per cent fat; they contain no water or but traces thereof, and they contain no salt. They are particularly suited for deep frying to which purpose butter and oleomargarine are entirely unsuited because of their considerable water content. Danish Nut Product and Verco Nut Product are "cooking fats" only insofar as butter and oleomargarine may be so called.

Moreover, it is clear from recipes in which one of these products is recommended for use that it can be used only where butter and oleomargarine can be used and in no case where they cannot be employed. In other words, these so-called "cooking fats" are substitutes for butter and not for lard.

OLIVE OIL.

Six samples of olive oil were examined, five of them for the Dairy and Food Commissioner. One sample, Italia brand, No. **33866**, sold by the Italian Coöperative Store, Hartford, was adulterated with sesame oil.

[1] Treasury Decision 4006, approved April 1st, 1927, holds that these so-called cooking compounds sufficiently resemble butter to warrant their classification as oleomargarine.

TABLE III. ANALYSES OF COOKING FATS, BUTTER, ETC.

	Water	Ash (Salt)	Nitrogen (calculated as casein)	Fat
	%	%	%	%
Cooking fats (7 analyses). (Wesson oil, Mazola, Cottolene, Crisco, etc.).				
Maximum	0.31	0.08	0.38	100.00
Minimum	0.00	0.00	0.00	99.53
Average	0.07	0.03	0.20	99.68
Butter (12 analyses). (Connecticut Creamery).				
Maximum	15.88	4.05	2.21	88.59
Minimum	8.52	0.21	1.21	80.93
Average	12.24	1.59	1.51	84.62
Animal Oil, Oleomargarine (5 analyses).				
Maximum	9.20	3.08	1.25	97.36
Minimum	1.67	0.41	0.56	86.72
Average	5.37	1.43	0.80	92.40
Vegetable Oil Oleomargarine (8 analyses).				
Maximum	12.64	6.06	2.71	91.20
Minimum	6.53	1.14	0.69	81.75
Average	10.99	2.85	1.39	84.77
Danish Nut Product, etc.				
1923—Nut-z-all	10.73	1.37	0.26	87.58
1925—Higgin's Nut Product	9.80	2.30	0.00	87.90
1926—Danish Nut Product	12.54	2.79	0.17	84.50
1926—Verco Nut Product	10.87	5.50	0.29	83.34

FLAVORING EXTRACTS.

Six samples almond extract and one of vanilla extract were examined and all were passed. Almond extract should be free from hydrocyanic acid and no evidence of this substance was found in any of the samples examined.

GELATIN.

One sample of gelatin was examined for a physician to determine the amount of salt present. The equivalent of 0.36 per cent of sodium chloride was estimated from the chlorine in the ash.

ICE CREAM.

Two hundred and eighty-five official samples of ice cream were examined and three were tested for individuals.

Only three samples contained less than the legal fat standard of 8 per cent for plain ice cream and 6 per cent for fruit and nut ice cream.

These three deficient samples are as follows:

No.		Dealer	Manufacturer
31972	*New Haven*	S. Vitale	Own make (?)
34690	*New Britain*	Chas. Picalo	Own make
33883	*Norwich*	G. Gressell	Own make

The distribution of samples on the milk fat basis is as follows:

Per cent of fat	No. of samples 1926	Per cent of total 1926	Corresponding percentage 1925	1924	1919-23
8.0 to 9.9	15	5.2	17.0	17.4	26.1
10.0 to 11.9	78	27.4	34.6	24.8	26.1
12.0 and above	189	66.3	46.7	55.9	41.1
7.9 and below	3	1.1	1.7	1.9	9.6

In the five-year period 1919-23 about ¼ of the samples examined contained from 8 to 10 per cent fat; the percentage of samples of this grade has decreased since that time and the corresponding percentage for 1926 is about 5 per cent. There has been a gradual increase in the proportion of samples containing over 12 per cent of fat; during the past year (1926), about ⅔ of the samples examined were of that grade.

These data, for the past year at least, represent for the most part the products of smaller establishments, and without information as to the gross production of the several grades it is not possible to state the average percentage of fat in ice cream as produced in this state to-day.

A federal standard of 12 per cent milk fat for ice cream, proposed by the Joint Committee on Definition and Standards, is opposed by the ice cream industry. Manufacturers generally favor an 8 per cent standard; but many of these are making products which test nearer 12 per cent than 8.

FROZEN PUDDING.

Products resembling ice cream and sold under the name of "frozen pudding" and similar labels have been held in this state to be subject to the regulations governing the manufacture and sale of ice cream. If they contain less than 8 per cent of milk fat the percentage of fat must be declared by a suitable sign displayed at the time and place of sale.

ICE CREAM CONES.

Twelve samples of the pastry cones in which ice cream is dispensed were examined for saccharin but none was detected.

Meat Products.

BEEF LOAF.

One sample of beef loaf was examined for presence of cereal and found to contain 4.96 per cent of starch. No label declaration of cereal is required for beef loaf.

FRANKFURTS, ETC.

Twenty-one samples of frankfurt sausage, bologna, etc., were examined, fifteen of which were found to contain undeclared cereal, or undeclared color, or both. This proportion is not to be understood to indicate the extent of adulteration or misbranding of meat products because samples submitted to us were only such as were suspected by the inspectors.

Deficient samples found are as follows:

No.	Dealer	Manufacturer	Remarks
	Ansonia		
33227	Chas. Powanda..	F. J. McNamara & Sons	Cereal undeclared
	Bridgeport		
33085	Peter Hron, Inc.	Own make	Cereal undeclared
33080	The Mohican Co.	F. Flaxington	Cereal undeclared
33081	The Mohican Co.	F. J. McNamara & Sons	Cereal undeclared
	Bristol		
33093	Central Beef & Provision Co..	Own make	Cereal undeclared
	Meriden		
34782	H. Brown	F. J. McNamara & Sons	Cereal undeclared
	New Britain		
33201	A. Y. O. Provision Co.	.....	Cereal undeclared
33091	B. Berkowitz ...	New England Food Products Co.	Cereal undeclared
33088	M. Zaleski	Central Beef & Provision Co.	Cereal undeclared
	New Haven		
33210	Carl Rossler ...	.....	Cereal and color undeclared
	Norwich		
33202	Sachem Provision Co.	Hartford Center Bologna Co.	Cereal undeclared
	Putnam		
33203	E. W. Mullan ..	Geo. Bockper Co., Worcester, Mass.	Cereal undeclared
33204	Pomfret Market	.....	Cereal undeclared
	Windsor Locks		
33226	J. Borracci	.....	Color undeclared
33208	.....	.....	Cereal undeclared

"Cereal" has been regarded as present when starch in excess of that reasonably attributable to spice starch has been found. It is recognized that non-cereal starchy materials such as buckwheat flour and potato flour may have been used.

Manufacturers should note that the use of milk powder in sausage requires a label declaration.

HAMBURG STEAK.

Three samples of hamburg steak submitted by the Dairy and Food Commissioner were examined and no evidence of sulphites found.

Another sample submitted by the Fulton Markets, Waterbury, on advice of the Dairy and Food Commissioner was found to contain 574 milligrams of sulphite per kilo.

Milk and Milk Products.

MARKET MILK.

Five hundred and fifty-six samples of milk were examined for the Dairy and Food Commissioner, three hundred and seventy-seven of which were taken in official inspections.

Two hundred and thirty-two samples were examined for individuals, making a total of seven hundred and eighty-eight.

The distribution of official samples, based upon analysis, is as follows:

	No. of samples	Per cent
Not found adulterated	178	47.2
Adulterated by watering	51	13.5
Below standard:		
in solids and solids-not-fat	78	20 7
in solids and fat	5	1.3
in solids, fat and solids-not-fat ...	65	17 3
Totals	377	100.0

Deficient samples are listed in Table IV.

TABLE IV. ADULTERATED MILK.

No.	Dealer	Solids	Fat
	Containing Added Water.		
	Bethel.		
31660	John Takacs	8.40	2.5
31661	John Takacs	8.57	2.6
31662	John Takacs	9.19	3.1
31663	John Takacs	8.96	2.8
	Bridgeport.		
33177	Sylvester Cocivi ...	10.27	3.1
33178	Sylvester Cocivi ...	10.40	3.1
33179	Sylvester Cocivi ...	10.26	3.3
33169	Geo. Gregory	10.06	2.8
33170	Geo. Gregory	10.13	3.0
33171	Geo. Gregory	9.98	2.9
33183	Christian Peterson..	10.43	3.4
33184	Christian Peterson..	11.30	3.7
	Brookfield.		
33512	Steve Piskura	10.29	3.2
33513	Steve Piskura	10.23	3.0
	Brookfield Center.		
33523	A. Sobriewitz	10.67	3.1
	Durham.		
33166	W. S. Cornell	10.55	3.1
33167	John Sigilini	10.67	3.5
33168	John Sigilini	10.77	3.6
	East Windsor.		
33418	J. S. Allen	10.67	3.1
33419	J. S. Allen	10.70	3.0
	Hawleyville.		
33520	W. S. Hawley	9.05	2.5
33521	W. S. Hawley	9.90	3.1
33522	W. S. Hawley	9.67	3.1
32131	Ralph Talarico	11.05	3.5
32132	Ralph Talarico	9.84	2.6
	Containing Added Water—Concluded.		
	New Britain.		
33118	J. E. Callahan	9.92	3.1
33119	J. E. Callahan	10.97	3.6
33120	J. E. Callahan	11.34	3.5
33121	J. E. Callahan	10.43	2.9
33122	J. E. Callahan	10.40	3.0
	Northford.		
34324	John Sigalini	11.19	3.8
	Ridgefield.		
33145	Geo. Cable	10.82	3.6
33146	Geo. Cable	12.39	5.0
33147	Geo. Cable	11.47	3.8
	Shelton.		
35196	Stanley Fritz	10.30	3.0
35197	Stanley Fritz	10.47	3.1
35200	J. Suren	10.74	3.2
35201	J. Suren	10.12	3.1
35202	J. Suren	10.59	3.2
35203	J. Suren	10.63	2.9
	Waterbury.		
34828	E. L. Bronson	10.26	2.9
34825	John Coscia	10.40	3.0
	Westport.		
33132	John Fike	12.11	4.6
33133	John Fike	11.24	3.5
33134	John Fike	11.70	4.5
	Willimantic.		
31449	Louis A. King	11.23	3.6
33600	Louis A. King	11.76	4.0
	Wilton.		
33131	Vincent Fito	10.54	3.2
33136	Arthur Little	11.30	3.6
33129	Edward Mills	10.43	3.3
33130	Edward Mills	10.39	3.3

EVAPORATED MILK.

One sample of evaporated milk, brand not given and not in the original container, was examined for the Board of Health of Norwalk. The sample was low in fat but no off-taste was noted.

CREAM.

Eight samples of cream were examined in a series of tests to detect added water cryoscopically. This work was done by Mr. Mathis in collaboration with the Referee on Dairy Products of the Association of Official Agricultural Chemists, and is reported elsewhere.[1]

Four other samples were examined for fat or for preservatives. No preservatives were found.

HUMAN MILK.

Two samples of human milk were examined for physicians.

SPICES.

MACE.

Thirteen samples of mace were submitted by the Dairy and Food Commissioner. Six were passed and seven were below standard.

Standard mace contains not less than 20 per cent nor more than 30 per cent of non-volatile ether extract, not more than 10 per cent of crude fiber, not more than 3 per cent of total ash, and not more than 0.5 per cent of ash insoluble in hydrochloric acid.

Analyses are given in Table V.

The deficiencies are chiefly excessive total ash usually accompanied by excesses of insoluble ash. Non-volatile ether extract are somewhat low in three samples. Crude fiber is within the limits set by the standard but two samples are conspicuously higher than the others. Compared with authentic samples of mace no evidence of adulteration was detected microscopically.

[1] Proceedings of the Assoc. of Off. Agr. Chemists, 1926.

TABLE V. ANALYSES OF MACE.

No.	Dealer	Manufacturer and brand	Non-volatile ether extract %	Crude fiber %	Total ash %	Ash insol. in HCl %
	Bristol.					
33336	North Side Market	Wm. Boardman & Sons, Putnam	21.59	3.82	1.81	0.04
33335	W. B. Woodruff	R. C. Williams & Co., Royal Scarlet	18.36	4.48	2.87	0.52
34770	W. B. Woodruff	R. C. Williams & Co., Royal Scarlet	22.86	3.20	2.85	0.55
	Hartford.					
33344	Epstein Bros.	Austin Nichols Co., Sunbeam	17.65	4.65	3.95	1.20
34767	Epstein Bros.	Austin Nichols Co., Sunbeam	19.02	3.47	3.81	1.29
31756	A. H. Phillips, Inc.	A. Colburne Co.	22.25	3.62	1.98	0.03
	New Britain.					
33341	J. A. Spinetta	Stickney & Poor Spice Co.	22.07	4.95	2.52	0.15
33340	J. A. Spinetta	Williams & Carleton Co.	21.96	4.95	3.65	0.94
33771	J. A. Spinetta	Williams & Carleton Co.	25.67	3.92	3.69	1.00
	Stamford.					
31788	Atlantic & Pacific Tea Co.	Atlantic & Pacific Tea Co.	20.39	3.70	2.43	0.35
33348	Modern Grocery Co.	E. R. Durkee & Co.	21.39	4.45	2.49	0.25
31789	P. W. Shea	B. Fischer & Co., Inc.	20.88	8.65	4.64	0.43
34779	P. W. Shea	B. Fischer & Co., Inc.	22.64	8.33	4.79	0.51

PREPARED MUSTARD.

Twelve samples of prepared mustard were examined and analyses are given in Table VI.

According to the revised definition and standard for prepared mustard[1] the fat-, salt-, and sugar-free solids should contain not more than 24 per cent of carbohydrates (calculated as starch), not more than 12 per cent of crude fiber, and not less than 5.6 per cent of nitrogen. Sugar may or may not be used in the manufacture of this product.

In the analyses nitrogenous material is calculated as protein, 5.6 per cent of nitrogen being equivalent to 35 per cent of protein. Sugar was not determined and results have therefore been calculated to the fat- and salt-free solids. On this basis all of the samples conform substantially to the specifications noted above for nitrogen, fiber and "starch" excepting **33337** which is somewhat low in nitrogen and high in the other two items. If this sample contained sugar, the percentage of all of these constituents would be somewhat increased in the fat-, salt-, and sugar-free solids.

[1] Food Inspection Decision 192, June, 1923.

TABLE VI. ANALYSES OF PREPARED MUSTARD.

No.	Manufacturer	Water	Acidity (as acetic acid)	Total solids	Total ash	Salt	Other ash	Protein	Crude fiber	"Starch"	N-free extract	Fat
		%	%	%	%	%	%	%	%	%	%	%
31787	The Atlantic & Pacific Co., New York	77.83	2.56	19.61	4.68	3.43	1.25	4.47	0.99	2.44	4.85	4.62
33333	J. W. Beardsley's Sons, Newark, N. J.	79.48	2.87	17.65	4.02	3.06	0.96	3.75	1.21	2.27	3.95	4.72
31777	Beechnut Packing Co., Rochester, N. Y.	72.54	4.06	23.40	2.99	1.69	1.30	5.33	1.17	3.62	6.90	7.01
31755	James Butler, Inc., N. Y.	75.49	3.22	21.29	3.42	1.98	1.44	4.77	1.44	2.95	6.02	5.64
33346	Cruickshank Bros. Co., Pittsburgh, Pa.	73.04	4.08	22.88	4.78	3.20	1.58	5.29	1.21	2.96	5.35	6.25
31757	The R. T. French Co., Rochester, N. Y.	80.34	3.63	16.03	3.27	2.66	0.61	3.75	0.89	1.91	4.39	3.73
33334	Charles Gulden, Inc., N. Y.	77.03	3.60	19.37	2.90	1.58	1.32	4.61	0.98	2.55	5.29	5.59
33342	H. J. Heinz, Pittsburgh, Pa.	72.31	3.99	23.70	4.09	2.89	1.20	5.74	1.07	2.80	5.33	7.47
31773	Libby, McNeill & Libby, Chicago, Ill.	76.07	3.52	20.41	3.28	2.17	1.11	4.40	1.20	2.63	6.73	4.80
31776	Mustard Products, Inc., Brooklyn, N. Y.	76.23	3.44	20.33	3.62	2.35	1.27	4.91	0.91	2.31	5.72	5.17
33345	D. & L. Slade Co., Boston, Mass.	77.85	3.12	19.03	4.10	2.95	1.15	4.52	1.29	2.55	4.58	4.54
33337	Stickney & Poor Spice Co., Boston, Mass.	79.31	3.20	17.49	3.48	2.62	0.86	3.37	1.73	2.88	5.11	3.80

TABLE VI. ANALYSES OF PREPARED MUSTARD—*Continued.*
(In the Fat- and Salt-Free Solids.)

No.	Ash	Protein	Crude fiber	"Starch"	N-free extract
31787	10.81	38.67	8.56	21.11	41.96
33333	9.73	37.99	12.26	23.00	40.02
31777	7.93	32.52	7.14	22.09	52.41
31755	10.54	34.89	10.54	21.58	44.03
33346	11.77	39.39	9.01	22.04	39.83
31757	6.33	38.90	9.23	19.81	45.54
33334	10.82	37.78	8.03	20.90	43.37
33342	9.00	43.02	8.02	20.99	39.96
31773	8.26	32.75	8.93	19.57	50.06
31776	9.92	38.34	7.10	18.04	44.64
33345	9.97	39.16	11.18	22.10	39.69
33337	7.77	30.44	15.63	26.02	46.16

PAPRIKA.

Paprika is the dried fruit of the large-fruited red pepper, *Capsicum annum*. Hungarian paprika is paprika having the characteristic pungency and flavor of that grown in Hungary; while piementon or pimiento, sometimes called Spanish paprika, is paprika having the peculiar characters of that produced in Spain.

Paprika should not have over 8.5 per cent of total ash nor more than 1 per cent of insoluble ash. The iodine number of the extracted oil should not be less than 125 nor more than 136.[1]

Fourteen samples were examined. Two of these were infested with beetles and were evidently old stock. Analyses of the other samples are given in Table VII.

All of the samples conformed to the limits for ash and insoluble ash as fixed by the standard. Iodine numbers were determined and found to be somewhat lower than recorded by Doolittle and Ogden[2] for authentic samples of Hungarian and Spanish paprika, and lower also than the minimum standard. The values obtained ranged from 105 to 122 and averaged 113. An old but authentic sample of Hungarian paprika ground in the laboratory, including seeds but no stems, yielded 15.32 per cent of ether extract having an iodine number of 122.

SYRUP.

One sample of maple syrup, **3719**, was examined and passed.

Analysis: Solids 64.2 per cent; sucrose by polarization 59.6 per cent; ash 0.6 per cent; lead number 1.14.

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[1] Circ. 136. Office of Secretary, U. S. Dept. Agr.
[2] Jour. Am. Chem. Soc., 30, 1481, 1908.

TABLE VII. ANALYSES OF PAPRIKA.

No.	Dealer	Manufacturer	Ash	Ash insol. in HCl	Ether extract
	Bristol.		%	%	%
33332	Public Market	R. T. French Co...	7.31	0.30	12.73
31764	Atlantic & Pacific Tea Co.	Atlantic & Pacific Tea Co.	8.01	0.46	11.92
	Hartford.				
31758	M. J. Babian	D. & L. Slade Co...	7.46	0.40	12.47
31760	Cooley-Larsen Co.	Williams & Carlton Co.	7.71	0.40	12.85
31768	Dubin Butter Co..	D. & L. Slade Co...	8.32	0.49	10.11
31763	Griffen's Delicatessen	Wm. Boardman & Sons	7.20	0.21	12.16
	New Britain.				
33339	J. A. Spinetta	Austin Nichols & Co.	8.00	0.33	13.76
	Plainville.				
33338	Eastwood & Foran	R. C. Williams & Co.	7.81	0.30	13.23
	Stamford.				
31753	James Butler, Inc.	James Butler, Inc.	7.80	0.39	13.13
33347	Modern Grocery Co.	E. R. Durkee & Co.	7.66	0.35	11.41
31751	The Samuel Price Co.	Mutual Spice Co...	8.17	0.49	17.15
33349	J. Sternbach	F. H. Leggett & Co.	7.97	0.67	12.66

VINEGAR.

Eight samples of vinegar were examined for the Dairy and Food Commissioner and all were passed.

Eleven samples submitted by individuals were also examined.

MISCELLANEOUS FOODS, ETC.

6224. *Penolia* Peanut Butter, made by the Bradley-Smith Co., New Haven.

Analysis: Water 1.50 per cent; ash 2.64 per cent; protein 30.88 per cent; fiber 2.07 per cent; carbohydrate (by difference), 13.56 per cent; fat 49.35 per cent.

3431. *Nu-Salt.* Eli Lilly & Co., Indianapolis. This is declared to be an iodized salt containing 97 per cent sodium chloride; 0.05 per cent sodium iodide; 0.95 per cent potassium chloride; 1.00 per cent calcium sulphate; and 1 per cent sodium bicarbonate.

Analysis: Moisture 0.59 per cent; iron and aluminum oxides none; calcium oxide 0.62 per cent; magnesium oxide 0.02 per cent; potassium oxide 1.00 per cent; sulphur trioxide 0.43 per cent; phosphorus pentoxide 0.35 per cent; iodine 0.04 per cent; insoluble matter 1.15 per cent; carbon dioxide 0.42 per cent.

Calculated composition: Calcium phosphate 0.76 per cent; calcium sulphate 0.49 per cent; magnesium sulphate 0.06 per cent; sodium sulphate 0.18 per cent; potassium chloride 1.58 per cent; sodium iodide 0.05 per cent; sodium bicarbonate 0.80 per cent; sodium chloride 95.49 per cent; moisture 0.59 per cent.

The composition of the salt is substantially as claimed.

32813. *Ovaltine.* The Wander Co., Chicago, Ill.

Analysis: Moisture 1.65 per cent; ash 3.80 per cent; protein (N x 6.25), 13.44 per cent; fiber 0.18 per cent; starch none; sugars (as dextrose), 39.53 per cent; undetermined carbohydrate (largely dextrin), 35.32 per cent; fat 6.08 per cent.

A product of the same name was analyzed in this laboratory in 1917[1] in which an active amylase was present and a small amount of lecithin phosphoric acid was found. We have not examined the newer product for amylase or for lecithin phosphoric acid, but otherwise the composition is substantially the same as previously found. The label declaration implies a high vitamin content but we have made no biological tests for vitamin. The original sample examined was an English product claimed to be made from malt, milk and eggs.

34421. *Cereal Meal.* Cereal Meal Corporation, St. Louis, Mo. No analysis was made but microscopic examination indicated that the product is essentially a mixture of agar agar, bran, flaxseed and germ.

34418. *Grape Fruit,* canned, submitted by a purchaser. The sample contained about 3 per cent of sugar and 9 per cent of invert sugar in the liquid portion which was 44 per cent of the contents. The fruit was evidently canned without added sugar.

ACORNS.[2]

The analyses in Table VIII are of shelled acorns of various species as harvested in the fall and at the time of germination in the following spring after storage in earth during the winter.

Starch was determined by the diastase method. Soluble carbohydrates means such as are soluble in 10 per cent alcohol and reduce Fehling's solution after hydrolysis. It was found that the maximum reducing power of these soluble carbohydrates was reached after 30 minutes hydrolysis; thereafter reducing power diminished due probably to the destruction of levulose. Direct reducing sugars were also determined.

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[1] Conn. Exp. Sta., Bull. 200, p. 154.

[2] These analyses by Mr. Shepard were made in collaboration with Dr. C. F. Korstian in his study of changes taking place during the germination of acorns. The results are discussed in a paper by Dr. Korstian for publication elsewhere.

Table VIII. Analyses of Shelled Acorns.

	White Oak Fall Nov. 1925 %	White Oak Spring Apr. 1926 %	Red Oak Fall Nov. 1925 %	Red Oak Spring Apr. 1926 %	Chestnut Oak Fall Nov. 1925 %	Chestnut Oak Spring Apr. 1926 %	Scarlet Oak Fall Nov. 1925 %	Scarlet Oak Spring Apr. 1926 %
In the Fresh Material.								
Water	39.68	36.66	32.90	26.57	47.23	40.70	23.83	31.67
Ash	1.55	1.54	1.76	2.11	1.19	1.75	1.57	1.70
Protein (N x 6.25)	4.48	4.93	4.80	5.06	4.49	5.27	5.90	5.10
Fiber	1.06	1.59	1.59	2.06	1.31	1.84	1.73	1.70
Carbohydrates:								
Starch	28.91	32.49	16.02	23.45	16.99	21.43	18.48	18.24
Soluble, as dextrose after hydrolysis 30 mins.	6.31 (4.83)[1]	5.95 (5.58)[1]	7.09 (4.30)[1]	4.60 (4.02)[1]	7.83 (7.07)[1]	7.71 (7.28)[1]	7.16 (4.05)[1]	4.48 (3.80)[1]
Undetermined	13.90	15.17	20.75	21.39	18.55	20.19	17.85	21.35
Fat	4.11	1.67	15.09	14.76	2.41	1.11	23.48	15.76
In the Water-free Material.								
Ash	2.56	2.43	2.62	2.87	2.26	2.96	2.06	2.48
Protein	7.42	7.79	7.16	6.90	8.50	8.88	7.75	7.46
Fiber	1.77	2.51	2.37	2.81	2.48	3.11	2.28	2.49
Carbohydrates:								
Starch	47.93	51.27	23.89	31.94	32.20	36.14	24.26	26.69
Soluble, as dextrose after hydrolysis 30 mins.	10.47 (8.01)[1]	9.39 (8.80)[1]	10.58 (6.41)[1]	6.26 (5.47)[1]	14.83 (13.40)[1]	13.00 (12.27)[1]	9.41 (5.32)[1]	6.56 (5.56)[1]
Undetermined	23.04	23.97	30.88	29.12	35.16	34.04	23.41	31.27
Fat	6.81	2.64	22.50	20.10	4.57	1.87	30.83	23.05

[1] Direct Reduction.

II. DRUGS.

Solution of Arsenous and Mercuric Iodide.

This preparation should contain in each 100 cc. not less than 0.95 gm. nor more than 1.05 gms. of arsenous iodide and not less than 0.95 gm. nor more than 1.05 gms. of mercuric iodide.[1]

Table IX. Analyses of Arsenous-Mercuric Iodide.

No.	Dealer	Arsenous iodide (AsI_3) gm/100 cc.	Total arsenic as arsenous iodide (AsI_3) gm/100 cc.	Mercuric iodide (HgI_2) gm/100 cc.
34490	Lee & Osgood, Norwich (own make)	0.48	0.96	0.69
34681	Wilson Drug Co., Willimantic (Lehn & Fink, N. Y.)	0.03	1.00	0.78

In both of these samples the arsenous iodide has largely oxidized to the pentiodide form. The rapid transformation of arsenic through oxidation in the case of this product has been pointed out.[2] Total arsenic calculated as triiodide is within the limits of the standard. Mercuric iodide was below the standard, however.

Spirit of Camphor.

Spirit of camphor contains not less than 9.5 gms. and not more than 10.5 gms. of camphor per 100 cc.[3]

Thirty-one samples were examined for the Dairy and Food Commissioner. Of this number only one varied from the standard by more than 10 per cent. This was sold by Barron's Drug Store, New Haven, and contained only 5 per cent of camphor, approximately ½ strength.

Analyses are given in Table X.

Table X. Analyses of Spirit of Camphor.

No.	Dealer	Manufacturer	Camphor, gms/100 cc.
	Branford		
34685	The Spaulding Co.	Own make	10.4
	Bristol		
34654	Bristol Pharmacy	Own make	9.2
34652	Holley Pharmacy	Own make	9.4
34655	Rickman's Drug Store	Mass. Wholesale Drug Co., Springfield, Mass.	11.0
34653	Leroy P. Tucker	Eastern Drug Co., Boston, Mass.	9.7
	Cromwell		
34666	Hitchcock's Pharmacy	Own make	9.6

[1] U. S. P. X, p. 208.
[2] Jour. Am. Pharm. Assoc., 15, 464, 1926.
[3] U. S. P. X, p. 351.

TABLE X. ANALYSES OF SPIRIT OF CAMPHOR. *Concluded.*

No.	Dealer	Manufacturer	Camphor, gms/100 cc.
	East Portchester		
34766	D. H. McHugh	Own make	8.7
	Forestville		
34659	Kent's Pharmacy	Brewer & Co., Springfield, Mass.	10.0
	Hartford		
34499	Jefferson Pharmacy	Own make	8.5
34496	Thomas A. Lynch	Sisson Drug Co., Hartford	10.4
	Manchester		
34693	Edward J. Murphy	Own make	9.1
	Meriden		
34673	N. P. Forcier	Own make	9.8
34668	The Graeber Pharmacy..		10 0
34670	Lynch Drug Co., Inc....	Own make	10.4
	Middletown		
34663	Geo. R. Cassidy	Own make	9 8
34665	John J. Cronin	Own make	10 6
34664	Lincoln Drug Store	United Drug Co., Boston, Mass.	9 9
	New Haven		
34763	Barron's Drug Store	Own make	5.0
	Plainville		
34661	Geo. R. Byington	Own make	8.8
34660	Thrall's Drug Store	Own make	11.2
	Portland		
34662	Conklin's Pharmacy	Own make	10.6
	So. Manchester		
34692	Miner's Pharmacy		9.7
	Terryville		
34656	Pelchar's Pharmacy	Own make	10.0
34658	Pelchar's Pharmacy		10.3
	Waterbury		
34760	Carroll Co.	Wolf-Thornen, Inc., N. Y.	10.4
	West Haven		
34764	John K. Stevenson	Hance Bros. & White, Philadelphia, Pa.	10.4
	Wethersfield		
34675	Wethersfield Pharmacy..	Own make	10.4
	Willimantic		
34680	Bay State Drug Co.	Own make	10.2
34679	Wilson's Windham Pharmacy	Own make	10.5
	Winsted.		
34677	Bannon's Drug Store	Eastern Drug Co., Boston, Mass.	9.8
34678	Frank S. Bunnell		9.6

CAMPHOR LINIMENT.

This preparation should contain not less than 19 per cent nor more than 21 per cent of camphor.[1]

Twenty-eight samples were examined. Five were found deficient in camphor, and one was misbranded. Sample **34672** was not camphor liniment but double strength spirit of camphor.

Analyses are given in Table XI.

TABLE XI. ANALYSES OF CAMPHOR LINIMENT.

No.	Dealer	Manufacturer	Camphor, per cent
	Ansonia		
34479	McArog's Pharmacy	Upjohn Co., Kalamazoo, Mich.	19.2
	Branford		
34684	Branford Pharmacy	C. S. Leete, New Haven	16.9
	Canaan		
34474	Farnum's Drug Store	Lehn & Fink, N. Y.	18.7
	East Portchester		
34765	D. H. McHugh	Filborn Pharmical Co., Brooklyn, N. Y.	20.9
	Falls Village		
34477	G. E. Frink	Brewer & Co., Worcester, Mass.	19.4
	Hartford		
34650	Jefferson Pharmacy	The Bronx Drug Co., N. Y.	19.6
34497	Thos. A. Lynch	J. Russell White, Staten Island, N. Y.	7.6
	Meriden		
34671	W. W. Mosher	The DePree Co., Holland, Mich.	19.1
34674	Palace Pharmacy	Own make	21.7
34672	Charles H. Pinks	Own make	19.5
	New Britain		
34487	Connor's Drug Store	Girard & Co., Inc., Mt. Vernon, N. Y.	18.9
	New Haven		
34686	Baker & Meade, Inc.	Own make	19.2
34687	Taft Pharmacy	Own make	20.9
	North Haven		
34469	North Haven Pharmacy	C. W. Whittlesey, New Haven	18.4
	Norfolk		
34471	Geo. T. Johnson Drug Co.	United Drug Co., Boston, Mass.	22.1
	Norwich		
34489	Dunn's Pharmacy	Eastern Drug Co., Boston, Mass.	19.6
34492	The Lee & Osgood Co.	Own make	21.0
34491	C. C. Treat	Hance Bros. & White, Philadelphia, Pa.	19.4
	Putnam		
34758	Joseph H. P. Gague	Own make	29.5

[1] U. S. P. X, p. 204.

TABLE XI. ANALYSES OF CAMPHOR LINIMENT. *Concluded.*

No.	Dealer	Manufacturer	Camphor, per cent
	Sharon		
34476	C. H. Egglestone	Gibson Snow Co., Albany, N. Y.	18.7
	South Manchester		
34691	Magnell Drug Co.	Own make	19.1
	Terryville		
34657	Pelchar's Pharmacy	Own make	18.9
	Waterbury		
34761	Carroll Co.	Standard Drug Co., Newark, N. J.	18.2
34759	The Leavenworth & Dikeman Co.	Own make	15.3
34762	Waterbury Drug Co. ...	Own make	20.5
	Willimantic		
34683	Curran & Flynn	Geo. L. Claflen Co., Providence, R. I.	5.6
34682	J. J. Hickey Drug Co. ..	Own make	19.2
	Winsted		
34676	Opera House Pharmacy	Own make	6.6

DICHLORAMINE, ETC.

Dichloramine should yield not less than 28 per cent nor more than 30 per cent of active chlorine.[1]

Two samples were examined and found to be of standard strength. One, **34466**, was made by the Abbott Laboratories, Chicago, and contained 29.82 per cent active chlorine; the other, **34468**, made by E. R. Squibb & Sons, New York, contained 29.85 per cent.

Chloramine is a similar product containing less active chlorine. It should contain not less than 11.5 per cent and not more than 13 per cent of active chlorine.[2]

Two products made by the Abbott Laboratories were analyzed. One, **34467**, called Chlorazene, contained 11.72 per cent of active chlorine. The other, **34473**, was in tablet form, each tablet declared to contain 4.6 grains of chloramine, and 4.4 grains were found.

A sample of solution of chlorinated soda (Labarraque's Solution), **34488**, was found to contain the required amount of active chlorine, i. e., not less than 2.5 per cent.[3] It was made by Powers-Weightman & Rosengarten.

[1] U. S. P. X, p. 125.
[2] U. S. P. X, p. 105.
[3] U. S. P. X, p. 224.

SOLUTION OF FORMALDEHYDE.

Solution of formaldehyde should contain not less than 37 per cent of formaldehyde.[1] Eight samples were examined and only one was found to be less than 90 per cent of the standard.

Analyses are given in Table XII.

TABLE XII. ANALYSES OF SOLUTION OF FORMALDEHYDE.

No.	Dealer	Manufacturer	Formaldehyde, per cent
	Hartford		
34498	Thos. A. Lynch	Mallinckrodt Chem. Co., N. Y.	36.6
	New Britain		
34486	Novecko Drug Store ...	Powers-Weightman & Rosengarten, Phila., Pa.	36.7
	North Haven		
34470	North Haven Pharmacy	Merck's, N. Y.	36.8
	Norfolk		
34472	Geo. T. Johnson Drug Co.	Sisson Drug Co., Hartford	32.9
	Norwich		
34493	The Lee & Osgood Co..	Hayden Chemical Co., Garfield, N. J.	36.5
	Sharon		
34475	C. H. Egglestone	.....	36.7
	South Norwalk		
34495	Plaisted Drug Store	Dolge Chemical Co., Westport	35.8
	Waterbury		
34478	West Side Pharmacy ...	Apothecaries Hall Co., Waterbury	36.8

SOLUTION OF MAGNESIUM CITRATE.

The standard for this article requires that it contain not less than 1.5 gm. of magnesium oxide per 100 cc.[2]

Three samples were examined. One, **34494**, purchased of E. F. Cornell, West Haven, was found to conform to this standard. It contained, however, somewhat less citric acid than the U. S. P. formula calls for.

Another sample, **33860**, made by the Atlantic Druggist Specialty Co., New Haven, contained less magnesium than the official preparation contains; and the magnesium was present partly as sulphate and the remainder as citrate. It was sold under a declaration that it was "not U. S. P." and is not, therefore, illegal.

[1] U. S. P. X, p. 215.
[2] U. S. P. X, p. 218.

Analysis: Magnesium oxide, gm./100 cc., 0.94; sulphur trioxide 0.94; total citric acid 2.00. Calculated as magnesium sulphate, 1.4; magnesium citrate 1.9.

A sample, **4848**, submitted by a purchaser contained 1.42 per cent of magnesium oxide.

Solution of Potassium Iodide.

To check the accuracy of a determination of potassium iodide made on a sample of this drug taken in our 1925 inspection, the third part of our sample **32605**, which was left with the dealer at the time of sampling, was assayed eight months later. It was found to contain 35.6 gms. of potassium iodide per 100 cc. as compared with checked results of 34.9 gms. at the time of preparation and sampling. The third part of this sample had concentrated somewhat due to loss of water during the eight months interval. This preparation should have contained, according to the prescription presented, not less than 45.5 gms. of potassium iodide per 100 cc.

Sample **4693**, McQuade's Drug Store, Ansonia, made and submitted by the dealer, contained 45.1 gms. potassium iodide per 100 cc. According to the formula used the preparation should contain 45.5 gms. assuming 99 per cent purity for the salt.

Tablets (Hypodermic).

34667. *Atropine sulphate tablets.* 1/150 grain. Sold by the Sisson Drug Co., Hartford, manufactured by the Eli Lilly Co. Should contain 0.0067 grains per tablet; found 0.006. The variation is a little wider from the claim than is tentatively accepted (9.0 per cent) for hypodermic tablets of this type and dosage, but the tablets were passed.

34669. *Strychnine sulphate tablets,* (1/30 grain). Sold by Lynch Drug Co., Inc., Meriden, manufactured by Sharp and Dohme. Should contain 0.033 grains per tablet; found 0.019. Tablets were low in strychnine sulphate.

Proprietary Remedies, etc.

Six preparations of this type were examined.

3350. *Ocean-O.* Oceano Products Co., Newark, N. J. This is a liquid preparation made from sea water by removing the common salt and concentrating the other mineral constituents. According to accompanying literature the product is "a scientific, concentrated extract consisting of the natural and vital elements from pure deep sea water."

Analysis, gms/100 cc.: Solids 21.6; ash 13.3; chlorine 9.4; sulphur trioxide 1.9; iodine trace (.0005); carbon dioxide, free 0.049; bicarbonate (as HCO_3), 0.018; silica (SiO_2), 0.001; iron and aluminum (as metal), 0.001; calcium (Ca), 0.04; strontium (Sr), none found; magnesium (Mg), 1.78; sodium (Na), 3.13; potassium (K), 0.53; lithium ?.

There was no evidence of organic material and the difference between the solids and ash is probably due chiefly to water of crystallization and partly to decomposition of magnesium salts. The above analysis agrees substantially with one given in advertising literature.

3836. *Histolo Therapy Inorganic Food Celloids.* Kali Mur. Made by Luyties Pharmacal Co., St. Louis. Three tablets were examined for the State Commissioner of Health.

The average weight of tablets was 4.1 grains each. They consisted of about 98 per cent milk sugar, a small amount (0.13 per cent) of mineral substance (ash), and the balance was largely or entirely moisture. The ash consisted chiefly of chlorides, potassium chloride being found in the amount of 3/100 of one per cent. The name "Kali Mur" means, or suggests, potassium muriate which is potassium chloride. A considerable part of the ash no doubt was derived from the lactose used as an excipient.

3508. *McCoy's Rinolin Emulsion.* Made by McCoy's Rinolin Co., Inc., 62 West 14th St., New York. The label indicates that this preparation is a mixture of mineral oil, agar-agar, phenolphthalein and cascarin.

The preparation contained about 40 per cent of water, 45 per cent of mineral oil and one per cent of phenolphthalein. No evidence of oxymethyl-anthraquinone derivatives was obtained. Agar or some other emulsifying agent is present. "Cascarin" is a name suggested for a hypothetical active principle of cascara which it has been shown[1] is not a definite chemical substance but a mixture of constituents of cascara.

3507. *Matamel.* The concentrated sap of the Mexican Maguey plant (also known as Agave, and American Aloe). Prepared by Philip Newton, M.D., Ometusco, Mexico. Advertising literature indicates that the preparation relieves bladder weaknesses.

Analysis: Solids at 60° C. (in vacuuo) 72.6 per cent; ash 2.0 per cent; invert sugar 19.4 per cent; sucrose 44.7 per cent; total nitrogen 0.27 per cent; gums, pectin, etc., (precipitated by alcohol), 0.36 per cent; acidity, as malic acid, 1.0 per cent.

Michand and Tristan[2] reported an inactive sugar in Agave Americana which they called "agavose." Stone and Lotz,[3] however, have claimed that this sugar is only sucrose. No references

[1] Welcome Research Laboratories, Report 47, 1904.
[2] Am. Chem. Jour., 14, 548, 1892.
[3] Ibid., 17, 368, 1895.

to the medicinal use of Maguey were found except that the fresh juice is said to be laxative, diuretic and amenagogue, and in doses of 2 fluid ozs., useful in scurvy.[1]

33987. A sample of *Asthma remedy* labeled as made by the Frontier Co., Buffalo, was submitted by a nurse. It was found to contain ammonia, iodides and caffeine; arsenic was not determined. A product made by a company of the same name was examined in the laboratory of the American Medical Association[2] and found to contain a mixture of ammonium sodium and potassium iodides, arsenic and caffeine.

3227. *Ibosan.* The Ibosan Agency, 3616 Lyndale Ave., So. Minneapolis, Minn. Accompanying literature says in part: It (Ibosan) is a tried and proven remedy for diabetes. It acts by breaking up the molecules of carbohydrates (sugar and sugar-making foods), and by creating what might be called sugar-tolerance in the organs which have to do with converting carbohydrates into food.

Partial analysis:

A powdered or granulated product which, on treating with hot water, has the odor of yeast.

Moisture 5.93 per cent; total nitrogen 6.75 per cent; ash 8.02 per cent; phosphoric acid (P_2O_5), 3.34 per cent; potassium oxide 3.19 per cent.

Enzymic action on starch slight or negligible.

Inverting action on sucrose marked.

Fermenting powder (zymase) not tested.

The chief effect of the powder, so far as carbohydrate metabolism is concerned, is to convert sucrose into simpler sugars, dextrose and levulose. The difficulty of the diabetic patient is not to convert sucrose, but to metabolize properly the simpler sugars, so that Ibosan offers no real aid to carbohydrate tolerance.

Miscellaneous Materials Examined for Poisons, etc.

Thirty-three samples have been examined chiefly for health officers or other public officials. This work is summarized as follows:

No.	Material	Remarks
33283	*Cooked Carrots.*	A green mold evidently led to the suspicion of Paris green. No poisonous metals were found.
4010	*Fish Lure.*	Sample too small for analysis. Chief noticeable characteristic was the odor which resembled that of anise. Fed to gold fish for two weeks and no unfavorable symptoms noted.

[1] U. S. Dispensatory, p. 1232.
[2] Am. Med. Assoc., Laboratory Report for 1916, p. 114.

No.	Material	Remarks
4201	*Linseed oil.*	Met the requirements of the U. S. P.
5221	*Liquid for cleaning bowling alleys.*	Alleged to have caused dizziness, headache, nausea and other symptoms in those working with it. Liquid found to consist of, or contain, varnish in a solution of carbon disulphide and carbon tetrachloride, the disulphide predominating. Both of these substances are toxic, causing symptoms as described above.
33877 33878 33879 33880 33881	*Materials for identification or to be tested for poison.*	33877 was identified as sodium bicarbonate. 33878 was cake. Fed to white rats for eight days and no unfavorable symptoms noted. 33879, baking powder, not in original container, found to contain 150 parts per million of arsenic. Baking powder does not ordinarily contain arsenic to the extent of more than 1 part per million. 33880 and 33881, sugar and salt. No poisons were found.
31799	*Meat.*	Alleged to have caused death of dogs. No evidence of arsenic, mercury or other metallic poisons, or of cyanide or alkaloids was found.
32844 32845 32846	*Medicines.*	32844. Digitalis capsules containing 1.5 grains of digitalis powder. These tablets are standardized in terms of so-called "cat-units" which involves a biological test. Capsules not assayed but they were made by a reliable firm. 32845. Prescription, theobromine and sodium salicylate. Contained 42.5% theobromine and the equivalent of 30.9% salicylic acid, which were substantially the amounts demanded. 32846. Hexamethylenetetramine tablets found to be of the strength called for by the prescription.
4767	*Medicine.*	No evidence of morphine or of other opium alkaloids found.
5358	*Medicine.*	Iron and ammonia sugar present. Solids had odor of vinegar. Probably iron and ammonium acetate.
4171	*Metal Polish.*	Flash point determined 66° F., open cup method.
4940	*Orange Soda.*	No evidence of poisons detected.
3363 3365 3368	*Stomach contents of dogs; also chopped meat.*	Strychnine identified by chemical and biological tests, both in stomach contents and in meat which had been fed to the animals.
3370	*Stomach of dog.*	No phosphorus (yellow), or other volatile poisons, no alkaloids, and no poisonous metals were detected.
4771	*Stomach, liver and kidney of dog.*	Bismuth and mercury were found but these substances were present in medicine administered to dog. No evidence of other poisonous substances was found.

No.	Material	Remarks
5794	*Stomach of fox.*	The material was preserved with formalin so that tests for cyanides could not be made. A substance was isolated which was probably strychnine but tests for identity were not conclusive.
4995	*Tablets.*	No morphine or other opium alkaloids detected.
3892	*Tablets used for gauging the strength of alkali.*	Tablets composed of potassium hydrogen sulphate, brown-phenol purple and a siliceous excipient. Each tablet contains about 0.34 gm. of potassium hydrogen sulphate which will neutralize 1/10 gm. of sodium hydroxide.
4892	*Unknown waxy material.*	Not positively identified.
5680	*Vaseline.*	No evidence of alkaloids found.
5361	*Water from spring.*	Contained particles of fat floating on surface. No evidence of strychnine, arsenic or cyanide found in the fat or in the water.
4927	*Water.*	No poisonous metals detected.
4895, 4896	*Water, well.*	No evidence of arsenic was found.
4998	*White powder.*	Identified as calcium carbonate. Arsenic test negative.
4772	*Worm capsules for dogs.*	Kamala, areca nut, santonin, chenopodium were tested for but not detected. Oil of savin was not identified but an oil having the odor of savin was present.

Examinations Made for the State Water Commission.

Coöperating with the State Water Commission, five samples of factory waste liquors, etc., have been examined and reported to Mr. Copeland, engineer to the Commission. This work is in accordance with the statute creating the commission which directs that this Station may be called upon for such analytical service as it can render. Analyses required in considerable detail were made by Mr. Fisher. Methods of the American Public Health Association were employed whenever applicable.

Glassware Used in the Babcock Test.

Under the statute requiring this Station to check the calibration of pipettes and test bottles used in operating the Babcock test, the following pieces of glassware have been tested.

	Broken (in transit)	Accurate	Inaccurate or not meeting requirements	Total
Pipettes 17.6 cc.	1	379	0	380
Milk test bottles	22	1745	47	1814
Cream test bottles ...	0	224	17	241
Totals	23	2348	64	2435

In addition 12 lactometers have been checked against our standard instrument.

Connecticut Agricultural Experiment Station
New Haven, Connecticut

The Biology of

THE BIRCH LEAF SKELETONIZER

Bucculatrix canadensisella, Chambers

ROGER B. FRIEND

CONTENTS

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

The Biology of

THE BIRCH LEAF SKELETONIZER*

Bucculatrix canadensisella, Chambers

Roger B. Friend

I. Introduction

The biology of *Bucculatrix canadensisella,* or, as it is more commonly called, the birch leaf skeletonizer, is known to only a very slight extent. Not only does the insect have peculiar habits and a specific structure, but its great abundance during certain years, coupled with its habit of feeding on native birches, renders it of interest economically as well as biologically. In the following pages are the results of investigations, made during the years 1924, 1925, and 1926, into its habits, reactions, distribution, history, and morphology. The work is not complete, but it is intended that the gaps shall be filled, in part at least, in the future.

I am indebted to Professor Alexander Petrunkevitch of Yale University and Dr. W. E. Britton of the Connecticut Agricultural Experiment Station for criticism of the work; to Professor G. C. Crampton of the Massachusetts Agricultural College for assistance in certain details of the morphological part; to Messrs. A. B. Gahan, R. A. Cushman, and C. F. W. Muesebeck of the United States Department of Agriculture for determining the species of parasites; to Dr. Annette F. Braun of the University of Cincinnati for some notes on the geographical distribution; to Mr. C. B. Hutchings of the Entomological Branch, Canada, for the use of an unpublished manuscript, and to Mr. B. H. Walden of the Connecticut Agricultural Experiment Station for the photographic work.

II. History

The earliest reference to the genus *Bucculatrix* is found in the first volume of de Geer's "Mémoires," in which is given the life history of a "little caterpillar with sixteen legs, smooth, green, which feeds on the lower side of the leaves of Frangula." It was the manner in which this caterpillar spun its cocoon which attracted the attention of de Geer, as the following extract from his

* This paper is a dissertation presented in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Yale University.

"Mémoires" shows: "Quand elles sont parvenues à leur juste grandeur, ce qui arrive dans le mois susdit, elles filent contre les feuilles mêmes de trés-jolies petites coques alongées. qui meritent extrèmement d'être connues, à cause de leur figure particulière. Ce sont ces coques qui m'ont déterminé à donner l'histoire de ces Chenilles." He gives a detailed description of the manner in which the cocoon is woven, and also gives brief attention to the pupal and adult stages. There is a plate of illustrations of the larva, the structure of the cocoon, the adult, and the injury to the plant. The species described was *Bucculatrix frangulella* and the host plant, *Rhamnus frangula,* the buckthorn.

In 1832 de Haan published a posthumous volume of Lyonet's works in which there is a description of a "chenille extrèmement petite, mais qui emploie une adresse inconcevable à se filer une coque cannelée." This description formed part of a letter from Lyonet to Réaumur written December 22, 1744, and was later sent to the president of the Royal Society of London to be published if the society saw fit to do so. Most of the description is devoted to the details of the structure and weaving of the cocoon. In his illustrations Lyonet figures the larva, cocoon and its structure, and adult. The larvae were found by Lyonet on the leaves of the oak. This species was *Bucculatrix ulmella* Mann (Zeller).

The history of the genus up to 1862 is given by Stainton in his "Natural History of the Tineina." Linnaeus and Fabricius neglected it entirely, and in 1783 Goeze, in his "Entomologische Beiträge," gave the name *Tinea frangulella* to de Geer's species. Neither de Geer nor Lyonet gave names to the species they described. Retzius, writing contemporaneously with Goeze, and Villers six years later, both gave different names to the *Tinea frangulella* of Goeze. The next person after de Geer to describe a species of this genus was Haworth, who in 1829 in "Lepidoptera Britannica" described *Tinea cuculipenella* with the varieties *beta, gamma,* and *delta.* Stainton notes that although Haworth's descriptions are very vague, *beta* was probably *Bucculatrix boyerella, gamma, B. crataegi,* and *delta, B. ulmella* (Lyonet's species). Three years later, in 1832, appeared the posthumous volume of Lyonet's works, in which is described what proved to be *Bucculatrix ulmella,* as mentioned above. In 1834 Stephens translated Haworth's description of *Tinea cuculipenella* without mentioning the varieties *gamma* and *delta.* In 1833 Treitschke had redescribed de Geer's species as *Elachista rhamnifoliella,* and a new species, *Elachista gnaphaliella.* In 1838 Duponchel figured four species in his "Lepidoptères de France," in the genus *Elachista,* namely, *E. boyerella, E. rhamnifoliella, E. gnaphaliella,* and *E. hippocastanella.* In 1839 Zeller, in "Isis," placed the following species in section A of his genus *Lyonetia: L. rhamnifoliella* (giving reference to de Geer), *L. albedinella* (*boyerella* of Duponchel),

L. hippocastani (*hippocastanella* of Duponchel), *L. cristatella, L. nigricomella, L. cidarella,* and *L. crataegi.*

In 1848 Zeller established the genus *Bucculatrix* with nine species, the descriptions appearing in "Linnaea Entomologica," volume III. The nine species, with the authors credited by Zeller, were:

1. *Bucculatrix cidarella* Tischer
2. *ulmella* Mann
3. *crataegi* Zeller
4. *boyerella* Duponchel
5. *gnaphaliella* Treitschke
6. *frangulella* Goeze
7. *hippocastanella* Duponchel
8. *nigricomella* Zeller
9. *cristatella* F. R.

The species *gnaphaliella* had been previously (1839) placed by Zeller in *Lithocolletis.* He included *Bucculatrix* in a group of leaf-mining moths possessing eye-caps. Much of the history of the genus from Zeller on does not concern us here and will be omitted. Stainton, from whose work much of the above information has been derived, listed in 1862 nineteen species of *Bucculatrix* of which he considered fourteen good and five doubtful. The fourteen were known in the larval form and their food plants were given. Twelve of the fourteen are described by Stainton very fully. This work covers practically all that was known of the genus up to the time of writing.

For the earliest described American species we must turn to the writings of Clemens, who, in the Proceedings of the Academy of Natural Sciences, Philadelphia, for 1860, published the descriptions of four new species of *Bucculatrix: B. coronatella, B. pomifoliella, B. agnella,* and *B. trifasciella.* These descriptions were again published in 1872 in a posthumous volume of the writings of Clemens, edited by Stainton. This volume also includes a description of the genus by Clemens. Chambers, in the Canadian Entomologist, volume V, 1873, described and mentioned nine American species of this genus and stated these to be all the described American species known to him. These nine are: *B. trifasciella* Clemens, *B. capitealbella* n. sp., *B. pomifoliella* Clemens, *B. obscurofasciella* n. sp. (possibly synonymous with *B. coronatella* Clemens), *B. luteella* n. sp., *B. agnella* Clemens, *B. packardella* n. sp., *B. coronatella* Clemens, *B. thuiella* Packard. Although Chambers considered his *obscurofasciella* possibly synonymous with *coronatella* Clemens, Forbes (1923) gives *trifasciella* Clemens and *obscurofasciella* Chambers synonymous with *packardella* Chambers. It is not proposed to give a discussion of systematics and synonymy here, however. This briefly concludes the history

of the genus in America up to 1875, when the species *canadensisella* was described.

In the Canadian Entomologist, volume VII, 1875, Chambers described *Bucculatrix canadensisella*, having received his specimen from Canada. This description (see page 401) concerns the adult only and does not mention the larva nor the larval food plants. *B. cidarella* of Europe Chambers considered close to *B. canadensisella*, although quite distinct. The larva of the European species *demaryella* feeds on birch, but according to the description given by Stainton (1862) it also is quite distinct from *canadensisella*.

For twelve years after the description by Chambers there occurs no mention of the species, but in 1887 Lintner recorded the occurrence of the insect in Monroe County, New York, where the larvae were very abundant on the leaves of *Betula lutea* during the fall of 1886. In 1890 Packard recorded what was in all probability this species on the leaves of the white birch at Brunswick, Maine. Lintner again reported it from New York in 1893, this time as injurious to all the native birches in the region of Ausable Forks during September, 1891. The same year Fletcher stated that all the birches around Ottawa, especially *Betula papyrifera*, *B. lutea*, and *B. alba* (European white birch) were severely injured. From this time on the reports of the insect become more frequent and the injury caused by its larvae more noticed. Hutchings published a brief life history in the 56th Annual Report of the Entomological Society of Ontario (1926), and this treats of the insect more fully than any other publication to date. The species is of some economic importance, and most of the literature on it concerns the injury done to the birch trees.

Systematically the genus has been neglected, and when mentioned it is referred to as aberrant. Forbes (1923) published a key to the species found in northeastern United States with descriptions. For descriptions of species discovered in the present century in America the writings of E. Meyrick, A. F. Braun, and A. Busck should be consulted; and for Old World species see the writings of E. Meyrick, especially his "Exotic Microlepidoptera."

The history of the insect is interesting in view of the fact that at frequent intervals it appears in extraordinary numbers and severely attacks birches over wide areas. In 1886 Lintner found it abundant in Monroe County, New York, and in 1887 it was reported as abundant in Massachusetts. During the years 1890, 1891, and 1892 a serious outbreak occurred in Ontario, New York, and New England. In 1901, 1902, and 1903 it was again very abundant and severely attacked birches throughout this same area. In 1907 a small outbreak occurred on Staten Island, New York, and in 1910 the insect was abundant at Kinderhook, New York.

In 1909 and 1910 birches in Minnesota were extensively skeletonized, and the insect's depredations were severe in Ontario in 1910, 1911, and 1912, and in New England in 1909, 1910, and 1911, growing less serious in 1912 and 1913. The third outbreak of this insect thus covered Ontario, Minnesota, and New England between 1909 and 1912, with small outbreaks in New York in 1907 and 1910. In 1919 the larvae were again beginning to appear in large numbers. This year they were abundant in New Brunswick and were noticed in Connecticut. In 1920 birches were heavily skeletonized and defoliated in Ontario, Quebec, and New Brunswick. In 1921 the infestation continued in these regions, and larvae were abundant in Minnesota and appeared commonly in Massachusetts. In 1922 the injury to birch trees was conspicuous over the Great Lakes region and in New England. This last outbreak began to subside in 1924, although the larvae were injurious in Quebec in 1925. Beginning about 1890 there have been four serious outbreaks of this insect, one about every ten years. Some of the possible reasons for this periodic abundance will be considered under the section dealing with predaceous and parasitic enemies.

III. Systematic Position

The genus *Bucculatrix* was placed by Zeller in a group of minute leaf-mining moths the adult antennae of which possessed eye-caps. Along with *Bucculatrix* were *Lyonetia, Cemiostoma, Nepticula,* etc. The first general treatise on *Bucculatrix* placed the genus in the Tineina (Stainton 1862). It is usually placed in the Lyonetiidae today and is so classified by Forbes (1923). There are, however, differences of opinion as to the classification of Lepidoptera and of this genus in particular. Thus Forbes places *Bucculatrix* in the family Lyonetiidae of the superfamily Tineoidea, but Mosher (1916) places it in the family Bucculatrigidae of the superfamily Gracilarioidea, basing her decision on pupal characters; and Fracker (1915) places it in the family Bucculatrigidae of the Tineoidea. The grouping of families and genera in the Tineina is still apparently an open question. The genus will here be placed in the Lyonetiidae according to the classification of Forbes and considered as slightly aberrant. For a taxonomic account of the genus and a key to the species of northeastern United States the work of this author may be consulted.

IV. Laboratory Methods

The life history data were secured by rearing individual larvae in glass jars or vials, each receptacle containing wet sand and a fresh birch leaf. Observations were made daily. Adults for

oviposition records were caged over a birch twig in a celluloid cylinder with cloth ends. This permitted natural conditions of light and air. The leaves were examined daily with a glass and eggs were marked with a circle of black ink and numbered. Pupae were obtained by simply placing small pieces of heavy cardboard under the plant in a stock rearing cage. The larvae spun their cocoons on the under side of the cardboard. The pupae were kept in a box sunk in the ground until the early summer. Just prior to the period of emergence they were placed singly or in groups of five in glass vials plugged with cotton or in large gelatin capsules, the ends of which were perforated. This made observations on the emergence of adults a simple matter. All life-history studies were made in an out-door insectary. For dissecting fresh material, it was found best to cover the chloroformed specimen with a drop of thick shellac, add one drop of alcohol, allow to set a few minutes, and then immerse in saline solution. The shellac became pitchy and held the insect firmly, but at the same time it could be easily removed from the chitin. For studying the external morphology the insects were boiled in 10 per cent potassium hydroxide until clear and then stained in tetrabromfluorescic acid twenty-four hours. The chitinized plates stained deeply red, and the membranous cuticle a light pink. The body being clear, the internal skeletal structures were readily observed. For the temperature experiments the larvae were kept singly in glass vials or in test tubes, the receptacle in either case being plugged with cotton. The food material was kept fresh and unwilted. The individual insects in all cases were from miscellaneous field collections made in the vicinity of New Haven except where otherwise noted.

V. Morphology

The morphological descriptions will be confined to the external appearance of the various stages and certain important anatomical details of the exoskeleton. The genital organs of the adult will be briefly mentioned as they are of considerable interest morphologically and have more or less influence on the external form. The internal anatomy is not further described here, but it is intended that a description of the anatomy and histology will be produced later.

The original description of the genus by Zeller (1848) is reprinted below.

Bucculatrix Zell.

Elachista Tr. Lyonetia ex p. Zell.

"Caput lanatum, comosum.
"Antennae breviusculae, conchula basali parvula instructae.
"Palpi nulli; os squamis epistomii tectum.

"Alae anteriores caudulatae; cellula discoidales acuta postice venulas 6 emittit; vena subcostalis longissime interrupta; subdorsalis simplex:
"posteriores lanceolatae; vena mediana in 3 ramos divisa, subdorsalis simplex.
"Tibiae posticae pilosae.
"Larva 16 pes supra epidermidem foliorum vivit; metamorphosis in folliculo affixo subit."

The presence of palpi will be brought out later, and the vein which Zeller calls "mediana" in the hind wing is designated in this paper the radius.

The following is the original description of *Bucculatrix canadensisella* by Chambers (1875):

Bucculatrix canadensisella n. sp.

"The ornamentation of this species differs from that of any other yet found in this country, and though allied to *B. cidarella* of Europe, it is still quite distinct.
"Head white. Tuft tipped with dark reddish brown, and the face faintly tinged with purplish fuscous. Upper surface of the thorax brown margined all around with white. Base of the fore wings white, followed by an oblique brown fascia, which is nearest the base on the costal margin, and is followed by an oblique white fascia; all of these are placed before the middle and are followed by a large brown patch which occupies the entire wing to the ciliae, except that it contains a white spot on the middle of the costal margin. The brown patch is margined before on the dorsal margin of the wing by a small tuft of raised brown scales. At the beginning of the dorsal ciliae is a white spot placed a little before, but becomes almost confluent with a longer white costal streak. Behind these streaks to the apex the wing is pale brown, with a darker velvety brown apical spot. Ciliae pale yellowish, with a dark brown hinder marginal line before their middle not extending into the costal ciliae. Hind wings pale fuscous. *Al. ex.* 3/8 inch."

A. Adult

1. External Appearance

As both the above descriptions are rather brief, the external appearance of the adult is here given in a little more detail. By reference to plate XVII and text figure 12 the important markings can be easily followed. Sexual differences are slight and will be referred to in the description.

The general appearance of the adult in repose is shown in plate XVII. The head bears a dorsal tuft of rather long hair-like scales, the center of which is brown and the outer parts white. The "face" is covered with gray or brownish scales. When the insect is at rest the head is bent ventrally so that the labium touches the bases of the prothoracic coxae and the short tongue is curled and concealed between the latter. There are no maxillary palpi, and the labial palpi are very small and concealed beneath the head. The eyes are black and partly concealed by the scapes of the antennae which

are expanded to form eye-caps. These eye-caps are white, and from the anterior border of each there extends down in front of the eyes curved slender scales which give the insect the appearance of having "shaggy brows." The pedicel of the antenna is short, and the flagellum contains 29 segments, each of which bears two whorls of brownish scales. The proximal segments of the

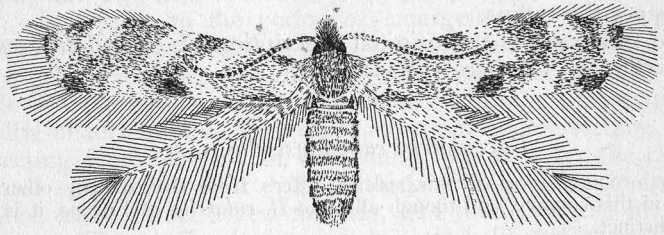

FIG. 12. Adult moth, enlarged about ten diameters.

flagellum have no scales on the ventral side. This "nude" area is usually considered sensory. The first segment of the flagellum (third of antenna) is longer than any of the remaining segments. The antenna is about two-thirds the length of the body and filiform.

The ground color of the fore wings is brown, and although typically reddish, it often varies to a yellowish. The wings are marked with transversely diagonal white bars as shown in figure 12. The basal bar is confluent with a white area on the mesothorax. The second bar forms an angle with the apex directed distally. It sometimes extends completely across the wing and is often interrupted in the center by brown scales. The remaining bars do not cross the wing but terminate near the midline. There are two extending from the costal border and one from the anal border, all three directed slightly apically. Close to the tip of the wing is another white area whose exact size varies somewhat in different individuals. It extends from the costal to the distal border of the wing but does not include the apex, this latter being dark, almost sable, in color. There are two other prominent dark spots on the wing, one at the anal angle and one at the distal margin of the second transverse white bar. Both of these are always present, and sometimes there are other dark spots on the costal border. Beginning slightly distal from the middle of the costal border a row of gray cilia extends around the wing almost to the proximal end of the anal border. The tuft of raised brown scales on the anal border of the wing as described by Chambers is usually conspicuous.

The hind wings are gray and their borders are almost completely ciliated. The superficial difference in shape between the fore and hind wings is due to the more extensive development of scales on the former. The scales on the hind wing are less numerous and do not project beyond the wing borders. Both the wings are really pointed.

The dorsal side of the thorax is brown with white areas laterally, these latter being confluent with the white basal areas on the wings. Each tegula bears a group of eight to ten bristle-like scales which extend along the costal border of the wing as far as the metathorax when the wings are folded. The pleural and sternal sides of the thorax are silvery-white. The coxae are large and of the same general color as the sternum of the thorax except that the lateral borders are brownish, particularly proximally. The femora and tibiae are brown laterally and white medially, as is the first tarsal joint. The tarsal joints two, three, and four each have a white ring proximally and a brown ring distally. The fifth tarsal joint is white, and its scales almost conceal the tarsal claws. At the posterior border of the mesothoracic tibiae at the distal end is a pair of spurs, and a pair of similar spurs is found at each end of the metathoracic tibiae. There is a pair of spines at the distal end of each of the first four tarsal joints. A row of thickly set long hairs is found on the anterior and posterior border of the metathoracic tibiae.

The abdomen is covered with silvery-white scales ventrally and brown scales dorsally. The males have seven segments superficially distinct on the ventral side, the second to the eighth inclusive, and the scales from the eighth practically cover the genitalia. The female has six segments superficially distinct ventrally, the second to the seventh inclusive. Scales from the seventh segment conceal the border between the seventh and eighth, and scales from the latter cover the remainder of the abdomen, giving the appearance of one broad segment. The ninth segment in the female is partly retracted within the eighth, and the tip of the ninth projects very slightly beyond the scales of the latter. The terminal fringe of scales on the male abdomen flares slightly but never does so on the female. The female abdomen is slightly larger than the male. On the dorsal side of the abdomen of each sex there are distinctly demarcated eight segments, the first to eighth inclusive.

The body length averages about three millimeters and the alar expanse seven millimeters. The sexes are of equal size.

2. Head (Text figure 13)

The head is somewhat compressed anterior-posteriorly, and the occipital surface is flat. The antennae are filiform and composed

of 31 joints, of which the first or scape is expanded to form the eye-cap. The second joint or pedicel is short and subspherical. The third joint (first of the flagellum) is half again as long as any of those following. The length of the antennae compared

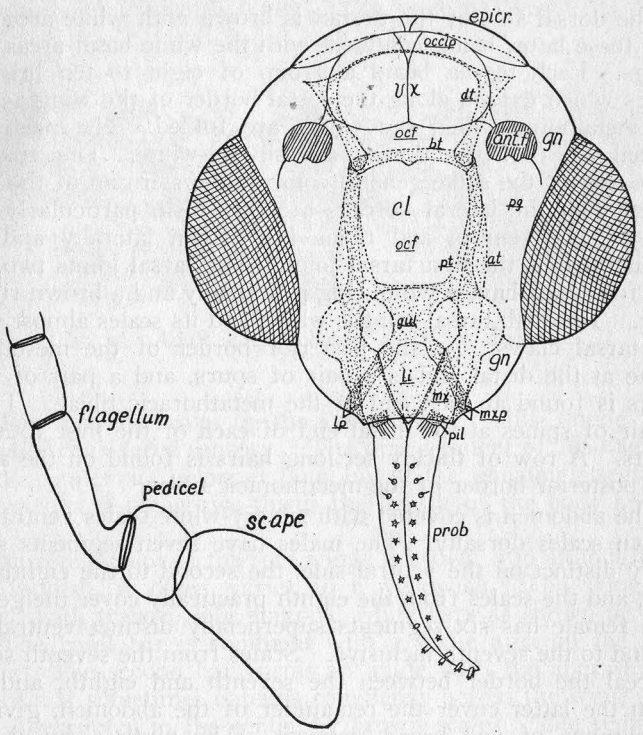

FIG. 13. Head and base of antenna of adult. *ant f*, antennal fossa; *at*, anterior arm of tentorium; *bt*, base of tentorium, *cl*, fronto-clypeus; *dt*, dorsal arm of tentorium; *epicr*, epicranium; *gn*, gena; *gul*, gular region; *li*, labium; *lp*, labial palpus; *mx*, maxilla; *mxp*, maxillary palpus; *occip*, occiput; *ocf*, occipital foramen; *pg*, postgena; *pil*, pilifer; *prob*, proboscis; *pt*, posterior arm of tentorium; *vx*, vertex.
The abbreviations underlined in the figure are on the posterior surface of the head.

with the body length is shown in figure 12. The eyes are black and weakly spherical. There are no ocelli. Between the antennal fossae (ant f) and connecting them is the suture which separates the fronto-clypeus (cl) from the epicranium (epicr). A suture running between the eyes and through the epicranium divides off the vertex (vx) anteriorly. The vertex bears the forward-projecting hairs of the dorsal tuft and is divided by a median light suture. The posterior part of the epicranium is likewise divided by a median suture and bears the upward- and backward-projecting hairs of the dorsal tuft. The occiput (occip) lies between the epicranium and occipital foramen and is not sharply demarcated from the postgenae laterally. The fronto-clypeus appears to extend laterally to the eyes. The labrum is not present as a distinct sclerite and is represented by a pair of pilifers (pil) placed one above each maxilla. There are no mandibles. The proboscis (prob) is reduced, being about the length of the head. Each half of the proboscis (the galea) bears on its anterior surface a row of eleven papillate projections which appear pentagonal in cross section and each of which terminates in a short peg. The particular function of these was not ascertained. Near the base of each half of the proboscis and also on the anterior surface are three or four setae. Near the base of each maxilla and projecting from the lateral side is a small protuberance (mxp) which may represent the rudiment of the maxillary palpus. The bases of the maxillae (mx) are, as usual with Lepidoptera, firmly fixed in the ventral (posterior in this case) side of the head. The labium (li) is a small triangular sclerite, with a forward-pointing apex, on the ventral side of the head and lies between the maxillae. It bears a pair of one-jointed palpi (lp). Between the labium and the occipital foramen (ocf) lies a gular region (gul) which is bounded laterally by the maxillae. Its separation from the labium is indistinct. The postgenae are separated dorsally from the genae (gn) by the suture which divides the epicranium and ventrally by the sutures connecting the maxillae with the lower border of the eyes. The genal regions are not distinctly separated from the fronto-clypeus.

The tentorium is similar to that of other Lepidoptera. The body of the tentorium (bt) separates the occipital foramen into a dorsal and ventral part. The anterior arms (at) come forward from the body and then turn ventrally to terminate at the ventro-lateral angles of the fronto-clypeus. The dorsal arms (dt) extend up from the body to the occiput, bordering the foramen laterally. The posterior arms (pt) extend down each side of the lower part of the foramen to the maxillae. In the figure of the head all the abbreviations of the parts on the posterior (morphologically ventral) side of the head are underlined.

3. Cervical Region (Text figure 14)

The head is supported by a pair of laterally placed cervical sclerites (cerv) which extend from the prothorax. At the cephalic end they meet the body of the tentorium, and at the posterior end they articulate with the episterna and then curve medially to meet in the midline.

4. Thorax

The three thoracic segments are distinct, although the prothorax is much reduced. The mesothorax is the most developed, due to the development of the fore wings and the powers of flight. In the following description the nomenclature of Crampton (1909) has been adhered to as far as possible.

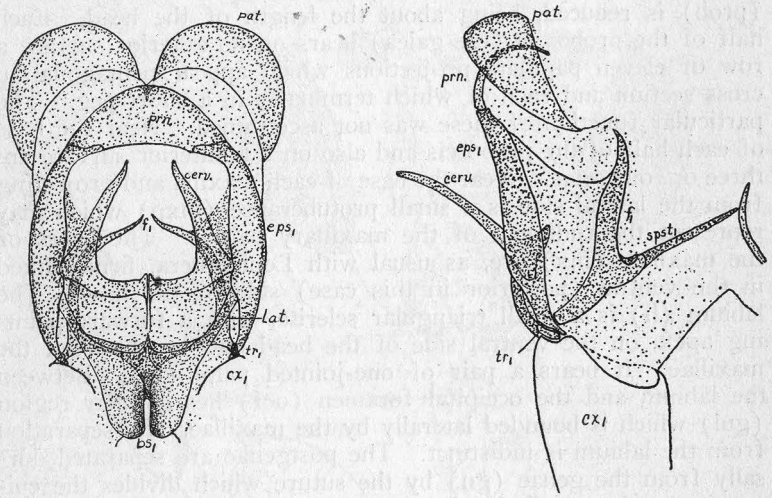

FIG. 14. Prothorax of adult, anterior (left) and lateral (right) aspects. *bs,* basi-sternum; *cerv,* cervical sclerite; cx_1, coxa; eps_1, episternum; f_1, furca; *lat,* precoxal bridge; *pat,* patagium; *prn,* pronotum; *spst,* spini-sternum; tr_1, trochantin.

a. Prothorax (Text figures 14 and 15)

The tergal region of the prothorax consists of a central triangular pronotum (prn) and two laterally placed and conspicuous patagia (pat). The apex of the pronotum meets the prescutum of the mesothorax in the midline.

The pleural region contains one narrow sclerite, the episternum, (eps) which meets the pronotum above and the coxa (cx) below. Anteriorly it supports the cervical sclerites and meets the precoxal bridge (lat) of the sternum. There is a very minute sclerite, the trochantin (tr), at the articulation of the coxa. The epimeron is obsolete. From the posterior border of the episternum the pleural apodeme extends into the body cavity and meets the arms of the furca (f_1). Of the sternal sclerites the basi-sternum (bs_1) is the larger and extends laterally in the precoxal bridge to

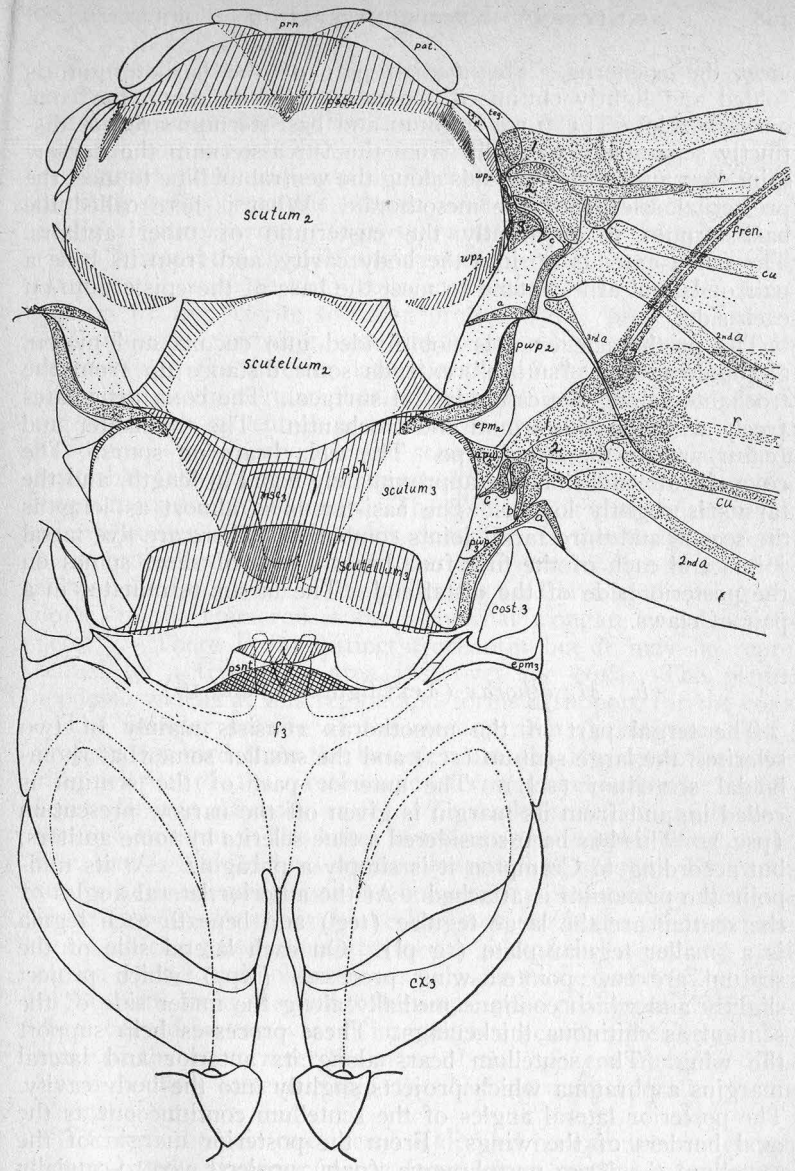

FIG. 15. Thorax of adult, dorsal aspect. *a, b, c,* axillary sclerites; *awp,* anterior wing process; *cost,* costal sclerite; *cu,* cubitus; *cx,* coxa; *epm,* epimeron; *f,* furca; *fren,* frenulum; *msc,* median area of scutum; *pat,* patagium; *pph,* postphragma; *prn,* pronotum; *psc,* prescutum; *psnt,* posterior chitinous plate on metathorax; *r,* radius; *teg,* tegula; *tg pl,* tegular plate; *wp,* wing process; *1, 2,* axillary areas; *2nd a, 3rd a,* anal veins. The inferior numbers indicate the thoracic segment to which the part belongs.

meet the episterna. The median part of the basi-sternum is folded and lightly chitinized, extending slightly down the coxa on each side. The furca-sternum and basi-sternum are not distinctly separated. Caudally from the furca-sternum the narrow spini-sternum ($spst_1$) extends along the ventral midline to meet the presternal sclerite of the mesothorax. What is here called the basi-sternum is apparently the eusternum of other authors. The furca extends up into the body cavity, and from its base a pair of lateral arms extend to meet the base of the episternum on each side.

The prothoracic coxa is not divided into eucoxa and meron, although a faint "suture" extends some distance up from the trochanter along the caudo-lateral surface. The coxa articulates freely with the episternum and trochantin. The trochanter and femur are of the usual type. The tibia bears no spurs. The coxa, femur, and tibia are approximately equal in length, and the tarsus is slightly longer. The basi-tarsus is almost as long as the second and third tarsal joints combined. There are five tarsal joints and each of the first four bears a pair of short spines on the posterior side of the distal end. The tarsus terminates in a pair of claws.

b. Mesothorax (Text figures 15 and 16)

The tergal part of the mesothorax consists mainly of two sclerites, the large scutum (sc_2) and the smaller somewhat rhomboidal scutellum (scl_2). The anterior part of the scutum is rolled in, and from its margin is given off the narrow prescutum (psc_2). This has been considered a true sclerite by some authors, but according to Crampton it is simply a phragma. At its midpoint the pronotum is attached. At the anterior lateral angles of the scutum are the large tegulae (teg) and beneath each tegula is a smaller tegular plate (tg pl). On each lateral side of the scutum are two pointed wing processes (wp_2) which project slightly and which continue medially along the under side of the scutum as chitinous thickenings. These processes help support the wing. The scutellum bears along its anterior and lateral margins a phragma which projects slightly into the body cavity. The posterior lateral angles of the scutellum continue out as the anal borders of the wings. From the posterior margin of the scutellum the large postphragma (pph) projects ventro-caudally into the body cavity. This phragma is made up of a layer from the mesoscutellum and one from the metathorax. The layers are easily separated. There is no true postnotum (or pseudonotum) present as a distinct sclerite. The curved process (pwp_2) which supports the anal area of the wing extends out from the lateral

angles of the scutellum. This is called the posterior wing process by Snodgrass (1909).

The pleuron of the mesothorax is largely made up of two sclerites, the epimeron (epm_2) and episternum (eps_2) separated by the vertical pleural suture. The pleural apodeme extends into the body cavity from this suture. The episternum is divided into a dorsal anepisternum ($aneps_2$) and a ventral katepisternum ($keps_2$) separated by a triangular middle area. At its anterior margin the anepisternum rolls in medially. From the dorsal margin of the sclerite the alar process (alp) projects upward and supports the wing, and the tegular arm (tega) extends anteriorly to the anterior lateral angle of the scutum where it abuts against the tegular plate. The tegular arm and alar process together with a ventral projection on the anepisternum appear to form a single anchor-shaped sclerite fused with the latter and separable from it with no great difficulty. The katepisternum meets the sternum ventrally. The epimeron is a single undivided sclerite somewhat membranous dorsally. It meets the posterior wing process and then arches over as a narrow arm to meet the arm of the furca (f_2). Just under the anal area of the wing and dorsal to the epimeron is the somewhat elongate costal sclerite ($cost_2$). There is no distinct trochantin but it may be represented by a triangular area just over the coxa. The pleural apodeme widens at this region and forms a support for the coxa.

The anterior sclerite of the mesosternum (presternum, pst_2) projects forward from the basi-sternum (bs_2) to meet the posterior sclerite of the prothoracic sternum and extends slightly beyond it into the body cavity. This sclerite widens as it meets the basi-sternum. The latter is triangular, its apex being posterior, and is divided by a median longitudinal suture. From this suture and extending into the body cavity is a median chitinous blade (mbl). Posterior to the basi-sternum is the furca-sternum (fs_2) which extends down the medial side of each coxa as a pedal region (pdr_2) and holds the coxa rigidly to the body. The furca (f_2) arises from the furca-sternum and sends from its base a short curved process (fpr_2) into the body cavity anteriorly. The arms of the furca meet the arms of the epimera dorsally. The latero-sternites extend from the basi-sternum laterally to the pleural suture.

The mesothoracic coxa (cx_2) is divided into an anterior eucoxa ($eucx_2$) and a posterior meron (mer_2) by a vertical suture on the outer side. On the medial surface of the coxa lies a heavily chitinized angular plate (cs_2) which meets the pedal region of the furca-sternum. The leg articulates at the trochanter, the coxa being immovable. The tibia bears at its distal end on the posterior side a pair of spurs of which the outer is longer. The tarsus is

similar to that of the prothoracic leg. The mesothoracic leg is slightly longer than that of the prothorax.

The wing venation (figure 17) is much reduced. The subcosta and costa are probably represented by the single costal vein. The radius (r) is rather faint at the base and gives off five branches distally. The median vein has disappeared except for the branches m_1 and m_2. The cubitus (cu) is single. There is a faint fold (1st a) which may represent the first anal vein. The second (2d a) and third (3d a) anals are distinct. There is some variation in the origin of r_4, as it sometimes branches off distally to the position shown in the figure. The costal vein bears a retinaculum (ret) for the frenulum. The veins named above are according to Forbes (1923).

The axial sclerites of the wing are as shown on the right side of figure 15. The sclerites a, b, c, 3, and the small sclerite between 1 and 3 are hard chitinous plates, but those marked 1 and 2 are thickenings of the wing similar to veins. The alar process of the pleuron abuts on 2, as does the anterior of the scutal wing-processes. The posterior of the two scutal wing-processes abuts on 3, and the posterior wing-process supports a. The anal area of the wing folds along the outer border of b.

c. *Metathorax* (Text figures 15 and 16)

The scutum (sc_3) of the metathorax is divided medially by a triangular area (msc_3). This does not appear to be a distinct sclerite but simply a more lightly chitinized region. The postphragma of the mesoscutellum is attached to the anterior margin of the scutum, its line of attachment extending to the wing process (awp_3) at the anterior lateral angles. The scutellum (scl_3) is a band stretching across the base of the scutum and appears to overlap the latter, due to the presence of a phragma which projects caudo-ventrally into the body cavity. From the posterior border of the scutellum a membrane drops ventrally to meet a chitinous arm which forms a bridge between the ends of the epimera. The center of this bridge bears a chitinous plate (psnt) to which the tergum of the first abdominal segment is attached. This represents the pseudonotum (Snodgrass), although much modified from a primitive condition. At its lateral angles the scutellum continues into a narrow posterior wing process (pwp_3) which supports the anal area of the wing.

The pleuron of the metathorax resembles that of the mesothorax. The trochantin area at the head of the coxa is more distinct here, however. Dorsally the alar process (alp) continues directly with the pleural apodeme, and the anepisternum ($aneps_3$) bears another process which also supports the wing. The costal ($cost_3$) sclerite is prolonged anteriorly as a long arm. The

epimeron (epm_3) extends further posteriorly than does the same sclerite in the mesothorax.

The sternum of the metathorax differs markedly from that of the preceding thoracic segment. From the central basi-sternum (bs_3) extend the narrow latero-sternites (not shown in the diagram). The basi-sternum extends caudo-ventrally to meet the

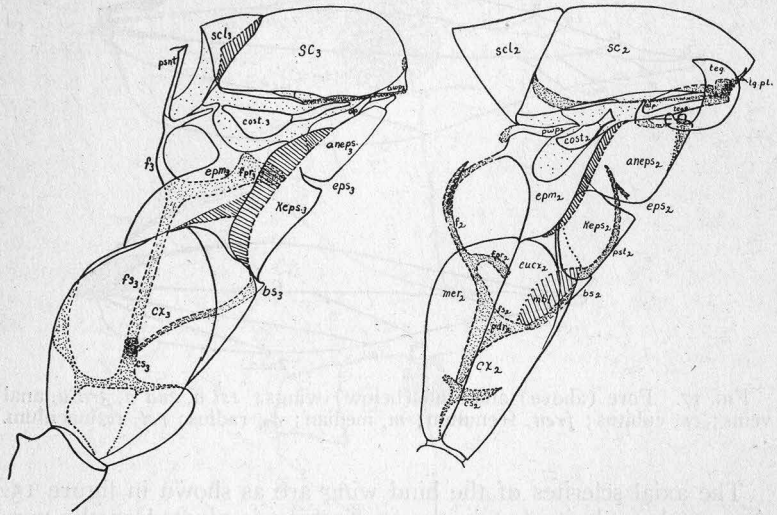

FIG. 16. Meso- (right) and meta- (left) thorax, lateral aspect; *alp,* alar process; *aneps,* anepisternum, *bs,* basi-sternum; *cs,* median coxal support; *eucx,* eucoxa; *fs,* furca-sternum; *fpr,* furcal process; *keps,* katepisternum; *mbl,* median blade; *mer,* meron; *pdr,* pedal region; *tega,* tegular arm; *sc,* scutum; *scl,* scutellum. For other abbreviations see figure 15.

furca-sternum (fs_3) at the coxal support. There is no pedal region of the furca-sternum, but the coxa is held rigidly by this sclerite plus the basi-sternum. The furca-sternum extends as a narrow arm dorsally and then divides into a furca (f_3). The anterior furcal process (fpr_3) is very large and the furca is heavy. Dorso-laterally the arms of the furca meet those of the epimera.

The meron of the coxa is much reduced and occupies a posterior-medial position, only the eucoxa being visible laterally. The tibia bears a pair of spurs on the posterior side of each extremity, and the outer spur of each pair is the longer. The leg is otherwise similar to that of the mesothorax.

The wings (figure 17) show greatly reduced venation. There are, besides the costal, three principal veins, the radius (r), cubitus (cu), and the second anal (2d a), the median being represented

by two branches only. The costal vein probably represents the combined costal and subcostal. The radius is single and from it there branch the two divisions of the median (m_2 and m_3). The cubitus is single. The frenulum (fren) consists of two stout setae that are held in the retinaculum of the fore wing.

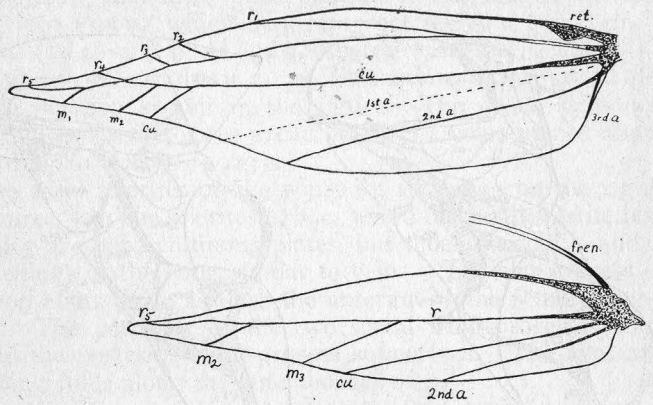

FIG. 17. Fore (above) and hind (below) wings; *1st a, 2nd a, 3rd a,* anal veins; *cu,* cubitus; *fren,* frenulum; *m,* median; 1-5, radius; *ret,* retinaculum.

The axial sclerites of the hind wing are as shown in figure 15. An angular sclerite (a) in the anal region is pivoted on the posterior wing process. The anal region folds along the outer side of this sclerite. Two sclerites (b and c) lie between this and the anterior wing process. These three constitute the chitinous axial plates homologous with those of the fore wing. The areas marked 1 and 2 are thickenings of the wing similar to veins and are homologous to the same areas of the fore wing. The sclerite c may correspond to 3 of the fore wing, and the sclerite b to b and c of the fore wing. The alar processes of the pleuron abut on the area marked 2, and the subcostal area (1) meets the anterior wing process and the sclerite marked c.

Snodgrass (1909) has described the typical arrangement of the axial sclerites in the wing, but the tracing of these in the wing here described is uncertain, due to the difference in arrangement, and hence the letters and numbers as given here do not correspond to those of the above author.

5. Abdomen (Text figures 18 to 20)

The abdomen has nine visible segments in the female and ten in the male, although in the latter sex the tenth is reduced to the socii. The apical segments in each sex are modified to form the

external genital apparatus. The first segment has a strongly chitinized tergum, probably a development in accordance with its function of supporting the abdomen on the thorax. The sternum of the first segment is indistinguishably fused with that of the second and both are quite membranous. The identification of two sterna is furnished by the presence of two spiracles on each side.

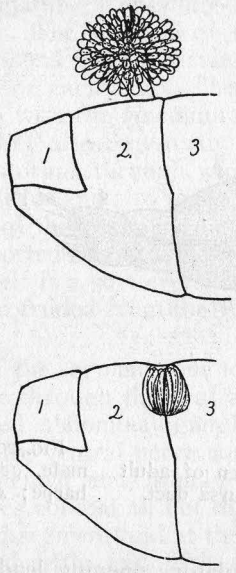

FIG. 18. "Alluring" organ on abdomen of adult male, expanded above, retracted below.

In the female the segments from two to seven inclusive are of the usual unmodified type, but in the male the second segment shows a peculiar sexual dimorphism. On the caudal margin of the tergum of this segment is located a protrusible organ which, for want of a better name, has been termed an alluring gland. Similar organs called alluring glands have been described as occurring on other parts of male Lepidoptera, and until a histological and cytological investigation is made of this particular case, the common term will be used in describing it. In other species of Lepidoptera there is considerable evidence that these organs give off a distinct odor when protruded, but the alluring function of these in a sexual sense is not definitely proved. This "gland" is shown in figure 18 protruded (above) and retracted within the abdomen (below). When retracted it folds in an eversible sac, and when protruded the entire organ, including the sac, projects out from the body, looking for all the world like a composite flower.

The scales composing it are of two kinds, some pointed and some lobular. This organ is found in all males and never in the females. The remainder of the male abdomen up to and including the eighth segment is in no wise unusual. In the female the eighth and ninth segments (figure 19) are modified somewhat. On the sternum of the eighth segment is a slight protuberance

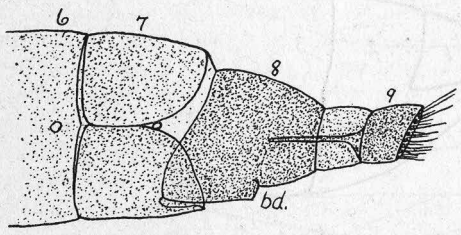

FIG. 19. Tip of abdomen of adult female. *bd,* opening of bursa duct.

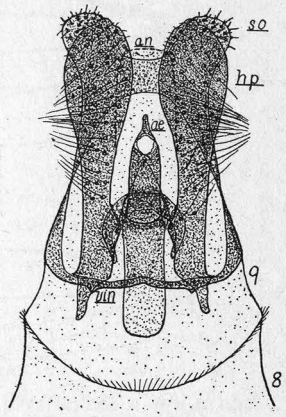

FIG. 20. External genitalia of adult male. *ae,* aedoeagus; *an,* anus; *hp,* harpe; *so,* socius; *vin,* vinculum.

which marks the copulatory opening leading into the bursa duct and thence to the bursa copulatrix. At the end of the ninth segment is the external opening of the vagina (ventrally) and the alimentary tract (dorsally). Petersen (1900) has described in some detail the female and male genital organs of Lepidoptera and shows the transitional stages from the type having one genital opening (at the tip of the abdomen) to that having two as here found. The presence of two genital openings is forecast in the pupa. On each side of the copulatory opening is found a tuft of orange-colored scales, and a third tuft is found on the dorsum at the anterior margin of the eighth segment. These three tufts are normally concealed from view under the posterior margin of the seventh segment. The lateral apodemes from the ninth project back into the eighth segment. The tip of the female abdomen is usually telescoped so that the eighth segment is partly retracted within the seventh, and the ninth is retracted within the eighth. The posterior part of the eighth is membranous. In the illustration the abdomen is shown with these segments drawn out into view. The tenth segment is not developed.

In the male (figure 20) the ninth and tenth segments are much modified and are usually retracted within the eighth. As shown in the figure, they are drawn out to expose the external genitalia. The nomenclature given is according to Eyer (1924). The tergum of the ninth forms a "roof" over the anus (an) which lies just beneath it. It is called the tegumen. Attached to its distal end are the socii (so) which really belong to the tenth segment and form the anal armature. They are paired and bear many short spines and setae. The sternum of the ninth segment consists of a narrow chitinous band, the vinculum (vin), which is fused with the tergum on each side. The paired claspers, called harpes (hp), articulate with the vinculum and are appendages of the ninth segment. They also bear many setae and short spines. The cone-like chitinous organ through which the aedoeagus (ae) projects is called the anellus and also probably belongs to the ninth segment as do the rest of the genitalia. The aedoeagus is a heavily chitinized tube supported by the anellus and tapering to a point distally. The penis itself is a soft eversible tube contained within the aedoeagus and is protruded from the ventral side of the tip of the latter.

There are on each of the segments one to seven inclusive a pair of spiracles, and visible through the ventral wall of the abdomen are the four pigmented abdominal ganglia of the nerve cord. The ganglia of the entire ventral nerve cord of all stages of this insect are deeply pigmented and usually visible externally. In the adult the appendages conceal all but the abdominal, and these are found at the second segment and at the junctions of the third and fourth, fourth and fifth, and fifth and sixth respectively. The last is larger than the others, being a compound ganglion. The third and fourth abdominal ganglia are often contiguous and sometimes are fused to some extent.

6. Genital organs and alimentary tract (Text figures 21 and 22)

The internal genital organs of the male and female are diagrammatically illustrated in figures 22 and 21. In the female the bursa copulatrix (bur) is by far the most conspicuous of these organs, and it occupies much of the anterior part of the abdomen, lying in the region of the third segment. It is connected by a duct to the external opening in the sternum of the eighth segment, and from the dorsal side of this duct near its external end there arises the long slender seminal duct which permits the passage of spermatozoa from the bursa into the oviduct and thence into the seminal receptacle (rec sem). The common oviduct divides into two ducts (ovid) from each of which are given off four ovarioles (ov), each of which terminates in a filament. The filaments on each side unite with each other. The ovarioles extend from the

oviduct along each side of the bursa to its anterior end, curve dorsally and posteriorly, then dorsally and anteriorly to a common point just above the bursa where the group from each side is attached by the filament tips to the dorsal wall of the abdomen.

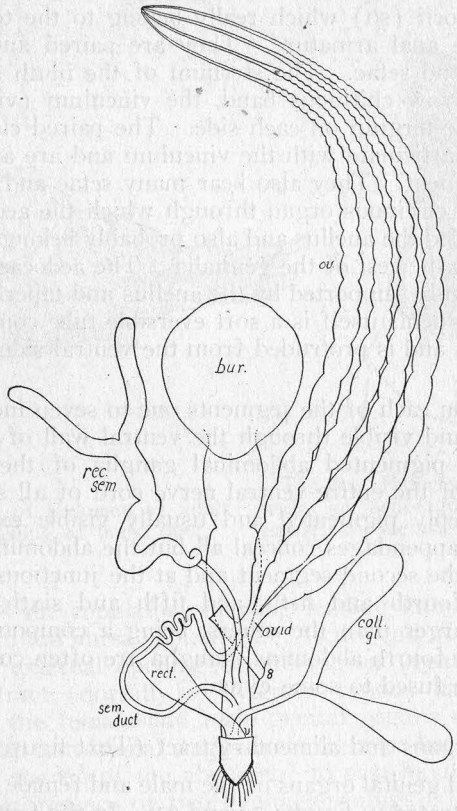

FIG. 21. Reproductive organs of female. *bur,* bursa copulatrix; *coll gl,* colleterial glands; *ov,* ovarioles; *ovid,* oviduct; *rec sem,* seminal receptacle; *rect,* rectum; *sem duct,* seminal duct.

The alimentary tract passes ventrally and to the right of the bursa, curves dorsally to pass above the union of the oviducts, then goes over the common oviduct to the tip of the abdomen, the rectum lying above the vagina. The ovarioles are of the polytrophic type, that is, the nutritive cells alternate with the ova. The seminal receptacle is bilobed and is attached to the dorsal wall of the common oviduct. The colleterial glands (coll gl) are paired and

are connected by a common duct to the dorsal wall of the vagina. They secrete the adhesive substance which attaches the egg to the leaf. In the illustration the genital organs are shown spread out and not in their normal positions.

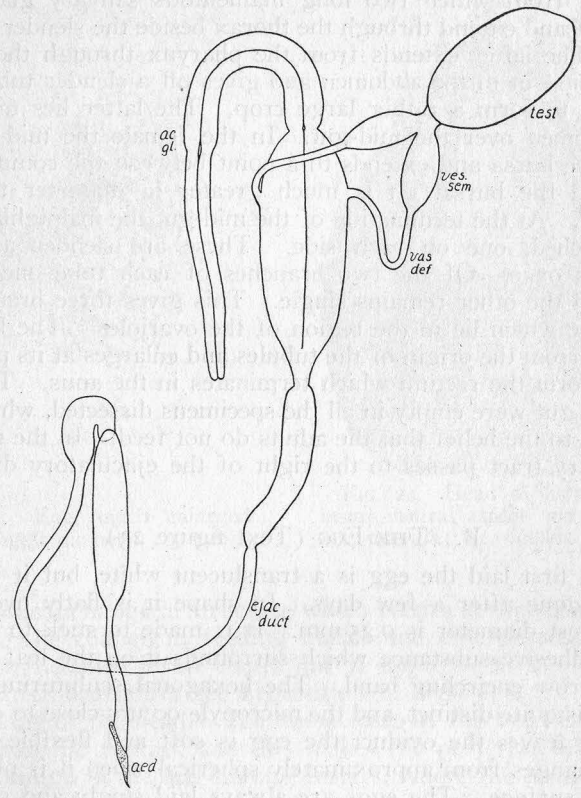

FIG. 22. Reproductive organs of male. *ac gl,* accessory glands; *aed,* aedoeagus; *ejac duct,* ejaculatory duct; *test,* testes; *vas def,* vas deferens; *ves sem,* seminal vesicle.

In the males the testes (test) are united and enclosed in a common scrotum. The vesicula seminales (ves sem) are paired and unite just under the testes. From the vesicula seminales, which are really enlargements of the vasa deferentia (vas def), the latter ducts pass to enlarged chambers which lead to the ejaculatory duct (ejac duct) which in turn terminates in the aedoeagus (ae). The accessory glands (ac gl) which presumably secrete a substance which mixes with the spermatozoa, are paired and

are connected with the enlargements at the terminations of the vasa deferentia. In some insects these glands secrete a substance which forms the spermatheca (especially Orthoptera). They occur here attached to each other rather loosely.

The alimentary tract begins anteriorly in a large muscular pharynx from which two long filamentous salivary glands are given off and extend through the thorax beside the slender oesophagus. The latter extends from the pharynx through the thorax to the mid-gut in the abdomen and gives off a slender tube which enlarges to form a rather large crop. The latter lies mainly in the abdomen over the mid-gut. In the female the mid-gut lies under the bursa and extends to a point between the common oviduct and the bursa. It is much greater in diameter than the pharynx. At the termination of the mid-gut the malpighian tubes are attached, one on each side. These are slender and each branches once. Of the two branches of each tube one divides once and the other remains single. This gives three branches of each tube which lie in the region of the ovarioles. The hind-gut extends from the origin of the tubules and enlarges at its posterior end to form the rectum which terminates in the anus. The crop and mid-gut were empty in all the specimens dissected, which adds evidence to the belief that the adults do not feed. In the male the alimentary tract passes to the right of the ejaculatory duct.

B. The Egg (Text figure 23)

When first laid the egg is a translucent white, but it becomes more opaque after a few days. In shape it is flatly ovoid, and the longest diameter is 0.25 mm. It is made to stick to the leaf by an adhesive substance which surrounds it on the leaf surface in a narrow encircling band. The hexagonal sculpturing of the surface is quite distinct, and the micropyle occurs close to one end. When it leaves the oviduct the egg is soft and flexible, and its shape changes from approximately spherical when it is placed on the leaf surface. The eggs are always laid singly and scattered over the leaf, as shown on plate XVII.

C. Larva (Text figures 24 and 25)

When first hatched the larva is minute (.35 mm. long), translucent, apodous, and flattened, a typical leaf-mining type. When it leaves the mine at the close of the third instar it has assumed a cylindrical form, the head has shifted from its former horizontal plane to a plane nearly at right angles with the body, and all the legs are present and functional. It measures about 2.5 mm. in length. When fully grown (plate XVII) the larva is about 6.0 mm. long and yellowish green in color with the setae on white

tubercles. The prothoracic shield is not conspicuous. The head is brown and typically that of a leaf-eating larva. There are the usual prolegs on abdominal segments, three, four, five, six and ten.

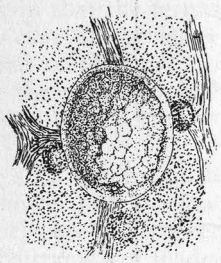

Fig. 23. Egg, much enlarged. Actual longest diameter .25 mm.

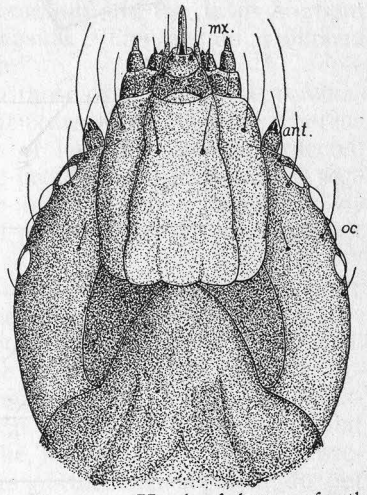

Fig. 24. Head of larva of 5th instar, ventral aspect. *ant,* antenna; *mx,* maxilla; *oc,* ocellus.

The radical change in structure which occurs at the second molt is due to the change in feeding habits and environment of the larva, for the third instar comes out of the mine to the leaf surface. This necessitates the acquisition of legs and the shifting of the plane of the head. The dorsal part of the head capsule is longer than the ventral, and this makes the posterior margin of the epicranium in the leaf-mining instars, where the head is horizontal, push back into the prothorax. Trägårdh (1913) has described structural transitions in several leaf-miners which change their feeding habits. The third instar resembles the fourth and fifth in general, but the setal pattern is somewhat different and there are fewer crochets on the prolegs. The prolegs of the abdominal segments three to six inclusive have one transverse row containing two crochets, and the prolegs of the anal segment bear one crochet.

The fourth instar is like the fifth except for size and no further mention need be made of it. The fifth instar is a typical caterpillar with the mouth-parts well developed. These are shown in a ventral view in figure 24. The antennae are minute, and there are only five ocelli (oc) present on each side. They are arranged

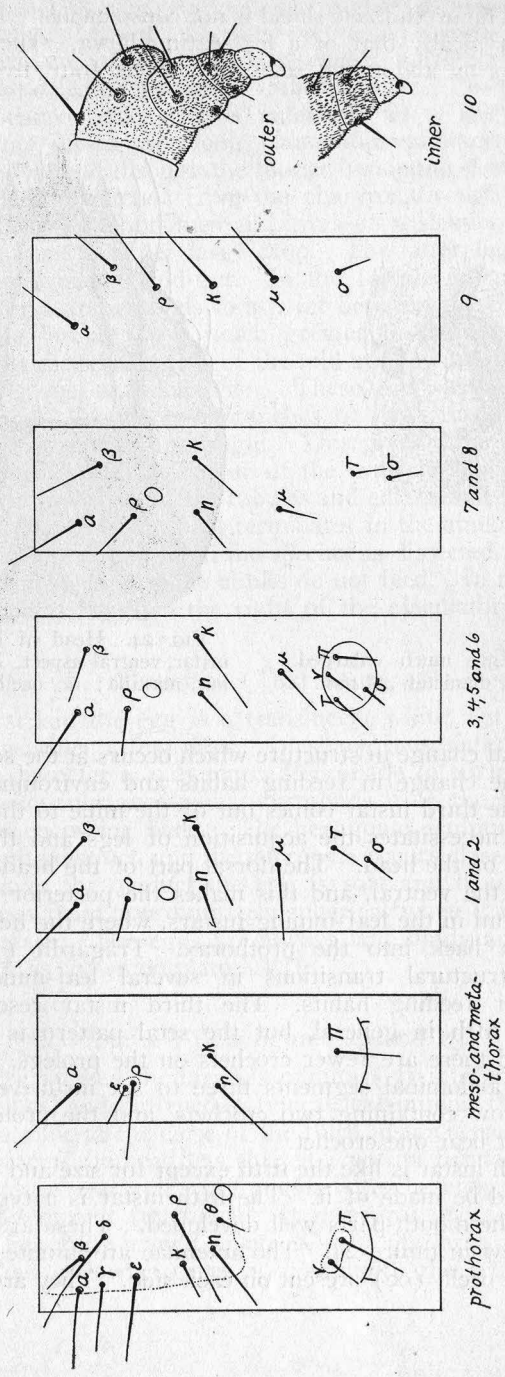

FIG. 25. Setal pattern of 5th instar larva.

in a curved row whose concavity is ventral. The labium is drawn out into a spinneret through which the duct of the silk glands reaches the exterior. The maxillae bear on the inner surface a pair of curved chitinous hooks. Otherwise the mouth-parts are not unusual. On the dorsal surface the adfrontals extend back to the posterior margin of the epicranium and the frons is about one-third the length of the head capsule. The labrum is bilobed and the mandibles bear four "teeth."

The prothoracic legs differ from those of the meso- and metathorax in that the terminal segment bears one claw only, whereas in the case of the latter two pairs of legs the claw is protected by a pair of terminal lappets. The prolegs of the abdominal segments three to six inclusive bear on the planta two rows of crochets, three per row. The anal prolegs have a single crochet only.

The setal pattern of the body of the larva is of some taxonomic importance and is shown in figure 25. In this description the nomenclature of Fracker, though cumbersome, has been followed. The diagrams are made so that the anterior margin of each segment is to the left and the dorsal midline is at the top. Each diagram is that of the left half of each segment projected on a flat surface. Certain segments are alike, and these have been represented by one diagram. The setae of the anal segment do not conform to those of any of the others.

D. PUPA (Text figures 26 to 29)

The pupa is spindle-shaped, about three millimeters long and brown in color. Many of the adult structures are evident, and the head thorax and abdomen are distinct. In the description here given the parts, although often incompletely developed, are named in accordance with the corresponding parts of the adult.

The vertex (vert) occupies most of the dorsal side of the head and is separated from the frons by the Y-shaped epicranial suture, the frons meeting the arms of the suture. The stem of the Y is indistinct. The frons (fr) extends caudally along the ventral side of the head from the epicranial suture to merge into the clypeal region, there being no demarcation between the two. The frons in figure 26 can be easily distinguished by the presence of the pointed cutting plate in its anterior part. This is the so-called "cocoon-breaker" with the aid of which the pupa emerges from the cocoon. The bases of the antennae (ant) are visible on the dorsal side of the head lateral to the epicranium. On the ventral side of the head and lateral to the frons are the eye-pieces (e). The clypeus bears the bilobed labrum, and on each side of the labrum is a small triangular mandibular sclerite. Neither labrum nor mandibles are found in the adult. The labrum bears a pair

of laterally placed setae. The maxillae are prominent and form the pair of medially placed appendages extending caudally from the labrum. Neither maxillary nor labial palpi are visible. The antennae extend caudally almost to the tips of the wings. Be-

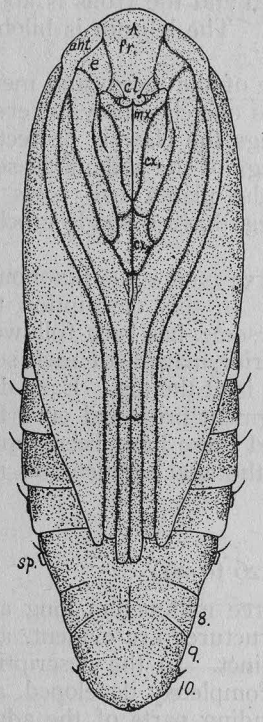

FIG. 26. Female pupa, ventral aspect, much enlarged. *ant,* antenna; *cl,* clypeus; *cx,* coxa; *e,* eye; *fr,* frons; *max,* maxilla; *sp,* spiracle.

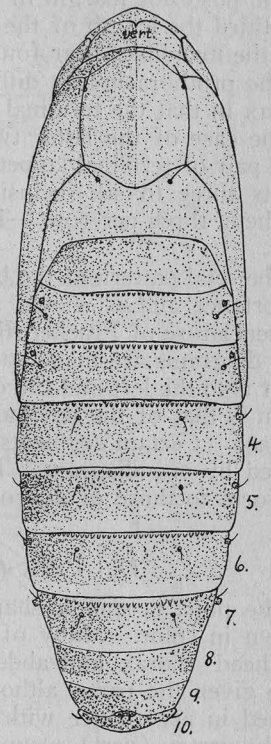

FIG. 27. Pupa, dorsal aspect, much enlarged.

tween the antennae and maxillae lie the folded prothoracic and mesothoracic legs. The tarsal regions of the metathoracic legs are visible between the tips of the antennae, most of this pair of appendages being covered by those preceding. A small part of the metathoracic coxae is visible in the midline posterior to the mesothoracic coxae. The metathoracic legs extend slightly beyond the tips of the wings. The fore wings extend to the seventh segment of the abdomen on the ventral side and conceal the hind wings. The appendages are loosely attached to each other

and are free from the body wall. They overlap, more or less, and the covered parts are quite membranous. When dissected out, the regions of the coxa, femur, tibia and tarsus are visible, although often not distinctly demarcated, and the tibial spurs are prominent. The two folds in the legs occur between coxa and femur and between femur and tibia. The tibia merges into the tarsus.

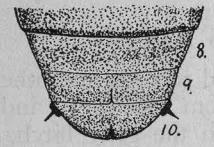

FIG. 28. Tip of abdomen of male pupa, ventral aspect.

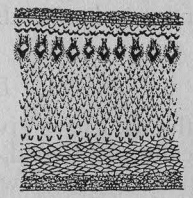

FIG. 29. Section of dorsum of abdomen of pupa.

The female has evidence of two genital openings on the ventral side, one on the posterior border of the eighth abdominal segment and one on the interior border of the ninth. These are short slits in the integument. The male has evidence of one genital opening only (figure 28), on the ninth segment. This condition in each sex corresponds to that of the adult. On the tip of the tenth abdominal segment is the indentation marking the anal opening, and on the lateral sides of this segment are a pair of short strong spines.

On the dorsal side of the pupa the prothorax is constricted in the middle and widens laterally. It lies between the epicranium and mesothorax and abuts on the antennae. The epicranial suture extends to the anterior margin of the prothorax. The mesothorax is a large quadrate sclerite separated by distinct sutures from the prothorax, metathorax, and fore wings. Along its midline it is raised into a very slight ridge. At the anterior-lateral angles are a pair of setae. The mesothoracic wings extend around the body to the ventral side. The metathorax is not so long as the mesothorax and merges indistinctly into the wings laterally. It bears also a pair of setae at the anterior-lateral angles, but these are more approximated than those of the mesothorax. The metathoracic wings are almost entirely concealed by those of the mesothorax, the bases only being visible. There are visible dorsally ten abdominal segments, of which numbers two to seven inclusive bear a pair of setae at the anterior-lateral angles, and numbers one to seven bear laterally placed spiracles. Segments four to seven inclusive bear also a pair of medially placed setae. The spiracles on the first abdominal segment are concealed by the hind

wings. At the anterior margin of the tenth segment is a dorsal tubercle bearing a pair of spines. This and the lateral spines on the tenth segment are purely pupal structures. The dorsal surface of the abdominal segments is covered with minute spines (figure 29) and on segments two to seven inclusive there is a row of heavy spines along the anterior margin.

In the male abdominal segments three to seven are movable, and in the female segments three to six are movable. The terminal segments are immovably united in both sexes.

VI. Life History and Habits

All the data here given, except for field records and other cases specifically mentioned, were obtained from records of individual insects reared in New Haven, Conn., on the gray birch, *Betula populifolia*. The field observations in Connecticut and Massachusetts are also of insects occurring on *Betula populifolia* unless otherwise stated. The period during which records were made covers the years 1924, 1925, and 1926.

The first adults appear the last of June in the region about New Haven, and the last disappear the last part of July. In 1924 adults were fairly numerous July 7th, and the last were seen July 31st. During 1926 adults were systematically collected with a net and by hand during July in one locality, a group of birches just north of Mt. Carmel, near New Haven, and these collections indicated a maximum number of adults were present the fourth week in July. During 1926 the season was later than usual. This species was abundant during the second and third weeks in July, but from the 27th to the 31st it declined in numbers from about a maximum to disappearance.

Pupae were kept at normal temperatures in an out-door screened insectary during 1924, 1925, and 1926. Those of 1924 were collected in the field during the spring of that year; those of 1925 and 1926 were reared in the out-door insectary. Records were kept of the emergence of 104 adults in 1924, 135 in 1925, and 36 in 1926. In 1924 the period of emergence was between June 4th and July 9th (only three emerged before June 23d); in 1925 between June 15th and July 19th, and in 1926 between July 2d and July 21st. The period of maximum emergence during 1924 was between June 25th and July 9th; in 1925 between June 18th and July 10th, and in 1926 between July 2d and July 9th. In 1925 all records obtained after July 1st were of individuals taken from New Haven to Woods Hole, Mass. The early appearance of adults in 1925 may possibly have been due to high temperatures early in June of that year, for, during the first ten days of June, 1925, the mean hourly temperature was 75.2°F. as opposed to 60.6°F. in 1926, and 61.2°F. in 1924 (U. S. Weather Bureau, New Haven, Conn., statistics).

Hutchings (1926) reports that in Ontario the adults are found during July (up to the 25th) with a maximum emergence from July 6th to July 14th. In New Brunswick, Gorham (1922) reports adults abundant the first two weeks of July. It would seem from these reports that the adult insect appears at approximately the same time of year over much of its entire range, being at a maximum during the first part of July.

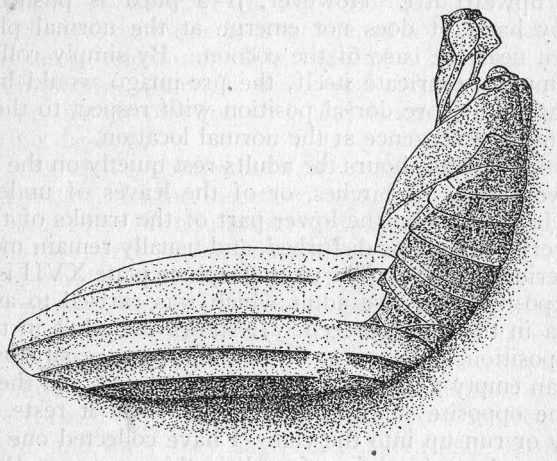

Fig. 30. Cast pupal skin and cocoon.

From the pupae collected in the field in the spring of 1926 there were secured 54 adults of which the sexes were determined. Thirty-three were females and 21 were males. Of 36 adults secured from laboratory-reared larvae, 19 were females and 17 were males. Although the females outnumber the males, the difference is not sufficiently great to warrant an assumption that there is not approximately an equal number of each sex under natural conditions.

When ready to emerge from the cocoon the insect is in the pre-imaginal stage, and the scales of the imago are easily seen through the pupal skin. The pre-imago works its way forward, probably with the assistance of the spines on the tenth abdominal segment, and breaks through the anterior end of the cocoon. The cutting plate on the vertex is of material aid in the process. When about three-fourths of the length is exposed, the body is held at an angle of about 40° from the cocoon. The pupal skin splits at the junction of the vertex and the prothorax and also longitudinally through the prothorax and mesothorax. The eye-pieces remain attached to the antennae and mouth parts. Figure 30 shows a cocoon and an empty pupal skin in the characteristic position.

According to Snodgrass (1922), the emergence from the cocoon is greatly assisted in *Bucculatrix pomifoliella* Clemens by the presence of three "valves" in the anterior end of the cocoon, these acting as an inclined plane to lift the insect. In *B. canadensisella* these structures are not present. The inner part of the cocoon is woven so that its lateral walls curve in at the base, making a "round corner," and this might conceivably give the pre-imago an upward lift. However, if a pupa is pushed gently forward by hand, it does not emerge at the normal place, but lower down near the base of the cocoon. By simply rolling over in its attempt to extricate itself, the pre-imago would bring the cutting plate in a more dorsal position with respect to the cocoon and thus insure emergence at the normal location.

During the daylight hours the adults rest quietly on the surfaces of the lower leaves of birches, or of the leaves of undergrowth under the birches, or on the lower part of the trunks of the trees. They fly very little unless disturbed, and usually remain motionless for long periods of time. The photograph on plate XVII is a three-minute exposure of a live adult which was carried to and from the camera in the position seen. It shows the adult in the characteristic position. They can be collected very easily by simply inverting an empty glass vial over the quiet insect and then gently tapping the opposite side of the leaf on which it rests. It will quickly fly or run up into the vial. I have collected one hundred in less than an hour from fern fronds in this manner. When disturbed, they fly quickly a few feet, very rarely over five or six, and usually much less. If confined in a bottle they run excitedly for a few minutes when disturbed.

From field observations it seems that as a rule the moths remain near the ground during the day and go up into the trees at about dusk. I have often failed to get them in a net by sweeping birches over my head, when many were secured by sweeping within four feet of the ground. Yet, in the same location, by sweeping the birches at dusk, several were netted very quickly at a height of about nine feet from the ground. In 1926 in one particular locality, moths were very abundant during the day on the fronds of ferns growing under the birch trees, but none were seen on the leaves of the birches which were not lower than four feet from the ground. An investigation of the birches at night with the aid of an acetylene lamp showed that the moths were all up on the birch leaves, and none were on the ferns below. The next day over one hundred were easily caught on the ferns, but none were on the leaves of the trees. At times, however, I have found moths on the leaves of the trees during the day five feet from the ground. Gorham (1922) reports that in New Brunswick he found moths on the birches in large numbers at all hours of the day, but he gives no further information on the distribution.

The moths prefer situations out of direct sunlight, and this may account for their position during daylight hours. This nightly migration into the trees may be affected somewhat by conditions of light, moisture, and amount of undergrowth, but it apparently occurs to some extent wherever conditions are normal.

The response of these moths to light is not very definite, due to their habit of remaining quiescent in one spot unless greatly disturbed. Attempts to make them show either a negative or positive response to daylight in the laboratory gave inconclusive results. Several attempts to attract them to a lighted lantern, an acetylene lamp, and automobile headlights at night in the field failed completely, although they were present in considerable numbers on the surrounding trees and were relatively more active than during daylight.

From the above observations it is assumed that oviposition occurs at night. In the insectary eggs were secured from three to seven days after the adults emerged, but in view of the fact that the moths are very inconsistent about ovipositing in captivity, these data may have to be extended under normal conditions.

It was necessary to place several males and females in a cage in order to ensure a supply of eggs. Although I have no data on the number of eggs laid by any one female, an examination of the oviducts shows that there may be a considerable number, for sixty-two fully formed eggs were dissected out from one female caught in the field, and there may have been several laid before she was captured. This number of eggs was never secured from any female in captivity. From four females thirty-four eggs were secured in one day in a cage, and from these same four, fourteen eggs the following day. They died without further oviposition. These females were reared and laid only the eggs recorded.

The adults have been kept alive in cages out of doors for twelve days after emergence from the cocoon, but they usually die sooner. They have never been seen to feed, and apparently they did not touch a honey-and-water mixture placed in the cage. The presence of a 25 per cent solution of honey in the cage did not prolong the duration of adult life. Certainly food is not a requisite and is not necessary to oviposition. All the adults collected in the field died in a few days, so twelve days probably is a fairly long period of life. Humidity and temperature have considerable effect on this, and moths caught in the field can be kept alive four to nine days if held at 10°-12°C., whereas they die in one to three days at room temperature. They will remain active after an exposure to 7°C. for twelve hours, but when the air is cooled to 5°C. they very quickly become inactive.

The eggs are laid singly on either side of the leaf and on any part of the surface. There is some preference shown for a position beside the midrib or some other prominent vein of the leaf,

but not to the exclusion of the rest of the leaf (plate XVII). Eggs are laid on leaves on all parts of the gray birch. Insectary records for 1924 showed a period of oviposition lasting from July 5th to July 21st, and field observations the same year showed unhatched eggs up to August 7th. No field observations were made during 1925, but gray birches sent from Boston, Mass., to Woods Holt, Mass., on July 9th, carried many unhatched eggs on the leaves. In 1926 eggs were found in the field between July 23d and August 3d, but in view of the fact that they were numerous July 23d and that some of those collected that day hatched July 30th, oviposition must have begun as early as July 16th. Many eggs collected August 3d hatched August 15th, so oviposition occurred as late as August 1st. Oviposition takes place usually during the month of July, and unhatched eggs may be found up to the middle of August. In 1926 the incubation periods of 48 eggs from laboratory-reared adults were 15 days on the average, the maximum being 17 days, the minimum 13 days, and the majority (27) taking 14 days. In all but three cases these eggs went through the incubation period between June 25th and July 13th, a month earlier than normal. They were from laboratory-reared adults which emerged earlier than normal. The other three eggs were incubated at the normal time, between July 31st and August 14th, and they took 14 days each, so the figure for all 48 was normal. This agrees with the period given by Hutchings in Ontario in 1925. The eggs have a high degree of fertility, and those that do not hatch are rare.

A short time before the larva leaves the egg it can be seen curled inside (figure 31). When it emerges, the young larva bores through the bottom of the egg into the leaf, and as it feeds it leaves the egg filled with dark excrement. This habit makes it very easy to determine whether or not the eggs are hatched, for after the larva has left, the egg appears brown or black in contrast to its former translucent condition. For several days the young larva mines close to the egg, but it finally straightens its path and mines in a more or less definite direction.

The larva completes the first and second instars and most of the third in the mine. I have found a head capsule in a mine only twice, but the measurements of the width of the head capsules (p. 444) and the descriptions of the larvae clearly indicate three mining instars. While in the mine the larva is always oriented dorso-ventrally with the leaf; that is, its dorsal side is always toward the upper surface of the leaf. For the first week the mine is extended very little and is always close to the egg, giving a blotch appearance, due to continuous turning of the mine in a small area. A mine six days old measured only 1.5 mm. across the mined area. This larva never makes a real blotch mine, but its excavations are always linear and winding, with slightly

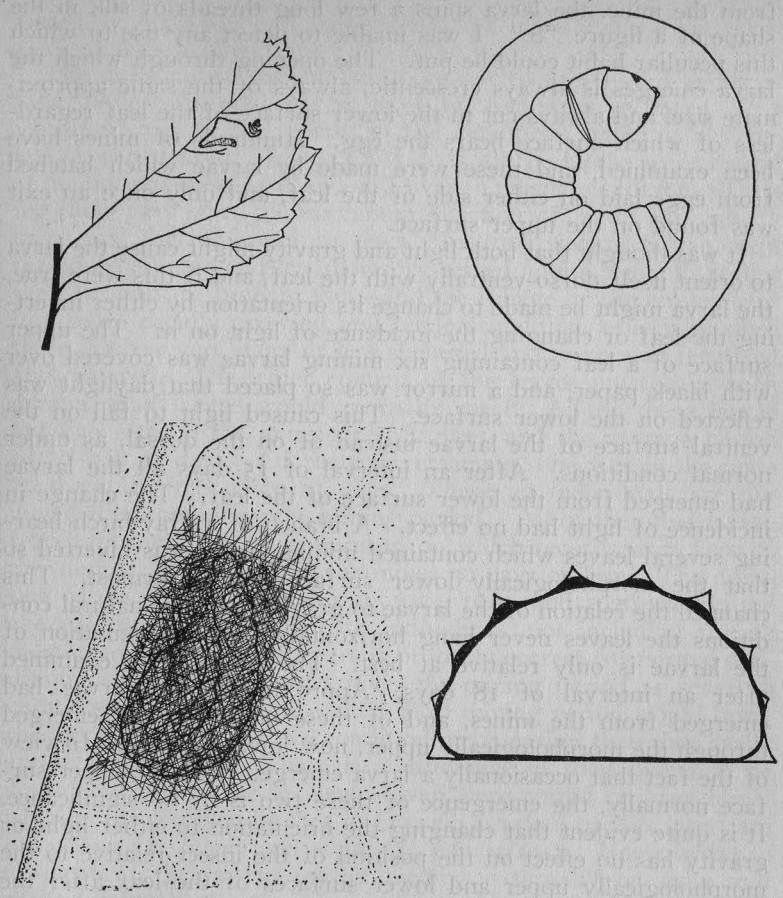

FIG. 31. Larval mine in birch leaf, slightly less than normal size (upper left); embryo in egg (upper right); larva in molting web (lower left); diagram of cross section of cocoon (lower right).

enlarged ends. During the last part of its mining life the larva lengthens the mine very rapidly and broadens it somewhat. Most of the mines are about three-fourths of an inch long when finished (figure 31).

When ready to emerge from the mine, the larva cuts a crescentic opening in the lower epidermis, an operation taking about fifteen minutes. It then works its way out until, by bending its body ventrally, it can grip the leaf surface with its thoracic feet. It then quickly pulls itself out of the mine, the entire performance consuming about two and one-fourth minutes. While emerging

from the mine. the larva spins a few long threads of silk in the shape of a figure "8." I was unable to detect any use to which this peculiar habit could be put. The opening through which the larva emerges is always crescentic, always of the same approximate size, and always cut in the lower surface of the leaf regardless of which surface bears the egg. Hundreds of mines have been examined, and these were made by larvae which hatched from eggs laid on either side of the leaf, and only once an exit was found on the upper surface.

It was thought that both light and gravity might cause the larva to orient itself dorso-ventrally with the leaf, and if this were true, the larva might be made to change its orientation by either inverting the leaf or changing the incidence of light on it. The upper surface of a leaf containing six mining larvae was covered over with black paper, and a mirror was so placed that daylight was reflected on the lower surface. This caused light to fall on the ventral surface of the larvae instead of on the dorsal, as under normal conditions. After an interval of 15 days all the larvae had emerged from the lower surface of the leaf. The change in incidence of light had no effect. A branch of a gray birch bearing several leaves which contained mining larvae was inverted so that the morphologically lower surface was uppermost. This changed the relation of the larvae to gravity. Under natural conditions the leaves never hang horizontally, so the orientation of the larvae is only relative at best. The leaves were examined after an interval of 18 days. Approximately 50 larvae had emerged from the mines, and of these only two had emerged through the morphologically upper, now lower, surface. In view of the fact that occasionally a larva emerges from the upper surface normally, the emergence of these two is of no significance. It is quite evident that changing the orientation to either light or gravity has no effect on the position of the insect relative to the morphologically upper and lower surfaces of the leaf after the mine is well under way; nor will the surface of the leaf through which the larva emerges from the mine be changed by any such procedure. In the above cases all the mines were about half finished when the conditions were changed. The orientation of the larva must be determined after it bores through the epidermis of the leaf from the egg and before it mines to any great extent, for all larvae examined were found with the ventral side toward the lower side of the leaf even when the mine was only two or three days old.

Where the insect is abundant it is by no means unusual to find 25 to 40 mines in one leaf. The mine shows more clearly through the upper epidermis of the leaf than through the lower, but this may be due to differences in the structure of these parts of the leaf rather than to the nature of the mine. The larvae are disinclined to gnaw through large veins, and usually the mine turns aside at these obstructions.

The duration of the mining stage varies greatly. The maximum period observed was 50 days, the minimum 13 days. This variation may be due partly to the conditions under which the larvae were reared. In 1924 and 1925 all the larvae were reared at the normal season and fed on leaves in normal condition. During these two years the maximum duration of larval life was 37 days, and the minimum 24 days. In 1926 several larvae were reared from eggs laid by laboratory-reared adults a month earlier than normal—in June, in fact—and the foliage of the birches was in a more rapidly growing and tender condition, especially since these birches were more or less sheltered and were well fertilized and watered. The water content of the leaves must have been greater than larvae would normally meet. All of these larvae but two were in the mines over 32 days, and the average period of 20 was 44 days. Of the two remaining, one was in the mine 16 days and the other 13 days. These 22 individuals are not included in computing the mining period. All of the other larvae reared during 1926, 35 in number, on which records were kept of the mining period, were in the mines 30 days or less. The duration of the mining stage during 1924, 1925, and 1926 was on the average 22 to 27 days for 50 individuals, not including the 22 mentioned above. This figure is probably correct for normal conditions. Hutchings (1926) gives the mining period as seven to eight days in Ontario, but such a short mining period would bring the larvae to a fully grown condition much earlier than they really appear in the field. There is a difference in food plants to be considered, for larvae in New Haven were reared on gray birch, whereas the common birches in Ontario attacked by this insect are the yellow (*B. lutea*) and white (*B. papyrifera*). Nevertheless in Connecticut the larvae appear feeding externally on gray and white birches at the same time, which indicates a similar mining period.

Mining larvae have been observed in the woods about New Haven as early as August 6th, and eggs collected on leaves have hatched July 30th when brought into the laboratory a week earlier. Larvae have been found out of the mines August 6th, but this is unusually early. The period when mining larvae occur around New Haven lies approximately between August 1st and September 15th, with a maximum number present the fourth week in August. The rearing records coincide with these limits.

When once free from the mine, the larva wanders over the leaf for a short time, an hour or two, and then spins its first molting web. A larva has never been seen to feed between the emergence from the mine and the spinning of the web. There may be a difference in different species of the genus, for Chambers (1882)

observed that *Bucculatrix ambrosiaefoliella* feeds two days between emerging from the mine and molting. The larva which emerges from the mine is structurally more like the following external feeding instar than the preceding mining instar. This may argue for possible external feeding, but there is no evidence that it occurs at this time. The exact interval of time between emergence from the mine and either beginning or completion of the first molting web was determined for three larvae, all typical cases. One larva emerged from the mine at 8.20 A. M. and completed its web at 10.45 A. M.; one emerged from the mine at 9.40 A. M., began its web at 10.40 A. M., and completed it at 12.10 P. M.; one emerged from the mine at 10.09 A. M., began its web about 10.42 A. M., and finished it at 12.12 P. M. The larva often selects a position beside a large vein for its web, but it will also spin on the flat upper surface of the leaf. There seems to be a preference for a hollow over which the "roof" of the web may be spun, as the angle between the base and sides of a glass bottle or the hollow beside the midrib of the leaf. Having selected a suitable location, the larva lays down a thin basal "floor" web on the surface of the leaf. This is about 1.5 mm. in diameter. Then it spins another web over this, making long tacks from side to side by swinging the entire thorax and the first two abdominal segments from one side to the other. The body is held facing out and the threads are always straight. In shifting its position the larva swings the abdomen quickly almost 180 degrees. The periphery of the web is thus built up first, the center being weak. A series of short tacks is now made over the "frame" of long threads, and the center is strengthened. This is followed by a series of short tacks all around the edge, a proceeding which evidently strengthens the web. A hole is quickly made through the web near the center, and the larva crawls in head first between the "floor" and the "roof." In crawling into its molting chamber the larva doubles ventrally so that its back is down on the "floor" and its feet touch the "roof"; that is, it is oriented dorsally to the leaf. Before it is all inside, the larva swings its head to and fro, weaving a mat on the under side of the "roof." Since the diameter of the web is not much more than half the length of the larva, the latter is forced to turn around, and when completely inside, its head almost touches the last abdominal segment, the body being bent in a U shape and to the right or left (figure 31). It is plainly visible through the web. The larva is not content with getting inside, but actually makes a turn around its molting chamber. All this time it swings its head, weaving figure "8" loops, and in due time it incidentally has to cover the hole in the "roof" by which it entered. Although this opening is always covered, the larva seems to make no deliberate attempt to cover it, doing so eventually as it works around inside. Most of the weaving is done after the larva is inside. In two instances to which particular attention was given, the time spent weaving prior to entering the web was eight minutes in each case, and the weaving time inside the web was 56 and 52 minutes respectively. In two other instances the larvae were weaving inside the web 60 and 70 minutes respectively. The principal part of the web is woven from the inside and is supported on the lighter structure previously woven from the outside. The entire process of spinning the web takes about one or one and one-half hours, varying somewhat with the larva. The procedure is essentially as described by Snodgrass for *Bucculatrix pomifoliella*. When the larvae are numerous, the birch leaves in August and September are spotted on both sides with many white webs. I call these "molting webs" rather than "cocoons," "pseudococoons," or "cocoonets," as termed by others, because I believe the word "cocoon" should be restricted to that structure, in which the pupal stage is passed.

Having completed its web, the larva retracts its appendages somewhat and remains quiescent a day or two. The tarsal claws and the crochets of the prolegs are not attached to the web, the larva lying freely with its ventral side away from the leaf. If the upper part of the web is removed, the larva falls out. Under such conditions it must molt in some sort of a chamber or fall off the leaf, which might be disastrous, for if food is not available after the molt, the larva dies in a few hours. The small size of the web holds the insect tightly, and the strong attachment to the leaf secures the web against being washed off or lightly brushed off. The web also offers protection from such enemies as ants during a period of helplessness. It is not essential to the process of molting, and seems to be an obstacle to quick molting rather than an aid. If removed from the web, the larva molts perfectly normally. Inside the web it has to pull itself around to get clear of its old skin. After one or two days in the web, the larva molts, and in a few hours, sometimes in one hour, it breaks out through the edge, at the junction of "roof" and "floor" (plate XVII). In molting, the head capsule separates from the rest of the old skin and is cast off first anteriorly. The larva then works its way clear of the remaining skin, casting it off the posterior segment of the abdomen. The molted head capsule and skin are left inside the web and separate from each other.

The manner of leaving the web shows how precisely instincts can regulate action. After it has molted, the larva normally bites a hole through the side of the web and emerges, but before molting it will not bite through and hence cannot get out even though it so desires. An individual which had just entered the web (in this case the second molting web) was rendered inert by hydrocyanic acid gas. After four minutes it regained sensibility and for the next 14 minutes made spasmodic movements while recov-

ering, being apparently normal at the end of this time. It then attempted to get out of the web by pushing against the sides, having "forgotten" the reason for its imprisonment. It pushed vigorously back and forth for seven minutes, stretching the sides of the web in its endeavors to escape, but to no avail. Half a minute's work with its mandibles would have set it free, and had it molted, escape would have normally been accomplished in this manner. The instinct to bite its way out was totally lacking. Finally it began to move around inside the web and spin irregularly, then it began to weave the normal figure "8" loops, and in 28 minutes the web was finished. The larva cannot use its only means of escape from the web until the act of molting is accomplished. This individual later molted and developed normally, not being in any way injured by its treatment.

If removed from the web before it is finished, or, if it is finished, before the pre-molting quiescent stage begins, the larva will spin another web or as much of another web as is possible and will molt normally. An effort is always made to complete another web, but sometimes lack of the necessary silk, or exhaustion, or some other factor, compels the larva to stop after a few strands have been spun, and it then molts in the most convenient place. If it has entered on the quiescent stage prior to molting and has become fixed in the shape of a horseshoe, it does not straighten out when taken from the web, but retains its curved shape until it molts.

Because of the fact that the larva leaves its web so soon after molting, the duration of the instars has been calculated to include the time spent in the web made by the particular instar in question. Thus the feeding period plus the subsequent quiescent period spent in the web gives the length of the instar.

The time spent in the first molting web is much affected by temperature, and usually varies between one and four days in this climate. Many larvae spend less than 24 hours in this web, but most of the larvae are in it about two days. If this period is added to the days of mining life, we get a period of 24 to 29 days for the first three larval instars. This is not remarkably long when compared to the length of the next two instars, which together total about two weeks.

After emerging from its first molting web, the larva feeds from one to nine days, the individuals varying greatly under the same conditions. If food is withheld from the newly molted larva, it dies in a few hours, a much shorter time than if starved after feeding a day or two. This is probably the result of remaining a day or two in the molting web without feeding. During the fourth instar the larvae are restless and wander about more or less. This probably accounts in part for the variation in the length of the instar, for the rapidity of development is much

dependent on the amount of food eaten. The average duration of the feeding period for 73 individuals recorded was about four days. In only one instance was the feeding period as short as one day. Temperature affects the duration of this period to some extent, as will be brought out later. The effect of different species of birch as food will also be discussed in another section of this paper.

The feeding occurs normally on the lower side of the leaf, and the veins and the upper epidermis are left intact. The entire leaf is never consumed. It is due to this habit of skeletonizing a leaf that the insect bears its common name. The larvae will eat whichever surface of the leaf is toward the ground, and normally this is the lower epidermis. A birch leaf was inverted so that the normal lower surface was uppermost and covered with a black paper. A mirror was so placed that it reflected light on the leaf from below. The larvae normally feed on the lower side of the leaf, and under normal conditions this side is not so light as the upper. If the larvae fed on the lower side of this inverted leaf, they would feed on the lighter side and at the same time on the side normally uppermost. The two sides of the leaf differ in physical as well as chemical constitution of the surface. Of ten larvae placed on the upper side of this inverted leaf, four migrated to other parts of the plant (a normal movement), one remained on the upper side and was feeding when examined, and five went to the lower side of the leaf and were feeding. Seventeen hours elapsed between the placing of the larvae on the leaf and the final observation. Larvae were then placed on the uppermost side of an inverted leaf and watched. Usually they wandered about restlessly for a time until they came to the edge of the leaf. They then turned to the side underneath. Light reflected on the lower surface by a mirror seemed to have no effect. At times movement to the lower surface was long delayed and at times direct. It very evidently is a reaction to gravity that impels these larvae to feed on the lower leaf surface and not any dislike for the upper surface nor any negative reaction to bright light. What factors developed the habit of feeding on the lower surface only is another matter. The habit of the larva is to feed continuously over a limited area, and it does not wander far unless the food supply gives out. If disturbed, the larva usually drops off the leaf, spinning a long thread as it falls. After falling a few inches it hangs on the end of the thread a moment and then quickly ascends. The thread is spun out the tip of the spinneret, and when the larva stops its descent, it is attached to the end of the thread by means of the spinneret. When it ascends the thread, it moves its head rapidly back and forth and winds the silk on the prothoracic legs which are held forward. If there is too much silk for the prothoracic legs, the mesothoracic legs are brought into use. On

regaining its support, the larva simply drops the bundle of thread and walks away. This performance can be easily watched under the binocular if a larva of the last instar is used. The spinning activities of the larva, the quickness with which it drops from a leaf, and the distance it drops are much greater in the last instar than in the fourth. The speed with which these little insects can spin a thread while falling a few feet is remarkable. If touched, they snap the body back and forth rapidly and thus wriggle off the leaf and drop toward the ground. Yet after they have fallen some distance, they suddenly check their descent and can be seen to be hanging by the end of a thread. The silk of which this thread is formed must be spun from the silk glands and out of the spinneret as rapidly as the larva falls. The act of spinning apparently occurs automatically when the larva is disturbed.

Because of their small size and their greenish color, together with the comparatively small amount of leaf tissue eaten, larvae of the fourth instar are not so noticeable as those following. In localities where Bucculatrix is abundant, however, ten to fifteen larvae may often be found on one leaf. Heavily infested birches frequently have 25 larvae of the fourth and fifth instars feeding on each leaf. During the majority of seasons no such number is likely to be present.

The fourth instar molts as did the third, in a white silken web. This web is larger than the previous one, being about 2.5 mm. across. The larva builds the web and lies in it as previously described, being clearly visible. There is a slight difference in structure, as this larva weaves an elliptical mat after it is inside the web. This thickened part gives the second molting web a characteristic appearance, as the first molting web has this structure to only a very slight degree. The time spent in this web varies normally from one to three days, the 75 individuals recorded averaging about two days. This is, of course, affected by the temperature, as was mentioned before. When added to the feeding period this figure gives the length of the fourth instar as about six days.

The larva molts as before and emerges from the second molting web as from the first. It normally feeds on the under side of the leaf, skeletonizing it (plate XVIII), and in this instar the feeding is much more extensive. The injury to the foliage is most noticeable at this time, usually during the last of August and most of September. If the larvae are present in large numbers, all the parenchymatous tissue is consumed, and the leaf dies and drops from the tree. These larvae show greater spinning activity than those of the former instar and may be seen suspended from the leaves in great numbers in seasons of abundance. They feed from two to ten days, the period varying with the individual and being affected by climatic conditions, and an average of 48 recorded individuals gives a period of nearly seven days. This

period includes the time from emergence from the second molting web to the spinning of the cocoon. Toward the last part of the feeding period the gonads are clearly seen through the dorsal skin of the abdomen of the larva. About twelve hours before the time when the larva will begin to spin its cocoon, it stops feeding. This interval of time varies considerably and may be much less. By this time the larva has turned brown in color, due to the color of the large silk glands which run almost the entire length of the body. When ready to spin the cocoon, the larva drops from the place of feeding to the ground, spinning out a long thread as it goes. Larvae may sometimes be seen suspended from a thread about fifteen feet long. If the trees on which they are feeding are shaken, these fully grown larvae drop to the ground quickly and in considerable numbers. Having reached the ground, they crawl under a stone, a fallen branch, a leaf, or any other object lying on the ground and spin their cocoons on the under side of this. Sometimes the cocoon is spun on the ground itself. In captivity they will frequently place the cocoons on the sides of the cage close to the base. I have reared hundreds of larvae, and they all have dropped to the ground or close to it to pupate. Fletcher (1893) mentions finding three cocoons on the twig of a birch, but all the cocoons which I have found in the field have been on fallen leaves or other objects lying on the ground.

The manner in which the larva spins its cocoon is characteristic of the genus and quite unique. The earliest description of this process in the genus *Bucculatrix* is by Lyonet, who wrote to Réaumur, December 22, 1744, concerning the larva of *B. ulmella* and its cocoon. This description was not published until 1832 and has been referred to in the historical part of this paper (page 396). De Geer, in the first volume of his "Mémoires," published in 1752, described the cocoon of *B. frangulella* (see page 395), and Snodgrass in 1922 likewise described the manner in which *B. pomifoliella* Clemens wove its cocoon. These three papers go into the details of the process by which the larva lays down its threads, and from a microscopic examination of the cocoon of *B. canadensisella* it is apparent that this larva weaves its threads in precisely the same manner as does *B. pomifoliella*. The general process of weaving is similar in all four species, differing only in a few details. Chambers (1882) described briefly the formation of the cocoon by *B. ambrosiaefoliella* Chambers, and McGregor (1916) gave a brief description of the finished cocoon of *B. thurberiella* Busck. In 1892 Fletcher briefly described the general procedure of weaving by *B. canadensisella* Chambers, and in 1893 Lintner mentioned the same subject, but the latter's description is not correct, and Fletcher's description is not detailed.

The larva of *B. canadensisella* Chambers first lays down an oval mat to serve as a base for its cocoon. It does not previously weave a palisade of poles around the site selected, as do many

species of the genus. It then commences at one end of the mat to weave an outer supporting ridged structure of comparatively coarse threads (about .005 mm. thick), facing the work and backing away as the woven structure progresses over the mat in an arch. The ridges are formed by the ends of a series of loops made from one side to the other. The diagram in figure 32 gives

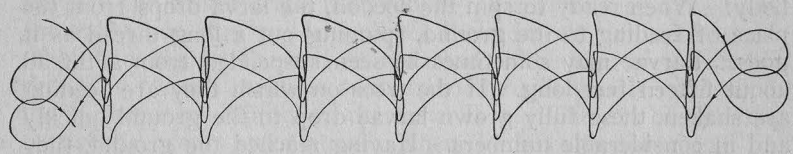

FIG. 32. Diagram of method by which larva of *Bucculatrix pomifoliella* Clemens weaves its cocoon. After Snodgrass.

the principle. Between ridges the threads cross diagonally. This figure is from Snodgrass (1922) and gives his conception of the actual motions made in weaving. As the cocoon becomes higher, the larva raises the anterior part of its body, and the radius of the structural arch is gauged by the raised part of the body as it swings from side to side, most of the body being fixed in the midline of the oval base. Possibly the prothoracic legs are used in the weaving to aid in guiding the work, as mentioned by Snodgrass and Lyonet. Certainly these legs are held up to the structure. When the cocoon is about two-thirds finished, the larva enters it, turns about, and crawls out until its head reaches the other end of the mat. It now has its anterior end outside of the cocoon but its posterior end in the cocoon. Beginning to weave exactly as before, the larva builds up the last third of the cocoon to meet the previously formed two-thirds, gradually enclosing itself as it works. When the two sections meet, they are joined by cross threads. The architecture is not perfect, for the ridges of the two sections rarely coincide, and sometimes the heights of the sections are not equal. The result is a break in the continuity of the ridges at the junction and often a sag in the contour of the cocoon. A completed cocoon is shown on plate XVIII. This outer structure is not closely woven and the insect can be seen clearly inside. It is, however, stiff and gives support to the lining which is to be woven. The sides meet the oval base perpendicularly.

Having completed its superstructure, the larva weaves a closely knit lining of fine threads (about half the thickness of the threads of the supporting structure) all around the inside by swinging its head in figure "8" loops. Where the walls of the superstructure join the base, the cocoon does not follow but makes a round

corner, as the diagram in figure 31 shows. It is this lining which makes the cocoon opaque. Snodgrass has described a series of "valves" in the anterior end of the cocoon of *B. pomifoliella* Clemens, but in the cocoon of *B. canadensisella* these are not present. The cocoon when first finished is almost pure white, but it soons turns brown. This brown color is due not to the pupa inside, for it is present before the prepupa molts, but to a change in the color of the silk when exposed to air. The time necessary to complete a cocoon is from eight to sixteen hours normally. Inside the cocoon the larva remains two or three days before pupating. This prepupal period plus the feeding period makes the fifth instar about nine days long on the average. The larva molts in the cocoon in a manner differing slightly from that which takes place in the molting webs. In the webs the head capsule is cast off entire and anteriorly while the rest of the larval skin is worked posteriorly off the anal segment. In the cocoon the entire larval skin, head capsule included, is worked off posteriorly.

The individuals which were reared in the outdoor insectary under normal temperatures in 1924 pupated from September 4th to September 25th; in 1925 from September 8th to September 13th; in 1926 from September 11th to September 23d. This does not indicate the time of disappearance of the last larvae in the field. During these three years an examination of birches about New Haven was made in order to determine the normal close of the larval period. In 1924 the last larvae were found October 9th; in 1925, September 19th; and in 1926, October 9th. The early disappearance of larvae in 1925, although not caused by any apparent natural enemy or unusual climatic condition, was exceptional. It may have been caused in part by an early season starting the life cycle earlier. In view of the fact that larvae will feed at 48° to 50°F. and will eat birch leaves until they begin to turn yellow, very few are caught before pupation by cold weather or lack of food.

The total larval life occupies from 38 to 46 days, as a rule, as the table on page 441 indicates. This is not an average of the completed larval life of a number of insects, but an average of the separate stages of many individuals, rather few of which completed the entire larval period while under observation. Nine larvae carried through from egg to pupa in 1926 averaged 41 days, the maximum being 45 days, and the minimum 36 days. This is as close as could be expected to the 38 days given in the summary for 1926. In the table below, the larval life from the hatching of the egg to the spinning of the cocoon is given for the nine individuals mentioned above. Two days as prepupa should be added to the six days of feeding in the fourth instar to give the total larval period of 41 days. It will be noticed that the larva does not accelerate through one instar if slowed down on a previous

instar, but that any retardation during the growing period is permanent as regards time. This is borne out by the other records. Seven larvae were reared in the laboratory in vials containing moist sand, and were under identical environmental conditions. The figures for the stages are given on pages 474-478 (larvae 131-137). The most slowly growing larva was six days in the fourth instar and was feeding six days and fifteen hours in the fifth, while the most quickly growing larva was four days and nine hours in the fourth instar and was feeding four days and nineteen hours in the fifth. It will also be noticed that the quiescent period spent in the molting web is independent of the length of the feeding period, and as the feeding period grows shorter, the proportion of time spent in the web during one instar grows greater. In larva number 9 in the table below, two-fifths of the fourth instar is quiescent, and in number 1, three-sevenths, but in numbers 2 and 4, only one-fourth of the fourth instar is quiescent. The effect of food and temperature on larval growth will be discussed later.

TABLE 1. COMPLETE LARVAL PERIOD

No.	Hatched	In Mine	In Web 1	Total Days	Feeding	In Web 2	Total Days	Feeding	Spun Cocoon	Total Days
1	8-14-26	26	2	28	4	3	7	5	9-23-26	40
2	8-11-26	22	2	24	6	2	8	7	9-19-26	39
3	8-11-26	22	3	25	4	2	6	6	9-17-26	37
4	8-14-26	20	2	22	6	2	8	6	9-19-26	36
5	8- 7-26	27	2	29	4	2	6	5	9-16-26	40
6	8-11-26	30	1	31	5	3	8	4	9-23-26	43
7	8- 7-26	27	3	30	5	2	7	6	9-19-26	43
8	8-14-26	20	2	22	5	2	7	6	9-18-26	35
9	8- 7-26	22	1	23	3	2	5	6	9-10-26	34
Aver.				26±.74			7±.22	6±.16		39±.7

The chart below (text figure 33) gives the periods during which the various stages may be found in the field around New Haven, Connecticut. These limits are computed from field observations and data obtained in the insectary and are broader than actual field observation alone would give. From what notes there are of the occurrence of this insect elsewhere, it seems likely that these periods are approximately correct for the entire region in which the insect is found.

TABLE 2. SUMMARIZED LIFE HISTORY OF *Bucculatrix canadensisella* CHAMBERS

Year	Adult	Egg	Mining instars			Fourth instar				Fifth instar			
	Number of individuals	Number of individuals	Days in egg	Number of individuals	Days in mine	Number of individuals	Days in 1st molting web	Total length of instars	Number of individuals	Days feeding	Days in 2d molting web	Total length of instar	Number of individuals	Days feeding	Days prepupa	Total length of instar	Days of larval life
1924	104			5		44			19				16				
max.					32		4			7	3			8			
min.					25		*1			1	1			2			
aver.					27		2	29		3	2	5		6	†2	†8	42
1925	135			10					34				27				
max.					37					8	3			10			
min.					24					2	1			6			
aver.					29		2	31		3	2	5		8	†2	†10	46
1926	36			35		34			20				15				
max.					30		3			6	3			7			
min.					18		1			2	1			4			
aver.					22		2	24		4	2	6		6	†2	†8	38

Period of emergence	
1924 max.	June 4 to July 9
1925 max.	June 15 to July 19
1926 max.	July 2 to July 21

Days in egg	
1926 max.	17
1926 min.	13
1926 aver.	15

* Several larvæ were in the first molting web less than 24 hours.
† The length of the prepupal stage was determined by removing several individuals from the cocoon at various times after the cocoon was completed. This stage was determined in 1926 and the 1926 figure used in computing the length of the stages in 1925 and 1924.

VII. Determination of the Number of Instars

It is very difficult to determine the number of instars by examining the mines for head capsules. A large number of mines were examined for this purpose and in two cases one capsule was found. The extent of growth and the morphological changes undergone during the mining period indicated at least two and per-

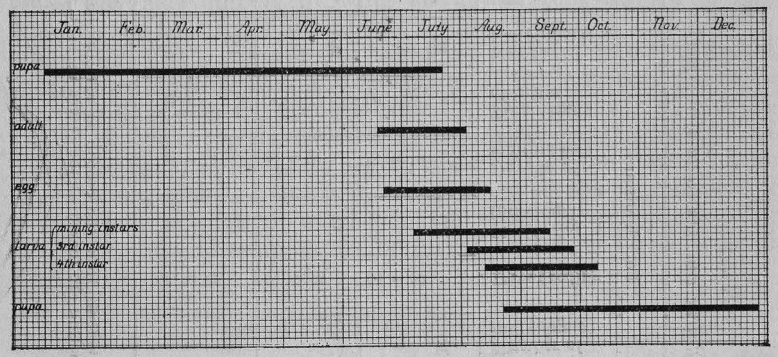

Fig. 33. Seasonal occurrence of the various stages of *B. canadensisella* in the vicinity of New Haven. The larval periods shown should read mining instars, fourth instar and fifth instar.

haps three larval stages. A number of larvae were collected in the field and the width of the heads measured. The head is not subject to growth changes during any one instar, and according to Dyar (1890) a constant numerical ratio exists between the widths of the heads of any two successive instars of a larva. If the heads of two successive instars are measured, or if a large number of miscellaneous heads are measured, the ratio for the species can be determined and the possibility of missing an instar removed. Any dimension of the head may be used, but the width is the most convenient.

Several embryos which had developed to the stage where they were about to emerge from the egg and where no further growth of the head could be expected were measured. These were all mounted in Canada balsam. As seen by the table on page 444, the average width is .078 mm., and nine of the twelve measured .076 mm., which latter figure may be considered normal. It is to be expected that the measurements for the first instar would conform to this figure, and of the sixty-one mining larvae measured, eighteen either equal this figure or closely approximate it. All but two of the eighteen equal it. The average width for the first instar is then .077 mm. Thirty-six of the sixty-one measure .114

mm. in width or very nearly so, thirty-four measuring just that figure and the other two measuring .120 mm. The normal and average for this group is .114 mm. The remainder of the mining larvae measured, thirteen, all give a head width of .171 mm. Two larvae were secured just as they left the mine and before they began to weave the molting web, and their heads measured. Both gave a width of .171 mm. These two are marked (ex) in the third column. This checked the group giving this measurement as the last mining instar. Also four larvae were found in the process of molting and with the head capsules just far enough off to permit the measurement of both the old capsule and the new head. Two of these gave the width of the old capsule as .076 mm. and the new head as .114 mm., while the other two gave .114 mm. and .171 mm. for the two widths. This gives a check on the three groups. According to Dyar's principle we should expect

$$\frac{.114}{.077}=\frac{.171}{.114}=R$$

In this case the ratio "R" is 1.5, and the number of instars in the mine is, as the figures indicate, three. To further check this principle, a number of external feeding larvae, also collected in the field, were measured. I have placed these forty-one larvae in two groups as the table shows. According to the principle used above, the measurements should be ,257 mm. (.171 x 1.5 = .257) and .385 mm. (.257 x 1.5) for the fourth and fifth instars. (The actual number of externally feeding instars was determined by actual observation, of course.) In the fourth instar the average width was found to be .245 mm. for the nineteen individuals, with a variation between .228 mm. and .257 mm. The last instar, containing twenty-two individuals, gave an average width of .353 mm. with a variation extending from .304 mm. to .390 mm. It is questionable whether the two larvae whose head widths are .304 mm. belong to the fourth or the fifth instars if one judges by these two measurements alone. The average width is less than that expected in both the external feeding instars, but even so the measurements are sufficiently closely grouped in each case to determine the instar. It is to be expected that the more nearly the larvae approach the fully grown condition, the more widely will they vary in size, for the absolute extent of variation in size under normal conditions increases with age. The change in environment from the mine to the surface of the leaf, with its difference in manner of feeding involved, would also change the shape of the head, because mining larvae have relatively flatter heads. The actual measurements obtained of the heads of the first three instars is much closer to the ideal than would usually be expected.

TABLE 3. HEAD WIDTHS OF THE LARVAE OF *B. canadensisella* CHAMBERS

(All dimensions in millimeters)

	Embryo	First instar	Second instar	Third instar	Fourth instar	Fifth instar
1	.076°	.076*	.114°	.171°(ex)	.257′	.323′
2	.076°	.076*	.114°	.171°(ex)	.247′	.352′
3	.076°	.076*	.114°	.171°	.247′	.323′
4	.076°	.076*	.120°	.171°	.228′	.304′
5	.086°	.076*	.114°	.171°	.247′	.371′
6	.076°	.076*	.114°	.171*	.238′	.380′
7	.086°	.076*	.114°	.171*	.247′	.380′
8	.082°	.076*	.114°	.171*	.247′	.390′
9	.076°	.076*	.114°	.171*	.228′	.380′
10	.076°	.076*	.114*	.171′	.247′	.371′
11	.076°	.076*	.114*	.171′	.238′	.361′
12	.076°	.076*	.114*	.171′	.247′	.361′
13		.076*	.114*	.171′	.247′	.304′
14		.095*	.114*	.171′	.247′	.370′
15		.076′	.114*	.171′	.252′	.380′
16		.082′	.114*		.228′	.352′
17		.076′	.114*		.250′	.361′
18		.076′	.120*		.257′	.361′
19			.114*		.247′	.352′
20			.114*			.332′
21			.114*			.380′
22			.114*			.370′
23			.114*			
24			.114*			
25			.114*			
26			.114°			
27			.114°			
28			.114°			
29			.114′			
30			.114′			
31			.114′			
32			.114′			
33			.114′			
34			.114′			
35			.114′			
36			.114′			
Theoretical average			.114	.171	.257	.385
Average found	.078±.0008	.077±.0001	.114±0001	.171±0.0	.245±.0013	.353±.0036
Standard deviation	.0039	.0045	.001	.000	.0085	.025
Greatest deviation from theoretical	.008	.008	.006	.000	.017	.081

In previous descriptions of the genus *Bucculatrix* it has been tacitly assumed or explicitly stated that the mining period included one instar only, and that the insect always molted on the surface of the leaf. The only mention I have found of a larva molting in the mine is in a description of the larva of *B. ambrosiaefoliella* Chambers by Chambers (1882) in which he states that the larva in question molts once in the mine, once on the surface of the leaf, and once in the cocoon. It would be well, however, to apply Dyar's principle, at least to the early stages, before making any definite statements regarding other species of this genus.

All the measurements given above were made with an ocular micrometer, using a low power of the microscope. The smallest micrometer scale division was .019 mm., and it was found impracticable to interpolate to less than one-fourth this, a measurement of .005 mm. The embryos measured were all mounted in Canada balsam. The larvae of the first three instars, marked with a small circle, "°," were also mounted in balsam; those marked with an asterisk, "*," were mounted in glycerine; and those marked with an apostrophe, "′," were specimens preserved in alcohol. All the fourth and fifth instar larvae were preserved in alcohol after fixation in Gilson-Carnoy's fluid.

VIII. FOOD PLANTS

The plants on which the larvae feed are restricted to the genus *Betula,* with the possible exception of the alder, *Alnus incana.* Johannsen, who reports (1911) the single instance of larvae attacking the alder, has also reported (1910) the presence of larvae on red oak. There are other species of *Bucculatrix* which feed on oak, one of which is very common in Connecticut, and it is very probable that the larvae referred to by Johannsen were not *B. canadensisella.* The mines in oak leaves are very similar to those of the birch skeletonizer, but the cocoons are white and are found on the trunk and branches of the trees. I have not bred this species, but Forbes (1923) gives *B. ainsliella* Murtfeldt and *B. packardella* Chambers as indigenous to northeastern United States, and both feed on oak. Alder is closely related to birch, and although the larvae of *B. canadensisella* did not survive in laboratory tests, through one complete instar on *Alnus* (*rugosa?*), under different conditions they may possibly feed on this plant. Of the species of birch on which this insect lives, four are native and one imported from Europe. These are *Betula populifolia* (gray birch), *B. papyrifera* (paper or white birch), *B. lutea* (yellow birch), *B. lenta* (black birch), and *B. alba* (European white birch) respectively. The European birch is a common ornamental tree in northeastern United States and southeastern Canada, and varieties are called the cut-leaf or weeping birch. This tree in Canada seems to be a favorite food plant, but in the vicinity of New Haven it is not quite so severely attacked as the gray birch.

Of the four native food plants, the black birch seems to suffer least, although Maheux reports (1926) that in Quebec this tree has been heavily skeletonized. Which of the other three is most severely injured seems to depend on which is prevalent in the locality. In most of Connecticut the gray birch is the preferred food plant, but on the shores of Highland Lake, where the white and black birches are the only two species common, the white birches were heavily skeletonized in 1925; and in other parts of

Litchfield County, where yellow birch is quite common, it is a favorite host. In Ontario and throughout the Great Lakes regions, the yellow and white birches are the trees which suffer most. The black birch in Connecticut is very slightly injured and usually is untouched, even though its branches intermingle with those of the white and gray birches when these two bear thousands of caterpillars. In laboratory tests the larvae ate the leaves of the black birch very readily. These larvae were taken from gray birch and fed on black birch during the fifth instar. Five of the ten larvae pupated normally, although the duration of the instar was 173 hours on the average as compared with 117 hours for the control. This delay in maturing was partly due to the delay the larvae experienced in getting accustomed to the new food plant.

The red or river birch (*Betula nigra*) is not a common tree in northern United States and southern Canada, and this may be the reason that it is not reported as being attacked by this insect. New England is about its northernmost range, and here it is found only in a few scattered places along river banks. No attempt was made to rear the larvae on the leaves of this tree, as the material is not readily available, and there are no references in the literature to it as a food plant.

There are four other genera of plants belonging to the same family as the birches and growing very commonly in the same localities as these trees. These are *Ostrya* (hop hornbeam), *Carpinus* (ironwood), *Alnus* (alder), and *Corylus* (hazelnut). Under natural conditions I have never observed any of these plants attacked by the larvae of *B. canadensisella,* although they very frequently intermingle with the birches. In the laboratory the larvae have been forced to eat the leaves of *Alnus* but could not maintain themselves on these leaves. The larva itself has really very little to do with the choice of food plants, for this is a leaf-mining insect in the early stages, and if the egg is not laid on a leaf in which the larva can live, death results. Even during the external-feeding stages it is very questionable if a larva could survive long enough to travel from an unfavorable to a favorable plant unless the two plants were very close together.

In an attempt to secure eggs on the leaves of the alder, I placed two alder twigs, each bearing two or three leaves, in a cage with five males and five females. One of the twigs had been dipped in the distillate from an aqueous extract of birch leaves, and the other was normal. The moths were collected in the field. Two females lived six days, one five days, one three days, and one two days, but no eggs were laid. In another similar trial with one female and six males, the female lived four days but laid no eggs. In view of the fact that the females are loath to lay eggs in captivity, the results are merely indicative and not conclusive.

An attempt was made to force larvae to eat the leaves of the alder and the black oak. All these larvae were collected in the field on gray birch. Five larvae in the first molting webs were placed in vials with the leaves of each plant. On the alder all five larvae died in three and one-half days or less without feeding. On the oak some feeding occurred and one larva went through the fourth instar in eight days and then died, starved, in fourteen. Three of the others died of starvation in four and one-half days or less, and one was accidentally killed. Although alder is more closely related to birch than is oak, yet the black oak was preferred as food, though it could not sustain the larvae. Ten larvae were then similarly kept with the leaves of these two plants, but the leaves were previously dipped in a distillate from an aqueous extract of birch leaves. It is sometimes possible to make insect larvae eat materials that have the odor of their food plants. Of the ten larvae used in this case, five were in the fourth instar and five in the fifth. On the alder both instars fed a little. One fifth-instar larva lived ten days, and two fourth-instar larvae lived seven days, but none went through a complete instar. On the oak there was more feeding than on the alder. One fifth-instar larva spun a cocoon after five days, and three others lived between seven and nine and one-half days. One fourth-instar larva lived sixteen and one-half days, molting meanwhile, and three others lived between five and one-half and eight days. In only one instance on the oak was the fourth instar completed. Although the distillate from the birch extract made the alder and oak more attractive to the larvae, and they ate relatively much more of the leaves when so treated, they did not show any growth except in the one instance mentioned above. All but one gradually shrunk in size and finally died of starvation before molting. Control larvae fed on the gray birch were normal in development. On this basis the possibility of larvae under natural conditions living on either oak or alder seems remote, and the reports of feeding on these plants were probably cases of misidentification of the insect in question.

Under laboratory conditions the larvae from the gray birch very readily eat leaves of paper and black birch, and larvae from paper birch just as readily eat leaves of gray birch. In all cases the larvae will mature. The trials conducted were not sufficiently extensive to determine whether or not there is a racial difference in the individuals from different host plants. This racial difference would be primarily manifested by the oviposition response of the adult, and difficulties in securing eggs consistently from females have precluded any definite experimental evidence on this matter to date. When the larvae were reared in the laboratory they were placed on the plants under trial, and if they left these plants, they were put back again. This was continued until they

ate the leaves or died. Under normal circumstances, no such condition would be met, and it is conceivable that the larvae might well starve to death in the midst of food which would sustain life, but which, for various reasons, they would not eat. The preference for birch as food, as concerns the larvae, is partly controlled by a chemical sense, for they eat oak and alder leaves more readily when these are first dipped in a distillate from an extract of birch leaves.

IX. Factors Affecting Abundance

The phenomenon of periodic outbreaks of *Bucculatrix* has been dealt with historically in previous pages. Some of the factors which have a bearing on the abundance and rate of increase of this insect deserve consideration. These may be grouped under food supply, climate, and natural enemies (including diseases). Man has not as yet played any direct rôle in the control of this species.

There is no scarcity of food plants in the northern United States and southern Canada, and the endemic population of Bucculatrix has no apparent effect on the growth of birch trees. Between outbreaks the larvae are scarcely noticeable. Paper birch forms a great part of the subarctic transcontinental forest and is a very common tree as far south as the Great Lakes and central New England. Gray birch is common farther south, and in New England and New York it is a weed tree which is constantly encroaching on cleared land. These two are the principal food plants and neither is being extensively cut by man. During an outbreak, when the larvae frequently eat all the foliage on the trees over considerable areas, the birches are not killed, even by several attacks in successive years, due to the lateness of the feeding period. The greater amount of feeding occurs during the last of August and September, and at this time of the year the trees have passed through the most active season and are not so severely injured as they would be by a similar attack earlier in the summer. This insect could probably never eliminate its food plant in any given region. It very probably checks the growth of the trees the year after a severe attack, but this check would not be sufficiently great to cause a decrease in the available larval food supply. Another factor that sometimes has some effect on the abundance of a particular insect is the competition for food with other species of insects. The defoliation of the birches in any region early in the summer would very obviously affect the survival of *Bucculatrix,* which feeds late in the season. At present this factor cannot be considered as of much importance. One of the most serious insect enemies of the birch in New England is the saw-fly, *Fenusa pumila* Klug, whose larvae mine the leaves during the entire summer, as there are several generations. Since

this insect confines its work entirely to the new terminal growth, while *Bucculatrix* larvae feed by preference on the older leaves of the tree, the two live together in harmony. There is always the possibility of the last *Bucculatrix* larvae of the brood not having sufficient food, because of the work of the earlier developing part of the brood, and hence being unable to survive. The habit of spending two days in a quiescent state in the molting web increases this danger, for during these two days the foliage on the tree may be entirely consumed. All the observations made in the field indicate, however, that there is no reason to believe that there occurs any decrease in food supply which would have any very important effect in reducing the numbers of this insect even following a year when it was abundant.

No data have been obtained on the effect of climate on the survival of this species. The greatest danger to an insect is during the hibernating period, when severely cold weather sometimes kills off much of the population of certain species. It is a well-known fact, however, that insects which hibernate under the snow are better able to survive extremes of cold than species which hibernate above the snow line. For this reason a very cold winter would not be expected to have a very great effect on the population of the birch *Bucculatrix.* This is an indigenous insect and is inured to the climate of its present geographical range, and the greatest effect of climate on its abundance is probably indirectly through limitations on the distribution of its food plants.

It is not inferred that climatic variations have *no* effect on the population, but rather that climate alone is not responsible for the more or less regular rise and fall in abundance.

The parasites and predaceous enemies of this insect probably account for the increase and decrease in its numbers more than any other one factor. Ten species of Ichneumonoidea and Chalcidoidea have been reared from the larvae and pupae. One of these, *Hemiteles,* is very probably hyper-parasitic, as Viereck (1916) states that all the species of this genus are probably secondary or hyper-parasites. The 10 species with the stage of the host from which they *emerged* are listed below:

	Stage of Host
1. *Bucculatriplex secundus* Viereck Braconidae	pupa
2. *Haltichella xanticles* Walker Chalcididae	pupa
3. *Gelis urbanus* Brues Ichneumonidae	pupa
4. *Cirrospilus ocellatus* Girault Elachertidae	larva (ext. feeding)
5. *Gelis bucculatricis* Ashmead Ichneumonidae	pupa
6. *Mesochorus* sp. Ichneumonidae	pupa
*7. *Pleurotropis bucculatricis* Gahan Entedontidae	pupa
8. *Closterocerus* (*cinctipennis* Ashmead?) Entedontidae	larva (mining)
9. *Derostenus* sp. Entedontidae	larva (mining)
10. *Hemiteles* sp. Ichneumonidae	pupa

* This is a new species the description of which, by Gahan, is published in Psyche, volume 34, June, 1927.

The family names are those used by Viereck (1916). These species are all small and occur singly in the host. The extent to which they parasitize the host varies, of course, from year to year and in different localities.

In the winter and spring of 1924 there were collected 397 cocoons from which there were secured 29 parasites as follows:

Gelis bucculatricis	14	specimens
Bucculatriplex secundus	7	"
Haltichella xanticles	6	"
Hemiteles sp.	2	"

These cocoons were collected from several localities around New Haven, where the host had been abundant in 1923. A large number of pupae died without metamorphosing, and only 152 adult moths were secured from this lot. In 1925 most of the pupae of which records were kept were from larvae reared in the insectary, and the parasitism, therefore, was abnormally low. Nine individuals of *Bucculatriplex secundus* and two of *Haltichella xanticles* were obtained from 352 cocoons. Conditions during the 1925 season of emergence were not normal, as the cocoons had to be kept in the laboratory. The records are not comparable to those obtained a year later. In 1926 there were collected during April and May 209 cocoons in a locality where the larvae had been very abundant the previous season. No collections had been made in this locality during either 1924 or 1925. All these cocoons contained pupae (as later examination showed), and from them were secured 53 parasites and 58 adult moths. The cocoons were kept outdoors in a shaded place until the emergence period was passed, and then those from which no insects had emerged (98 cocoons) were examined. Five contained dead parasites and 93 contained dead pupae. Of the insects which emerged, then, 47.7 per cent were parasites, and of the total number of pupae collected 27.7 per cent were parasitized. The parasites were of the following species:

Bucculatriplex secundus	37	specimens
Pleurotropis bucculatricis	12	"
Haltichella xanticles	1	specimen
Gelis urbanus	2	specimens
Undetermined (escaped)	1	specimen

It is evident that of the insects which emerge from the cocoons the parasites make up a large percentage, and the parasites are better able to survive than the host. Of the 151 non-parasitized pupae, only 58, or 38.4 per cent, produced adults, whereas of the parasitized pupae, 58 in all, 53 or 91.4 per cent produced parasites. The presence of a parasite in a pupa is very easy to determine after three months, as by this time the parasite has consumed most of the host tissue. A parasite could not have been easily overlooked in the examination of dead pupae. Since these parasites occur singly in the host, the percentages are comparable. There is, of course, the possibility that some of the parasitized pupae died before the parasites had developed far enough to be observed in a dead and desiccated host. The fact that of the 93 dead pupae above mentioned 44 had reached the pre-imaginal stage before dying indicates that this possibility would have no great bearing on the results obtained, for had any parasite been present in any of these, it would have prevented the host from reaching the condition of the pre-imago. It is also true that the parasites are better able to withstand high and low temperatures during the period of emergence than is the host. Three lots of 20 cocoons each were kept at different temperatures, one at 31-33°C., one at room temperature which varied between 18° and 26°, and one at 8-15°. The cocoons were placed in test tubes (50 cc. capacity), 10 in each tube. To serve as a check on the humidity effect, one of the tubes of each lot contained a piece of wet blotting paper which produced a moisture-saturated atmosphere in that tube. The other tube received nothing. All tubes were kept corked except for an interval of about one minute each day when they were opened in the room in order to renew the air supply. The relative humidity of the room averaged 67 per cent, with a variation of 13-14 per cent each side of this for brief intervals of time. The experiment began June 2, 1926. From the cocoons held at room temperature 18 insects were secured, nine from each tube. This represented a normal emergence. Four of these were parasites, all *Bucculatriplex secundus,* and 14 were adult moths. From the cocoons held at 8-15°, two parasites only emerged, one from each tube. One was a specimen of *Bucculatriplex,* and the other was *Mesochorus* sp. From the cocoons held at 31-33° two parasites only emerged, both from the tube containing room air. Both were *Haltichella xanticles.* After being examined July 10th, all the cocoons from which no insects had emerged were removed to the outdoor insectary. Eight adult moths subsequently emerged from the tubes that had been held at 8-15°, four from each tube. After the emergence period was well passed the remaining cocoons were examined. No dead parasites were found, and most of the dead pupae had reached the pre-imaginal stage. Although the number of insects concerned was not large, the parasites were very evidently better able to withstand the extremes of temperature than was the host, for all the parasites emerged under these conditions, but no moths were obtained. The two parasites which came out of the tubes held at 8-15° emerged July 3, and the two from the tubes held at 31-33° emerged June 5 and June 6 respectively. In the case of the latter two, it might be suspected that the difference in development between host and parasites enabled the parasites to complete

the metamorphosis and emerge when the host could not, for they were exposed to the high temperature only three and four days. However, from a third tube set up the same as the others but containing calcium chloride and held likewise at 31-33°, there emerged two parasites only, one specimen of *Bucculatriplex secundus* on June 23, and one specimen of *Pleurotropis bucculatricis* on July 4. The cocoons in this last tube were exposed not only to the high temperature, but also to the desiccating effect of the chloride. No adult moths were secured, and no parasites died before emerging.

In addition to this emergence of parasites from pupae, there is sometimes a considerable parasitism of the mining larvae by *Closterocerus* and *Derostenus*. When these parasites were first discovered, it was thought that they were one and the same species, as they were in the larval stage and resembled each other closely. They are therefore grouped together here. If the mines of the *Bucculatrix* larvae are examined in September, many will be seen to contain the remains of the larva and in addition a very minute parasite larva about .75 mm. in length. September 10 and 14, 1925, there were collected 619 *Bucculatrix* mines in gray birch leaves. Of these, 522 were vacant and showed by the exit hole that the *Bucculatrix* larva had emerged normally. The other 97, or 15.7 per cent, contained each the remains of a *Bucculatrix* larva and one parasite larva belonging to one of the two genera in question. The only exception to this was one mine which contained two parasite larvae. The first of October, 1926, the same locality was visited and 289 mines were collected. The mines this year were much less abundant than in 1925. Of these 289 mines, 100 had been normally vacated by the *Bucculatrix* larvae and 58, or 20.1 per cent, contained parasites. The remainder, 131, contained dead *Bucculatrix* larvae, but the cause of their death could not be determined. It could hardly have been the parasites in question, for the *larvae* of these two species were found in the other mines.

The above figures show that there may be a heavy mortality of the host by the combined attack of the parasites. Of these, *Bucculatriplex secundus* is the most commonly found. Only one locality has been examined for *Derostenus* and *Closterocerus,* and it is not known just how widely spread these two species are. *Pleurotropis bucculatricis, Haltichella xanticles,* and *Gelis bucculatricis* are also rather common. One specimen only has been secured of *Mesochorus* and *Cirrospilus ocellatus.* The former emerged from a cocoon in 1926, and the latter was found in the pupal stage in a molting web of *Bucculatrix.* *Hemiteles* may be a secondary parasite and hence of no use in checking the reproduction of *Bucculatrix.* There is a possibility that some of the others also are secondary parasites.

The adults of *Derostenus* appear the last of the summer, but the adults of the other parasites appear about the same time that the host adults appear. This indicates that there may be other hosts for some of the parasites. *Bucculatrix secundus* hibernates as a larva in the pupal cuticle of the host. *Derostenus* and *Closterocerus* kill the host larva before it completes the third instar and hibernate as larvae in the mines of the host. The other species hibernate in the pupal cuticle of the host, but the hibernating stage of these was not determined. All the parasites are minute. The Ichneumonoidea adults are about 1.75-2.00 mm. in length, and *Haltichella xanticles* is about the same size. *Pleurotropis bucculatricis* is about 1.5 mm. long, and *Derostenus* and *Closterocerus* are each about .60 mm. in length.

More important as enemies of the *Bucculatrix* larvae than any one of the above species of parasites, and perhaps than all of them combined, are the various species of ants and other predaceous insects which capture the larvae when they descend to the ground to pupate. Ants will not only capture the larvae before the cocoon is well begun, but will also pull a larva out of the cocoon in which it is almost entirely enclosed. In 1925 ants destroyed the entire stock of larvae in the insectary. On one occasion the litter on the ground under a birch which had borne hundreds of larvae was very carefully examined for cocoons after all the larvae had disappeared, and not over 25 entire cocoons were found. A large number of the cocoons were partly completed. This tree had been under observation and no extensive mortality of the larvae on the leaves was noticed. There is no question that most of the larvae reached the ground, and most of these fell prey to their insect enemies before they could pupate. In collecting cocoons in the field in localities where there has been an outbreak of larvae and the trees have been practically defoliated, it is surprising to find relatively few cocoons that are entire and contain pupae.

Although no detailed observations have been made on the activities of birds, Dr. Britton informs me that he has observed certain warblers apparently feeding extensively on the larvae. While there is no question that birds do have some effect on the abundance of these insects, the effect of ants and other predaceous insects seems to be much greater.

The interrelations of host, parasites, and predaceous foes have been very clearly described in the case of the fall webworm by Tothill (1922), whose conclusions are here briefly summarized, and many of the reasons for the occurrence of outbreaks and the following decline in numbers of this insect are applicable to *Bucculatrix canadensisella.* Under normally balanced natural conditions the parasites are most effective and keep the host in an endemic and harmless state for a number of years. The predaceous enemies are also effective, for without their help

the host might increase in spite of the parasites. The combined attack of parasites and predaceous foes reduces the numbers of the host, but at the same time the number of parasites is reduced, for a competitive struggle for food occurs among the species of parasites and among the members of one species. During the last few days of its life in the host, the parasite is much more destructive to the host tissue than at any other time, and although several parasites may start life in one host, which is particularly the case when the host becomes scarce, the only individual that survives is the one which first reaches this rapidly destructive stage, the others perishing from lack of food. The predatory enemies apparently do not discriminate in favor of the parasitized larvae, and this also tends to reduce the number of parasites. Some species of parasites may become locally extinct, and not being strong fliers, do not come in again from the surrounding territory for some years. Any environmental change favorable to the host now gives it an opportunity to increase in the absence of a large part of its enemies, and it soon reaches a stage of great abundance. After a period of years the parasites, which have now found themselves provided with an abundant food supply, increase, and finally, with the aid of the predaceous foes, overcome the host and again reduce its numbers to an endemic state. Over a long period of years the result of these opposing factors is a series of outbreaks following each other at more or less regular intervals. When the host begins to decrease markedly, the parasites also begin to decrease, since they have more difficulty in finding the host, so during the decline of the host population there is not necessarily an increase in the percentage of parasitism. For example, during 1925 the parasitism of *Bucculatrix canadensisella* mining larvae by *Closterocerus* and *Derostenus* was 15.7 per cent, and the following year, in the presence of a very marked reduction in the abundance of mines, the parasitism from these two species was increased only 4.4 per cent.

When the larvae of *Bucculatrix* are abundant there may be expected up to 20 per cent parasitism in the mining instars and an equal percentage of parasitized pupae. To this must be added a heavy mortality due to predaceous enemies. There are also certain undetermined factors, possibly both internal and external, which prevent the development of the insect beyond the pupal stage and cause the mortality of a number of pupae. These last factors are more effective on the host than on the parasite. Aside from the effect of parasites, a considerable number of the mining larvae may sometimes succumb from some cause unknown to the writer. All the factors except parasites maintain a constant attack on the various stages of *Bucculatrix canadensisella*, and when the *Bucculatrix* population begins to decline, the severity of this attack is more keenly felt. A parasite population fluctuates

with a host population and has direct bearing on the periodic abundance of the host but cannot entirely eliminate it, as the parasites decrease when the host decreases.

A species of fungus belonging to the genus *Verticillium* has frequently been found growing on the dead pupae of this insect, and it was thought at first that this might possibly be the cause of these fatalities. Several attempts to inoculate healthy normal pupae with cultures grown on oat agar failed completely. The procedure followed was to make a small opening in the cocoon and expose the pupa within. A drop of water containing a suspension of the spores and mycelium was placed on the pupa, which was then set aside in a petri dish for future observation. Although a number of inoculations were made, in not a single case did an infection of the pupa develop, and it was concluded that the fungus concerned is entirely saprophytic. Several species of *Verticillium* are found on dead insects. I am indebted to Dr. McCormick of the Connecticut Experiment Station for determining this fungus and for carrying out the inoculations.

X. Geographical Distribution

This insect, as far as reports in the literature and information acquired directly from entomologists indicate, is found only in the northern United States and in Canada. Its southern limit is North Carolina, and in Canada it occurs in New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, Alberta, and British Columbia. Mr. Hutchings, of the Entomological Branch, Ottawa, informs me that it probably occurs up as far as the Yukon. It is recorded as far west as Minnesota in the United States. In Ontario, Quebec, New Brunswick, the New England States, New York, Michigan, Wisconsin, and Minnesota it is very common and sometimes appears in such numbers that the birches are defoliated. On the map (figure 34) is marked with a cross every locality from which I have definite records of the occurrence of the insect.

According to data obtained from Sargent's "Silva of North America" (1896), the four native food plants (the paper, gray, yellow, and black birches) of *Bucculatrix canadensisella* occur over a much wider area than that from which the insect is reported. The region occupied by these birches is shaded on the map. The paper birch (*Betula papyrifera*) is very widespread and is a favorite food plant. It is found almost everywhere within the shaded region on the map, but it is not abundant west of the Rocky Mountains nor south of Minnesota, Wisconsin, Michigan, and New York. The red birch (*Betula nigra*) is not a common tree in northern United States and I have no records of its being attacked by this insect. Its range extends much further south

FIG. 34. Distribution of *Bucculatrix canadensisella* Chambers and its food plants. The shaded area shows the distribution of the gray, paper, yellow, and black birches. The crosses indicate localities from which the insect has been recorded.

than that of the other birches. The parts of North America in which these food plants (*B. populifolia, B. papyrifera, B. lutea,* and *B. lenta*) are found corresponds very closely with the boreal and transition zones as outlined by C. Hart Merriam (1898), except for the Rocky Mountain region of the United States. In

Indiana, which is just south of the transition zone, the insects are not plentiful, and in New Jersey they are reported from two counties, Essex and Morris, both in the northern part of the state, and both within the transition zone. In North Carolina adults have been collected in Jackson County. Although the geographical distribution of the birches in the North includes Newfoundland, there are no records of the occurrence of *B. canadensisella* on that island. It is possible that the distribution of this insect coincides with that of the paper, gray, yellow, and black birches, but the map clearly shows that it is most commonly found in the region around the Great Lakes and thence east to the Atlantic Ocean.

That the pupal stage can withstand low temperatures is quite evident, for the region around Port Arthur, Ontario, and the northern shore of Lake Superior very frequently reaches between -20°F. and -30°F. Temperatures would not interfere with the spread of the insect rather far north in western Canada, for the isotherms during the winter run in a curve from Quebec south, and then north through Saskatchewan and Alberta, making the Dakotas, the northern shore of Lake Superior, and the region just north of it much colder than regions directly to the east and west, and this insect is frequently very abundant along the northern shores of Lake Superior. The fact that it hibernates on the ground under leaves and under the winter snow also enables it to endure a very cold climate. It would not be surprising if an examination of white birches during the last of the summer in the northern limits of the range of this tree would reveal the presence of this insect. The southern limit of the insect is also very probably the southern limit of its food plants. This is a very small and inconspicuous moth, and unless it is present in large numbers, it is easily overlooked. As the larval food plants become scattered along the limits of their geographical range, the insect becomes less noticeable. That it has not been reported from more localities is not surprising.

During seasons when it is not very abundant over any great area, the infestations of *B. canadensisella* are often spotted, and a small group of birches may have their leaves completely skeletonized, while one hundred yards away the leaves of others are practically unharmed. This is in all probability due to the fact that the insect flies very little and very rarely goes beyond the shelter of the birch trees.

The insect has probably reached its present geographic range by entirely natural means of spread, for its habits preclude any great distribution by human agencies. It is found on the trees only in the larval state, and then on the leaves only. If birch trees are shipped any distance, transportation always occurs when the tree is dormant and bears no leaves. Birches are cut after the leaves fall, so that there is little probability of cocoons occurring on cut timber. Early records of forest-inhabiting species of

insects are none too common in North America, and *B. canadensisella* was probably very prevalent over the entire area from which it has been reported before Chambers described it in 1875. Even today it attracts no attention except during those periods when it becomes extraordinarily abundant and defoliates the trees.

XI. Effect of Temperature on Development

In view of the fact that temperature seems to be a very important factor in the development of these insects, experiments were carried out to determine the effect of different temperatures on the larva during the period when it was feeding externally on the leaf; that is, during the fourth and fifth instars. The temperatures used ranged from 10° to 35°C., and each temperature was held as nearly constant as possible under the conditions. Those at the lower end of the range, 10°, 11°, 12°, were obtained by using ice-boxes. Incubators were used for 25°, 29°, 34° and 35°, and an incubator was cooled with ice for 14° and 15°; 20°, 21° and 22° were laboratory temperatures. Observations were made at 8.00 A. M., 2.00 P. M., and 10.00 P. M., or as close as possible to these hours, each day, and the temperature and condition of the larvae noted. This gives a possible error of four to five hours in the observations, but in a series of observations this error tends to be compensated. The temperature for any given larval stage is the average of all the readings, and the charted temperatures are those obtained daily by averaging the three temperatures for the day. In all cases a fairly constant daily temperature was held. The temperatures were averaged for each individual larva, and the fluctuations of a degree in either direction made the mean temperatures for different larvae kept in the same location vary slightly. For this reason the groups tabulated under 11° and 12° were both held at the temperature charted on line (c), text figure 35, those tabulated under 14° and 15° were held at the temperature charted on line (d), those under 20°, 21°, and 22° on line (e), and those under 34° and 35° on line (h). In some stages there is a difference of only one degree between groups with very little difference in the duration of the stage at the different temperatures. This is due not only to the fact that one degree would not be expected to show much difference under the conditions, but also to the method of averaging temperature readings. The tabulated temperatures are correct within one-half of one degree; that is, if the temperature for one larva during the fourth instar averaged 20.4°C., that larva was placed in the 20° group. A difference of one-tenth of a degree in the average might throw the larva into a higher group, for if the temperature averaged 20.5°C., the larva was placed in the 21° group.

In view of the fact that the larvae kept in ice-boxes were in darkness, eight larvae were reared in a dark box at the laboratory room temperature, 20°-21°C., as a check on the effect of absence of light. Two of these died in the fifth instar and the other six pupated. The mortality was not exceptional. The mean duration of the fourth instar was 125 ± 5.1 hours, with a standard deviation of 21 hours; the mean duration of the fifth instar was 131 ± 4.3 hours with a standard deviation of 18 hours, and the mean duration of the entire external feeding period was 248 ± 6.8 hours with a standard deviation of 25 hours. These periods are practically the same as the periods of larvae reared at the same temperature in the lighted laboratory, and the absence of light caused no error.

The larvae were reared in individual glass vials as described previously, and the relative humidity was kept constant by wet sand in the vials. The leaves used as food were renewed as often as was necessary for keeping the food material fresh and unwilted. At temperatures of 25° and higher, the leaves were renewed daily; at 14°, 15°, 20°, 21° and 22°, every other day; at all temperatures below 14°, twice a week. The leaves used were all from the lower parts of gray birch trees, that is, the older leaves, and in all but three or four instances were from the same group of trees. Leaves selected were as uniform as possible. All the larvae used in this experiment were obtained from gray birches bordering a field about eight miles north of New Haven. The large number of larvae reared at room temperature (20° and 21°) was due to the fact that a control of each lot of larvae was kept at this temperature.

Four larval periods were considered: (1) the quiescent period in the second molting web; (2) the fourth larval instar, which includes the period in the second molting web; (3) the fifth larval instar up to the spinning of the cocoon; (4) the entire period of life spent outside the mine, which includes the fourth and fifth instars. Although the fifth instar really includes a prepupal period in the cocoon, observations on this period were not possible without disturbing the conditions of the experiment, so this prepupal period was omitted. The actively growing period of the larva is over when feeding ceases, and the omission of the prepupal period does not affect the results. In each case the endpoint is sharply defined.

The chart on page 465, figure 35, gives the temperatures at which the different groups of larvae were kept, and the letter in parentheses at the left of each temperature curve corresponds to the same letter opposite each temperature in tables 4 to 7 and indicates the curve for that temperature group. In the tables are given the number of each larva, the day it began the period

represented by the table, the duration of that period, the mean duration for each temperature group, and the standard deviation for each temperature group (in parentheses after the mean). The temperature at which any larva or group was held, together with the temperature fluctuations during the period, may be ascertained by examining the temperature chart (figure 35). Fluctuations occurred one degree each side of the mean except in a few cases where a brief fluctuation of two degrees is found. The latter cases were so few and the variations in temperature for any one larva were of such brief duration that the results are not affected. Table 8 on page 481 is a condensation of the other tables and gives the data which form the basis for the curves shown in figures 36 to 40. These curves show the relation between temperature and development.

Each figure contains two curves. The curve marked A gives the duration of the period in hours for each temperature within the limits of the curve. The abscissae represent degrees centigrade, and the ordinates, on the left of the figure, hours. The number of degree-hours (developmental units) required for development at any temperature may be calculated from this curve by multiplying time by temperature. If the curve conformed to the formula of a true equilateral hyperbola, the number of degree-hours for each point on the curve would be the same, according to the mathematical definition of the curve, and this constant figure would be the so-called "thermal constant." In no two consecutive temperatures of the experiment were the number of degree-hours equal or approximately equal, and the curves clearly show that no thermal constant exists in the development of the larvae under these experimental conditions. The curve marked B gives the index of development for each degree of temperature. The abscissae are the same as those of the A curve, and the ordinates, on the right of the figure, are the reciprocals of the ordinates of the A curve. Each point on the B curve gives that fraction of the total development which is completed in one hour at that particular temperature. The curve thus gives the rate of development directly and changes in that rate corresponding to changes in temperature. If curve A conformed to the formula of an equilateral hyperbola, the curve B corresponding to it would be a straight line by definition, but A is not an equilateral hyperbola, and B is not a straight line. Where a thermal constant exists, the rate of development curve B is always rectilinear, and if a thermal constant exists for any narrow range of temperatures, within that range the developmental curve is straight. According to the data and the curves, there is no thermal constant over any range of temperatures greater than the error of the experiment. In drawing the curves, the points were plotted for the A curve from the experimental data, and the curve was made to

conform to these points as closely as possible. These points are enclosed in small circles in the figures. The index of development curve B was then drawn to conform to curve A, and the reciprocals of the plotted points in A are enclosed in circles in B. In the absence of a thermal constant, the rate of development of the larvae and the degree-hours required for the completion of any stage must be calculated from the curves directly. No attempt has been made to project the curves beyond the limits of the experimental data.

The lowest constant temperature at which larvae would survive the fourth and fifth instars and pupate was found to be between 10° and 12°C., and the highest temperature was found to be slightly under 34°C. Eight larvae in the first molting web were held at 6°C. [line (a)] 6 days, during which time they did not molt, and four larvae were held at 3°-6°C. [line (a)] 10 days. during which time no molting occurred. The duration of the period in the molting web at 21° is about 40 hours. All twelve of these larvae molted within 29 hours after removal to the laboratory, where the temperature was 20°-21° [line (e)]. Development thereafter was normal. Six larvae in the first molting web were kept at 9°-10°C. [line (b)]. None of these completed development, but three molted within 9 days and lived 50 days. 39 days, and 10 days respectively, after the molt. The other three died in the web without molting. Ten larvae in the second molting web were kept at 9°-10°C. [line (b)], and all molted within 8 days. Four died in 24-45 days, and six pupated in 18-30 days. Controls of all these larvae kept at 20°-21° in the laboratory were normal and had a mortality of zero (25 larvae in all). It is quite apparent that although some development occurs at 9°-10°C., the continuous exposure of larvae in the fourth instar to this temperature is fatal. If the larvae are in the fifth instar, they may or may not complete development, depending on individual hardiness. Ten larvae in the first molting web were kept at 11°-12°C. [line (c)]. All molted within 4 days, 8 completed the fourth instar, and 7 pupated. Ten larvae in the second molt web were held at the same temperature. Eight of these molted within 3 days and pupated. Controls of these two lots were kept at 20°-21° in the laboratory [line (e)], were normal in development, and had a mortality of 2 larvae in 22. At 11°-12°C., development is slow but otherwise is normal. It may possibly be that the fifth-instar larvae are more able to withstand low temperatures than the fourth. Death at 9°-10°C. seemed due to starvation, the cold preventing the larvae from feeding, and even under normal conditions the fifth-instar larvae eat more constantly than do those of the fourth instar. The larvae at this low temperature were always sensitive to touch, and sometimes spun silk threads. It appears as if the first effect of the cold was to stop feeding activity. The

larvae then shrunk in size and finally died from lack of nourishment. The curves (figure 39) of development for the period including the fourth and fifth instars necessarily begin at 12°C., in accordance with the above facts.

At the high temperatures (34°-35°) the effect was somewhat different. The procedure was essentially similar to that described for the low temperatures, and the temperature line (h) in figure 35 depicts the temperature used. This temperature was also fatal to fourth-instar larvae if maintained continuously, but the larvae were able to molt, complete the fourth instar, molt again and begin the fifth instar. None pupated, however. Feeding was very actively carried on until about 12-24 hours before death, and starvation was not a factor to be considered. Fifth-instar larvae molted and pupated without difficulty. The data for the larvae at these temperatures is given in the tables. Since the total feeding period could not be completed at 34°-35°C., the curve of this period stops at 29°C., the highest temperature at which the larvae completed two instars and pupated. At the high temperature, as well as at the low, the fifth-instar larvae seemed better able to endure the adverse conditions and fed more consistently. The lethal high temperature, using the curve as a guide, is in all probability very close to 34°C.

The above data demonstrate that a real threshold of development ("developmental zero") and a real maximum lethal temperature are determinable only when the length of exposure to those temperatures is considered, and that some development may occur at temperatures beyond the lethal high and low (for the entire period) if these exposures are not too prolonged. The difference between that temperature which gives a maximum speed of development and the lethal high is much less than the difference between the same maximum and the lethal low, but development occurs at both extremes. For example, at 9°-10°C., the fourth-instar larvae will ultimately die, but some development will have occurred meanwhile. The same is true of 34°-35° and even higher, for in another experiment an exposure to 37°C. for a few hours caused neither cessation of feeding nor other deleterious effects. In calculating the effect of low temperatures on the life cycle of insects, it has been customary to eliminate all "ineffective temperatures"; that is, all temperatures below a given threshold, this threshold depending, of course, on the insect in question. Theoretically the developmental curve B (figures 36 to 39) should cut the temperature axis at the threshold of development. The corresponding theoretical point on the time-temperature curve A would be at infinity. The curve B, however, shows no marked inclination toward the temperature axis at its lower end, and it would be rash to predict from any data obtained by a time-development study just where it is going to cut that axis. Under natural conditions the temperature fluctuates considerably, and

even though it should rise above or sink below that point at which the larvae could not complete development, some development would probably take place at these extremes of the fluctuations. The fact that the curve A is not a true equilateral hyperbola and the curve B is not a straight line makes it inadvisable to project these curves beyond the experimental data in order to determine theoretical points, and no attempt has been made to determine an absolute threshold of development.

The curves A and B in figures 36 to 39 show clearly the depressing effect of high temperatures on the larvae. According to these figures the maximum rate of development would occur at 30°-31°C., and the experimental data give the maximum rate at 29°C., no experiments being carried out between 29°C. and 34°C. Either side of the 30°-31° point, the rate of development is slower, whether the temperature rises or falls.

The curve B shows the rate at which the speed of development varies and the direction of this variation for each degree of temperature. Beginning at the lowest point in the curve, the rate at which development is speeded up increases with each increase in temperature until at a certain point, the steepest part of the curve, a maximum is reached. At this point fluctuations in temperature have their greatest effect on the development of the larvae. As the temperature increases above this point, the rate at which development is speeded up with the rising temperature decreases until the point of maximum rate of development is reached, 30°-31°C. Any increase in temperature beyond this causes an actual decrease in the rate of development. It is this variation in rate of development which forbids the "summing" temperatures on a "developmental unit" basis.

In all four figures (36 to 39) the curves are sigmoid. In the curves representing the total external feeding period, those temperatures beyond 12°C. in one direction and 29°C. in the other are omitted, due to the non-survival of larvae beyond these points, but the curves take the same general form as the others. The effect of temperature in these experiments was similar for both quiescent and active periods. The shorter periods give the better developmental curves, for as the period lengthens the index of development becomes less numerically, and the curve "flattens," if the system of coördinates remains unchanged. In figure 40 the rates of development as actually obtained have been plotted on logarithmic paper, and the curves give a correct impression of the relative effects of temperature for the different stages. The curves are much more nearly parallel than those plotted on arithmetic paper and show that the effect of temperature on the rate of development of the different stages is somewhat similar.

Due to the small scale on which the curves are drawn, the steepest part of any one of the curves is somewhat difficult to determine by mere examination. However, a calculation of the tangents of

the curves at all temperatures shows that for the period in the second molting web this steepest part lies between 21° and 22°; for the fourth instar, between 23° and 24°; for the fifth instar, between 24° and 25°; and for the total external feeding period, between 23° and 24°. The tangents of these parts of the curves are 1.8855, .6335, .4280, and .2300 respectively. These tangents are calculated for the rate curves as drawn. The lower temperature at which this is found in the period spent in the second molting web may be due to the inactivity of the insect. The temperature relations for the two feeding instars approximate each other fairly well.

A theoretical use of such curves as those marked B in the figures in considering the development of an insect under natural conditions where fluctuating temperatures occur is in the prediction of the time taken to complete a stage of development. In making such calculations, if the mean temperature of a short duration of time, a few hours, for example, be ascertained and the index of development at this temperature be multiplied by the number of hours during which this mean temperature is considered effective, the amount of development completed during this time can be approximately determined. When the sum of these last determinations equals 1, the development is theoretically completed. This is the method proposed by Sanderson (1908) and seems to be more logical than any alternative method. In practice it has been customary to determine the mean temperature for each hour. The method more commonly used in determining amount of development during short intervals of time under conditions of fluctuating temperatures depends on the assumption that the changes in velocity of development vary directly with increases in temperature and that the velocity curve (B in the figures in this paper) is a straight line for a certain temperature range, if not for all temperatures between the "threshold" and the "maximum." With such an assumption there exists a thermal constant within certain temperature limits ("medial" temperature according to Shelford—1926) and the number of developmental units required to complete development is this thermal constant, i. e., the product of time by temperature. If the amount of development completed during a brief interval of time be computed, it will represent a fraction of the thermal constant (*not* of 1), that is, a certain number of developmental units. When the sum of these determinations, the total of developmental units, equals the thermal constant, development is theoretically completed. The fault with this method lies in its uselessness when the velocity curve is not a straight line, and even if part of this curve is assumed to be straight, the method is not good for fluctuations outside of this temperature range. The small scale on which curves are plotted sometimes gives an erroneous impression of rectilinearity.

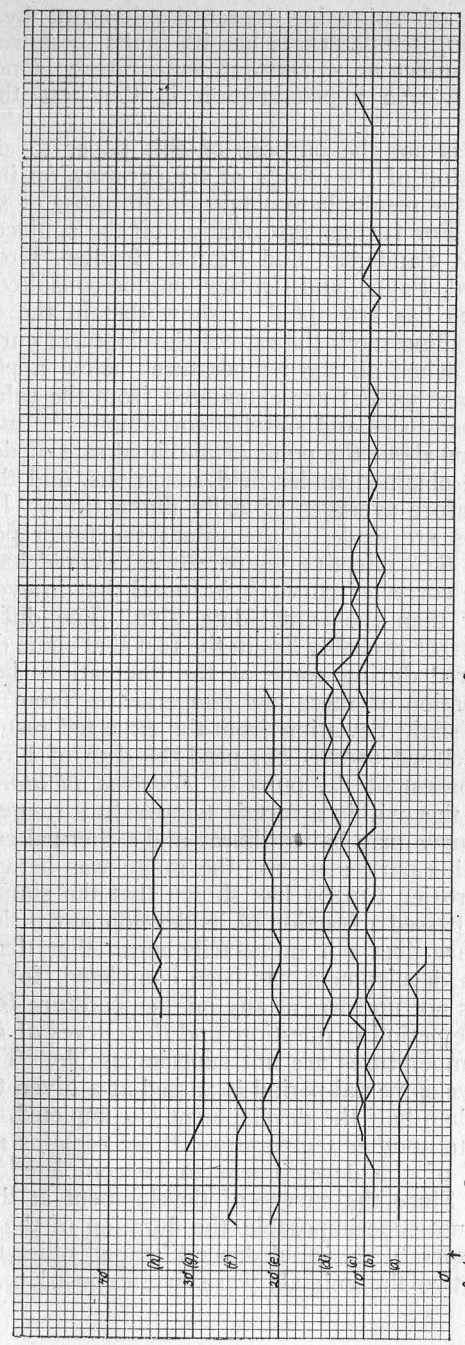

FIG. 35. Chart of temperatures of incubators, etc.

Any method of estimating insect development by averaging widely fluctuating temperatures has its faults, because the development of an insect at a constant temperature is not uniform (Crozier 1926). An approximation is the best that can be attained.

Although it is not the purpose of this paper to enter into a detailed discussion of the effects of temperature on insect life, a comparison of the results here obtained with those of some others is of interest. For further information on the subject the works of Bachmetjew, Sanderson and Peairs, Headlee, Krogh, Glenn, Peirce, Shelford, Payne, and Crozier may be consulted.

Glenn (1922) has attempted to show that in the case of the pupae of the codling moth the rate of development curve becomes a straight line when all the temperatures below a physiological zero (in this case 52°F.) are eliminated from the calculations of the mean temperatures and suitable corrections are made for the high fluctuations above the point of maximal rate of development. The data were obtained under field conditions, and the temperatures are therefore averages of daily fluctuations. However, if the calculations are made of the values the lower points (5.1°, 6.8°, 7.0°, and 8.6° effective temperatures) should have in order to fall into the corrected curve, it is found that in every case the value is lower than the actual data give. The differences are small, but the error probably lies in the fact that some development actually occurred during some of the fluctuations below 52°F., and the elimination of these low temperatures from the calculations caused a slight deviation from the expected results.

Recently Shelford (1926) has used the data of Krogh (1914) on the development of the pupa of *Tenebrio molitor* to demonstrate the fact that within a certain temperature range the rate of development curve may be rectilinear and a thermal constant may be used. In this particular case the range was between 18.5°C. and 28°C. Crozier (1926) has shown that the simple fact that an animal has passed a fraction of its developmental time at a certain temperature does not necessarily mean that that particular fraction of its development has been completed, for the rate of development is not uniform at any one temperature for the entire duration of the period in question, and the curves of development at any two temperatures are not superimposable. Thus, if one-half of the developmental period is passed at a given temperature, more or less than half the development is completed, and when a shift is made to another temperature, there remains more or less than one-half of the development to be completed at the new temperature. Since the curves of development at the two temperatures are not superimposable, the duration of the total period at the two temperatures would depend, among other things, upon which of the two the animals were first exposed to. This fact

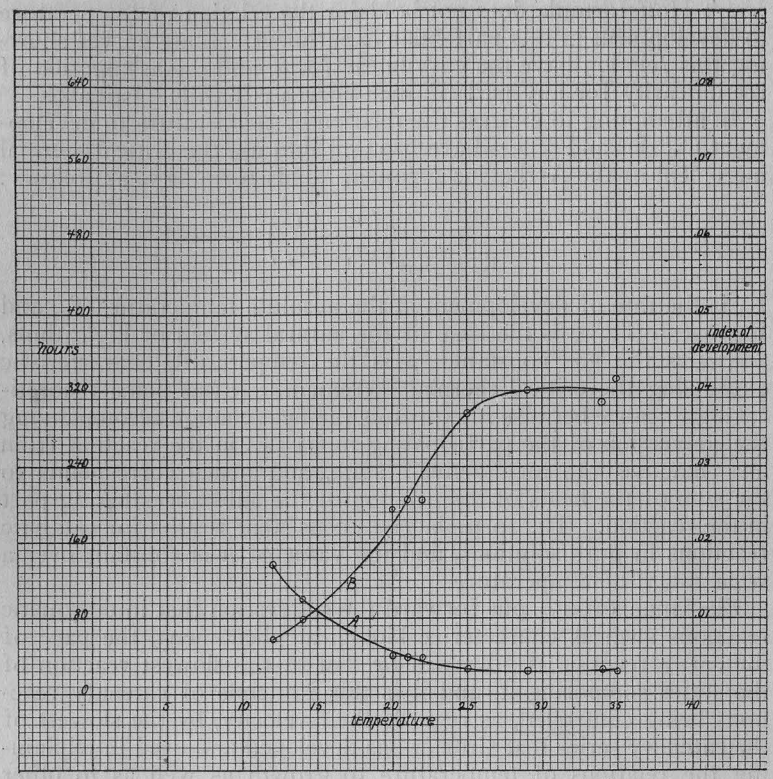

FIG. 36. Effect of temperature on the period in the second molting web. A is the time-temperature curve, and B is the rate of development curve.

alone would throw doubt on the justification of using a thermal constant for any range of temperatures. Moreover, the actual data of Krogh show that the curve is not truly rectilinear even between 18.5° and 28°, but is slightly sigmoid. The calculations were made from Krogh's data, and the last figures are added to show the trend of the curve outside the range in question.

Temperature	Tangent to curve	Angle of curve
18.0 -20.9° C.	.8143	39° 9′
20.9 -23.65	.8291	39 40
23.65-27.25	.8500	40 22
27.25-32.7	.5321	28 1

If the curve were rectilinear between 18.5° and 28°, the second and third tangents at least of those given above should be equal. Moreover, according to Krogh's own statement the Q 10 of the

Van't Hoff formula does not hold for the relation of temperature to development in this particular experiment. Most curves showing this relation have the curvilinear form, and the assumption of rectilinearity for any part of such curves is hardly justifiable.

In attempting to express the relation of temperature to development Crozier and others have brought into use the critical thermal increment of the Arrhenius formula. This formula is as follows:

$$K_2 = K_1 e^{\frac{\mu}{2}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)}$$

K_1 is the rate of development at the absolute temperature T_1, and K_2 that at T_2; e is the base of the natural system of logarithms, and 2 is the gas constant. μ is the temperature characteristic expressing the critical thermal increment. It has some theoretical significance because it expresses the heat change accompanying the conversion of the participating molecules in the reaction from an "inactive" to an "active" state, and hence corresponds to the sum of the heats of dissociation of the substances taking part in the reaction. The formula gives consistent results for catalytic reactions in pure solutions, and the value of μ is constant over a wide range of temperature.

Blackman (1905) put forward the suggestion that in enzymatic reactions such as characterize biological phenomena, the pace of the entire reaction is governed by that of the slowest reaction of the series composing it, and it is this principle of catenary reactions being controlled, as regards their velocity, by the slowest of the catenary series that Crozier has developed and used in explaining the relations of temperature to growth as well as to other biological processes. Within a certain range of temperatures a certain reaction may be the slowest in the process and hence will govern the speed of the whole, but when the temperature rises above a definite point, another reaction of the chain becomes the slowest and hence the governing one. Within the temperature range governed by one reaction of the series, the temperature characteristic for that reaction is the temperature characteristic for the whole process, and when the second reaction becomes the governing one, a different characteristic, that of this second reaction, governs. In a monomolecular reaction the curve obtained by plotting the logarithm of the rate against the reciprocal of the absolute temperature is rectilinear, as can be readily seen from the formula of Arrhenius. The problem becomes one of getting the value of the critical thermal increment (temperature characteristic) for the process at different temperatures and plotting the above curve. If this is rectilinear, the value of μ is constant, and a temperature constant for the process is obtained.

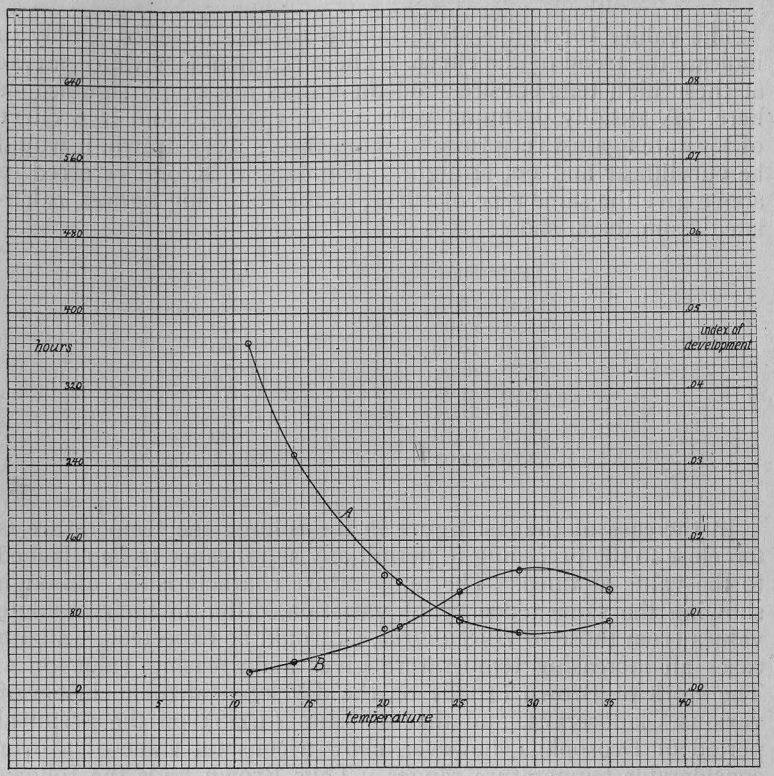

FIG. 37. Effect of temperature on the fourth instar. A is the time-temperature curve, and B is the rate of development curve.

In calculating the value of μ for the development of *Bucculatrix* the period in the second molting web and that of the fifth instar will be considered, as they give two distinct phases in the larval life, and in this particular case contain the data for the most larvae. The values are as follows:

Second Molting Web Temperature	μ	Fifth Instar Temperature	μ
12°-14°	24468	12°-15°	20644
14 -21	23003	15 -21	16637
21 -25	16396	21 -25	14709
25 -29	3431	25 -29	9694
		29 -34	—7793

The values for temperatures above 29° are included simply to indicate the trend of the curve. There is a non-survival of larvae at these high temperatures and the values are of no significance here. A steadily declining value of μ is shown, and if a curve of log rate against reciprocal of temperature were drawn, it would be curvilinear and not straight. The data of Krogh referred to above give the same type of curve, as the following figures, calculated from them, show:

Temperature	μ
13.45°-15.55°	32989
15.55 -17.00	25040
17.00 -18.80	28400
18.80 -20.90	26673
20.90 -23.65	19475
23.65 -27.25	15362
27.25 -32.70	7589
32.70 -32.95	18203

In the case of the last figure in the column the temperature is too close to the preceding to permit any significance to be attached to the value attained. The temperature characteristics, although showing the same tendency of variation, differ in their absolute values from those of *Bucculatrix,* as would be expected. In both cases an increasing temperature gives a decreasing value of μ. The work of Brown (1926) on the development of an instar of various Cladocerans, and that of Bliss (1926) on the prepupal period of Drosophila, however, show a constant value of μ over considerable temperature ranges. Thus Brown finds the following characteristics for Cladocerans:

	Temperature	μ
Simocephalus serrulatus	15° -24.6° C.	16950
	24 -32	4780
Monia macrocarpa	11 -20	28500
	20 -27.6	17210
	27.6-33	7410
Pseudosida bidentata	14 -27.5	19800

Bliss derives the following values for Drosophila:

Temperature	μ
12° -16°	33210
16 -25	16850
25 -30	7100

Crozier (1926) has stated that "there is as yet scarcely sufficient evidence to verify the prediction that the curve relating log velocity of growth to 1/T, when velocity equals reciprocal of

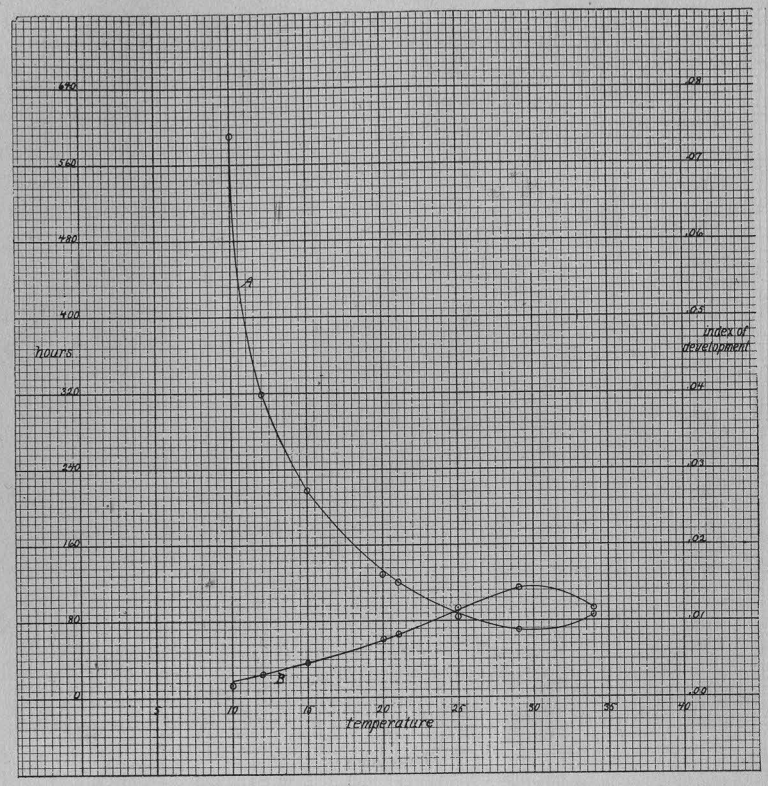

FIG. 38. Effect of temperature on the fifth instar. A is the time-temperature curve, and B is the rate of development curve.

time required to reach a defined stage, should be slightly curvilinear. But there is an indication that growth velocities, where evidenced as constant rates of increase, adhere satisfactorily to the Arrhenius formula; and even when we may quite reasonably expect that an autocatalytic system is involved, the agreement is quite as good as might be desired. The values of the temperature characteristics of growth phenomena are quite varied, yet they cluster quite definitely about the following magnitudes: 7-8,000; 11-12,000; 16-17,000; 20,000; 24,000; 27,000." He brings a considerable mass of evidence to support this view, and for a detailed discussion his works may be consulted. It is simply desired here to compare the values for *Bucculatrix* with those for other animals and to call attention to the fact that different species vary. Heilbrunn (1925) has offered some criticism of the

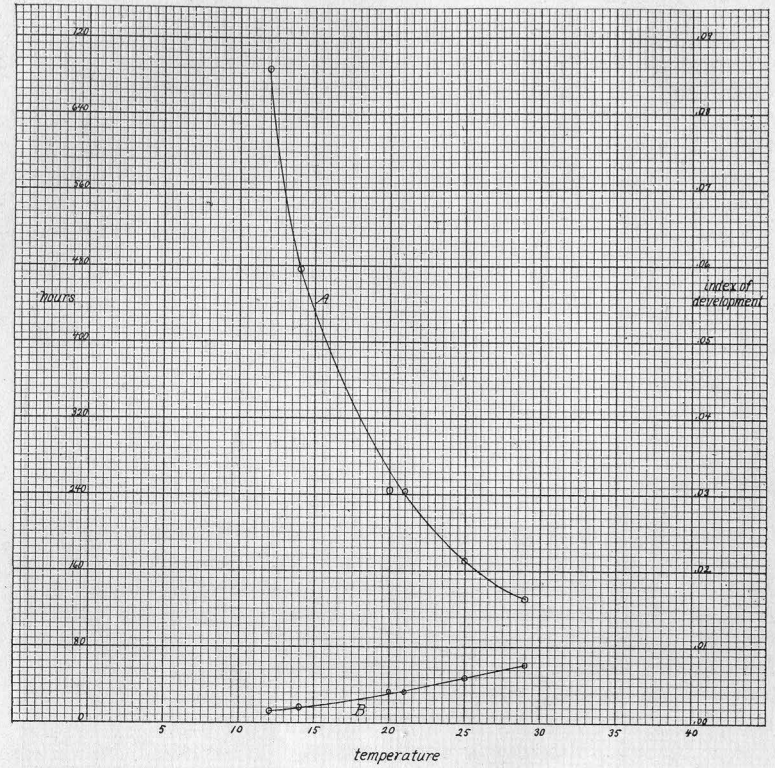

FIG. 39. Effect of temperature on the total external feeding period. A is the time-temperature curve, and B is the rate of development curve.

use of the critical thermal increment of Arrhenius in relation to biological processes of a complex nature and involving several physical as well as chemical reactions, and the identification of basic biological processes by comparing temperature characteristics is open to question.

The effect of temperature on the development of the larvae of *Bucculatrix canadensisella* may be summarized as follows:

The lowest constant temperature at which larvae will complete development is between 10° and 12°C., and the highest temperature is slightly under 34°C.

The curve of the rate of development is sigmoid, and above 30°-31° the temperature has a depressing effect.

In view of the fact that larvae will live for a considerable period of time at 10° and even develop somewhat, although this temperature is lethal if continuous, this cannot be considered a physiological zero.

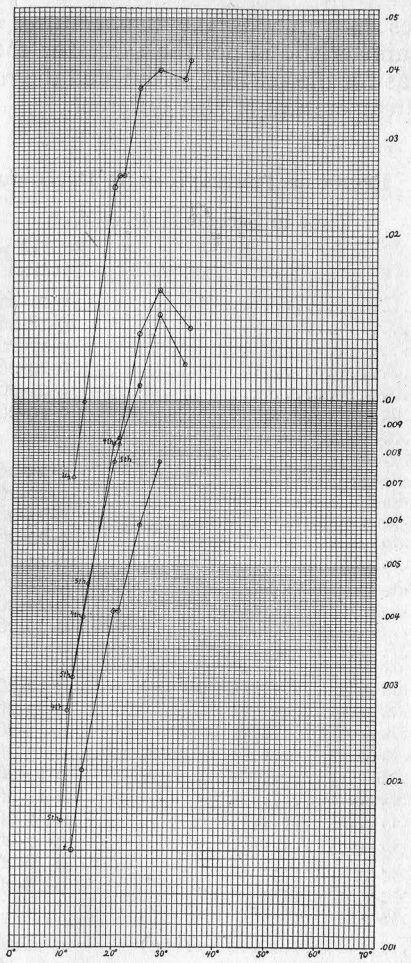

FIG. 40. Effect of temperature on rate of development. W_2 represents the period in the second molting web; 4th, the fourth instar; 5th, the fifth instar; t, the total feeding period. The data are the same as those used in making the B curves in figures 36 to 39 but the plotting paper is arithlogarithmic, and no attempt has been made to smooth the curves. This figure shows the comparative effect of temperature for the different stages.

Fluctuations in temperature have their greatest effect on the growth of the larvae when they occur around 21° to 25°.

The temperature characteristic (critical thermal increment) calculated according to the Arrhenius formula is not constant but

steadily declines in value as the temperature increases. This temperature characteristic is not the same for the quiescent pre-molting period as for the feeding period, and the rate of its change with changing temperature is also different.

TABLE 4. EFFECT OF TEMPERATURE ON DEVELOPMENT, 1926

Time in Second Molting Web

Larva No.	Temp. (C.)	Entered web (date)	Hours in web
164	12° (c)	9-21-26	178
165		9-18-26	130
167		9-17-26	136
169		9-24-26	128
170		9-21-26	111
173		9-19-26	138
Mean			137 (20)
251	14° (d)	9-23-26	96
254		9-22-26	112
255		9-23-26	100
256		9-22-26	101
257		9-24-26	95
258		9-22-26	103
259		9-22-26	95
260		9-25-26	104
Mean			101 (5)
122	20° (e)	9-12-26	39
125		9-13-26	54
127		9-12-26	39
128		9-13-26	47
226		9-14-26	41
235		9-12-26	39
131		9- 7-26	40
132		9- 7-26	42
133		9- 6-26	32
134		9- 8-26	39
Mean			41 (5)
123	21° (e)	9-12-26	47
129		9-12-26	33
135		9- 8-26	48
136		9- 7-26	40
137		9- 8-26	48
228		9-11-26	23
229		9-10-26	40
230		9-11-26	23
231		9-11-26	39
232		9-11-26	39
233		9-11-26	39
234		9-13-26	38
281		9-20-26	42
282		9-21-26	40
283		9-21-26	40
285		9-22-26	32
286		9-21-26	40

TABLE 4. EFFECT OF TEMPERATURE ON DEVELOPMENT, 1926—*Concluded*

Time in Second Molting Web—*Concluded*

Larva No.	Temp. (C.)	Entered web (date)	Hours in web
287		9-20-26	49
288		9-21-26	40
289		9-20-26	49
Mean			39 (7)
237	22° (e)	9-23-26	34
238		9-23-26	42
239		9-24-26	39
240		9-24-26	40
Mean			39 (3)
110	25° (f)	9- 5-26	31
111		9- 4-26	32
112		9- 5-26	15
113		9- 5-26	28
114		9- 5-26	28
115		9- 6-26	33
116		9- 5-26	30
118		9- 5-26	22
119		9- 4-26	25
120		9- 4-26	25
121		9- 5-26	28
Mean			27 (5)
155	29° (g)	9- 9-26	23
156		9 -9-26	25
158		9- 9-26	25
159		9-10-26	25
160		9- 9-26	23
161		9- 9-26	31
162		9-10-26	24
163		9- 9-26	25
Mean			25 (2)
261	34° (h)	9-17-26	23
262		9-17-26	23
265		9-17-26	33
270		9-17-26	23
Mean			26 (4)
263	35° (h)	9-16-26	24
264		9-17-26	24
266		9-17-26	24
268		9-16-26	24
Mean			24 (0)

TABLE 5. EFFECT OF TEMPERATURE ON DEVELOPMENT, 1926

Duration of Fourth Instar

Larva No.	Temp. (C.)	First molt web vacated (date)	Duration of instar (hours)
164	11° (c)	9- 9-26	465
165		9- 7-26	381
166		9- 9-26	343
167		9- 9-26	359

TABLE 5. EFFECT OF TEMPERATURE ON DEVELOPMENT, 1926—*Continued*

Duration of Fourth Instar—*Continued*

Larva No.	Temp. (C.)	First molt web vacated (date)	Duration of instar (hours)
168		9- 8-26	319
173		9-11-26	345
Mean			369 (47)
251	14° (d)	9-18-26	231
252		9-15-26	239
253		9-15-26	217
254		9-15-26	281
255		9-17-26	263
256		9-17-26	225
257		9-18-26	240
258		9-15-26	264
259		9-16-26	255
260		9-17-26	281
Mean			250 (21
128	20° (e)	9- 9-26	144
131		9- 4-26	105
132		9- 3-26	143
133		9- 3-26	111
136		9- 4-26	120
281		9-18-26	105
Mean			121 (16)
122	21° (e)	9- 9-26	112
123		9- 9-26	134
124		9- 9-26	119
125		9- 9-26	158
126		9- 9-26	119
127		9- 9-26	112
129		9- 9-26	90
134		9- 4-26	135
135		9- 4-26	144
137		9- 4-26	144
226		9- 9-26	161
228		9- 8-26	81
229		9- 8-26	81
230		9- 8-26	81
231		9- 8-26	97
232		9- 8-26	97
233		9- 8-26	97
234		9- 8-26	144
235		9- 9-26	105
237		9-20-26	106
238		9-21-26	105
239		9-21-26	111
240		9-20-26	145
282		9-18-26	113
283		9-18-26	113
285		9-18-26	130
286		9-18-26	120
287		9-18-26	118
288		9-18-26	113
289		9-17-26	118
Mean			117 (21)

TABLE 5. EFFECT OF TEMPERATURE ON DEVELOPMENT, 1926—*Concluded*

Duration of Fourth Instar—*Concluded*

Larva No.	Temp. (C.)	First molt web vacated (date)	Duration of instar (hours)
110	25° (f)	9- 3-26	85
111		9- 2-26	76
112		9- 2 26	69
113		9- 3-26	77
114		9- 3-26	77
115		9- 3-26	94
116		9- 3-26	79
117		9- 3-26	79
118		9- 3-26	71
119		9- 3-26	64
120		9- 3-26	64
121		9- 3-26	75
Mean			76 (8)
154	29° (g)	9- 7-26	71
155		9- 8-26	55
157		9- 8-26	48
158		9- 8-26	55
159		9- 8-26	80
160		9- 8-26	55
161		9- 7-26	71
162		9- 7-26	89
163		9- 8-26	56
Mean			63 (11)
261	35° (h)	9-15-26	77
262		9-15-26	77
263		9-15-26	62
264		9-15-26	63
265		9-15-26	95
266		9-15-26	79
268		9-15-26	62
270		9-15-26	77
Mean			74 (11)

TABLE 6. EFFECT OF TEMPERATURE ON DEVELOPMENT, 1926

Duration of Fifth Instar

Larva No.	Temp. (C.)	Second molt web vacated (date)	Duration of instar (hours)
531	10° (b)	9-23-26	567
533		9-24-26	452
534		9-28-26	738
536		9-25-26	587
537		9-24-26	604
Mean			590 (91)
164	12° (c)	9-28-26	249
165		9-23-26	239
167		9-24-26	285
168		9-21-26	388
169		9-30-26	486

TABLE 6. EFFECT OF TEMPERATURE ON DEVELOPMENT, 1926—*Continued*

Duration of Fifth Instar—*Continued*

Larva No.	Temp. (C.)	Second molt web vacated (date)	Duration of instar (hours)
170		9-25-26	278
173		9-25-26	284
542		9-25-26	357
543		9-25-26	339
544		9-24-26	259
545		9-24-26	250
546		9-23-26	379
547		9-26-26	403
549		9-23-26	267
550		9-23-26	311
Mean			319 (69)
251	15° (d)	9-27-26	220
254		9-27-26	226
255		9-28-26	211
257		9-28-26	187
258		9-26-26	213
259		9-26-26	229
260		9-29-26	242
Mean			218 (16)
123	20° (e)	9-14-26	120
124		9-14-26	135
126		9-14-26	135
127		9-14-26	152
129		9-13-26	150
230		9-12-26	104
235		9-14-26	107
Mean			129 (18)
122	21° (e)	9-14-26	104
125		9-15-26	120
128		9-15-26	120
131		9- 9-26	115
132		9- 9-26	126
133		9- 7-26	153
134		9- 9-26	93
135		9-10-26	159
136		9- 9-26	135
137		9-10-26	92
226		9-16-26	123
228		9-12-26	135
231		9-12-26	123
232		9-12-26	99
233		9-12-26	99
234		9-14-26	148
237		9-25-26	115
238		9-25-26	170
239		9-25-26	153
240		9-26-26	122
281		9-22-26	129
283		9-23-26	131
285		9-24-26	126
286		9-23-26	94

TABLE 6. EFFECT OF TEMPERATURE ON DEVELOPMENT, 1926—*Concluded*

Duration of Fifth Instar—*Concluded*

Larva No.	Temp. (C.)	Second molt web vacated (date)	Duration of instar (hours)
287		9-22-26	115
288		9-23-26	114
291		9-20-26	91
293		9-20-26	120
294		9-20-26	97
295		9-21-26	120
296		9-20-26	97
297		9-20-26	86
298		9-20-26	112
299		9-19-26	104
300		9-20-26	104
551		9-24-26	146
552		9-23-26	99
553		9-23-26	175
554		9-23-26	112
555		9-24-26	116
556		9-23-26	156
557		9-24-26	104
558		9-24-26	178
559		9-23-26	99
Mean			121 (24)
110	25° (f)	9- 7-26	92
111		9- 6-26	97
115		9- 7-26	97
116		9- 6-26	108
117		9- 6-26	80
118		9- 6-26	88
119		9- 5-26	133
120		9- 5-26	75
121		9- 6-26	72
Mean			94 (18)
155	29° (g)	9-10-26	77
156		9-10-26	55
157		9-10-26	80
158		9-10-26	55
159		9-11-26	82
160		9-10-26	81
161		9-10-26	65
163		9-10-26	65
Mean			70 (11)
526	34° (h)	9-22-26	90
527		9-23-26	91
528		9-23-26	96
529		9-24-26	66
530		9-23-26	86
Mean			86 (10)

TABLE 7. EFFECT OF TEMPERATURE ON DEVELOPMENT, 1926

Duration of External Feeding Period

Larva No.	Temp. (C.)	First molt web vacated (date)	Duration of period (hours)
164	12° (c)	9- 9-26	714
167		9- 9-26	644
168		9- 8-26	707
169		9- 9-26	803
170		9-11-26	629
173		9-11-26	629
Mean			688 (62)
251	14° (d)	9-18-26	451
252		9-15-26	476
253		9-15-26	456
254		9-15-26	507
257		9-18-26	427
258		9-15-26	477
259		9-16-26	484
260		9-17-26	523
Mean			475 (29)
230	20° (e)	9- 8-26	185
127		9- 9-26	264
128		9- 9-26	264
129		9- 9-26	240
132		9- 3-26	269
Mean			244 (31)
122	21° (e)	9- 9-26	216
123		9- 9-26	254
124		9- 9-26	254
125		9- 9-26	278
126		9- 9-26	254
131		9- 4-26	220
133		9- 3-26	264
134		9- 4-26	228
135		9- 4-26	303
136		9- 4-26	255
137		9- 4-26	236
226		9- 9-26	284
228		9- 8-26	216
231		9- 8-26	220
232		9- 8-26	196
233		9- 8-26	196
234		9- 8-26	292
235		9- 9-26	212
237		9-20-26	221
238		9-21-26	275
239		9-21-26	264
240		9-20-26	267
281		9-18-26	234
283		9-18-26	244
285		9-18-26	256
286		9-18-26	214
287		9-17-26	233
288		9-18-26	227
Mean			243 (28)

TABLE 7. EFFECT OF TEMPERATURE ON DEVELOPMENT, 1926—*Concluded*

Duration of External Feeding Period—*Concluded*

Larva No.	Temp. (C.)	First molt web vacated (date)	Duration of period (hours)
110	25° (f)	9- 3-26	177
111		9- 2-26	173
115		9- 3-26	191
116		9- 3-26	187
117		9- 3-26	159
118		9- 3-26	159
119		9- 3-26	197
120		9- 3-26	139
121		9- 3-26	147
Mean			170 (19)
155	29° (g)	9- 8-26	132
156		9- 7-26	118
157		9- 8-26	128
158		9- 8-26	110
159		9- 8-26	162
160		9- 8-26	136
161		9- 7-26	136
163		9- 8-26	121
Mean			130 (14)

TABLE 8. EFFECT OF TEMPERATURE ON DEVELOPMENT, 1926

Duration of Quiescent Period in Second Molting Web

Number of Larvae	Temperature (C.)	Average Time in Web (hours)	Standard Deviation (hours)	Index of Development	Tangent to Curve B
6	12°	137± 5.6	20	.0072	
8	14	101± 1.2	5	.0099	.6770
10	20	41± 1.1	5	.0244	1.3100
20	21	39± 1.0	7	.0256	1.7100
4	22	39± 1.0	3	.0256	1.8855
11	25	27± 1.0	5	.0370	1.2800
8	29	25± 0.5	2	.0400	.8350
4	34	26± 1.4	4	.0385	
4	35	24± 0	0	.0417	.7700

Duration of Fourth Instar

Number of Larvae	Temperature (C.)	Average Duration of Instar (hours)	Standard Deviation (hours)	Index of Development	Tangent to Curve B
6	11°	369±13.2	47	.0027	
10	14	250± 4.4	21	.0040	.2395
6	20	121± 4.5	16	.0083	.4215
30	21	117± 2.6	21	.0085	.4275
12	25	76± 1.5	8	.0132	.6265
9	29	63± 2.5	11	.0159	.1240
8	35	74± 2.6	11	.0135	.3860

Duration of Fifth Instar

Number of Larvae	Temperature (C.)	Average Duration of Instar (hours)	Standard Deviation (hours)	Index of Development	Tangent to Curve B
5	10°	590±27.4	91	.0017	
15	12	319±12.0	69	.0031	.2885
7	15	218± 4.1	16	.0046	.2610
7	20	129± 4.6	18	.0077	.3580
44	21	121± 2.4	24	.0083	.3725
9	25	94± 4.0	18	.0106	.4280
8	29	70± 2.6	11	.0143	.2935
5	34	86± 3.0	10	.0116	.5956

Duration of External Feeding Period

Number of Larvae	Temperature (C.)	Average Duration of Period (hours)	Standard Deviation (hours)	Index of Development	Tangent to Curve B
6	12°	688±17	62	.0015	
8	14	475± 6.9	29	.0021	.1515
5	20	244± 9.3	31	.0041	.1760
28	21	243± 3.6	28	.0041	.1895
9	25	170± 4.3	19	.0059	.2235
8	29	130± 3.3	14	.0077	.1855

XII. Control

The control of these larvae is a very simple matter on ornamental trees. The trees should be sprayed about the middle of August with lead arsenate at the rate of 3 pounds of powder to 100 gallons of water. Add one pound of casein-lime to aid in spreading the poison and making it adhere to the foliage. The larvae feed on the lower side of the leaves, and this side must be covered with the arsenate. Experiments conducted by the writer have shown that if the trees are carefully sprayed there will be practically no feeding by the insects.

XIII. Summary

The history of the genus *Bucculatrix* up to the description of the species *canadensisella* Chambers has been briefly reviewed, and an account has been given of the periodic abundance of this species in North America up to the present. Systematically the genus is usually placed in the family Lyonetiidae.

A brief description is given of the external morphology of the different stages.

There is but one generation a year of *B. canadensisella.* The adults emerge from the cocoons in June and July and oviposit on the leaves of birches. The incubation period of the eggs averages 15 days. The larvae mine in the leaf during the first three instars, the mining period averaging between 24 and 31 days. The last two instars feed externally on the under side of the leaf, skeletonizing it, and this feeding period averages from 13 to 15 days. The total larval life averages from 38 to 46 days. The cocoon is spun on the under side of debris on the ground, and hibernation occurs in the pupal stage. The last larvae are found in the field the latter part of September. There are five larval instars.

The number of larval instars was determined by applying Dyar's hypothesis to the width of the head capsules.

The principal larval food plants are the gray, paper, yellow, and European white birches. Some feeding on black birch has been observed.

The Hymenopterous parasites, of which ten species have been reared, and the ants and other predaceous foes are the principal factors affecting the abundance of this insect.

The geographical range includes southern Canada and northern United States, the insect being particularly abundant around the Great Lakes and east to the Atlantic Ocean.

Temperature has a marked influence on the development of the larvae. At 10°C and lower, and at 34°C. and higher, they cannot survive. The curve obtained by plotting rate of development (reciprocal of hours taken to complete a given stage) against temperature is sigmoid. Above 30° temperature has a depressing effect. An absolute physiological zero was not obtained because of the ability of the larvae to develop slightly at a low temperature which was fatal if continued a sufficient length of time. There is no thermal constant for any temperature range beyond the experimental error, and the temperature characteristic as computed by the Arrhenius formula steadily decreases in magnitude as the temperature increases.

The use of a lead arsenate spray about the middle of August will protect the trees against injury by the larvae.

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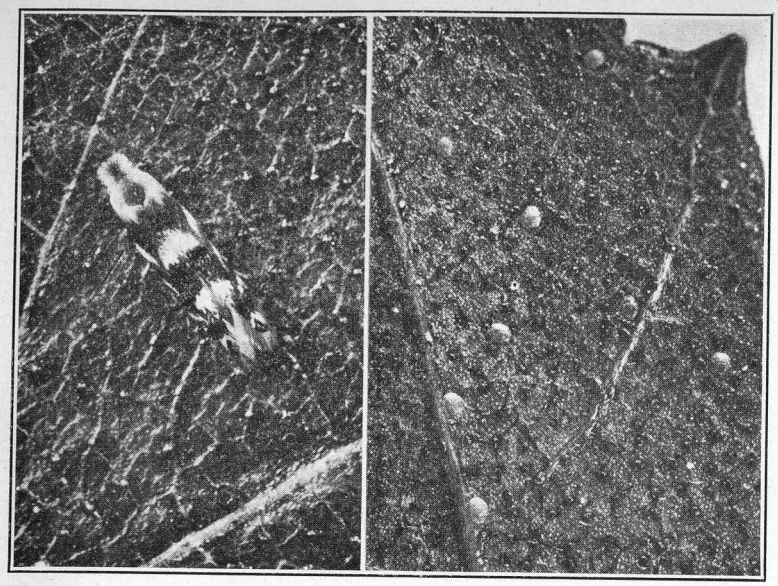
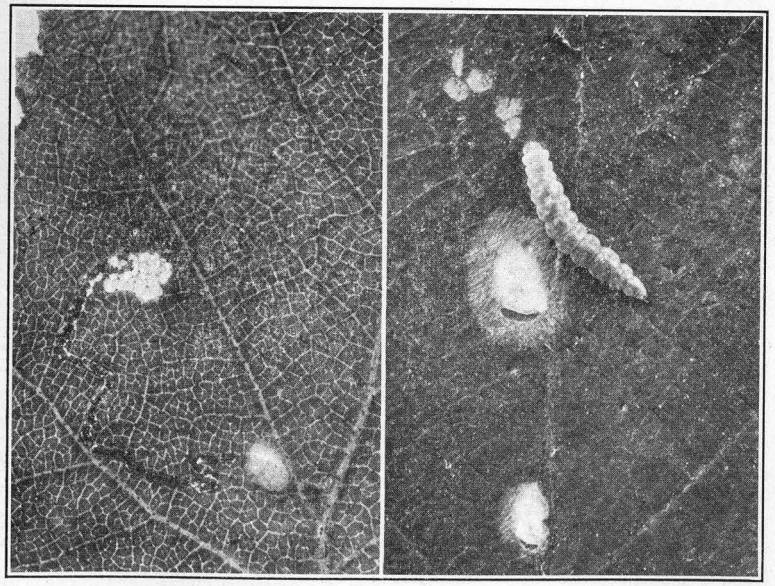
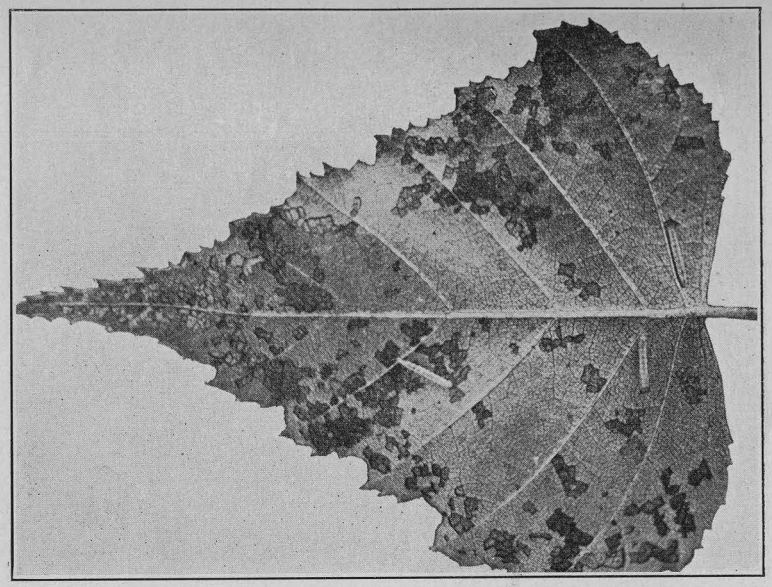


a. Adult (left) and eggs (right) of *Bucculatrix canadensisella* on birch leaves. Adult enlarged eight times, eggs enlarged ten times.

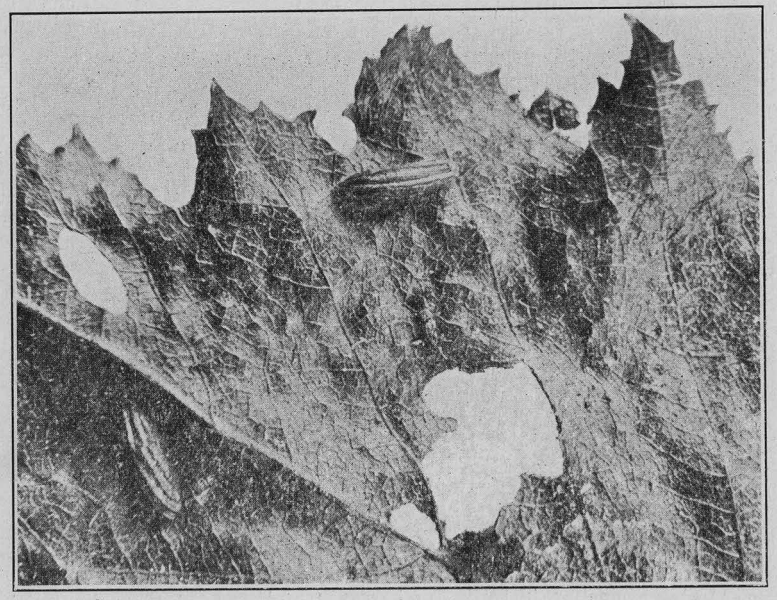


b. Vacant mine of larva in birch leaf (left) and fully grown larva (right) with first (lower) and second (upper) vacant molting webs. Enlarged four times.

BIRCH LEAF SKELETONIZER



a. Larva of *Bucculatrix canadensisella* skeletonizing leaf of gray birch. Slightly enlarged.



b. Cocoons of *Bucculatrix canadensisella* on dead leaf. Enlarged four times.

BIRCH LEAF SKELETONIZER

Connecticut Agricultural Experiment Station
New Haven, Connecticut

REPORT ON INSPECTION
OF
COMMERCIAL FEEDING STUFFS

1926-1927

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

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as of

August, 1927

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THE TUTTLE, MOREHOUSE & TAYLOR COMPANY

CONTENTS.

CHANGE IN REGISTRATION DATE.

The law relating to Commercial Feeding Stuffs has been revised so that beginning January 1st, 1928, registrations will be required annually by calendar years. Heretofore the registration period has been from September 1st to August 31st of the following year. All registrations of record with this Station for the present year ending August 31st will be held to be in force until January 1st, 1928, at which time renewals are required.

COMMERCIAL FEEDING STUFFS

E. M. Bailey.*

The Feed Law.

The text of the law relating to concentrated commercial feeding stuffs and of regulations made jointly by the Dairy and Food Commissioner and the Director of this Station for carrying out its provisions, are given in a special bulletin[1] recently issued.

Some essential provisions of the law and the regulations may be briefly restated here.

Exemptions. It is held that the law exempts from classification as concentrated commercial feeding stuffs, and therefore from registration, (1) roughages such as hays, straws, corn stover, ensilage and all materials containing over 60 per cent of water; (2) whole grains and mixtures thereof; (3) meals made from whole grains when not mixed with other materials or with each other; (4) feed ground from whole grains and sold by the manufacturer directly to the consumer; (5) feed ground from materials furnished by the consumer; or (6) feed mixed according to a formula furnished by the consumer, for his own use.

Under the provision of clause 6 above, a feed must be sold as a formula only, without a private brand name and without analysis. But a feed cannot be offered for general trade as a formula in order to avoid registration and the registration fee.

Labelling. All concentrated commercial feeding stuffs must be labelled either by a statement printed on the bag or upon a properly attached tag; except that in the case of cottonseed meal sold for fertilizer, or of any concentrated feeding stuff sold in bulk, a certificate which shall contain the information otherwise required to appear upon the bag or upon the tag, may be issued by the dealer in lieu thereof.

The law requires a statement of (1) the net weight of the feed contained in the package; (2) the name, brand or trademark under which the feed is sold; (3) name and address of the manufacturer or importer; (4) the minimum percentages of (a) crude protein and (b) crude fat, and the maximum percentage of (c) crude fiber contained in the feed; and (5) the separate ingredients of which the feed is composed.

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* Analyses were made by Messrs. Nolan, Mathis and Walden; microscopic examinations by Mr. Shepard; inspection and sampling by Mr. Churchill: and the compilations largely by Miss Bacon.

[1] Bull. Immediate Information No. 60, June, 1927.

While the law requires only a statement of the items enumerated above no objection will be raised to more complete statements of chemical composition.

Affixing tags. The use of wire or any metal in affixing tags to feed packages is prohibited by law.

Registration and registration fee. The law requires an annual registration of all concentrated feeds sold or offered for sale in this State. Registrations are to be made with the Connecticut Agricultural Experiment Station and beginning January 1st, 1928, the registration period is for the duration of the calendar year. The registration fee is fifteen dollars ($15.00), for each brand, a distinct brand name or a distinct analysis constituting a distinct brand.

Duties of manufacturers, jobbers and dealers. All concentrated commercial feeding stuffs must be registered annually on January 1st, or before they are offered for sale.

Manufacturers, jobbers or individuals shipping feeds into Connecticut will be expected to register their brands and pay the necessary fees thereon. Connecticut dealers should assure themselves that the brands they handle are properly registered and labelled. In case the manufacturer or jobber outside the State neglects or refuses to register, the dealer who handles such feeds will be held responsible for such registrations, registration fees and other legal requirements.

Dealers within the State who mix their own brands are responsible for the registration and proper labelling thereof.

Cottonseed meal. Cottonseed meal sold as a fertilizer is required to be registered under the terms of the fertilizer law; if sold also as a feeding stuff it is required also to be registered under the provisions of the feed law; if sold exclusively for one or the other of these purposes, it may be registered only under that law which applies.

Explanation of Terms Used in an Analysis of Feeding Stuff.

In registering feeding stuffs the law requires that the minimum percentages of crude protein and crude fat, and the maximum percentage of crude fiber, shall be given; that is, the registrant must guarantee that the feeds registered will contain *not less* than the stated percentages of crude protein and of crude fat and *not more* than the stated percentage of crude fiber.

The term *crude protein* denotes those nutrients which contain nitrogen, and is obtained by multiplying the percentage of total nitrogen in the feed by the factor 6.25.

The term *crude fat* denotes those substances which are soluble in ether and includes, besides fat, such non-fatty materials as chlorophyll and coloring matter.

The term *crude fiber* denotes the coarse, woody tissues characteristic of all forms of roughage and which are present in the outer coats of cereal and other fodder grains.

While the law requires only a statement of the three nutrients just defined, no objection is taken to more complete statements of composition, but such further statements, if given, must be correct. Thus, tags sometimes bear guaranties for nitrogen-free-extract and for carbohydrates.

The term *nitrogen-free-extract* denotes those nutrients of the starch and the sugar types. This group is never determined directly but is obtained by subtracting from 100 per cent the sum of the percentages of moisture, ash, crude protein, crude fiber and crude fat.

The term *carbohydrates* denotes the combined percentages of crude fiber and nitrogen-free-extract.

Registrations.

(Late Registrations for the period September 1st, 1925, to August 31st, 1926.)

To the brands registered for 1925 in our last report should be added:

American Milling Co., Peoria, Ill.

Amco Chick Grains
Amco Egg Mash
Amco Egg Mash with Buttermilk
Amco Egg Mash with Meat Scraps
Amco Scratch Grains
Amco Starting and Growing Mash
Amco 12% Fitting Ration
Sucrene Calf Meal
Sucrene Scratch Feed

Archer-Daniels Midland Co., Minneapolis, Minn.

Pure Old Process Linseed Meal

Beacon Milling Co., Inc., Cayuga, N. Y.

Beacon Chick Feed
Beacon Developer Feed
Beacon Growing Mash
Beacon Hog Feed
Beacon Starting Feed
Cayuga Laying Mash with Buttermilk
Chariot Chick Feed
Chariot Developer Feed

The Coles Co., Middletown, Conn.

Fortune Chick Feed
Fortune Egg Mash
Fortune Growing Feed
Fortune Scratch
Fortune Stock Feed

Chapin & Co., 327 South LaSalle St., Chicago, Ill.
Ajax Dairy Ration
Green Diamond Cottonseed Meal
Unicorn Scratch Feed

Dietrich & Gambrill, Inc., Frederick, Md.
D & G Dairy Feed
Gambrill's Dairy Feed
Gambrill's Horse Feed

John W. Eshelman & Sons, Lancaster, Pa.
Eshelman's Growing Mash
Eshelman's Liberty Horse Feed
Eshelman's Pennsy 16 Dairy Feed

Hecker H-O Co., Inc., Buffalo, N. Y.
Re-Ground Oat Feed

R. H. Holcomb, Newtown, Conn.
Holcomb's Special Dairy Ration

Hudson Feed & Grain Co., Windsor, Conn.
Hudson Developing Mash

L. B. Lovitt & Co., Memphis, Tenn.
"Lovit Brand" 36% Cottonseed Meal
"Lovit Brand" 41% Cottonseed Meal
"Lovit Brand" 43% Cottonseed Meal

The Mann Bros. Co., Buffalo, N. Y.
31% Protein Pure Old Process Linseed Meal

Maritime Milling Co., Inc., Buffalo, N. Y.
Bull Brand Developing Feed
Bull Brand Growing Mash (with Dried Buttermilk)

Niagara Falls Milling Co., Niagara Falls, N. Y.
Niagara Choice Wheat Bran
Niagara Choice Wheat Flour Middlings
Niagara Choice Wheat Mixed Feed

W. N. Potter & Sons, Inc., Greenfield, Mass.
A. D. P. 24% Dairy Ration
Puritan Dry Mash

Ralston Purina Co., St. Louis, Mo.
Purina Bulky Las Feed
Purina Chick Growena Feed
Purina Chick Startena Feed containing Buttermilk
Purina Pigeon Chow Feed
Purina Pigeon Chow Feed containing Corn

St. Albans Grain Co., St. Albans, Vt.
Franklin Pasture Ration containing Minerals
King Baby Chick Food
King Growing Feed containing Dried Buttermilk and Beef Scraps
King Intermediate Chick Feed
King 22 Protein Milk Ration
Wirthmore Hog Feed
Wirthmore Pig Feed

Syracuse Milling Co., Syracuse, N. Y.
Jordan Molasses Horse Feed
Jordan Sweet Dairy Feed
Syragold Molasses Horse Feed

D. L. Talcott, Litchfield, Conn.
Economy Dairy Ration

Thomaston Supply Co., Inc., Thomaston, Conn.
Thomaston Dairy Ration
Thomaston Egg Mash
Thomaston Scratch Feed

Tioga Mill & Elevator Co., Waverly, N. Y.
Chicatine
Colonel's Ration
Or-Co Feed
Red Brand Tioga Dairy Feed
Tioga Calf Food
Tioga Chick Feed
Tioga Poultry Grain
White Brand Tioga Dairy Feed

United Flour & Feed Co., Inc., Albany, N. Y.
Chicklet Chick Feed
Chick Starter Feed

(For the period September 1st, 1926, to August 31st, 1927.)

One hundred and seventy-seven firms and individuals have registered 793 brands of feeding stuffs. As required by Statute these registrations are listed as follows:

C. L. Adams Co., Woodbury, Conn.
Claco

E. T. Allen Co., Atlanta, Ga.
Empire-High Grade Cottonseed Meal
Premier-Choice Cottonseed Meal

American Agricultural Chemical Co., New Haven Sales Dept., New Haven, Conn.
"Capital Meat and Bone Scrap"
"Protox Meat and Bone Scrap"

American Linseed Co., N. Y.
Old Process Flaxseed Screenings Oil Feed

American Maize-Products Co., 41 East 42d St., New York, N. Y.
Cream of Corn Gluten Feed

American Milling Co., Peoria, Ill.
Alfalfa Meal
Amco Arab Horse Feed
Amco Calf Meal
Amco Egg Mash
Amco Egg Mash with Dried Buttermilk
Amco Horse Feed

Amco June Pasture Alfalfa and Molasses
Amco Laying Mash with Alfalfa Leaf Meal
Amco Old Process Linseed Meal
Amco Provender Pure Ground Corn and Oats ½ and ½
Amco 16½% Sucrene Dairy Ration
Amco Scratch Grains (No. 1 Formula)
Amco Starting and Growing Mash with Dried Buttermilk
Amco 12% Fitting Ration
Amco 20% Dairy Ration (Flexible Formula)
Amco 20% Empire
Amco 20% National Dairy Ration
Amco 24% Batch Mix
Amco 24% Dairy Ration (Flexible Formula)
Amco 24% Universal

Apothecaries Hall Co., Waterbury, Conn.
Sterilized Steamed Bone

Arcady Farms Milling Co., Chicago, Ill.
Advanced Registry Dairy Feed
Arcady Besbet Laying Mash
Arcady Scratch Grains
Arcady Stock Feed
Arcady 32 Dairy Feed
Milkers' Ready Ration
Peerless Milk Ration
Sweet 16 Dairy Feed
Wonder Dairy Ration
Wonder Horse Feed
Wonder Laying Mash

Archer-Daniels Midland Co., Minneapolis, Minn.
Pure Old Process Linseed Meal 32%
Pure Old Process Linseed Meal 34%

Ashcraft-Wilkinson Co., Atlanta, Ga.
Helmet Brand Cottonseed Meal
Monarch Brand Cottonseed Meal
Paramount Brand Cottonseed Meal

Atlan Mfg. Co., Jersey City, N. J.
Atlan's Diamond Pick Meat and Bone Scraps

E. W. Bailey & Co., Montpelier, Vt.
Bailey's Fancy Winter Mixed Feed
Bailey's Open Formula 20% Dairy Feed
Bailey's Open Formula 24% Dairy Feed
Capital Dairy Ration
Capital Mixed Feed
Favorite Dairy Ration
"Our Own" Dairy Ration
Pennant Scratch Feed
Pennant Stock Feed

H. J. Baker & Bro., N. Y.
Baker Brand Dried Beet Pulp

Bay State Milling Co., Winona, Minn.
Wingold Pure Hard Wheat Bran
Wingold Diamond "G" Pure Hard Wheat Red Dog
Wingold Fancy Pure Hard Wheat Mixed Wheat Feed
Wingold Pure Hard Wheat Fancy White Flour Middlings
Wingold Standard Hard Wheat Middlings and Wheat Screenings
Wingold Rye Middlings and Rye Screenings

Beach Soap Co., Lawrence, Mass.
Beach's Star Brand Beef Scraps

Beacon Milling Co., Inc., Cayuga, N. Y.
Auburn Dairy Feed
Auburn Scratch Feed
Beacon Breeders Mash with Buttermilk
Beacon Calf Meal
Beacon Chick Feed
Beacon Dairy Ration
Beacon Developer Feed
Beacon Egg Mash with Buttermilk
Beacon Growing Mash
Beacon Horse Feed
Beacon Laying Mash
Beacon Pigeon Feed
Beacon Scratch Grains
Beacon Special Scratch Grains
Beacon Starting Mash
Beacon "20"
Cayuga Laying Mash with Buttermilk
Cayuga Scratch Feed
Cayuga Stock Feed
Chariot Chick Feed
Chariot Developer Feed

Ira W. Beers, Hamden, Conn.
Beers Dairy Ration
Beers Laying Mash
Beers Scratch Feed

A. A. Beltz, Minneapolis, Minn.
A-A Pure Wheat Bran

Blatchford Calf Meal Co., Waukegan, Ill.
Blatchford's Calf Meal
Blatchford's Chick Mash

Amos D. Bridge's Sons, Inc., Hazardville, Conn.
Success Dairy Ration

F. W. Brode Corp., Memphis, Tenn.
Owl Brand 41% Prime Cottonseed Meal
Owl Brand 43% Prime Cottonseed Meal
Owl Brand 36% Prime Cottonseed Meal

Buckeye Cotton Oil Co., Cincinnati, Ohio.
Buckeye Prime 41% Cottonseed Meal

C. Buckingham & Co., Southport, Conn.
Buckingham's Dry Mash
C. B. Dairy Feed

C. E. Buell, Inc., Boston, Mass.
Buell Boston Dried Skim Milk

Camilla Cotton Oil Co., Camilla, Ga.
Micoga Brand Good Cottonseed Meal
Micoga Brand High Grade Cottonseed Meal

C. W. Campbell Co., Stonington, Conn.
Egg-O Dry Mash
Egg-O Scratch Feed
No-Botheration Dairy Ration
Provender

The Canada Linseed Oil Mills, Ltd., Montreal, Canada.
"Maple Leaf" Brand Linseed Oilcake Meal

Cereal Mills Co., Wausau, Wis.
Hominy Feed

Chapin & Co., 327 South LaSalle St., Chicago, Ill.
Ajax Dairy Ration—20%
Ajax Dairy Ration—24%
Green Diamond Cottonseed Meal
Unicorn Dairy Ration
Unicorn Horse Feed
Unicorn Scratch Feed

Clinton Corn Syrup Refining Co., Clinton, Iowa.
Clinton Corn Gluten Feed

The Coles Co., Middletown, Conn.
Albert Angell Jr.'s Chick Starter
Albert Angell Jr.'s Coarse Chick Scratch
Albert Angell Jr.'s Egg Mash
Albert Angell Jr.'s Fine Chick Scratch
Albert Angell Jr.'s Growing Mash
Albert Angell Jr.'s Scratch Feed
Fortune Egg Mash with Dried Buttermilk
Fortune Growing Feed
Fortune Intermediate Scratch
Fortune Scratch Feed
Fortune Stock Feed
20% Dairy Ration
24% Dairy Ration

Collis Products Co., Clinton, Iowa.
Collis Process Pure Dried Buttermilk

The G. E. Conkey Co., Cleveland, Ohio.
Conkey's Buttermilk Grain and Bone Starting Feed
Conkey's Buttermilk Meat, Grain and Bone Growing Mash
Conkey's Buttermilk Meat, Grain and Bone Laying Mash

Conkey's Chick Grains
Conkey's Dairy Ration
Conkey's Gecco Egg Mash
Conkey's Growing Grains
Conkey's Scratch Grains
Conkey's Pigeon Feed (Breeders)
Conkey's Pigeon Feed (Flyers)
Gecco Chick Grains
Gecco Dairy Ration
Gecco Growing Grains
Gecco Scratch Grains
Red Seal Dairy Ration
Red Seal Scratch Feed
Superior Scratch

Conn. Fat Rend. & Fertz. Corp., West Haven, Conn.
The Conn. Fat Rend. & Fertz. Corp. Meat Scrap 40%
The Conn. Fat Rend. & Fertz. Corp. Meat Scrap 50%

Copeland Flour Mills, Ltd., Midland, Ontario, Canada.
Copeland's Dandy Bran
Copeland's Dandy Shorts

Corn Products Refining Co., 17 Battery Place, New York, N. Y.
Buffalo Corn Gluten Feed
Co-Pro-Co Horse and Mule Feed
Diamond Corn Gluten Meal

C. A. Cowles, Plantsville, Conn.
C. A. Blue Seal Mash
Cowles' Scratch Feed
Cowles' 24% Dairy Ration

Chas. M. Cox, Boston, Mass.
Lakewoods Pure Standard Middlings (Lake of the Woods Milling Co., Ltd., Montreal)
Lakewoods Wheat Bran (Lake of the Woods Milling Co., Ltd., Montreal)
Pioneer Pure Wheat Bran (Western Canada Flour Mills, Ltd., Toronto, Ont.)
Pioneer Shorts (Western Canada Flour Mills, Ltd., Toronto, Ont.)
Rex Wheat Middlings (Maple Leaf Milling Co.)
Wheat Bran (Maple Leaf Milling Co.)

Crosby Milling Co., Brattleboro, Vt.
Crosby's Balanced Ration
Crosby's 22% Dairy Feed
Crosby's Egg Mash Feed
Crosby's Ready Ration
Crosby's Scratch Feed
Crosby's Stock Feed

R. G. Davis & Sons, Inc., New Haven, Conn.
Basic Dairy Ration
Davis Horse Feed
Davis Mash Feed
Davis No. 1 Provender
Davis Stock Feed
Davis Scratch Feed

S. P. Davis, Little Rock, Ark.
Beauty Brand 36% Protein C/S Meal
Goodluck Brand 41% Protein C/S Meal
Steerboy Brand 43% Protein C/S Meal

Decatur Milling Co., Decatur, Ill.
Homco Brand Hominy Feed

Delaware Mills, Inc., Deposit, N. Y.
Delaware Chick Starting Mash (with Dried Buttermilk)
Delaware Dairy Feed
Delaware Growing Mash (with Dried Buttermilk)
Delaware Laying Mash
Delaware Scratch Grains
Delaware Stock Feed
Indian Laying Mash
Indian Scratch Grains

Denver Alfalfa Milling & Products Co., Lamar, Colo.
Alfalfa Meal
Alfalfa Leaf Meal (Leafalfa Brand)

The Devon Coal & Ice Co., Devon, Conn.
Devon Dairy Ration
Devon Laying Mash
Devon Sweet Stock Feed

The Dewey Bros. Co., Blanchester, Ohio.
Eagle 3D Grains, or Dewey's Distillers Dried Grains

Dietrich & Gambrill, Inc., Frederick, Md.
D & G Dairy Feed
D & G Stock Feed
Frederick Horse Feed
Frederick Laying Mash
Gambrill's A1 Dairy Ration
Gambrill's Dairy Feed
Gambrill's Horse Feed
Gambrill's Laying Mash
Gambrill's Scratch Feed

Dominion Flour Mills, Montreal, Canada.
Wheat Bran
Wheat Shorts

Dry Milk Co., 15 Park Row, New York, N. Y.
Chikora

Duluth-Superior Milling Co., 620 Board of Trade Bldg., Duluth, Minn.
Boston Mixed Feed
Duluth Imperial Wheat Bran

Eastern States Farmers' Exchange, 33 Lyman St., Springfield, Mass.
Eastern States Buttermilk Egg Mash
E. S. Egg Mash
Eastern States Fitting Ration
Eastern States Fulpail Dairy Ration
Eastern States Milkmore Dairy Ration
E. S. Scratch Grains

Elevator Milling Co., Springfield, Mass.
Ideal White Hominy Feed

Elmore Milling Co., Inc., Oneonta, N. Y.
Elmore Baby Chick Mash with Dried Buttermilk
Elmore Calf Meal
Elmore Egg Mash
Elmore Growing Mash
Elmore Horse Feed with Molasses
Elmore Milk Grains
Elmore Poultry Mash with Buttermilk
Elmore's Red Dog Flour Middlings
Elmore (Storrs Formula) Laying Mash
Elmore Scratch Feed
Elmore Snow Middlings
Elmore Stock Feed
Emco Feed
Emco Scratch Feed

John W. Eshelman & Sons, Lancaster, Pa.
Eshelman's Baby Chick Starter
Eshelman's Chick Feed
Eshelman's Conestoga 18 Dairy Feed
Eshelman's Garden Spot Horse Feed
Eshelman's Golden Rod 25% Dairy Feed
Eshelman's Growing Mash
Eshelman's Lancaster 20 Dairy Feed
Eshelman's Lancaster 60 Horse Feed
Eshelman's Lancaster Stock Feed
Eshelman's Laying Mash
Eshelman's Liberty Horse Feed
Eshelman's Pennsy 16 Dairy Feed
Eshelman's Red Rose 24 Dairy Feed
Eshelman's Red Rose 85 Horse Feed
Eshelman's Scratch Feed
Eshelman's Stock Feed
Eshelman's Sugared Stock Feed
Eshelman's Susquehanna Dairy Feed
Eshelman's Thorobred Horse Feed
Eshelman's Wheat Flour Middlings
Imperial Scratch Feed
Pennsy Scratch Feed

Evans Milling Co., Indianapolis, Ind.
Emco Hominy Feed

Everett, Aughenbaugh & Co., Minneapolis, Minn.
E-A-CO Hard Wheat Mixed Feed
E-A-CO Pure Wheat Bran
E-A-CO Pure Wheat Flour Middlings
E-A-CO Standard Middlings

Fairchild Milling Co., Cleveland, Ohio.
Special Fine Wheat Middlings
Standard Middlings
Wheat Bran, with Gr. Screenings

Fairmont Creamery Co., Omaha, Neb.
Fairmont's Better Pure Flake Buttermilk

Farmers' Feed Co., New York, N. Y.
"Bull Brand" Dried Brewers Grains

Federal Mill & Elevator Co., Inc., Lockport, N. Y.
Dairy Maid Winter Wheat Middlings
Dairy Maid Winter Wheat Mixed Feed
Lucky Hard Wheat Bran
Sphinx Fancy Hard Wheat Flour Middlings

Flory Milling Co., Inc., Bangor, Pa.
Blue Mountain Horse Feed
Butterfat Dairy Feed
Flory's Baby Chick Feed
Flory's Chick Starter
Flory's Dairy Feed
Flory's Egg Mash
Flory's Growing Mash
Flory's Horse Feed
Flory's Intermediate Chick Feed
Flory's Pure Wheat Bran
Flory's Scratch Feed
Flory's Special Stock Feed
Golden Egg Laying Mash
Golden Egg Scratch Feed
National Cow Feed
Record Dairy Feed
Sunray Scratch Feed
Vio Horse Feed

A. W. Forbes, East Haven, Conn.
R OWN Dairy Ration
R OWN Laying Mash
R OWN Scratch Feed

L. T. Frisbie Co., New Haven, Conn.
Frisbie's Bone Meal 20/25% Protein (for cattle and poultry)
Frisbie's Bone and Meat Meal 35/45% Protein
Frisbie's Cracked Bone (for poultry)
Frisbie's Poultry Feed 45/55% Protein
Frisbie's Poultry Feed 55/65% Protein

Grain Belt Mills Co., South Saint Joseph, Mo.
Bronco Horse and Mule Feed

D. H. Grandin Milling Co., Jamestown, N. Y.
Grandin's Growing Feed
Grandin's Laying Mash with Buttermilk
Grandin's Screened Scratch Feed
Grandin's 12 Twin Six 12 Dairy Ration
Grandin's 24% Balanced Dairy Ration

Hales & Hunter Co., Chicago, Ill.
Cackle Scratch Feed, No Grit
Red Comb Egg Mash with Dried Buttermilk
Red Comb Scratch Feed, No Grit

Wm. Hamilton & Son, Inc., Caledonia, N. Y.
Wheat Bran
Wheat Middlings

The Hecker H-O Co., Inc., Buffalo, N. Y.
Algrane Horse Feed
Algrane Milk Feed
Algrane New England Stock Feed
Algrane Read The Tag Dairy Feed
Algrane Steam-Cooked Chick Feed
Re-Ground Oat Feed

Hecker-Jones-Jewell Milling Co., 40 Corlears St., New York, N. Y.
Choice Wheat Bran
H. Wheat Middlings
Red Dog Flour

(Buffalo Mill)
Choice Wheat Bran
Extra Heavy Wheat Mixed Feed
Wheat Flour Middlings
Wheat Red Dog Flour
Wheat Standard Middlings

J. C. Hubinger Bros. Co., Keokuk, Iowa.
Ke Ok Uk Corn Gluten Feed

L. W. Hudson, Windsor, Conn.
Hudson's Cow Feed
Hudson's Developing Mash
Hudson's Laying Mash

Humphreys-Godwin Co., Memphis, Tenn.
Bull Brand Cottonseed Meal
Dixie Brand Cottonseed Meal
Danish Brand Cottonseed Feed

Imperial Grain & Milling Co., Toledo, Ohio.
Imperial Steam Cooked Feed

Z. C. Ingersoll, Stratford, Conn.
Ingersoll's Special Egg Mash

International Agricultural Corp., Columbus, Ga.
International Rainbow—36% Brand Cottonseed Meal
International Rainbow—43% Brand Cottonseed Meal
Zenith 36% Brand Cottonseed Meal

International Milling Co., Minneapolis, Minn.
Blackhawk Pure Wheat Bran
Blackhawk Wheat Standard Middlings

International Sugar Feed Co., Minneapolis, Minn.
International Diamond Dairy Feed
International Ready Ration Dairy Feed
International Special Dairy Feed

Kansas Flour Mills Corp., Kansas City, Mo.
Big Flake Pure Wheat Bran

Kasco Mills, Inc., Waverly, N. Y.
Apex Milk Maker
Beatsall Milk Grains

Kellogg Co., Battle Creek, Mich.
Kellogg's Fine White Hominy

Kelloggs & Miller, Amsterdam, N. Y.
Old Process Linseed Oil Meal

Spencer Kellogg & Sons, Inc., Buffalo, N. Y.
"Kellogg's Pure Old Process Linseed Meal"

Keno Feed & Grain Corp., Buffalo, N. Y.
Buffalo Corn Feed Meal

H. H. King Flour Mills Co., Minneapolis, Minn.
"Gold Mine" Feed

Chas. A. Krause Milling Co., Milwaukee, Wis.
Badger Stock Feed
Sugared Badger Stock Feed

S. F. Labieniac, Kensington, Conn.
Dry Mash

The Larabee Flour Mills Co., Kansas City, Mo.
Wheat Bran and Wheat Screenings

The Larrowe Milling Co., Box 68 North End Station, Detroit, Mich.
Dried Beet Pulp
Dried Molasses Beet Pulp
Larro
Larro Chick Grains
Larro Chick Starter
Larro Egg Mash
Larro Growing Grains
Larro Growing Mash
Larro Scratch Grains

Francis H. Leggett & Co., Stamford, Conn.
Nabob Scratch Feed
Premier Growing Feed
Premier Mash Feed (egg)
Premier Scratch Feed

C. W. Lines Co., New Britain, Conn.
Homestead Dry Mash
Homestead Scratch Feed
Millpride Dairy Ration
Millpride Milk Mash for Laying Hens
Millpride Fancy Scratch Feed

Litchfield County Coöperative Ass'n, Torrington, Conn.
Common Sense Dairy Ration
Common Sense Growing Mash
Common Sense Laying Mash

Long Hill Feed Store, Long Hill, Conn.
Square Deal Dairy Ration
Square Deal Mash

Louisville Milling Co., Inc., Louisville, Ky.
Sonny South Hominy Feed

L. B. Lovitt & Co., Memphis, Tenn.
"Lovit Brand" 36% Cottonseed Meal
"Lovit Brand" 41% Cottonseed Meal
"Lovit Brand" 43% Cottonseed Meal

E. Manchester & Sons, Winsted, Conn.
Buttermilk Growing Mash
Flour Middlings
Red Star Dairy Feed
Red Star Mixed Feed
Red Star Scratch Feed
Storrs Egg Mash

The Mann Bros. Co., Buffalo, N. Y.
The Mann Bros. Co. 31% Pure Old Process Linseed Meal

Marianna Sales Co., Memphis, Tenn.
White Mule Brand 36% Cottonseed Meal
White Mule Brand 41% Cottonseed Meal
White Mule Brand 43% Cottonseed Meal

Maritime Milling Co., Inc., Buffalo, N. Y.
Bull Brand Chick Feed
Bull Brand Chick Starter (with Dried Buttermilk)
Bull Brand Dairy Ration
Bull Brand Developing Feed
Bull Brand Growing Mash (with Dried Buttermilk)
Bull Brand Heavy Mixed Feed
Bull Brand Laying Mash (with Dried Buttermilk)
Bull Brand Scratch Feed
Bull Brand Stock Feed
Hi-Test Dairy Feed
Red Dog Wheat Flour
Red-E-Lay Laying Mash
Red E Mixt Scratch Feed

A. G. Markham & Co., Springfield, Mass.
Cooked Meat and Bone Scrap 45%
Cooked Meat and Bone Scrap 50%

Geo. E. Marsh Co., Lynn, Mass.
Marsh's Pure Ground Scrap for Poultry

C. J. Martenis Grain Co., L-3 Produce Exchange, New York, N. Y.
Alco Dried Distiller Grains

Meader Milling Co., Inc., Hoboken, N. J.
Green Velvet Feed
Monogram Feed

Meech & Stoddard, Inc., Middletown, Conn.
Red Wing Dairy Ration
Red Wing Mixed Feed
Red Wing Molasses Horse Feed
Red Wing Scratch Feed
Red Wing Special Buttermilk Chick Starter
Red Wing Special Buttermilk Growing Feed
Red Wing Special Buttermilk Laying Mash
Red Wing Special Chick Feed

Red Wing Special Dairy Ration
Red Wing Special Intermediate Chick Feed
Red Wing Stock Feed

Memphis Cottonseed Products Co., Memphis, Tenn.
Durham Forty-One Cottonseed Meal
Durham Forty-Three Cottonseed Meal
Durham Thirty-Six Cottonseed Meal

Miner-Hillard Milling Co., Wilkes-Barre, Pa.
No. 1 Scratch Feed
Rye Middlings
"1795" Steam Cooked Corn and Oats
Steam Cooked Hominy Feed

Geo. Q. Moon & Co., Inc., Binghamton, N. Y.
Moon's Fresh Ground Mixed Feed
Moon's Laying Mash with Dried Buttermilk
Moon's 24% Dairy Ration
Old Times Horse Feed

Moran-Patton Co., New Haven, Conn.
C-B Mash

Fred C. Morse, Guilford, Conn.
Old Mill Buttermilk Laying Mash
Old Mill Dairy Ration
Old Mill Mash Feed
Old Mill Provender
Old Mill Scratch Feed

Mt. Vernon Milling Co., Mt. Vernon, Ind.
Poco Hominy Feed

National Milling Co., Toledo, Ohio.
Osota Feed

R. N. Neal & Co., Memphis, Tenn.
"Triangle" Brand 36% Cottonseed Meal
"Triangle" Brand 41% Cottonseed Meal

Nebraska Consolidated Mills Co., Omaha, Nebr.
Pure Wheat Bran

New England By-Products Co., 20 West St., Lawrence, Mass.
Blue Seal Meat Scraps
White Seal Meat Scraps

Newman Bros. Grain Co., Rochester, N. Y.
Corn Feed Meal
Lay She Will Egg Mash with Buttermilk
Mystic Dairy Ration
Mystic Growing Mash with Buttermilk
Mystic Laying Mash
Mystic Milk Maker
Mystic Stock Feed
Newman's Best Dairy Feed

Newsome Feed & Grain Co., Pittsburgh, Pa.
Palmo Midds

Niagara Falls Milling Co., Niagara Falls, N. Y.
Niagara Choice Wheat Bran
Niagara Choice Wheat Middlings

The Northwestern Consolidated Milling Co., Minneapolis, Minn.
Planet Feed
Pure Wheat Bran
Wheat Flour Middlings
Wheat Mixed Feed
Wheat Standard Middlings
XXX Comet

Norton Tallow Co., Somerville, Mass.
Norton's High Grade Meat and Bone for Poultry

Nowak Milling Corp., Hammond, Ind.
Domino Baby Chick Starter with Buttermilk
Domino Butterine Dairy Feed
Domino Chick Feed
Domino Crate Fattener with Buttermilk
Domino Developing Feed
Domino Growing Mash with Buttermilk
Domino Hog Feed
Domino Horse Feed with Alfalfa
Domino Laying Mash with Buttermilk
Domino Pep O Lene Horse Feed
Domino Pigeon Feed
Domino Scratch Feed
Domino 32% Protein Mixing Dairy Feed
Domino 24½% Dry Dairy Feed
Domino Union Dairy Feed
Domino Vim O Lene Horse Feed
Export Scratch Feed
Fidelity Dairy Feed
Fidelity Horse Feed
Fidelity Scratch Feed
Fidelity Stock Feed
Hammond Dairy Feed
Marathon Chick Feed
Marathon Dairy Feed
Marathon Horse Feed
Marathon Laying Mash with Buttermilk
Marathon Scratch Feed

Ogilvie Flour Mills Co., Ltd., Montreal, Canada.
Ogilvie's Pure Wheat Bran
Ogilvie's Pure Wheat Shorts

Ontario Milling Co., Inc., Oswego, N. Y.
Uncle John's 24% Cream Pot Ration

S. V. Osborn Estate, Branford, Conn.
Osborn Mash
Osborn Provender
Osborn Scratch

Park & Pollard Co., Inc., Buffalo, N. Y.
Arlington Horse Feed
Baby Buster Chick Feed

Belmont Horse Feed
Bet-R-Milk Ration
Bidwell Dry-Mash
Bidwell Scratch Feed
Bison Stock Feed Sweetened
Bonnie Booster
Chelsea Horse Feed
Corn Feed Meal
Corn and Oats ½ and ½
Go Tu It Hog Ration
Growing Feed
Herdhelth Ration
Intermediate Chick Feed
Lay or Bust Dry Mash
Leghorn Special Dry-Mash
Milk-Maid 24% Dairy Ration
Overall 24% Dairy Ration
Over the Top Scratch Feed
Papco Mixed Feed
Pigeon Feed
Pretty Special Mixed Feed
Red Ribbon Chick Feed
Red Ribbon Scratch Feed
Stevens "44" Dairy Ration
Stevens "44" Sweetened Dairy Ration
Stevens Milkade Calf Meal
The Park & Pollard Co. Dairy Growing Ration
The Park & Pollard Co. 16% Dairy Ration
The Park & Pollard Co. 20% Dairy Ration
The Park & Pollard Stock Feed
Wheat Flour Middlings

The Patent Cereals Co., Geneva, N. Y.
Hominy Feed

Penick & Ford, Ltd., Inc., Cedar Rapids, Iowa.
Douglas Corn Gluten Feed
Douglas Corn Gluten Meal

The Peterson-Hendee Co., Derby, Conn.
P-H Mash
P-H Scratch Feed

Philadelphia Seed Co., Inc., 103-105 Arch St., Philadelphia, Pa.
Purgrain Breeding Feed
Purgrain Pigeon Feed No. 4

Pillsbury Flour Mills Co., Minneapolis, Minn.
Palisade Chick Feed, No Grit
Pillsbury's Chick Grains, No Grit
Pillsbury's Dairy Ration
Pillsbury's Durum Wheat Bran and Screenings
Pillsbury's Egg Mash
Pillsbury's Fancy Mixed Feed and Screenings
Pillsbury's Growing Grains
Pillsbury's Growing Mash with Buttermilk
Pillsbury's Hard Wheat A Middlings and Screenings
Pillsbury's Hard Wheat Bran and Screenings
Pillsbury's Hard Wheat Standard B Middlings and Screenings

Pillsbury's Rye Middlings and Screenings
Palisade Scratch Feed, No Grit
Pillsbury's Scratch Grains
Pillsbury's Starting Feed with Buttermilk
Pillsbury's XX Daisy
Pillsbury's Wheat Bran and Screenings
Pillsbury's Wheat Gray Shorts

Pittsburgh Plate Glass Co., Newark, N. J.
Red Wing Linseed Meal

Frank S. Platt Co., Inc., New Haven, Conn.
Platco Laying Mash
Platco Perfection Grain Mixture
Platt's Pigeon Mixture

Postum Cereal Co., Inc., Battle Creek, Mich.
Burt's Cereal Feed
Burt's Dairy Feed
Burt's Hominy Feed
Burt's Stock Feed

W. N. Potter & Sons, Inc., Greenfield, Mass.
A. D. P. 24% Dairy Ration
Puritan Dry Mash
Puritan Growing Feed

Pratt Food Co., Hammond, Ind.
Pratt's Baby Chick Food with Buttermilk
Pratt's Circle A Chick Scratch Feed
Pratt's Circle A Large Scratch Feed
Pratt's Supreme Dairy Ration
Pratt's Supreme Growing Mash with Buttermilk
Pratt's Supreme Pigeon Feed with Flint Corn
Pratt's Supreme Stock Feed
Pratt's Victory Chick Scratch Feed
Pratt's Victory Intermediate Scratch Feed
Pratt's Victory Laying Mash with Buttermilk
Pratt's Victory Large Scratch Feed

(Buffalo Mills)
Armour's 24% Dairy Feed
Cak Cak Laying Mash with Buttermilk, Oat Meal, Fish, Meat, etc.
Iroquois Chop Feed
Iroquois Laying Mash
Iroquois Poultry Mash
Iroquois Scratching Grains
Pratt's White Hominy Feed

H. C. Puffer Co., Springfield, Mass.
Egg-Em-On Growing Feed
Egg-Em-On Laying Mash
Egg-Em-On Scratch Grains
Producer Dairy Feed

The Quaker Oats Co., Chicago, Ill.
Bell Cow Bran
Bell Cow Shorts
Big Egg Scratch Grains, No Grit
Buckeye Feed

Fine Ground Oat Feed
Hominy Feed (Aunt Jemima Mills Branch, St. Joseph, Mo.)
Quaker Ful-O-Pep Chick Starter
Quaker Ful-O-Pep Coarse Chick Feed
Quaker Ful-O-Pep Egg Mash
Quaker Ful-O-Pep Fine Chick Feed
Quaker Ful-O-Pep Growing Mash
Quaker Ful-O-Pep Scratch
Quaker Green Cross Horse Feed
Quaker Pig-N-Hog Meal
Quaker Schumacher Feed
Quaker 16% Protein Dairy Ration
Quaker 20% Protein Big "Q" Dairy Ration
Quaker 24% Protein Boss Dairy Ration
Richford White Diamond Stock Feed
Schumacher Calf Meal
Schumacher Little Chick Feed, No Grit
Schumacher Scratch Grains, No Grit
Sterling Stock Feed with Molasses
Vim Feed
White Hominy Feed
White Star Stock Feed, Fine
Yellow Hominy Feed
Quaker Sugared Schumacher Feed

Ralston Purina Co., St. Louis, Mo.

Fine Ground Green Poultry Alfalfa Meal
Corn Feed Meal
Protena Dairy Feed
Purina Baby Chick Chow Feed
Purina Bulky Las Feed
Purina Calf Chow Feed
Purina Chicken Chowder Feed containing Charcoal not over 1%
Purina Chicken Fatena Feed
Purina Chicken Fat Chow Feed
Purina Chick Growena Feed
Purina Chick Startena Feed
Purina Cow Chow Feed
Purina Hen Chow Feed
Purina Intermediate Hen Chow Feed
Purina Omolene Feed
Purina Pig Chow Feed containing Charcoal not over 1%
Purina Pigeon Chow Feed
Purina Pigeon Chow Feed containing Corn
Purina Steer Fatena Feed containing Charcoal not over 1%
Winner Scratch Feed

E. Rauh & Sons Fertilizer Co., Indianapolis, Ind.

Meato

John Reardon & Sons Co., Cambridge, Mass.

Reardon's 45% Meat and Bone Scrap
Reardon's 55% Meat Scraps

Red Wing Milling Co., Red Wing, Minn.

Red Wing Special Standard Wheat Middlings
Red Wing Special Wheat Bran

Riverdale Products Co., Chicago, Ill.

Chapman's Special Odorless Steamed Bone Meal

Robin Hood Mills, Calgary, Canada.

Superior Pure Wheat Bran
Superior Pure Wheat Shorts

Rockville Grain & Coal Co., Rockville, Conn.

Diamond Dairy Feed
Diamond Scratch Feed

The Rogers & Hubbard Co., Portland, Conn.

Edible Bone Flour

Russell-Miller Milling Co., Minneapolis, Minn.

Alta Hard Wheat Middlings
Hard Wheat Occident Bran
Hard Wheat Occident Mixed Feed

Russia Cement Co., Gloucester, Mass.

Chic-Chuk, "The Ideal Concentrated Poultry Food"

B. F. Schwartz & Co., 2 Broadway, N. Y.

Wheat Bran
Wheat Standard Middlings

P. Schwartz Co., New London, Conn.

Homespun Dairy
Homespun Mash
Homespun Scratch
Homespun Stock

Seymour Grain & Coal Co., Seymour, Conn.

See-More-Egg Buttermilk Mash
See-More-Milk Dairy Ration
See-More-Egg Scratch Feed

The Sheets Elevator Co., Cleveland, Ohio.

Diamond Horse Feed
S. B. Alfalfa Horse Feed
S. B. Horse and Mule Feed

Sheffield Elevator Co., Minneapolis, Minn.

Sherwin-Williams Old Process Meal

Shelton Feed Co., Inc., Shelton, Conn.

Nelson's Laying Mash
Nelson's Mixed Feed

Winchell Smith, Inc., Farmington, Conn.

Mill Streams "Boomerang" Dairy Feed
Mill Streams "Fortune Hunter" Scratch Grains
Mill Streams "Lightnin" Laying Mash
Mill Streams "Twenty Percent" Dairy Feed

The Southwestern Milling Co., Inc., Kansas City, Mo.

Red Turkey Pure Wheat Bran

Spratt's Patent (American), Ltd., Newark, N. J.
Spratt's Chicgrain
Spratt's Mash Food with Buttermilk

Springfield Rendering Co., Springfield, Mass.
Springfield Bone Meal
Springfield Ground Meat Scraps

A. E. Staley Manufacturing Co., Decatur, Ill.
Staley's Corn Gluten Feed

John T. Stanley Co., Inc., 642 West 30th St., New York, N. Y.
Stanley's 45% to 50% Protein Meat and Bone Scrap

State Mill & Elevator Co., Grand Forks, N. Dak.
Dakota Maid Standard Wheat Middlings

St. Albans Grain Co., St. Albans, Vt.
Brewers' Dried Grains
Charlestock
King Baby Chick Food containing Buttermilk
King Chick Feed
King Dairy Feed with Beet Pulp
King Growing Feed containing Dried Buttermilk and Beef Scraps
King Intermediate Chick Feed
King Mash Feed containing Buttermilk
King Scratch Feed
King Stock Feed
King 22 Protein Milk Ration
Paragon Dairy Feed for Dairy Cows
Paragon Gritless Chick Feed
Paragon Hominy Feed
Paragon Scratch Feed
Wirthmore Balanced Ration for Dairy Cows
Wirthmore Buttermilk Baby Chick Food
Wirthmore Buttermilk Mash Feed with Fish and Meat Scraps
Wirthmore Certified Scratch Feed
Wirthmore Flour Middlings
Wirthmore Gritless Chick Feed
Wirthmore Growing Feed with Dried Buttermilk and Beef Scraps
Wirthmore Intermediate Chick Feed
Wirthmore Pig Feed
Wirthmore Scratch Feed
Wirthmore 16% Summer Ration containing Minerals
Wirthmore Stock Feed
Wirthmore 20% Dairy Feed
Wirthmore Wheat Feed

The St. Lawrence Flour Mills Co., Ltd., Montreal, Canada.
Bran

Syracuse Milling Co., Syracuse, Onondaga County, N. Y.
Jordan Horse Feed with Molasses
Jordan Sweet Dairy Feed
Onondaga Dairy Feed
Onondaga Scratch Grains
Symco Scratch Grains
Syragold Chick Feed

Syragold Chick Starter
Syragold Dairy Feed
Syragold Egg Mash
Syragold Feed Meal
Syragold Growing Mash
Syragold Horse Feed with Molasses
Syragold Milk Ration
Syragold Scratch Grains
Syragold Stock Feed

D. L. Talcott, Torrington, Conn.
Talcott's Economy Dairy Ration

Thomaston Supply Co., Inc., Thomaston, Conn.
Thomaston Dairy
Thomaston Egg Mash
Thomaston Scratch Feed

Thompson Milling Co., Lockport, N. Y.
Angelus Wheat Bran with Ground Screenings
Angelus Wheat Middlings with Ground Screenings

Thornton & Chester Milling Co., Buffalo, N. Y.
T & C Wheat Bran
T & C Wheat Mixed Feed
T & C Standard Midds

Tioga-Empire Feed Mills, Inc., Waverly, N. Y.
Blue Brand Tioga Dairy Feed
Chicatine
Colonel's Ration
Derby Corn and Oat Feed
Derby Meal
Derby Scratch Feed
Egatine
E-Gee Stock Feed
OrCo Feed
Red Brand Ti-O-Ga Dairy Feed
Ti-O-Ga Calf Food
Tioga Chick Grains
Ti-O-Ga Growing Grains
Ti-O-Ga Growing Mash
Ti-O-Ga Laying Food
Tioga Poultry Grain
White Brand Tioga Dairy Feed

Traders Feed & Grain Co., Inc., Buffalo, N. Y.
Bonny Brand Hard Wheat Bran and Screenings

The Ubiko Milling Co., Cincinnati, Ohio.
Union Grains Biles Ready Dairy Ration

Union Starch & Refining Co., Columbus, Ind.
Union Corn Gluten Feed

United Flour & Feed Co., Inc., Albany, N. Y.
Chicklet Intermediate Chick Feed
Rex Dairy Feed

Rex Scratch Feed
United Dairy Ration
United Laying Mash (with Buttermilk)
United Laying Mash (Storrs' Formula)
United Scratch Feed
Waldorf Milk Grains

Van Vechten Milling Co., Inc., Rochester, N. Y.
Irving Mills Rye Feed

Victor Flour Mills, Inc., Pittsford & Victor, N. Y.
Victor Spring Wheat Bran
Victor Spring Wheat Middlings

Vitality Mills, 1254 Continental & Commercial Bank Bldg., Chicago, Ill.
Advance Dairy Feed
Advance Egg Mash with Buttermilk
Advance Scratch Feed, No Grit
"77" Scratch Feed, No Grit
"77" Stock Feed
Special Rosebro Horse Feed
Vitality Chick Starter
Vitality Coarse Chick Scratch
Vitality Dairy Feed
Vitality Egg Mash
Vitality Fine Chick Scratch
Vitality Growing Mash
Vitality Pigeon Feed, No Corn, No Grit
Vitality Scratch-NG
Will Pay Dairy Ration

Wadsworth Feed Co., Warren, Ohio.
Wadfeeco Dairy Ration
Wadsworth's Special Dairy Ration

Washburn-Crosby Co., Minneapolis, Minn.
Eventually Gold Medal Chick Feed, No Grit
Eventually Gold Medal Chick Starter (with Dried Buttermilk)
Eventually Gold Medal Developing Feed, No Grit
Eventually Gold Medal Growing Mash (with Dried Buttermilk)
Eventually Gold Medal Hard Wheat Bran
Eventually Gold Medal Hard Wheat Flour Middlings
Eventually Gold Medal Hard Wheat Standard Middlings
Eventually Gold Medal Pure Hard Wheat Adrian Red Dog
Eventually Gold Medal Scratch Feed, No Grit
Eventually Gold Medal Vitimin Dairy Ration (containing Wheat Germ)
Eventually Gold Medal Vitimin Dairy Ration (24% Protein)
Eventually Gold Medal Vitimin Egg Mash (containing Wheat Germ Embryo)
Gold Medal Corn and Oat No. 2
Gold Medal Hominy Feed (Guaranteed Pure)
North Star Scratch Feed, No Grit
Washburn's Gold Medal Fancy Mixed Feed

Worcester Rendering Co., Auburn, Mass.
P. W. Meat Scrap
P. W. Special Meat Scrap

Yantic Grain & Products Co., 3 Cove St., Norwich, Conn.
Abington Dairy Feed
Big (Y) Dairy Ration
Big (Y) Flour Middlings
Big (Y) Growing Feed
Big (Y) Laying Mash
Big (Y) Mixed Feed
Echo Dairy Feed
Perfection Dairy Feed
Uncas Dairy Feed
Uncas Stock Feed

INSPECTION.

(For the year September 1, 1926, to August 31, 1927.)

During the year 898 samples of commercial feeding stuffs and other fodder materials have been analyzed. Of this number 670 were official samples drawn by the Station inspector; 141 were examined for the Storrs Station in connection with field and other experiments; and the remainder were submitted by individuals. Only those samples taken for official inspection purposes and those examined for individuals are discussed in this report.

The Station inspector has visited 145 grain dealers in 99 towns in the State and collected 672 samples of feeds which number includes all the brands which could be found on sale. Results of analyses as soon as available have been reported to manufacturers or jobbers, dealers and others interested. In cases of deficiencies second samples were drawn and analyzed if they could be obtained.

Analyses are given in Table I. Deficiencies greater than 0.75 per cent in protein and fiber and 0.25 per cent in fat are given in bold face type. Analyses of unofficial samples appear in Table II.

About one-sixth of the total number of samples analyzed were deficient in one or more of the nutrients guaranteed. These deficient samples were confined largely to the class of proprietary mixed feeds. With three items of nutrients guaranteed on each sample there were 2,010 guaranties made and 126 deficiencies were found. In other words 83 per cent of the samples met or exceeded guaranties and 94 per cent of the guaranties made were substantially met or exceeded. These percentages are almost identical with similar ones computed for the inspection of 1925.

It is illegal in this State to attach tags by means of wire or other metallic device and the practice has been largely abandoned. Only two instances of such practice were found during the past year.

A careful microscopic examination of all feeds has been made to identify the ingredients claimed to be present. In general, the ingredients found were substantially as declared and no acceptable evidence of the substitution of inferior materials was obtained.

The following tabulated statement summarizes the results of the inspection.

SUMMARY OF INSPECTION.

Feed	Samples examined	Samples deficient	Deficiencies in			Total deficiencies
			Protein	Fat	Fiber	
Cottonseed Meal	23	9	5	2	5	12
Linseed Meal	9	0	0	0	0	0
Wheat Bran	27	0	0	0	0	0
Wheat Middlings	36	2	0	0	2	2
Wheat Red Dog	3	1	0	0	1	1
Wheat Feed (Mixed Feed)	21	0	0	0	0	0
Corn Gluten Feed	9	0	0	0	0	0
Hominy Feed	17	4	1	0	4	5
Rye Products	3	0	0	0	0	0
Brewers' and Distillers' Grains	4	1	1	0	0	1
Dried Beet Pulp	2	0	0	0	0	0
Horse Feeds, etc.	48	6	0	1	5	6
Dairy Feeds	126	29	11	8	12	31
Stock Feeds	39	10	2	8	2	12
Calf Feeds, etc.	9	1	0	0	1	1
Poultry Feeds	259	39	6	6	31	43
Beef Scrap, etc.	35	12	9	0	3	12
Totals	670	114	35	25	66	126

Feeds should be free from viable weed seeds but in commercial practice it is doubtful if the destruction of such seeds is ever complete. In a few instances the presence of whole weed seeds was conspicuous. Samples **6311**, International Ready Ration Dairy Feed, **6312**, International Special Dairy Feed, and **6313**, International Diamond Dairy Feed, made by the International Sugar Feed Co., Minneapolis, contained whole seeds estimated at from 4,000 to 12,000 per pound of feed, germination tests showing that from 3 per cent to 7.5 per cent were likely to grow. The seeds were mainly pigweed, barnyard grass, shepherd's purse and smartweed. Sample **6392**, Hammond Dairy Feed, also contained many whole seeds but none germinated. If fed to sheep and poultry these weed seeds would probably be destroyed; but if fed to cattle many seeds would be transferred to the fields in the stable manure.

TABLES OF ANALYSES.

Analyses of official samples taken for inspection purposes are given in Table I, pages 518 to 571 inclusive. Analyses of samples drawn and submitted by individuals are given in Table II, pages 572 to 575 inclusive. For these last named samples the Station is responsible for the analyses only.

In certain cases the brand names as they appear in Table I do not correspond in all respects with names as they appear in the registration list. This is because limited space may have required some abbreviation of titles in the analytical tables; and again, brand names may have been revised by manufacturers after our samples were taken.

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1926.

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25) Found	Protein (N x 6.25) Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat Found	Fat Guaranteed, not less than
	OIL SEED PRODUCTS.										
	Cottonseed Meal.										
5510	*Empire.* E. T. Allen Co., Atlanta, Ga.	*Granby:* E. H. Rollins	6.80	5.72	41.13	41.00	10.75	10.00	29.51	6.09	6.00
5998	*Premier.* E. T. Allen Co., Atlanta, Ga.	*New Hartford:* Geo. W. Case, Inc.	5.85	5.69	42.56	43.00	10.58	10.00	29.04	6.28	6.00
5388	*Helmet.* Ashcraft-Wilkinson Co., Atlanta, Ga.	*Torrington:* D. L. Talcott	9.03	6.34	40.50	41.00	9.90	10.00	27.78	6.45	6.00
5691	*Monarch.* Ashcraft-Wilkinson Co., Atlanta, Ga.	*Danielson:* Young Bros. Co.	6.05	5.76	42.63	43.00	10.29	10.00	28.62	6.65	6.00
5379	*Paramount.* Ashcraft-Wilkinson Co., Atlanta, Ga.	*North Haven:* W. L. Thorpe	7.40	5.07	**34.69**	36.00	14.15	14.00	32.94	5.75	5.50
6260	*Paramount.* Ashcraft-Wilkinson Co., Atlanta, Ga.	*New Haven:* R. G. Davis & Sons	6.75	6.10	38.25	36.00	11.21	14.00	30.09	7.60	5.50
6198	*Beauty.* S. P. Davis, Little Rock, Ark.	*Thompsonville:* Geo. S. Phelps & Co.	6.20	5.05	35.88	36.00	**15.20**	14.00	32.32	**5.35**	6.00
6411	*Beauty.* S. P. Davis, Little Rock, Ark.	*Thompsonville:* Geo. S. Phelps & Co.	7.35	5.01	**35.13**	36.00	**14.79**	14.00	32.19	**5.53**	6.00
6412	*Good Luck.* S. P. Davis, Little Rock, Ark.	*Manchester:* O. E. Bailey	7.55	6.50	40.88	41.00	10.08	10.00	27.96	7.03	6.00
5319	*Bull.* Humphreys-Godwin Co., Memphis, Tenn.	*Rockville:* Rockville Grain & Coal Co.	6.48	5.81	43.00	43.00	9.50	10.00	28.88	6.33	5.00
5339	*Danish.* Humphreys-Godwin Co., Memphis, Tenn.	*Guilford:* Fred C. Morse	6.40	5.90	36.00	36.00	13.38	15.00	31.97	6.35	5.00

5543	*Dixie.* Humphreys-Godwin Co., Memphis, Tenn.	*Watertown:* Watertown Co-op. Assoc.	8.20	5.62	41.69	41.00	9.53	10.00	28.34	6.62	5.00
6404	*International Rainbow.* International Agricultural Corp., Columbus, Ga.	*North Haven:* W. L. Thorpe	7.60	6.39	38.50	36.00	10.45	14.00	30.33	6.73	5.00
5885	*International Rainbow* 43%. International Agricultural Corp., Columbus, Ga.	*Bloomfield:* Bloomfield Farmers' Exchange	6.23	6.56	**41.31**	43.00	8.85	14.00	29.97	7.08	6.00
6237	*International Rainbow* 43%. International Agricultural Corp., Columbus, Ga.	*Bloomfield:* Bloomfield Farmers' Exchange	7.73	6.65	**41.25**	43.00	8.20	14.00	28.13	8.04	6.00
6231	*Zenith* 36%. International Agricultural Corp., Columbus, Ga.	*Wallingford:* A. E. Hall	7.70	5.78	36.19	36.00	12.93	14.00	31.25	6.15	6.00
5367	*Lovit* 36%. L. B. Lovitt & Co., Memphis, Tenn.	*Middletown:* Meech & Stoddard, Inc.	8.40	5.38	37.81	36.00	11.50	15.00	29.81	7.10	5.00
5692	*Lovit* 43%. L. B. Lovitt & Co., Memphis, Tenn.	*Danielson:* Young Bros.	6.18	6.80	43.88	43.00	7.85	10.00	27.34	7.95	6.00
5999	*White Mule* 36%. Marianna Sales Co., Memphis, Tenn.	*New Hartford:* Geo. W. Case, Inc.	7.38	5.20	**34.88**	36.00	14.75	14.00	31.49	6.30	5.00
5994	*White Mule* 41%. Marianna Sales Co., Memphis, Tenn.	*East Haven:* A. W. Forbes	7.23	6.37	40.75	41.00	**11.03**	10.00	28.32	6.30	6.00
5997	*White Mule* 43%. Marianna Sales Co., Memphis, Tenn.	*Woodbury:* C. L. Adams Co.	8.23	6.31	44.06	43.00	11.03	10.00	21.52	8.85	6.00
5803	*Durham* 36%. Memphis Cottonseed Products Co., Memphis, Tenn.	*New Haven:* R. G. Davis & Sons	6.93	5.44	35.56	36.00	**14.70**	10.00	31.14	6.23	5.00
4804	*Durham* 43%. Memphis Cottonseed Products Co., Memphis, Tenn.	*Plantsville:* C. A. Cowles	13.64	5.60	40.19	43.00	**10.90**	10.00	22.77	6.90	6.00
	Linseed Meal, Old Process.										
5390	*Amco.* American Milling Co., Peoria, Ill.	*Rockville:* Rockville Grain & Coal Co.	8.95	5.54	31.56	30.00	9.65	10.00	36.92	7.38	5.00
5187	*Pure.* Archer-Daniels Midland Co., Minneapolis, Minn.	*Plantsville:* C. A. Cowles	9.55	6.06	32.25	32.00	8.00	9.00	37.99	6.15	5.00
5261	*Pure.* Archer-Daniels Midland Co., Minneapolis, Minn.	*Hazardville:* Amos D. Bridges Sons	9.33	5.67	34.38	34.00	8.03	9.00	37.69	4.90	5.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1926—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	OIL SEED PRODUCTS—*Concluded.* *Linseed Meal, Old Process—Concluded.*										
6281	*"Maple Leaf."* Canada Linseed Oil Mills, Montreal, Canada..	*Norwich:* Yantic Grain & Products Co.	10.50	4.56	36.38	35.00	6.56	7.00	36.27	5.73	5.00
5258	*Kellogg's.* Spencer Kellogg & Son, Buffalo, N. Y.	*Thompsonville:* Geo. S. Phelps & Co.	10.18	5.05	36.25	34.00	7.23	10.00	34.36	6.93	5.00
5840	Kellogg & Miller, Amsterdam, N. Y.	*New Milford:* Geo. T. Soule	8.45	5.49	32.13	31.00	7.18	9.00	40.27	6.48	5.00
5389	*Pure.* Mann Bros. Co., Buffalo, N. Y.	*Manchester:* Manchester Grain Co.	10.25	5.50	30.50	31.00	8.40	10.00	37.65	7.70	6.00
5535	*Red Wing.* Pittsburgh Plate Glass Co., Newark, N. J.	*Thomaston:* Thomaston Supply Co.	9.60	5.61	33.63	34.00	7.55	9.00	36.46	7.15	6.00
6199	*Sherwin-Williams.* Sheffield Elevator Co., Minneapolis, Minn.	*Rockville:* Rockville Milling Co.	7.15	4.94	36.81	35.00	7.65	7.50	35.25	8.20	5.50
	WHEAT PRODUCTS. *Wheat Bran.*										
5832	*Wingold.* Bay State Milling Co., Winona, Minn.	*Danbury:* F. C. Benjamin	9.90	6.35	16.56	15.20	8.90	12.40	53.19	5.10	5.30
5417	*Dandy.* Copeland Flour Mills, Midland, Canada	*Unionville:* F. D. Lawton & Son	9.88	5.64	15.88	15.00	10.04	11.50	52.83	5.73	3.50
6200	Dominion Flour Mills, Montreal, Canada	*Guilford:* Fred C. Morse	8.18	5.50	17.19	15.00	10.13	11.50	53.07	5.93	3.50
5597	*Duluth Imperial.* Duluth Superior Mills, Duluth, Minn.	*Stepney:* M. Nusbaum	10.73	5.26	16.06	14.00	8.30	13.00	54.05	5.60	3.75
4866	The Fairchild Milling Co., Cleveland, Ohio	*Highwood:* T. C. Hadden & Co.	12.15	5.23	16.19	14.00	8.36	12.00	53.85	4.22	3.50
5861	The Fairchild Milling Co., Cleveland, Ohio	*Highwood:* T. C. Hadden & Co.	11.33	5.24	16.31	14.00	8.35	12.00	53.52	5.25	3.50
5754	Wm. Hamilton & Son, Honeoye Falls, N. Y.	*Westerly:* C. W. Campbell Co...	10.68	5.49	13.88	13.25	8.80	11.60	57.15	4.00	2.90
5343	*Choice.* Hecker-Jones-Jewell Milling Co., New York City	*Higganum:* F. A. Petrofsky	9.55	6.35	16.94	14.00	9.35	14.00	52.46	5.35	3.50
4867	*Blackhawk.* International Milling Co., Minneapolis, Minn.	*Plantsville:* Mehmel & Sarvi	11.04	6.05	14.88	15.00	11.54	12.00	52.10	4.39	3.20
5643	*Big Flake.* Kansas Flour Mills Corp., Kansas City, Mo.	*Southbury:* H. R. Stone	10.02	7.30	15.94	15.00	9.33	11.00	53.31	4.10	3.50
5881[1]	The Larrabee Flour Mills Corp., Wellington, Kans.	*Hazardville:* Amos D. Bridges Sons	7.78	6.27	16.94	15.00	8.98	10.00	56.03	4.00	3.50
5174	Maple Leaf Milling Co., Toronto, Canada	*Plainville:* M. Kosenko	10.63	5.59	15.06	15.00	10.13	11.50	52.91	5.68	3.50
5646	*Pure.* Nebraska Consolidated Milling Co., Omaha, Neb.	*East Winsted:* Leonard Grain Co.	10.15	5.69	16.69	15.50	8.00	11.00	54.92	4.55	3.50
5256	*Niagara Choice.* Niagara Falls Milling Co., Niagara Falls, N. Y.	*Thompsonville:* Geo. S. Phelps & Co.	10.03	6.25	16.13	15.00	9.13	11.00	53.26	5.20	3.50
5212	*Pure.* Northwestern Consolidated Milling Co., Minneapolis, Minn.	*North Haven:* W. L. Thorpe	11.68	6.26	16.31	13.00	9.28	12.00	51.64	4.83	4.00
5317	*Ogilvie Pure.* Ogilvie Flour Mills, Montreal, Canada	*Rockville:* Rockville Grain & Coal Co.	10.35	5.17	15.25	15.00	9.54	11.50	54.07	5.62	3.50
5350	Pillsbury Flour Mills Co., Minneapolis, Minn.	*Wallingford:* Laden Bros.	10.98	5.81	16.63	14.00	8.48	12.00	53.30	4.80	4.00
5551	*Bell Cow.* Quaker Oats Co., Chicago, Ill.	*Waterbury:* H. S. Coe & Co., Inc.	10.43	5.09	16.19	15.00	9.18	10.00	53.93	5.18	3.50
6197	*Red Wing Special.* Red Wing Milling Co., Red Wing, Minn.	*Plantsville:* Mehmel & Sarvi	7.75	6.03	15.75	13.50	10.68	15.60	54.31	5.48	4.10
5266	*Occident.* Russell Miller Milling Co., Minneapolis, Minn.	*Windsor:* W. C. Everett	11.10	6.41	18.00	14.00	8.65	11.50	50.84	5.00	4.00
6007	B. F. Schwartz & Co., New York City	*Thompsonville:* Geo. S. Phelps & Co.	9.83	6.07	14.50	13.00	10.65	13.00	54.67	4.28	4.00

[1] Wire tags illegal.

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1926—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25) Found	Protein (N x 6.25) Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat Found	Fat Guaranteed, not less than
	WHEAT PRODUCTS—*Continued*										
	Wheat Bran—Concluded.										
5639	*Red Turkey.* Southwestern Milling Co., Kansas City, Mo.	*Lakeville:* E. W. Spurr Co.	9.10	6.14	16.50	14.50	8.75	11.00	54.98	4.53	3.50
5542	St. Lawrence Flour Mills, Montreal, Canada	*Woodbury:* C. L. Adams Co. ..	8.95	5.39	15.81	15.00	9.99	11.50	54.31	5.55	3.50
5888	*Angelus.* Thompson Milling Co., Lockport, N. Y.	*New Britain:* Stanley Svea Coal Co.	10.65	5.97	16.13	15.50	9.38	11.50	52.62	5.25	4.00
5412	*Victor Spring.* Victor Flour Mills, Victor, N. Y.	*East Hartford:* Meech Grain Co.	10.70	5.17	17.63	15.00	8.83	11.00	51.89	5.78	4.00
5190	*Gold Medal.* Washburn-Crosby Co., Minneapolis, Minn.	*Southington:* Southington Lumber Co.	9.58	5.71	14.31	14.00	9.58	12.00	55.34	5.48	4.00
5167	*Pioneer.* Western Canada Flour Mills, Goderich, Canada	*West Cheshire:* Cheshire Grain & Coal Co.	11.65	5.10	16.50	15.00	9.70	11.50	51.37	5.68	3.50
	Wheat Middlings, etc.										
5638	*Wingold Fancy White Flour.* Bay State Milling Co., Winona, Minn.	*Torrington:* D. L. Talcott	9.48	2.42	17.88	18.70	2.06	4.60	64.03	4.13	5.00
6015	*Wingold Fancy White Flour.* Bay State Milling Co., Winona, Minn.	*Torrington:* D. L. Talcott	10.30	2.65	17.88	17.50	2.95	3.50	61.87	4.35	3.50
5642	*Wingold Standard.* Bay State Milling Co., Winona, Minn. ..	*Torrington:* D. L. Talcott	8.80	4.58	17.94	16.60	8.05	8.90	54.78	5.85	4.90

3637	*Pioneer Shorts.* Chas. M. Cox, Boston, Mass.	*Torrington:* D. L. Talcott	9.55	4.14	18.13	16.00	7.59	11.00	54.06	6.53	4.50
5503	*Pioneer Shorts.* Chas. M. Cox, Boston, Mass.	*Thomaston:* Peter Cunningham	10.60	3.96	17.75	16.00	7.12	9.00	54.57	6.00	4.50
6591	*Flour.* John W. Eshelman & Sons, Lancaster, Pa.	*Thomaston:* Thomaston Supply Co.	10.35	3.16	17.25	16.00	4.58	6.00	60.21	4.45	4.00
5418	*E. A. Co. Standard.* Everett, Aughenbaugh & Co., Minneapolis, Minn.	*Unionville:* F. D. Lawton & Son	10.50	5.08	18.19	15.00	7.65	9.50	52.94	5.64	3.00
5995	*Shorts.* Dominion Flour Mills, Montreal, Canada	*Guilford:* Fred C. Morse	8.48	4.20	18.50	16.00	7.65	8.00	55.27	5.90	5.00
5151	*Special.* Fairchild Milling Co., Cleveland, Ohio	*Highwood:* T. C. Hadden & Co.	10.48	3.50	16.13	15.00	5.00	8.00	60.94	3.95	3.50
5340	*Standard.* Fairchild Milling Co., Cleveland, Ohio	*Guilford:* F. H. Rolf	11.10	5.52	18.38	15.00	6.83	9.00	53.27	4.90	4.00
5740	*Dairy Maid.* Federal Mill & Elevator Co., Lockport, N. Y. ..	*Putnam:* Bosworth Bros.	9.88	2.86	15.31	15.50	4.65	6.00	62.67	4.63	4.50
5469	Wm. Hamilton & Son, Honeoye Falls, N. Y.	*Derby:* Peterson-Hendee Co. ...	10.25	3.16	15.56	14.90	3.95	5.40	62.45	4.63	4.90
5231	Hecker-Jones-Jewell Milling Co., New York City	*Meriden:* Meriden Grain & Coal Co.	9.38	4.58	16.63	15.00	7.10	9.50	56.98	5.33	5.00
6316	Hecker-Jones-Jewell Milling Co., New York City	*Hazardville:* Amos D. Bridges Sons	10.20	4.66	18.06	15.00	7.91	9.50	52.74	6.43	4.75
5185	*Black Hawk.* International Milling Co., Minneapolis, Minn. ..	*Plantsville:* Mehmel & Sarvi ...	10.38	4.75	17.44	16.00	7.50	8.50	54.33	5.60	4.50
5576	*Flour.* E. Manchester & Sons, Winsted	Sampled at factory	9.08	4.15	16.19	15.00	4.42	6.00	62.36	3.80	4.00
5173	*Rex.* Maple Leaf Milling Co., Toronto, Canada	*Plainville:* M. Kosenko	10.68	4.08	17.44	17.50	6.58	7.50	55.64	5.58	5.50
6233	*Palmo Midds.* Newsome Feed & Grain Co., Pittsburgh, Pa. ...	*Middletown:* Meech & Stoddard, Inc.	7.65	5.16	16.06	16.00	6.43	9.00	55.37	9.33	7.00
5246	*Niagara Choice.* Niagara Falls Milling Co., Niagara Falls, N. Y.	*Meriden:* H. Grülich	10.25	4.59	16.94	15.50	6.83	9.50	55.89	5.50	4.00
5214	*Flour.* Northwestern Consolidated Milling Co., Minneapolis, Minn.	*North Haven:* W. L. Thorpe ...	11.05	3.93	18.75	15.00	5.60	6.00	55.72	4.95	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1926—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	WHEAT PRODUCTS—*Continued.*										
	Wheat Middlings, etc.—Concl.										
5211	*Standard.* Northwestern Consolidated Milling Co., Minneapolis, Minn.	*North Haven:* W. L. Thorpe	10.00	4.55	17.56	15.00	8.73	9.50	53.48	5.68	4.00
5485	*Ogilvie's Shorts.* Ogilvie Flour Mills Co., Montreal, Canada	*Seymour:* Seymour Grain & Coal Co.	10.09	4.14	17.44	16.00	6.98	8.00	55.57	5.78	5.00
5206	*Flour.* Park & Pollard Co., Buffalo, N. Y.	*Plainville:* F. B. Newton	11.70	3.88	16.44	16.00	5.28	6.00	59.02	3.68	4.00
5672	*Flour.* Park & Pollard Co., Buffalo, N. Y.	*West Stafford:* C. P. Bradway	10.50	3.12	15.88	16.00	5.23	6.00	60.84	4.43	4.00
5171	*Pillsbury's A with Screenings.* Pillsbury Flour Mills, Minneapolis, Minn.	*West Cheshire:* Cheshire Grain & Coal Co.	10.85	2.99	18.75	16.00	3.90	6.00	58.11	5.40	4.00
5165	*Pillsbury's Standard B with Screenings.* Pillsbury Flour Mills, Minneapolis, Minn.	*Hamden:* Ira W. Beers	10.83	4.13	17.63	15.00	6.75	9.50	55.28	5.38	4.00
5161	*Bell Cow Shorts with Screenings.* Quaker Oats Co., Chicago, Ill.	*Plainville:* M. Kosenko	11.85	3.80	16.56	15.00	6.28	8.00	55.86	5.65	4.00
6196	*Red Wing Special.* Red Wing Milling Co., Red Wing, Minn.	*Plantsville:* Mehmel & Sarvi	6.95	4.94	18.31	15.00	8.30	9.50	55.62	5.88	5.10
6012	*Standard.* B. F. Schwartz & Co., New York City	*Middletown:* Meech & Stoddard, Inc.	11.13	4.20	16.69	14.00	7.63	9.50	55.65	4.70	4.00

5751	*Dakota Maid with Screenings.* State Mill & Elevator Co., Grand Forks, No. Dak.	*Jewett City:* Red Wing Feed Store	9.83	3.99	16.94	16.10	6.15	8.10	57.21	5.88	5.70
5436	*Wirthmore Flour.* St. Albans Grain Co., St. Albans, Vt.	*Granby:* E. H. Rollins	10.92	4.33	14.44	14.00	5.71	6.00	59.38	5.22	4.00
5889	*Angelus with Screenings.* Thompson Milling Co., Lockport, N. Y.	*New Britain:* Stanley Svea Coal Co.	10.78	4.54	17.69	15.50	7.33	7.00	54.51	5.15	4.50
5332	*Gold Medal Flour.* Washburn-Crosby Co., Minneapolis, Minn.	*Branford:* S. V. Osborn Est.	10.23	3.62	16.88	16.00	4.28	6.00	60.64	4.35	4.00
5306	*Gold Medal Standard.* Washburn-Crosby Co., Minneapolis, Minn.	*East Haven:* A. W. Forbes	11.38	4.67	17.50	15.00	6.75	9.50	54.67	5.03	4.00
5739	*Big Y Flour.* Yantic Grain & Products Co., Norwich	*Willimantic:* Boston Grain Co.	9.70	3.63	17.81	17.00	5.50	5.00	57.81	5.55	5.00
	Wheat Red Dog.										
5255	*Elmore Red Dog Flour Middlings.* Elmore Milling Co., Oneonta, N. Y.	*Thompsonville:* Geo. S. Phelps & Co.	11.50	2.47	15.50	15.00	2.70	6.00	64.25	3.58	4.00
4810	*Red Dog Flour.* Maritime Milling Co., Buffalo, N. Y.	*Thompsonville:* Geo. S. Phelps & Co.	11.59	3.48	17.38	16.00	4.29	4.00	58.16	5.10	4.00
5304	*Gold Medal Adrian Red Dog.* Washburn-Crosby Co., Minneapolis, Minn.	*Rockville:* Rockville Grain & Coal Co.	11.15	2.45	17.00	16.00	1.85	4.00	63.82	3.73	3.50
	Wheat Feed (Mixed Feed).										
5637	*Wingold Fancy Pure.* Bay State Milling Co., Winona, Minn.	*Torrington:* D. L. Talcott	8.98	4.83	16.69	16.20	6.90	8.10	57.75	4.85	4.20
5750	*Dairy Maid.* Federal Milling Co., Lockport, N. Y.	*Putnam:* Bosworth Bros.	9.98	4.69	14.94	15.50	6.88	8.00	59.11	4.40	4.00
5425	*"Gold Mine."* King Flour Mills Co., Minneapolis, Minn.	*Hartford:* C. A. Pease & Co.	10.43	5.34	18.75	15.00	7.03	9.50	53.72	4.73	4.50
6252	*Red Star.* E. Manchester & Sons, Winsted	*Thomaston:* Thomaston Supply Co.	10.20	3.94	17.56	16.00	6.38	7.50	57.24	4.68	4.00
5577	*Bull.* Maritime Milling Co., Buffalo, N. Y.	*New Milford:* Geo. E. Ackley & Co.	9.68	4.25	15.81	15.00	7.86	8.00	57.07	5.33	4.00
5396	*Red Wing.* Meech & Stoddard, Middletown	*East Hartford:* Meech Grain Co.	9.73	4.83	16.19	15.00	7.20	10.00	56.95	5.10	4.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1926—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	WHEAT PRODUCTS—*Concluded*										
	Wheat Feed (Mixed Feed)—Concluded.										
5647	*Moon's.* Geo. Q. Moon & Co., Binghamton, N. Y.	*Norfolk:* Aug. P. Curtis	9.96	4.53	16.13	14.00	6.25	10.00	58.83	4.30	4.00
5380	*Osota.* National Milling Co., Toledo, Ohio	*Bloomfield:* Bloomfield Farmers' Exchange	9.83	4.51	15.75	15.00	6.58	10.00	58.80	4.53	4.50
5268	*XXX Comet.* Northwestern Consolidated Milling Co., Minneapolis, Minn.	*Bloomfield:* Bloomfield Farmers' Exchange	11.13	2.92	18.31	16.00	2.10	4.00	60.56	4.98	4.00
5213	*Planet.* Northwestern Consolidated Milling Co., Minneapolis, Minn.	*North Haven:* W. L. Thorpe	11.20	4.73	18.31	15.00	6.23	8.00	54.55	4.98	4.00
5210	Northwestern Consolidated Milling Co., Minneapolis, Minn.	*North Haven:* W. L. Thorpe	11.08	5.25	17.31	15.00	7.50	8.50	53.71	5.15	4.00
5713	*Papco.* Park & Pollard Co., Buffalo, N. Y.	*Woodbury:* C. L. Adams Co.	9.33	5.46	15.38	15.10	8.30	9.50	56.55	4.98	5.30
6251	*Papco.* Park & Pollard Co., Buffalo, N. Y.	*Woodbury:* C. L. Adams Co.	11.00	5.62	17.88	15.10	7.97	9.50	53.28	4.25	5.30
5434	*Pillsbury's with Screenings.* Pillsbury Flour Mills, Minneapolis, Minn.	*Granby:* E. H. Rollins	10.50	4.12	16.81	15.00	5.79	8.50	58.03	4.75	4.00
5226	*XX Daisy.* Pillsbury Flour Mills, Minneapolis, Minn.	*Wallingford:* A. E. Hall	11.33	2.87	16.69	16.00	2.93	4.00	61.50	4.68	4.00
5678	*Pretty Special.* Park & Pollard Co., Buffalo, N. Y.	*Putnam:* Bosworth Bros.	9.25	3.98	16.00	16.00	7.75	9.00	58.24	4.78	4.00
5202	*Buckeye.* Quaker Oats Co., Chicago, Ill.	*Kensington:* I. F. Labieniec	11.95	5.71	16.44	15.50	7.55	10.00	53.75	4.60	4.50
5225	*Occident.* Russell-Miller Milling Co., Minneapolis, Minn.	*Wallingford:* A. E. Hall	10.85	4.84	17.06	15.00	7.30	9.50	54.50	5.45	4.50
5661	*Wirthmore.* St. Albans Grain Co., St. Albans, Vt.	*So. Coventry:* E. W. Latimer	9.23	4.37	16.00	15.00	6.30	8.00	59.62	4.48	4.50
6264	*T. & C.* Thornton & Chester Milling Co., Buffalo, N. Y.	*Andover:* E. A. Standish	10.58	5.05	16.69	15.00	7.99	10.00	54.83	4.86	5.00
5300	*Gold Medal.* Washburn-Crosby Co., Minneapolis, Minn.	*Manchester:* Manchester Grain Co.	11.05	4.17	15.88	16.00	4.95	7.50	60.02	3.93	4.00
5745	*Big Y.* Yantic Grain & Products Co., Norwich	Sampled at factory	9.45	5.19	17.25	16.00	7.38	7.00	55.70	5.03	4.50
	MAIZE PRODUCTS.										
	Corn Gluten Feed.										
5655	American Maize Products Co., New York City	*Stratford:* Z. C. Ingersoll	7.13	3.83	26.50	23.00	7.20	8.50	50.61	4.73	2.00
5484	*Clinton.* Clinton Corn Syrup Refining Co., Clinton, Iowa	*Seymour:* Seymour Grain & Coal Co.	8.53	4.60	25.63	23.00	6.45	8.50	51.47	3.32	2.00
5254	*Buffalo.* Corn Products Refining Co., New York City	*Suffield:* Spencer Bros.	8.93	4.35	26.13	23.00	7.13	8.50	49.63	3.83	2.00
5323	*Diamond.* Corn Products Refining Co., New York City	*East Haven:* A. W. Forbes	9.88	1.11	44.81	40.00	1.78	4.00	40.49	1.93	1.00
5653	*Keokuk.* J. C. Hubinger Bros. Co., Keokuk, Iowa	*Devon:* Devon Coal & Ice Co.	7.41	3.56	23.25	23.00	7.68	8.50	50.65	7.45	2.00
5269	*Douglas* (Meal). Penick & Ford, Ltd., Cedar Rapids, Iowa	*Bloomfield:* Bloomfield Farmers' Exchange	8.25	3.22	41.63	40.00	3.33	4.00	40.59	2.98	1.00
5318	*Douglas.* Penick & Ford, Ltd., Cedar Rapids, Iowa	*Rockville:* Rockville Grain & Coal Co.	9.00	7.42	26.75	23.00	7.54	8.00	46.74	2.55	1.00
5180	*Staley's.* A. E. Staley Mfg. Co., Decatur, Ill.	*West Cheshire:* Cheshire Grain & Coal Co.	8.45	4.53	25.63	23.00	6.90	8.00	52.09	2.40	1.00
6207	*Union.* Union Starch & Refining Co., Columbus, Ind.	*New London:* Paty Schwartz Co.	7.43	6.93	26.44	23.00	7.29	8.00	49.28	2.63	1.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1926—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	MAIZE PRODUCTS—*Concluded.*										
	Hominy Feed.										
5628	Aunt Jemima Mill Branch (Quaker Oats Co.), St. Joseph, Mo.	*Warehouse Point:* C. T. Lewis..	8.65	2.90	11.00	10.00	5.53	8.00	65.52	6.40	5.00
5844[1]	Cereal Mills Co., Wausau, Wis.	*New London:* New London Grain Co.	8.08	2.65	12.69	10.00	4.55	5.00	64.60	7.43	5.00
5186	*Homco.* Decatur Milling Co., Decatur, Ill.	*Plantsville:* C. A. Cowles	9.93	2.67	11.25	10.00	5.13	6.00	62.64	8.38	7.00
6590	Elevator Milling Co., Springfield, Ill.	*Thomaston:* Thomaston Supply Co.	10.15	2.76	11.50	10.00	4.73	6.00	63.91	6.95	7.00
5829	*Emco.* Evans Milling Co., Indianapolis, Ind.	*Ridgefield:* Ridgefield Lumber Co.	9.35	2.96	11.94	10.00	4.93	6.00	63.14	7.68	7.00
5169	*Kellogg's.* Kellogg Co., Battle Creek, Mich.	*West Cheshire:* Cheshire Grain & Coal Co.	9.18	2.51	11.13	10.00	4.53	5.00	65.80	6.85	6.00
5857	*Sonny South.* Louisville Milling Co., Louisville, Ky.	*Plantsville:* C. A. Cowles	8.70	2.54	10.88	10.00	4.60	6.00	67.15	**6.13**	7.00
6255	*Sonny South.* Louisville Milling Co., Louisville, Ky.	*Plantsville:* C. A. Cowles	8.53	2.86	10.88	10.00	4.40	6.00	67.53	**5.80**	7.00
5224	*Steam Cooked.* Miner-Hillard Milling Co., Wilkes-Barre, Pa.	*Wallingford:* A. E. Hall	10.48	2.15	10.88	10.00	3.83	5.00	67.88	4.78	4.00
5687	*Poco.* Mt. Vernon Milling Co., Mt. Vernon, Ind.	*Willimantic:* Willimantic Grain Co.	7.90	2.64	11.00	10.00	4.63	6.00	65.61	8.22	7.00

[1] Wire tags illegal.

5164	Patent Cereals Co., Geneva, N. Y.	*Hamden:* Ira W. Beers	10.78	2.77	11.25	10.00	4.50	5.00	66.02	**4.68**	5.00
5658	Patent Cereals Co., Geneva, N. Y.	*Farmington:* Winchell Smith, Inc.	9.94	2.65	11.06	10.00	4.83	5.00	66.13	5.39	5.00
5182	*Burt's.* Postum Cereal Co., Inc., Battle Creek, Mich.	*Plantsville:* Mehmel & Sarvi	11.05	2.35	10.63	10.00	3.73	5.00	66.11	6.13	6.00
6236	*Pratt's White.* Pratt Food Co., Buffalo, N. Y.	*Danbury:* C. S. Barnum & Son	11.73	2.37	10.31	10.00	3.58	6.00	66.91	5.10	5.00
5552	*White.* Quaker Oats Co., Chicago, Ill.	*Waterbury:* H. S. Coe & Co., Inc.	11.13	1.31	**9.38**	10.50	2.93	6.00	71.77	**3.48**	5.00
5549	*Yellow.* Quaker Oats Co., Chicago, Ill.	*Waterbury:* H. S. Coe & Co., Inc.	10.40	2.37	10.50	10.50	3.60	6.00	67.85	5.28	5.00
5721	*Paragon.* St. Albans Grain Co., St. Albans, Vt.	*Brooklyn:* C. G. Lawton	9.28	3.87	10.56	10.00	4.50	7.00	65.06	6.73	6.00
	RYE PRODUCTS.										
5636	*Wingold Middlings with Screenings.* Bay State Milling Co., Winona, Minn.	*Torrington:* D. L. Talcott	8.88	3.76	16.81	16.60	5.48	7.40	61.27	3.80	3.50
5228	*Middlings.* Miner-Hillard Milling Co., Wilkes-Barre, Pa.	*Wallingford:* A. E. Hall	10.90	3.41	15.88	12.00	3.50	5.00	63.41	2.90	2.50
6315	*Irving Mills Feed.* Van Vechten Milling Co., Rochester, N. Y.	*Higganum:* F. A. Petrofsky	9.98	3.29	16.00	13.00	3.40	10.00	64.45	2.88	2.00
	BREWERS' AND DISTILLERS' GRAINS.										
5841	*Dried Brewers' Grains.* Farmers' Feed Co.. Buffalo, N. Y.	*Plantsville:* C. A. Cowles	3.78	2.89	30.31	22.00	10.53	15.00	43.09	9.40	6.00
6014	*Alco Distillers' Grains.* C. J. Martenis Grain Co., New York	*Plantsville:* C. A. Cowles	5.50	1.60	28.75	25.00	10.95	15.00	44.17	9.03	5.00
5216	*Dried Brewers' Grains.* St. Albans Grain Co., St. Albans, Vt.	*Kensington:* I. F. Labieniec	8.70	3.40	**21.25**	23.00	12.48	13.50	47.67	6.50	6.00
5802	*Dried Brewers' Grains.* St. Albans Grain Co., St. Albans, Vt.	*Guilford:* F. C. Morse & Son	5.43	3.94	23.25	23.00	13.18	13.50	46.90	7.30	6.00
	DRIED BEET PULP.										
5229	Larrowe Milling Co., Detroit, Mich.	*Wallingford:* A. E. Hall	8.08	4.03	10.50	8.00	17.95	22.00	58.51	0.93	0.50
6272	*Molasses Beet Pulp* Larrowe Milling Co., Detroit, Mich.	*Putnam:* Dayville Grain Co.	8.53	6.38	7.69	8.00	13.90	20.00	62.90	0.60	0.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1926—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS.										
	Horse Feed, etc.										
4882	*Amco.* American Milling Co., Peoria, Ill.	*Stamford:* Francis H. Leggett & Co.	5.21	5.05	11.75	10.00	6.53	10.00	68.59	2.87	2.50
5518	*Beacon.* Beacon Milling Co., Cayuga, N. Y.	*New Milford:* W. L. Richmond & Son	6.38	4.02	10.44	9.00	5.55	11.00	70.21	3.40	2.50
5757	*Provender.* C. W. Campbell Co., Westerly, R. I.	Sampled at factory	9.18	2.34	11.38	10.00	6.08	9.00	65.82	5.20	4.00
5351	*Co-Pro-Co.* Corn Products Refining Co., New York City	*Wallingford:* Laden Bros.	8.10	4.65	9.50	8.00	10.80	12.00	63.95	3.00	2.50
5516	*Davis.* R. G. Davis & Sons, New Haven	*Westville:* Davis Feed Store	5.50	3.29	10.75	9.00	7.70	10.00	68.53	4.23	3.00
5805	*Davis No. 1 Provender.* R. G. Davis & Sons, New Haven	Sampled at factory	9.40	2.82	10.94	10.00	8.28	8.00	64.71	3.85	3.50
5495	*Alfalfa Meal.* Denver Alfalfa Milling Co., Lamar, Colo.	*Torrington:* F. L. Wadhams	7.74	9.57	14.44	12.00	28.10	35.00	38.22	1.93	1.00
6409	*Alfalfa Leaf Meal.* Denver Alfalfa Milling Co., Lamar, Colo.	*Plainville:* W. S. Eaton	8.53	10.04	19.94	20.00	19.10	18.00	39.85	2.54	2.50
3645	*Elmore, with Molasses.* Elmore Milling Co., Oneonta, N. Y.	*Beacon Falls:* Edward Gruber	7.31	3.19	9.88	9.00	7.30	11.00	69.79	2.53	2.50
5545	*Elmore, with Molasses.* Elmore Milling Co., Oneonta, N. Y.	*Beacon Falls:* Edward Gruber	6.95	4.60	10.38	9.00	7.53	11.00	67.17	3.37	2.50
5297	*Red Rose 85.* John W. Eshelman & Son, Lancaster, Pa.	*Manchester:* Little & McKinney	9.63	3.55	10.06	9.00	7.55	10.00	65.23	3.98	3.00
5385	*Lancaster 60.* John W. Eshelman & Son, Lancaster, Pa.	*Simsbury:* Woods Chandler Co.	9.03	5.92	10.50	9.00	9.95	10.00	61.42	3.18	2.50
4116	*Liberty.* John W. Eshelman & Son, Lancaster, Pa.	*Bridgeport:* Federal Grain Corp.	6.48	8.25	9.88	7.00	9.65	10.00	62.51	3.23	2.00
5387	*Liberty.* John W. Eshelman & Son, Lancaster, Pa.	*Shelton:* Wolf Savinsky	7.95	7.69	8.56	7.00	9.88	10.00	63.54	2.38	2.00
5381	*Thorobred.* John W. Eshelman & Son, Lancaster, Pa.	*Manchester:* Little & McKinney	9.30	1.81	10.63	9.50	3.65	4.00	70.13	4.48	4.00
5847	*Garden Spot.* John W. Eshelman & Son, Lancaster, Pa.	*Norwalk:* Frank Libner & Son	8.65	5.73	8.63	7.00	7.08	10.00	67.21	2.70	2.00
5652	*Vio.* Flory Milling Co., Bangor, Pa.	*Long Hill:* Long Hill Feed Store	4.69	10.30	9.69	6.00	10.98	12.00	61.44	2.90	2.00
6262	*Bronco.* Grain Belt Mills Co., St. Joseph, Mo.	*Middletown:* Meech & Stoddard, Inc.	13.10	8.87	9.69	9.00	12.00	15.00	54.71	1.63	2.00
6413	*Bronco.* Grain Belt Mills Co., St. Joseph, Mo.	*Middletown:* Meech & Stoddard, Inc.	11.48	9.28	10.19	9.00	12.50	15.00	54.92	1.63	2.00
5801	*Algrane.* Hecker H-O Co., Buffalo, N. Y.	*Westerly:* C. W. Campbell Co.	9.43	4.88	10.31	10.00	10.08	10.00	61.72	3.58	3.00
5188	*Re-Ground Oat.* Hecker H-O Co., Buffalo, N. Y.	*Plantsville:* C. A. Cowles	6.38	6.31	6.94	5.00	24.68	28.00	52.91	2.78	2.00
5366	*Imperial.* Imperial Grain & Milling Co., Toledo, Ohio	*Middletown:* Meech & Stoddard, Inc.	11.40	2.08	9.81	9.50	4.83	4.00	67.43	4.45	4.00
5886	*Imperial.* Imperial Grain & Milling Co., Toledo, Ohio	*East Hartford:* Meech Grain Co.	10.88	2.05	10.38	9.50	4.33	4.00	67.83	4.53	4.00
5845	*Green Velvet.* Meader Milling Co., Hoboken, N. J.	*East Bridgeport:* Kaplan Feed Co.	6.25	10.35	12.00	9.00	16.43	20.00	54.39	0.58	0.50
5846	*Monogram.* Meader Milling Co., Hoboken, N. J.	*East Bridgeport:* Kaplan Feed Co.	7.28	7.07	15.94	12.00	10.98	12.00	55.48	3.25	2.00
5357	*Red Wing, with Molasses.* Meech & Stoddard, Inc., Middletown	Sampled at factory	9.35	3.73	10.25	9.00	7.93	10.00	64.41	4.33	3.00
6314	*"1795" Steam Cooked Corn and Oats.* Miner-Hillard Milling Co., Wilkes-Barre, Pa.	*Westerly:* C. W. Campbell Co.	9.73	2.14	10.25	9.50	5.03	5.00	68.42	4.43	4.00
5650	*Old Time.* Geo. Q. Moon & Co., Binghamton, N. Y.	*Norfolk:* Aug. P. Curtis	10.70	2.38	11.25	8.50	6.70	9.00	64.34	4.63	4.50
5335	*Old Mill Provender.* Fred C. Morse, Guilford	Sampled at factory	10.55	2.45	10.50	10.00	5.55	7.00	66.42	4.53	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1926—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Horse Feeds—Concluded.										
5553	*Domino Vim-O-Lene.* Nowak Milling Corp., Hammond, Ind.	*Waterville:* Wooster's Feed Store	5.45	2.75	11.50	8.00	6.50	9.00	69.85	3.95	2.00
5325	*Osborn Provender.* S. V. Osborn Est., Branford	Sampled at factory	11.38	2.28	9.75	10.00	8.00	8.00	64.69	3.90	4.00
5671	*Arlington.* Park & Pollard Co., Buffalo, N. Y.	*West Stafford:* C. P. Bradway	4.33	4.81	10.94	9.00	8.60	11.00	66.76	4.56	2.50
5548	*Chelsea.* Park & Pollard Co., Buffalo, N. Y.	*Waterbury:* Spencer Grain Co.	6.70	8.21	9.31	8.00	12.58	12.00	61.22	1.98	2.00
4871	*Herdhelth.* Park & Pollard Co., Buffalo, N. Y.	*Newtown:* R. H. Holcomb Co.	5.08	10.53	18.31	16.00	11.47	12.00	49.95	4.66	6.00
5541	*Herdhelth.* Park & Pollard Co., Buffalo, N. Y.	*Newtown:* R. H. Holcomb Co.	6.98	10.14	18.63	16.00	11.63	12.00	49.04	3.58	6.00
6250	*Herdhelth.* Park & Pollard Co., Buffalo, N. Y.	*Newtown:* R. H. Holcomb Co.	12.58	9.17	15.31	16.00	10.64	12.00	48.00	4.30	4.00
4811	*Green Cross.* Quaker Oats Co., Chicago, Ill.	*Thompsonville:* Geo. S. Phelps & Co.	9.39	5.63	11.94	10.00	11.43	12.00	58.97	2.64	2.50
5204	*Green Cross.* Quaker Oats Co., Chicago, Ill.	*Thompsonville:* Geo. S. Phelps & Co.	8.25	6.21	12.13	10.00	11.10	12.00	59.86	2.45	2.50
5160	*Vim.* Quaker Oats Co., Chicago, Ill.	*Plantsville:* C. A. Cowles	6.33	6.93	6.25	5.00	25.35	28.00	53.21	1.93	2.00

4868	*Purina Bulky Las.* Ralston Purina Mills, St. Louis, Mo.	*Derby:* Peterson-Hendee Co.	7.58	9.10	13.75	9.00	14.60	15.00	52.79	2.18	2.00
5364	*Purina Bulky Las.* Ralston Purina Mills, St. Louis, Mo.	*Middletown:* H. G. Wadhams Co.	8.75	9.49	12.31	9.00	11.18	15.00	56.83	1.44	2.00
5720	*Purina Bulky Las.* Ralston Purina Mills, St. Louis, Mo.	*New Haven:* Moran-Patton Co.	6.35	7.92	11.00	9.00	14.83	15.00	58.15	1.75	2.00
5419	*Purina O-Molene.* Ralston Purina Mills, St. Louis, Mo.	*Unionville:* F. D. Lawton & Son	9.00	3.95	11.00	9.70	6.74	9.00	64.46	4.85	3.20
5808	*Special Rosebro.* Rosenbaum Bros., Chicago, Ill.	*East Bridgeport:* Kaplan Feed Co.	4.78	5.22	10.13	10.00	9.05	11.00	66.72	4.10	2.00
5305	*Syragold, with Molasses.* Syracuse Milling Co., Syracuse, N. Y.	*Rockville:* Rockville Milling Co.	9.23	4.81	11.25	8.00	8.00	12.00	63.56	3.15	2.50
5760	*Jordan, with Molasses.* Syracuse Milling Co., Syracuse, N. Y.	*So. Norwalk:* Roodner Feed Co.	5.05	5.39	9.88	7.00	11.50	12.00	65.04	3.14	2.00
5591	*Derby Corn and Oat Feed.* Tioga Mill & Elevator Co., Waverly, N. Y.	*Hawleyville:* W. A. Honan	11.15	2.28	10.50	9.20	5.08	8.00	66.14	4.85	4.00
6572	*Derby Meal.* Tioga-Empire Feed Mill, Waverly, N. Y.	*Hawleyville:* W. A. Honan	13.83	1.42	9.00	9.02	2.63	3.50	68.87	4.25	3.06
	Dairy Feeds.										
5170	*Claco.* C. L. Adams Co., Woodbury	*West Cheshire:* Cheshire Grain & Coal Co.	9.83	7.14	21.50	20.00	8.68	9.00	47.60	5.25	5.00
5400	*Amco 20% Empire.* American Milling Co., Peoria, Ill.	*Farmington:* T. E. Stephenson	8.83	7.64	21.63	20.00	7.61	9.00	49.76	4.53	4.50
5825	*Amco 24% Universal.* American Milling Co., Peoria, Ill.	*Stamford:* Clapboard Hill Feed Co.	9.00	8.75	25.50	24.00	6.93	9.00	44.84	4.98	5.00
4877	*Empire.* American Milling Co., Peoria, Ill.	*Middletown:* Chas. Dragoo	7.05	7.25	22.56	20.00	6.31	9.00	51.92	4.91	4.00
4881	*Universal.* American Milling Co., Peoria, Ill.	*Stamford:* Francis H. Leggett & Co.	8.60	8.06	24.56	24.00	8.80	9.00	44.85	5.13	5.00
5437	*Advanced Registry.* Arcady Farms Milling Co., Chicago, Ill.	*Simsbury:* Woods Chandler Co.	9.43	4.68	22.88	25.00	8.65	10.00	49.01	5.35	5.00
5865	*Advanced Registry.* Arcady Farms Milling Co., Chicago, Ill.	*Simsbury:* Woods Chandler Co.	8.58	6.12	24.88	25.00	8.25	10.00	47.09	5.08	5.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1926—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25) Found	Protein (N x 6.25) Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat Found	Fat Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Dairy Feeds—Continued.										
5373	*Peerless Milk Ration.* Arcady Farms Milling Co., Chicago, Ill.	*So. Manchester:* Smith Bros.	8.98	8.01	16.75	20.00	11.60	12.00	50.75	3.91	4.00
5374	*Sweet 16.* Arcady Farms Milling Co., Chicago, Ill.	*So. Manchester:* Smith Bros.	9.35	7.89	16.69	16.00	11.89	12.00	50.30	3.88	4.00
5822	*Wonder.* Arcady Farms Milling Co., Chicago, Ill.	*Plantsville:* Mehmel & Sarvi	7.38	6.03	27.00	24.00	9.13	10.00	45.06	5.40	5.00
6266	*Bailey's Open Formula 20%.* E. W. Bailey & Co., Montpelier, Vt.	*Mansfield Depot:* M. M. Hanson	10.90	7.52	21.13	20.00	8.55	9.00	47.25	4.65	4.50
5669	*Capitol.* E. W. Bailey & Co., Montpelier, Vt.	*Mansfield Depot:* M. M. Hanson	8.83	5.19	25.19	24.00	7.96	9.00	47.43	5.40	5.00
5677	*Favorite.* E. W. Bailey & Co., Montpelier, Vt.	*West Willington:* H. M. Hanson	9.08	5 05	22.56	20.00	7.15	7.50	51.38	4.78	5.50
6265	*Favorite.* E. W. Bailey & Co., Montpelier, Vt.	*West Willington:* H. M. Hanson	9.40	4.34	22.00	20.00	7.40	7.50	51.51	5.35	5.50
5467	*Auburn.* Beacon Milling Co., Cayuga, N. Y.	*Derby:* Peterson-Hendee Co.	9.93	7.57	22.19	20.00	6.43	10.00	49.10	4.78	4.50
5519	*Beacon.* Beacon Milling Co., Cayuga, N. Y.	*New Milford:* W. L. Richmond & Son	10.15	6.79	23.31	24.00	8.13	10.00	46.74	4.88	5.00
5166	*Beers.* I. W. Beers, Hamden	Sampled at factory	10.18	4.76	20.63	19.00	8.18	8.00	51.55	4.70	3.75

5259	*Success.* Amos D. Bridges' Sons, Hazardville	Sampled at factory	10.00	4.93	22.38	20.00	8.28	9.50	49.21	5.20	5.20
6576	*C. B.* C. Buckingham Co., Southport	Sampled at factory	9.45	5.91	17.88	18.00	10.05	8.70	52.01	4.70	4.80
5756	*No-Botheration.* C. W. Campbell Co., Westerly, R. I.	Sampled at factory	8.55	5.87	20.56	20.00	6.03	8.00	54.15	4.84	5.00
5198	Unicorn. Chapin & Co., Chicago, Ill.	*Plantsville:* C. A. Cowles	8.80	8.01	23.75	24.00	8.63	10.00	45.21	5.60	5.00
6201	*20% Dairy Ration.* The Coles Co., Middletown	Sampled at factory	8.30	5.15	23.00	20.00	8.93	10.00	49.59	5.03	4.00
6256	*24% Dairy Ration.* The Coles Co., Middletown	Sampled at factory	8.98	6.29	22.75	24.00	10.03	12.00	47.40	4.55	4.50
6598	*24% Dairy Ration.* The Coles Co., Middletown	Sampled at factory	9.97	5.06	19.50	24.00	9.43	12.00	51.59	4.45	4.50
5477	*Crosby's Balanced Ration.* Crosby Milling Co., Brattleboro, Vt.	*Shelton:* Wolf Savinsky	9.43	5.51	25.00	25.00	8.25	9.00	45.88	5.93	5.50
5833	*Crosby's 22%.* Crosby Milling Co., Brattleboro, Vt.	Sampled at factory	6.53	6.16	26.25	22.00	8.78	14.00	47.05	5.23	4.00
5594	*Cowles' 24% Dairy Ration.* C. A. Cowles, Plantsville	Sampled at factory	8.15	5.14	25.44	24.00	7.66	10.00	47.23	6.38	6.00
5475	*Crosby's Ready Ration.* Crosby Milling Co., Brattleboro, Vt.	*Shelton:* Wolf Savinsky	9.60	4.84	20.19	20.00	7.77	10.00	52.47	5.13	5.00
5481	*Basic Dairy Ration.* R. G. Davis & Sons, New Haven	*Ansonia:* Ansonia Flour & Feed Co.	10.05	5.39	21.56	20.00	7.70	9.00	50.05	5.25	4.50
5378	*Delaware Dairy Feed.* Delaware Mills, Deposit, N. Y.	*Southington:* Southington Lumber & Feed Co.	9.20	6.05	22.88	23.00	9.84	10.00	45.48	6.55	5.00
5719	*Devon.* Devon Coal & Ice Co., Devon	Sampled at factory	8.60	5.68	20.25	22.00	10.05	9.00	50.32	5.10	4.00
6235	*Devon.* Devon Coal & Ice Co., Devon	Sampled at factory	9.78	5.96	19.69	22.00	10.45	9.00	49.59	4.53	4.00
5490	*Eastern States Fitting Ration.* Eastern States Farmers' Exchange, Springfield, Mass.	*Seymour:* John Swan	10.09	6.71	15.69	15.00	6.85	8.00	55.72	4.94	3.50
5489	*Eastern States Full Pail Dairy Ration.* Eastern States Farmers' Exchange, Springfield, Mass.	*Seymour:* John Swan	8.37	8.01	21.88	20.00	7.15	9.00	49.11	5.48	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1926—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Dairy Feeds—Continued.										
5660	*Eastern States Milkmore Dairy Ration.* Eastern States Farmers' Exchange, Springfield, Mass.	*Farmington:* Albert Thompson..	7.78	7.53	24.56	24.00	7.15	9.00	46.90	6.08	4.50
5257	*Elmore Milk Grains.* Elmore Milling Co., Oneonta, N. Y. ..	*Thompsonville:* Geo. S. Phelps & Co.	8.40	5.09	26.00	25.00	9.33	11.00	45.48	5.70	5.00
5884	*Conestoga 18 Dairy Feed.* John W. Eshelman & Son, Lancaster, Pa.	*Danbury:* F. C. Benjamin	8.88	8.25	21.38	18.00	11.13	10.00	44.48	5.88	3.50
5227	*Lancaster 20 Dairy Feed.* John W. Eshelman & Son, Lancaster, Pa.	*Wallingford:* A. E. Hall	8.15	6.02	21.19	20.00	10.00	10.00	48.94	5.70	4.00
4803	*Pennsy 16 Dairy Feed.* John W. Eshelman & Son, Lancaster, Pa.	*Stepney:* H. Goldman	16.48	7.60	17.31	16.00	11.27	10.00	43.13	4.21	3.00
5598	*Pennsy 16 Dairy Feed.* John W. Eshelman & Son, Lancaster, Pa.	*Stepney:* M. Nusbaum	6.08	8.35	20.63	16.00	10.78	10.00	46.28	7.88	3.00
6530	*Pennsy 16 Dairy Feed.* John W. Eshelman & Son, Lancaster, Pa.	*Stepney:* M. Nusbaum	11.20	6.70	17.31	16.00	10.58	11.00	47.98	6.23	3.00
6230	*Red Rose 24 Dairy Feed.* John W. Eshelman & Son, Lancaster, Pa.	*Wallingford:* A. E. Hall	10.55	6.62	23.63	24.00	9.67	11.00	44.43	5.10	4.00
5512	*Globe Cow Feed.* Flory Milling Co., Bangor, Pa.	*Thomaston:* I. Levy	10.08	6.83	22.56	20.00	9.90	11.00	45.60	5.03	4.00
5601	*National Cow Feed.* Flory Milling Co., Bangor, Pa.	*Long Hill:* Long Hill Feed Store	6.78	7.34	18.31	16.50	10.93	11.00	52.59	4.05	3.50
6228	*R. Own Dairy Ration.* A. W. Forbes, East Haven	Sampled at factory	11.68	5.65	20.94	19.00	6.68	9.00	51.85	3.20	4.00
5809	*Algrane Milk Feed.* Hecker H-O Co., Buffalo, N. Y.	*So. Norwalk:* Roodner Feed Co.	8.00	5.84	17.00	16.00	10.03	15.00	55.05	4.08	4.00
4870	*Holcomb's Special.* R. H. Holcomb, Newtown	Sampled at factory	8.50	8.39	21.44	22.00	13.18	12.00	44.32	4.17	4.00
5629	*"Hudson's" Cow Feed.* L. W. Hudson, Windsor	Sampled at factory	8.55	5.29	19.44	20.00	7.98	8.00	53.54	5.20	5.50
3718	*"Hudson's" Cow Feed.* L. W. Hudson, Windsor	Sampled at factory	8.18	5.78	20.06	20.00	7.65	8.17	52.43	5.90	5.91
6313	*International Diamond.* International Sugar Feed Co., Minneapolis, Minn.	*Putnam:* Dayville Grain Co.	11.45	9.22	21.44	24.00	11.08	10.00	41.63	5.18	5.00
6311	*International Ready Ration.* International Sugar Feed Co., Minneapolis, Minn.	*Putnam:* Dayville Grain Co.	11.55	8.66	21.88	20.00	10.83	11.50	41.90	5.18	5.00
6312	*International Special.* International Sugar Feed Co., Minneapolis, Minn.	*Putnam:* Dayville Grain Co.	12.28	8.84	14.69	15.00	13.03	12.00	45.57	5.59	4.50
5644	*Apex Milk Maker.* Kasco Grain Mills, Waverly, N. Y.	*East Winsted:* Leonard Grain Co.	9.15	5.24	20.81	20.00	8.98	11.00	50.74	5.08	4.50
5645	*Beatsall Milk Grains.* Kasco Grain Mills, Waverly, N. Y.	*East Winsted:* Leonard Grain Co.	10.46	5.63	23.19	22.00	8.93	10.00	47.71	4.08	4.50
6016	*Beatsall Milk Grains.* Kasco Grain Mills, Waverly, N. Y.	*East Winsted:* Leonard Grain Co.	9.18	5.49	23.38	22.00	8.28	10.00	48.34	5.33	4.50
5153	Larro. Larrowe Milling Co., Detroit, Mich.	*Highwood:* T. C. Hadden & Co.,	9.28	5.50	21.19	20.00	10.23	12.00	49.57	4.23	4.00
5370	*Millpride Dairy Ration.* C. W. Lines Co., New Britain	Sampled at factory	9.63	6.41	26.69	24.00	7.50	10.00	44.77	5.00	5.50
5890	*Millpride Dairy Ration.* C. W. Lines Co., New Britain	Sampled at factory	8.85	6.53	26.94	24.00	7.00	10.00	44.93	5.75	5.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1926—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Dairy Feeds—Continued.										
5996	*Common-Sense Dairy Ration.* Litchfield Co-op. Assoc., Torrington	Sampled at factory	8.50	6.50	21.88	20.00	7.80	9.50	49.90	5.42	5.00
3636	*Common-Sense Dairy Ration.* Litchfield Co-op. Assoc., Torrington	Sampled at factory	8.40	6.67	20.88	20.00	8.33	9.50	50.38	5.34	5.00
5599	*Square Deal Dairy Ration.* Long Hill Feed Store, Long Hill	Sampled at factory	8.60	6.96	21.88	20.00	9.25	10.00	48.31	5.00	5.00
5574	*Red Star.* E. Manchester & Sons, Winsted	Sampled at factory	8.80	6.56	24.00	23.00	8.14	10.00	47.22	5.28	4.00
5223	*Bull Brand.* Maritime Milling Co., Buffalo, N. Y.	*North Haven:* W. L. Thorpe	8.85	7.75	23.56	24.00	10.25	12.00	44.06	5.53	6.00
5714	*Bull Brand.* Maritime Milling Co., Buffalo, N. Y.	*Riverton:* L. A. Coe	8.68	6.64	24.00	24.00	9.83	12.00	45.05	5.80	6.00
5722	*Hi-Test.* Maritime Milling Co., Buffalo, N. Y.	*Colchester:* P. Cutler, Inc.	7.75	8.18	20.88	20.00	10.88	12.00	47.16	5.15	5.00
5232	*Red Wing.* Meech & Stoddard, Inc., Middletown	*Meriden:* Meriden Grain & Coal Co.	8.40	6.89	21.06	20.00	8.03	9.00	49.07	6.55	5.50
5183	*Red Wing Special.* Meech & Stoddard, Inc., Middletown	*Plantsville:* Mehmel & Sarvi	8.03	5.15	23.69	24.00	7.73	9.00	47.95	7.45	5.50
5648	*Moon's 24% Dairy Ration.* Geo. Q. Moon & Co., Binghamton, N. Y.	*Norfolk:* Aug. P. Curtis	9.07	5.41	26.13	24.00	7.48	10.00	46.41	5.50	5.00
5333	*Old Mill Dairy Ration.* Fred C. Morse, Guilford	Sampled at factory	8.70	6.63	23.06	23.00	8.83	9.00	46.68	6.10	5.00
5347	*Domino 24 1-2 Dry Dairy Feed.* Nowak Milling Corp., Hammond, Ind.	*Higganum:* F. A. Petrofsky	8.43	7.75	24.13	24.50	9.35	10.00	45.39	4.95	5.00
5555	*Domino 32% Protein.* Nowak Milling Corp., Hammond, Ind.	*Waterville:* Wooster's Feed Store	8.75	8.56	30.88	32.00	8.86	10.00	38.25	4.70	4.50
5392	*Hammond.* Nowak Milling Corp., Hammond, Ind.	*Manchester:* I. P. Campbell	6.25	11.76	17.81	16.50	11.28	13.50	46.97	5.93	4.00
5393	*Marathon.* Nowak Milling Corp., Hammond, Ind.	*Manchester:* I. P. Campbell	9.15	6.70	22.38	22.00	10.00	12.00	46.59	5.18	4.00
5550	*Uncle John's Cream Pot Ration.* Ontario Milling Co., Oswego, N. Y.	*Waterbury:* H. S. Coe & Co., Inc.	8.50	6.20	24.25	24.00	7.53	9.00	47.24	6.28	5.50
6270	*Bet-R-Milk Ration.* Park & Pollard Co., Buffalo, N. Y.	*Putnam:* Bosworth Bros.	11.25	9.39	21.00	20.00	10.23	10.00	40.60	7.53	5.00
5168	*Milk Maid 24% Dairy Ration.* Park & Pollard Co., Buffalo, N. Y.	*West Cheshire:* Cheshire Grain & Coal Co.	8.58	9.65	24.50	24.00	11.80	11.00	40.37	5.10	5.00
5668	*Milk Maid 24% Dairy Ration.* Park & Pollard Co., Buffalo, N. Y.	*So. Coventry:* E. W. Latimer	9.18	8.56	24.44	24.00	11.25	11.00	41.17	5.40	5.00
5679	*The Park & Pollard Co. 16% Dairy Ration.* Park & Pollard Co., Buffalo, N. Y.	*Moosup:* T. E. Main & Sons	8.43	8.87	17.63	16.00	10.30	14.00	50.62	4.15	5.00
5540	*The Park & Pollard Co. 20% Dairy Ration.* Park & Pollard Co., Buffalo, N. Y.	*Newtown:* R. H. Holcomb Co.	8.78	8.56	21.44	20.00	9.37	12.00	47.22	4.63	5.00
5882	*The Park & Pollard Co. 20% Dairy Ration.* Park & Pollard Co., Buffalo, N. Y.	*Putnam:* Bosworth Bros.	9.70	9.00	20.00	20.00	8.50	12.00	48.30	4.50	5.00
5539	*Stevens "44" Sweetened Dairy Ration.* Park & Pollard Co., Buffalo, N. Y.	*Southbury:* H. R. Stone	7.98	8.44	23.63	24.00	9.26	12.00	45.76	4.93	5.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1926—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25) Found	Protein (N x 6.25) Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat Found	Fat Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Dairy Feeds—Continued.										
5321	*Pillsbury Dairy Ration.* Pillsbury Flour Mills, Minneapolis, Minn.	*Rockville:* Rockville Milling Co.	9.88	7.10	21.31	20.00	8.45	10.00	48.18	5.08	5.00
5439	*Burt's Cereal Feed.* Postum Cereal Co., Battle Creek, Mich.	*Weatogue:* R. B. Eno	7.88	3.96	20.19	17.00	15.75	20.00	47.38	4.84	3.00
5435	*Burt's Dairy Feed.* Postum Cereal Co., Battle Creek, Mich.	*Granby:* E. H. Rollins	8.18	6.19	23.25	24.00	7.80	9.00	49.44	5.14	5.00
6263	*A. D. P. 24% Dairy Ration.* W. N. Potter & Son, Greenfield, Mass.	*Andover:* E. A. Standish	10.15	6.40	24.06	24.00	6.28	10.00	49.06	4.05	4.00
6003	*Armour's 24% Dairy Feed.* Pratt Food Co., Buffalo, N. Y.	*Danbury:* C. S. Barnum & Sons	7.43	8.29	**20.44**	24.00	12.65	12.00	45.64	5.55	5.00
5295	*Producer.* H. C. Puffer Co., Springfield, Mass.	*Bloomfield:* Bloomfield Farmers' Exchange	9.83	6.21	25.50	24.00	7.18	10.00	45.60	5.68	3.50
5154	*Big Q Dairy Ration.* Quaker Oats Co., Chicago, Ill.	*Highwood:* T. C. Hadden & Co.	8.30	7.90	20.25	20.00	11.30	12.00	48.10	4.15	3.25
5264	*Boss.* Quaker Oats Co., Chicago, Ill.	*Warehouse Point:* C. T. Lewis..	8.50	7.54	24.88	24.00	9.15	10.50	44.50	5.43	4.00
4794	*Quaker 16% Ration.* Quaker Oats Co., Chicago, Ill.	*Rockville:* Rockville Milling Co.	17.79	7.94	17.44	16.00	9.89	13.50	42.67	4.27	4.00

5263	*Quaker 16% Ration.* Quaker Oats Co., Chicago, Ill.	*Warehouse Point:* C. T. Lewis..	8.70	8.41	16.13	16.00	13.38	13.50	48.68	4.70	4.00
5568	*Protena.* Ralston Purina Co., St. Louis, Mo.	*Litchfield:* Wadhams Co.	9.40	7.09	18.94	16.50	11.45	12.00	49.17	3.95	3.50
5363	*Purina Cow Chow.* Ralston Purina Co., St. Louis, Mo.	*Middletown:* H. G. Wadhams Co.	9.58	6.65	25.94	24.00	10.18	12.00	42.82	4.83	4.00
5838	*Diamond.* Rockville Grain & Coal Co., Rockville	Sampled at factory	7.50	6.78	24.69	24.00	9.45	10.00	46.33	5.25	5.00
5693	*Advance.* Rosenbaum Bros., Chicago, Ill.	*Danielson:* Dayville Grain Co	8.33	8.67	17.88	16.00	11.03	14.00	47.14	6.95	3.50
6008	*Will Pay Dairy Ration.* Rosenbaum Bros., Chicago, Ill.	*Thompsonville:* Geo. S. Phelps & Co.	9.25	8.96	20.69	20.00	8.40	9.00	48.37	**4.33**	5.00
5858	*Homespun Dairy Ration.* Paty Schwartz Co., New London	Sampled at factory	8.15	5.32	23.13	22.00	9,48	10.00	49.69	4.23	4.00
5486	*See-More-Milk Dairy Ration.* Seymour Grain & Coal Co., Seymour	Sampled at factory	9.28	5.91	21.88	20.00	7.74	8.00	49.80	5.39	4.50
5414	*Mill Streams Boomerang.* Winchell Smith, Inc., Farmington	Sampled at factory	9.45	5.14	**22.06**	24.00	5.97	10.00	52.50	4.88	6.00
5863	*Mill Streams Boomerang.* Winchell Smith, Inc., Farmington	Sampled at factory	9.13	5.41	**23.13**	24.00	5.73	10.00	51.75	4.85	6.00
5415	*Mill Streams 20% Dairy Feed.* Winchell Smith, Inc., Farmington	Sampled at factory	9.30	5.89	20.38	20.00	7.65	8.00	52.15	4.63	5.00
5864	*Mill Streams 20% Dairy Feed.* Winchell Smith, Inc., Farmington	Sampled at factory	9.38	6.06	20.75	20.00	7.85	8.00	51.23	4.73	5.00
6267	*King Dairy Feed with Beet Pulp.* St. Albans Grain Co., St. Albans, Vt.	*Willimantic:* Willimantic Grain Co.	10.28	5.21	21.56	21.00	9.60	11.00	48.80	4.55	4.50
5666	*King 22 Protein Milk Ration.* St. Albans Grain Co., St. Albans, Vt.	*Norwich:* Norwich Grain Co. ..	8.88	6.96	23.63	22.00	8.88	10.00	46.57	5.08	5.00
5583	*Paragon.* St. Albans Grain Co., St. Albans, Vt.	*Lakeville:* E. W. Spurr Co.	8.60	7.91	21.69	22.00	11.30	12.00	45.87	4.63	4.00
5159	*Wirthmore Balanced Dairy Ration.* St. Albans Grain Co., St. Albans, Vt.	*West Cheshire:* Cheshire Grain & Coal Co.	9.33	5.33	26.19	25.00	8.48	9.00	45.04	5.63	5.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1926—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Dairy Feeds—Concluded.										
5207	*Wirthmore 20% Dairy Feed.* St. Albans Grain Co., St. Albans, Vt.	*Plainville:* F. B. Newton	9.63	5.08	21.75	20.00	7.43	9.00	50.41	5.70	5.00
6247	*Jordan Sweet.* Syracuse Milling Co., Syracuse, N. Y.	*Southport:* C. Buckingham & Co.	10.78	6.50	16.63	16.00	11.38	12.00	50.03	4.68	3.00
5354	*Onondaga.* Syracuse Milling Co., Syracuse, N. Y.	*Middletown:* H. G. Wadhams Co.	8.33	6.28	22.75	20.00	11.10	12.00	46.20	5.34	4.00
5299	*Syragold.* Syracuse Milling Co., Syracuse, N. Y.	*Manchester:* Little & McKinney	8.95	4.67	25.00	24.00	10.00	12.00	45.13	6.25	4.50
5298	*Syragold Milk Ration.* Syracuse Milling Co., Syracuse, N. Y.	*Manchester:* Little & McKinney	9.20	5.17	22.00	20.00	9.68	12.00	48.60	5.35	4.00
4865	*Talcott's Economy Dairy Ration.* D. L. Talcott, Torrington	Sampled at factory	10.53	5.25	23.63	23.00	7.60	9.00	47.95	5.04	5.00
5496	*Talcott's Economy Dairy Ration.* D. L. Talcott, Torrington	Sampled at factory	8.58	6.01	24.88	23.00	8.23	9.00	47.32	4.98	4.50
3639	*Thomaston Dairy Ration.* Thomaston Supply Co., Thomaston	Sampled at factory	9.21	6.66	22.88	20.00	7.38	8.00	48.97	4.90	6.00
5500	*Thomaston Dairy.* Thomaston Supply Co., Thomaston	Sampled at factory	9.38	6.84	22.75	20.00	7.30	8.00	48.18	5.55	5.00
5342	*Red Brand.* Tioga Mill & Elevator Co., Waverly, N. Y.	*Guilford:* F. H. Rolf	8.75	7.01	27.38	24.00	8.08	10.00	43.25	5.53	4.50
5433	*Union Grains, Biles Ready Dairy Ration.* Ubiko Milling Co., Cincinnati, Ohio	*Hartford:* C. A. Pease & Co.	8.95	5.49	23.81	24.00	9.54	10.00	47.03	5.18	5.00
5466	*United Dairy Ration.* United Flour & Feed Co., Albany, N. Y.	*Weatogue:* R. B. Eno	9.68	5.72	24.31	24.00	9.12	11.00	45.82	5.35	5.00
5265	*Waldorf Milk Grains.* United Flour & Feed Co., Albany, N. Y.	*Windsor:* W. C. Everett	9.38	4.45	22.13	20.00	7.60	10.00	51.36	5.08	3.50
5633	*Wadfeeco Dairy Ration.* Wadsworth Feed Co., Warren, Ohio	*Shelton:* Shelton Feed Co.	8.80	6.54	24.88	24.00	7.58	9.00	46.90	5.30	5.00
5632	*Wadsworth Special Dairy Ration.* Wadsworth Feed Co., Warren, Ohio	*Shelton:* Shelton Feed Co.	8.18	6.38	23.63	20.00	10.95	12.00	45.83	5.03	5.00
5738	*Big Y Dairy Ration.* Yantic Grain & Products Co., Norwich	*Willimantic:* Boston Grain Co.	8.13	6.61	24.75	25.00	8.20	10.00	46.66	5.65	5.00
5742	*Echo.* Yantic Grain & Products Co., Norwich	*Norwich:* Greenville Grain Co.	7.60	6.79	24.63	24.00	11.68	12.00	44.00	5.30	4.50
6280	*Perfection.* Yantic Grain & Products Co., Norwich	Sampled at factory	8.90	6.93	21.81	22.00	13.18	13.00	44.54	4.64	4.50
5741	*Uncas.* Yantic Grain & Products Co., Norwich	*Moosup:* Moosup Grain Co.	8.83	5.55	22.19	20.00	7.75	9.00	50.43	5.25	5.00
6403	*Uncas.* Yantic Grain & Products Co., Norwich	Sampled at factory	11.63	6.10	19.44	20.00	7.25	9.00	51.38	4.20	5.00
	Stock Feeds.										
5823	*Arcady.* Arcady Farms Milling Co. Chicago, Ill.	*So. Manchester:* Smith Bros.	7.58	5.24	11.75	9.00	11.53	12.00	60.45	3.45	3.15
5670	*Pennant.* E. W. Bailey & Co., Montpelier, Vt.	*Mansfield Depot:* M. M. Hanson	8.45	5.07	11.31	9.50	10.20	9.50	58.72	6.25	5.50
4873	*Fortune.* The Coles Co., Middletown	Sampled at factory	15.36	3.34	9.38	9.00	8.92	11.00	58.67	4.33	5.00
6204	*Fortune.* The Coles Co., Middletown	Sampled at factory	8.35	3.40	9.81	9.00	9.80	11.00	64.54	4.10	5.00
5690	*Crosby's.* Crosby Milling Co., Brattleboro, Vt.	*Willimantic:* Windham Grain Store	8.10	4.94	11.13	9.00	12.78	12.00	57.77	5.28	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1926—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25) Found	Protein (N x 6.25) Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat Found	Fat Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Stock Feeds—Continued.										
6258	*Crosby's.* Crosby Milling Co., Brattleboro, Vt.	*Willimantic:* Windham Feed Store	9.48	4.72	9.63	9.00	10.65	12.00	60.69	4.83	4.00
5515	*Davis.* R. G. Davis & Sons, New Haven	*Westville:* Davis Feed Store	9.73	4.63	13.13	10.00	10.33	14.00	59.15	3.03	2.00
5377	*Delaware.* Delaware Mills, Deposit, N. Y.	*Southington:* Southington Lumber Co.	9.28	5.50	9.81	9.00	12.35	12.00	58.26	4.80	3.00
5717	*Devon Sweet Stock Feed.* Devon Coal & Ice Co., Devon	Sampled at factory	8.50	4.79	11.50	8.00	11.52	12.00	59.64	4.05	2.50
5544	*Elmore.* Elmore Milling Co., Oneonta, N. Y.	*Beacon Falls:* Edward Gruber	9.05	3.65	10.06	10.00	8.98	12.00	63.51	4.75	3.00
3643	*Elmore.* Elmore Milling Co., Oneonta, N. Y.	*Beacon Falls:* Edward Gruber	7.98	4.39	10.25	10.00	9.79	12.00	63.16	4.43	3.00
5384	*Eshelman's.* John W. Eshelman & Sons, Lancaster, Pa.	*Simsbury:* Woods Chandler Co.	9.60	3.60	9.31	10.00	10.18	10.00	63.01	4.30	3.00
5383	*Eshelman's Sugared.* John W. Eshelman & Sons, Lancaster, Pa.	*So. Manchester:* Smith Bros.	8.50	5.60	11.56	10.00	13.98	11.00	56.48	3.88	3.25
6238	*Eshelman's Sugared.* John W. Eshelman & Sons, Lancaster, Pa.	*So. Manchester:* Smith Bros.	8.85	5.50	12.06	10.00	14.70	11.00	55.09	3.80	3.25
5736	*Lancaster.* John W. Eshelman & Sons, Lancaster, Pa.	*Stratford:* Farmers' Flour & Grain Co.	9.03	3.64	9.50	10.00	10.60	10.00	63.65	3.58	3.00
5513	*Flory's Special.* Flory Milling Co., Bangor, Pa.	*Thomaston:* I. Levy	8.88	3.83	9.13	8.00	13.23	14.00	61.34	3.59	3.00
5798	*Algrane New England.* Hecker H-O Co., Buffalo, N. Y.	*Westerly:* C. W. Campbell Co.	8.35	5.96	10.13	9.50	10.18	9.75	61.65	3.73	4.00
6284	*Algrane New England.* Hecker H-O Co., Buffalo, N. Y.	*Westerly:* C. W. Campbell Co.	10.03	5.79	12.19	9.50	9.25	9.75	58.31	4.43	4.00
5842	*Badger.* Chas. A. Krause Milling Co., Milwaukee, Wis.	*Putnam:* Dayville Grain Co.	6.80	5.59	8.19	10.00	16.70	12.00	59.14	3.58	3.00
5843	*Sugared Badger.* A. Krause Milling Co., Milwaukee, Wis.	*Putnam:* Dayville Grain Co.	7.10	5.85	8.75	10.00	16.38	12.00	57.92	4.00	3.00
5502	*Bull.* Maritime Milling Co., Buffalo, N. Y.	*Thomaston:* P. Cunningham	9.35	3.85	11.00	10.00	10.25	10.00	60.66	4.89	3.50
5356	*Red Wing.* Meech & Stoddard, Inc., Middletown	Sampled at factory	8.70	4.81	10.38	9.00	9.38	12.00	62.30	4.43	3.00
5346	*Fidelity.* Nowak Milling Corp., Hammond, Ind.	*Higganum:* F. A. Petrofsky	9.50	4.00	8.31	8.00	10.33	12.00	64.63	3.23	3.00
5172	*Park & Pollard.* The Park & Pollard Co., Buffalo, N. Y.	*West Cheshire:* Cheshire Grain & Coal Co.	8.78	5.16	10.19	8.00	10.25	12.00	60.67	4.95	2.50
5252	*Pratt's Supreme.* Pratt Food Co., Philadelphia, Pa.	*New Britain:* S. P. Strople	9.95	4.22	9.56	9.00	9.48	12.00	62.94	3.85	3.00
4799	*Schumacher.* Quaker Oats Co., Chicago, Ill.	*Danbury:* F. C. Benjamin	12.88	6.10	10.75	10.00	10.93	12.00	56.00	3.34	3.25
5483	*Schumacher.* Quaker Oats Co., Chicago, Ill.	*Ansonia:* Ansonia Flour & Feed Co.	8.12	5.49	10.13	10.00	12.93	12.00	59.10	4.23	3.25
6017	*Schumacher.* Quaker Oats Co., Chicago, Ill.	*Ansonia:* Ansonia Flour & Feed Co.	7.53	5.66	10.94	10.00	11.60	12.00	59.67	4.60	3.25
5205	*Sugared Schumacher.* Quaker Oats Co., Chicago, Ill.	*Thompsonville:* Geo. S. Phelps & Co.	8.40	4.73	9.81	10.00	11.48	12.00	61.38	4.20	3.25
5651	*White Star.* Quaker Oats Co., Chicago, Ill.	*Long Hill:* Long Hill Feed Store	7.64	5.87	8.63	9.00	13.03	14.00	60.73	4.10	3.00
5747	*Purina Steer Fatena.* Ralston Purina Mills, St. Louis, Mo.	*New Canaan:* Clapboard Hill Feed Co.	11.83	8.89	13.88	12.00	8.73	10.00	52.24	4.43	2.50
5682	*77 Stock Feed.* Rosenbaum Bros., Chicago, Ill.	*Stafford Springs:* Dennis Grain Mill	7.88	8.66	9.19	9.00	14.60	15.00	56.34	3.33	3.50
5860	*Homespun.* Paty Schwartz Co., New London	Sampled at factory	8.40	5.09	9.75	9.00	12.90	12.00	59.53	4.33	4.00
5584	*Charlestock.* St. Albans Grain Co., St. Albans, Vt.	*Kent:* Kent Grain & Coal Co.	7.88	4.19	9.06	9.00	13.34	14.00	60.18	5.35	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1926—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Stock Feeds—Concluded.										
5663	*King.* St. Albans Grain Co., St. Albans, Vt.	*Willimantic:* Willimantic Grain Co.	8.20	4.34	10.38	9.00	10.10	12.00	60.93	6.05	5.00
5215	*Wirthmore.* St. Albans Grain Co., St. Albans, Vt.	*Meriden:* H. Grulich	8.60	3.91	10.31	9.00	8.70	9.50	62.40	6.08	4.00
5752	*Syragold.* Syracuse Milling Co., Syracuse, N. Y.	*Colchester:* David Shea	9.25	3.92	10.13	9.00	10.18	12.00	62.39	4.13	3.00
6573	*E-Gee.* Tioga-Empire Feed Mill, Waverly, N. Y.	*Hawleyville:* W. A. Honan	8.60	4.84	12.50	10.00	9.65	12.00	59.08	5.33	3.00
5743	*Uncas.* Yantic Grain & Products Co., Norwich	*Norwich:* Greenville Grain Co.	7.48	5.34	11.13	9.00	13.10	12.00	57.95	5.00	4.00
	Calf Feeds, etc.										
5509	*Blatchford.* Blatchford Calf Meal Co., Waukegan, Ill.	*Middletown:* Meech & Stoddard, Inc.	10.50	7.92	24.19	24.00	5.35	6.75	47.44	4.60	5.00
6011	*Blatchford.* Blatchford Calf Meal Co., Waukegan, Ill.	*Middletown:* Meech & Stoddard, Inc.	10.20	7.37	24.13	24.00	5.55	6.75	47.95	4.80	5.00
6317	*Elmore.* Elmore Milling Co., Oneonta, N. Y.	*Hazardville:* Amos D. Bridges Sons	11.03	4.75	23.44	24.00	3.70	4.00	52.75	4.33	4.00
5546	*Stevens Milkade.* Park & Pollard Co., Buffalo, N. Y.	*Waterbury:* Spencer Grain Co.	7.58	9.13	22.44	20.00	4.93	7.50	47.24	8.68	8.00
6522	*Schumacher.* Quaker Oats Co., Chicago, Ill.	*Rockville:* Rockville Milling Co.	7.88	7.18	20.56	18.00	2.85	4.00	53.73	7.80	8.00
5302	*Purina Calf Chow Feed.* Ralston Purina Co., St. Louis, Mo.	*Manchester:* Manchester Grain Co.	10.73	4.34	28.25	27.00	3.30	4.50	49.30	4.08	3.20
5303	*Purina Pig Chow Feed.* Ralston Purina Co., St. Louis, Mo.	*Manchester:* Manchester Grain Co.	11.15	9.80	24.75	20.00	5.75	7.00	45.17	3.38	3.20
6001	*Wirthmore Pig Feed.* St. Albans Grain Co., St. Albans, Vt.	*Chester:* Leet Bros.	9.53	6.08	18.19	17.00	5.50	9.00	55.05	5.65	4.00
5587	*Tioga Calf Food.* Tioga Mill & Elevator Co., Waverly, N. Y.	*Hawleyville:* W. A. Honan	8.38	6.50	23.50	21.00	4.68	7.00	52.01	4.93	4.00
	Poultry Feeds.										
4875	*Amco Egg Mash.* American Milling Co., Peoria, Ill.	*Middletown:* Chas. Dragoo	13.32	8.44	20.63	20.00	5.95	7.00	47.04	4.62	3.50
4879	*Amco Egg Mash with Dried Buttermilk.* American Milling Co., Peoria, Ill.	*Middletown:* Chas. Dragoo	10.61	8.23	20.63	20.00	5.95	7.00	50.21	4.37	4.50
5883	*Amco Egg Mash with Dried Buttermilk.* American Milling Co., Peoria, Ill.	*Stamford:* Clapboard Hill Feed Co.	9.15	7.02	19.13	19.00	6.38	7.00	53.07	5.25	4.00
4878	*Amco Chick Grains.* American Milling Co., Peoria, Ill.	*Middletown:* Chas. Dragoo	12.00	1.43	11.38	10.00	1.28	4.00	71.11	2.80	3.00
4874	*Amco Scratch Grains.* American Milling Co., Peoria, Ill.	*Middletown:* Chas. Dragoo	20.84	1.59	10.88	10.00	2.51	4.50	61.06	3.12	3.00
4880	*Amco Starting and Growing Mash with Buttermilk.* American Milling Co., Peoria, Ill.	*Middletown:* Chas. Dragoo	10.49	9.00	19.31	18.00	5.41	4.00	50.83	4.96	6.00
5839	*Wonder Laying Mash.* Arcady Farms Milling Co., Chicago, Ill.	*So. Manchester:* Smith Bros.	7.58	12.41	21.06	20.00	6.53	8.00	47.04	5.38	4.50
5520	*Auburn Scratch Feed.* Beacon Milling Co., Cayuga, N. Y.	*New Milford:* W. L. Richmond & Son	12.46	1.34	9.88	9.00	2.08	5.00	71.26	2.98	3.00
6574	*Beacon Chick Feed.* Beacon Milling Co., Cayuga, N. Y.	*Danbury:* C. S. Barnum & Son	12.50	1.58	10.50	11.00	1.43	3.00	70.09	3.90	2.50
5511	*Beacon Developer Feed.* Beacon Milling Co., Cayuga, N. Y.	*Derby:* Peterson-Hendee Co.	11.88	1.46	10.56	10.00	1.19	5.00	70.84	4.07	2.50
5468	*Beacon Egg Mash with Buttermilk.* Beacon Milling Co., Cayuga, N. Y.	*Derby:* Peterson-Hendee Co.,	9.03	9.87	22.13	22.00	5.10	7.00	48.74	5.13	4.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1926—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feeds—Continued.										
4806	*Beacon Growing Mash.* Beacon Milling Co., Cayuga, N. Y. ..	*New Milford:* W. L. Richmond & Son	10.63	9.51	17.56	17.00	5.77	7.00	51.76	4.77	4.50
6527	*Beacon Growing Mash.* Beacon Milling Co., Cayuga, N. Y. ..	*Derby:* Peterson-Hendee Co. ..	10.68	9.87	16.94	17.00	5.40	7.00	52.13	4.98	4.50
4869	*Beacon Scratch Grains.* Beacon Milling Co., Cayuga, N. Y. ..	*Derby:* Peterson-Hendee Co. ..	15.11	1.51	9.81	9.00	2.12	5.00	68.72	**2.73**	3.00
5831	*Beacon Scratch Grains.* Beacon Milling Co., Cayuga, N. Y. ..	*Danbury:* C. S. Barnum & Son	12.18	1.38	9.69	9.00	2.13	5.00	71.89	**2.73**	3.00
6249	*Beacon Scratch Grains.* Beacon Milling Co., Cayuga, N. Y. ..	*Danbury:* C. S. Barnum & Son	13.85	1.46	9.31	9.00	2.50	5.00	70.08	2.80	3.00
4805	*Beacon Starting Mash.* Beacon Milling Co., Cayuga, N. Y. ..	*New Milford:* W. L. Richmond & Son	14.50	7.92	16.69	14.00	4.71	6.00	51.70	4.48	4.50
6528	*Beacon Starting Mash.* Beacon Milling Co., Cayuga, N. Y. ..	*Derby:* Peterson-Hendee Co. ...	10.78	8.14	15.31	14.00	4.30	6.00	57.57	**3.90**	4.50
6593	*Beacon Laying Mash.* Beacon Milling Co., Cayuga, N. Y. ..	*Danbury:* C. S. Barnum & Son	10.45	9.11	21.25	20.00	6.18	8.00	47.83	5.18	5.00
5517	*Cayuga Laying Mash with Buttermilk.* Beacon Milling Co., Cayuga, N. Y.	*Southbury:* H. R. Stone	9.30	8.51	19.63	20.00	5.88	7.00	51.05	5.63	4.00
4807	*Chariot Chick Feed.* Beacon Milling Co., Cayuga, N. Y. ..	*New Milford:* W. L. Richmond & Son	13.70	1.52	9.88	10.00	1.07	5.00	70.46	3.37	2.50
6571	*Chariot Chick Feed.* Beacon Milling Co., Cayuga, N. Y. ..	*Brookfield:* W. L. Richmond & Son	13.45	1.45	10.00	10.00	1.21	5.00	70.54	3.35	2.50
4808	*Chariot Developer Feed.* Beacon Milling Co., Cayuga, N. Y. ..	*New Milford:* W. L. Richmond & Son	12.85	1.23	10.44	10.00	1.72	5.00	70.70	3.06	2.50
5158	*Beers' Laying Mash.* Ira W. Beers, Hamden	Sampled at factory	10 00	8.46	21.69	22.00	6.13	7.00	48.14	**5.58**	6.00
5157	*Beers' Scratch Feed.* Ira W. Beers, Hamden	Sampled at factory	12.48	1.68	10.75	9.00	3.33	4.00	68.56	**3.20**	4.00
5208	*Bidwell Scratch Feed.* The Park & Pollard Co., Buffalo, N. Y.	*Plainville:* F. B. Newton	12.00	1.51	10.31	10.00	2.38	5.00	70.62	3.18	1.50
3632	*Blatchford's Chick Mash with Buttermilk.* Blatchford Calf Meal Co., Waukegan, Ill.	*Middletown:* Meech & Stoddard, Inc.	9.45	12.64	18.50	18.00	4.73	6.50	50.54	4.14	4.00
5755	*Egg-O-Dry Mash.* C. W. Campbell Co., Westerly, R. I.	Sampled at factory	8.03	9.40	21.44	18.00	7.50	12.00	47.80	5.83	2.00
5753	*Egg-O-Scratch Feed.* C. W. Campbell Co., Westerly, R. I.	Sampled at factory	12.75	1.37	10.19	10.00	2.13	5.00	71.18	2.38	2.00
6257	*Albert Angell Jr.'s Chick Starter.* Coles Co., Middletown	Sampled at factory	10.15	8.55	18.38	15.00	4.25	5.00	53.62	5.05	5.00
6526	*Albert Angell Jr.'s Coarse Chick Scratch.* Coles Co., Middletown	Sampled at factory	14.18	1.31	9.81	10.00	1.95	3.00	70.05	**2.70**	5.00
6525	*Albert Angell Jr.'s Egg Mash.* Coles Co., Middletown	Sampled at factory	9.20	11.38	21.13	20.00	5.15	8.00	47.94	5.20	4.00
6261	*Albert Angell Jr.'s Fine Chick Scratch.* Coles Co., Middletown	Sampled at factory	10.30	1.59	12.00	10.00	1.20	3.00	70.61	**4.30**	5.00
6414	*Albert Angell Jr.'s Fine Chick Scratch.* Coles Co., Middletown	Sampled at factory	12.33	1.52	11.25	10.00	1.45	3.00	69.72	**3.73**	5.00
6202	*Albert Angell Jr.'s Growing Mash.* Coles Co., Middletown	Sampled at factory	9.00	6.39	17.56	15.00	5.07	6.00	56.85	5.13	5.00
6597	*Albert Angell Jr.'s Scratch Feed.* Coles Co., Middletown	Sampled at factory	14.58	1.70	10.25	10.00	**4.00**	3.00	65.47	4.00	2.75
4812	*Fortune Egg Mash.* Coles Co., Middletown	Sampled at factory	8.91	5.45	24.00	17.00	8.98	9.00	46.16	6.50	3.50
6206	*Fortune Egg Mash with Dried Buttermilk.* Coles Co., Middletown	*Colchester:* David Shea	8.95	9.06	19.50	17.00	5.30	9.00	50.84	6.35	3.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1926—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Fiber		Protein (N x 6.25)		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feeds—Continued.										
4813	*Fortune Scratch.* Coles Co., Middletown	Sampled at factory	14.41	1.68	10.63	10.00	3.99	5.00	65.76	3.53	2.50
6203	*Fortune Scratch.* Coles Co., Middletown	Sampled at factory	12.48	1.52	10.19	10.00	2.63	5.00	70.38	2.80	2.50
5595	*C. A. Blue Seal Mash.* C. A. Cowles, Plantsville	Sampled at factory	8.63	8.36	20.50	18.00	4.98	6.00	52.11	5.42	4.00
5596	*Cowles Scratch Feed.* C. A. Cowles, Plantsville	*Meriden:* West End Feed & Supply Co.	11.88	1.35	9.88	10.00	2.02	5.00	72.17	2.70	1.50
5365	*Conkey's Buttermilk, Grain and Bone Starting Feed.* G. E. Conkey Co., Cleveland, Ohio..	*Middletown:* Meech & Stoddard, Inc.	10.88	5.13	14.25	14.00	3.55	4.00	61.11	5.08	3.00
6595	*Conkey's Buttermilk Meat, Grain and Bone Laying Mash.* G. E. Conkey Co., Cleveland, Ohio...	*So. Norwalk:* Roodner Feed Co.	10.33	12.66	23.56	20.00	4.60	6.00	43.19	5.66	5.00
5830	*Conkey's Growing Grains.* G. E. Conkey Co., Cleveland, Ohio..	*Ridgefield:* Ridgefield Lumber Co.	10.60	1.68	12.44	13.00	1.50	2.00	69.28	4.50	2.50
5479	*Crosby's Egg Mash Feed.* Crosby Milling Co., Brattleboro, Vt. ..	*Shelton:* Wolf Savinsky	9.90	10.36	22.06	20.00	4.70	7.00	47.29	5.69	4.00
5476	*Crosby's Scratch Feed.* Crosby Milling Co., Brattleboro, Vt...	*Shelton:* Wolf Savinsky	12.48	1.45	9.75	11.00	2.48	5.00	70.69	3.15	3.00
6248	*Crosby's Scratch Feed.* Crosby Milling Co., Brattleboro, Vt...	*So. Norwalk:* Roodner Feed Co.	17.08	1.47	9.75	11.00	3.14	5.00	66.53	2.03	3.00
5482	*Davis Mash Feed.* R. G. Davis & Sons, New Haven	*Ansonia:* Ansonia Flour & Feed Co.	9.82	6.55	18.44	18.00	5.80	7.00	53.94	5.45	5.00
5480	*Davis Scratch Feed.* R. G. Davis & Sons, New Haven	*Ansonia:* Ansonia Feed Co.	13.21	1.52	9.81	10.00	2.26	5.00	70.12	3.08	2.00
5382	*Delaware Scratch Grains.* Delaware Mills, Deposit, N. Y.....	*Meriden:* Standard Grain & Coal Co.	13.95	1.47	9.50	10.00	2.63	5.00	69.50	2.95	2.50
5866	*Indian Laying Mash.* Delaware Mills Deposit, N. Y.	*Bloomfield:* Bloomfield Farmers' Exchange	9.38	7.14	18.13	18.00	5.73	7.00	53.27	6.35	4.00
6529	*Indian Scratch Grains.* Delaware Mills, Deposit, N. Y.	*Stepney:* M. Nusbaum	14.28	1.46	9.81	10.00	2.65	5.00	68.77	3.03	2.50
5718	*Devon Laying Mash.* Devon Coal & Ice Co., Devon	Sampled at factory	8.93	8.35	21.50	18.00	5.45	7.00	50.09	5.68	5.00
5659	*Eastern States Egg Mash.* Eastern States Farmers' Exchange, Springfield, Mass.	*Farmington:* Albert Thompson..	9.67	6.87	19.56	18.50	6.03	8.00	51.92	5.95	3.50
5635	*Eastern States Egg Mash Buttermilk.* Eastern States Farmers' Exchange, Springfield, Mass.	*Seymour:* John Swan	8.85	5.85	18.38	17.00	6.07	7.50	54.88	5.97	5.00
5494	*Eastern States Scratch Grains.* Eastern States Farmers' Exchange, Springfield, Mass.	*Seymour:* John Swan	13.09	1.50	10.44	10.00	2.25	4.50	69.62	3.10	3.00
3644	*Elmore Egg Mash.* Elmore Milling Co., Oneonta, N. Y.	*Beacon Falls:* Edward Gruber..	10.20	7.21	20.38	18.00	6.28	8.00	50.60	5.33	4.00
5260	*Elmore Egg Mash.* Elmore Milling Co., Oneonta, N. Y.	*Hazardville:* Amos D. Bridges Sons	9.40	9.27	19.50	18.00	4.45	8.00	51.40	5.98	4.00
4797	*Elmore Growing Mash.* Elmore Milling Co., Oneonta, N. Y...	*Colchester:* P. Cutler, Inc.	14.30	9.05	17.44	17.00	5.58	8.00	49.63	4.00	4.00
6279	*Elmore Storrs Formula Laying Mash.* Elmore Milling Co., Oneonta, N. Y.	*Willimantic:* Windham Grain Store	11.43	9.33	19.25	20.00	6.05	7.00	47.99	5.95	4.00
6286	*Elmore Scratch Feed.* Elmore Milling Co., Oneonta, N. Y...	*Higganum:* F. A. Petrofsky ...	13.43	1.62	10.44	10.00	2.60	7.00	68.81	3.10	3.50
6600	*Elmore Scratch Feed.* Elmore Milling Co., Oneonta, N. Y. ..	*Higganum:* F. A. Petrofsky ...	14.10	1.30	10.19	10.00	2.69	7.00	69.04	2.68	3.50
5316	*Emco Scratch Feed.* Elmore Milling Co., Oneonto, N. Y...	*Hazardville:* Amos D. Bridges Sons	12.63	1.52	10.50	10.00	3.05	7.00	69.10	3.20	3.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1926—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feeds—Continued.										
6009	*Emco Scratch Feed.* Elmore Milling Co., Oneonta, N. Y.	*Hazardville:* Amos D. Bridges Sons	13.78	1.51	10.31	10.00	3.03	7.00	68.18	3.19	3.50
6277	*Eshelman's Baby Chick Starter.* John W. Eshelman & Son, Lancaster, Pa.	*Wallingford:* A. E. Hall	8.20	5.01	15.63	10.00	3.30	5.00	62.66	5.20	4.00
6276	*Eshelman's Chick Feed.* John W. Eshelman & Son, Lancaster, Pa.	*Wallingford:* A. E. Hall	12.68	1.75	10.88	10.00	1.45	3.00	68.61	4.63	3.00
5582	*Eshelman's Growing Mash.* John W. Eshelman & Son, Lancaster, Pa.	*Canaan:* Ives & Pierce	9.33	6.23	19.00	16.00	5.24	8.00	54.70	5.50	4.00
5152	*Eshelman's Laying Mash.* John W. Eshelman & Son, Lancaster, Pa.	*Highwood:* T. C. Hadden & Co.	9.75	7.09	21.38	20.00	5.15	7.00	50.75	5.88	5.00
5386	*Eshelman's Scratch Feed.* John W. Eshelman & Son, Lancaster, Pa.	*Bristol:* Bristol Grain & Supply Co.	13.23	1.46	10.31	10.00	2.45	4.00	69.55	3.00	3.00
5296	*Imperial Scratch Feed.* John W. Eshelman & Son, Lancaster, Pa.	*Manchester:* Little & McKinney	13.05	1.30	9.44	9.00	2.15	4.00	70.88	3.18	3.00
5197	*Pennsy Scratch Feed.* John W. Eshelman & Son, Lancaster, Pa.	*Highwood:* T. C. Hadden & Co.	12.53	1.32	9.63	9.00	2.00	4.00	71.82	2.70	3.00
5746	*Pennsy Scratch Feed.* John W. Eshelman & Son, Lancaster, Pa.	*Norwalk:* Frank Libner & Son	12.60	1.31	9.88	9.00	2.05	4.00	71.51	2.65	3.00
5267	*Flory's Superior Egg Mash.* Flory Milling Co., Bangor, Pa.	*Bloomfield:* Bloomfield Farmers' Exchange	8.53	10.54	19.94	20.00	7.83	8.00	47.96	5.20	5.50
5868	*Flory's Superior Egg Mash.* Flory Milling Co., Bangor, Pa.	*Bloomfield:* Bloomfield Farmers' Exchange	9.50	9.79	19.25	20.00	7.55	8.00	49.08	4.83	5.50
5867	*Flory's Superior Scratch Grains.* Flory Milling Co., Bangor, Pa.	*Bloomfield:* Bloomfield Farmers' Exchange	13.43	1.44	10.00	9.00	2.23	4.00	70.20	2.70	2.50
5505	*Golden Egg Scratch Feed.* Flory Milling Co., Bangor, Pa.	*Thomaston:* I. Levy	13.13	1.56	10.25	9.00	2.35	5.00	69.59	3.12	2.50
5514	*Golden Egg Laying Mash.* Flory Milling Co., Bangor, Pa.	*Thomaston:* I. Levy	9.68	7.16	18.88	18.00	6.24	10.00	52.84	5.20	4.00
5504	*Sunray Scratch Feed.* Flory Milling Co., Bangor, Pa.	*Thomaston:* I. Levy	12.60	1.58	10.13	9.00	2.38	5.00	70.28	3.03	2.50
6229	*R Own Laying Mash.* A. W. Forbes, East Haven	Sampled at factory	10.78	9.80	22.50	20.00	4.73	6.00	47.39	4.80	5.00
6006	*R Own Scratch Feed.* A. W. Forbes, East Haven	Sampled at factory	10.78	1.73	10.75	10.00	3.58	5.00	69.43	3.73	3.00
4795	*Grandin's Intermediate Chick Feed.* D. H. Grandin Milling Co., Jamestown, N. Y.	*Willimantic:* Willimantic Grain Co.	14.65	1.34	11.00	10.00	1.35	5.00	69.07	2.59	2.50
5196	*Cackle Scratch Feed, No Grit.* Hales & Hunter Co., Chicago, Ill.	*Highwood:* T. C. Hadden & Co.	12.35	1.42	10.19	10.00	1.98	5.00	70.91	3.15	2.50
5194	*Red Comb Egg Mash with Dried Buttermilk.* Hales & Hunter Co., Chicago, Ill.	*Highwood:* T. C. Hadden & Co.	9.33	7.81	19.31	20.00	5.20	7.00	53.27	5.08	4.50
5195	*Red Comb Scratch Feed, No Grit.* Hales & Hunter Co., Chicago, Ill.	*Highwood:* T. C. Hadden & Co.	12.00	1.58	10.69	10.00	2.55	5.00	69.73	3.45	2.50
4802	*Algrane Steam-Cooked Chick Feed.* Hecker H-O Co., Buffalo N. Y.	*So. Norwalk:* Roodner Feed Co.	12.80	1.31	11.00	12.00	1.09	4.00	71.57	2.23	3.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1926—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feeds—Continued.										
6310	*"Hudson's" Developing Mash.* L. W. Hudson, Windsor	Sampled at factory	7.73	8.03	18.88	17.00	5.15	5.40	54.46	5.75	6.00
5630	*"Hudson's" Laying Mash.* L. W. Hudson, Windsor	Sampled at factory	8.30	11.92	20.06	19.00	6.75	5.00	47.12	5.85	6.00
5656	*Ingersoll's Special Egg Mash.* Z. C. Ingersoll, Stratford	Sampled at factory	8.72	9.91	18.88	18.00	7.20	8.44	48.96	6.33	6.45
5248	*Dry Mash.* I. F. Labieniec, Kensington	Sampled at factory	9.88	8.72	19.75	19.00	7.20	9.00	48.77	5.68	5.00
4800	*Larro Chick Grains.* Larrowe Milling Co., Detroit, Mich. ...	*Danbury:* H. E. Meeker	13.94	1.25	11.75	10.00	2.46	3.50	67.73	2.87	3.00
6568	*Larro Chick Grains.* Larrowe Milling Co., Detroit, Mich. ...	*Winsted:* E. Manchester & Sons	11.65	1.35	10.69	10.00	1.40	3.50	71.58	3.33	3.00
4798	*Larro Chick Starter.* Larrowe Milling Co., Detroit, Mich. ...	*Collinsville:* Lawton-Miner Co..	14.11	6.23	16.13	14.00	4.34	6.50	54.45	4.74	4.50
6567	*Larro Chick Starter.* Larrowe Milling Co., Detroit, Mich. ...	*Winsted:* E. Manchester & Sons	11.10	6.16	15.06	14.00	4.40	6.50	58.08	5.20	4.50
5162	*Larro Egg Mash.* Larrowe Milling Co., Detroit, Mich.	*Plainville:* W. S. Eaton	8.78	11.15	20.19	19.00	5.78	8.00	48.90	5.20	5.00
6570	*Larro Growing Mash.* Larrowe Milling Co., Detroit, Mich. ...	*New Milford:* Geo. E. Ackley & Co.	10.45	8.34	17.38	16.00	5.70	6.50	52.94	5.19	5.00

5828	*Nabob Scratch Feed.* Francis H. Leggett & Co., Stamford	*Stamford:* Clapboard Hill Feed Co.	11.75	1.38	9.94	9.00	2.00	4.00	72.25	2.68	3.00
5826	*Premier Growing Feed.* Francis H. Leggett & Co., Stamford ..	*Stamford:* Clapboard Hill Feed Co.	8.18	7.60	16.94	15.00	5.38	4.50	56.30	5.60	4.50
5827	*Premier Scratch Feed.* Francis H. Leggett & Co., Stamford ..	*Stamford:* Clapboard Hill Feed Co.	11.53	1.48	10.25	9.00	2.00	4.00	71.66	3.08	3.00
5368	*Homestead Dry Mash.* C. W. Lines Co., New Britain	Sampled at factory	9.80	9.90	20.31	18.00	6.65	7.00	47.36	5.98	4.00
5371	*Homestead Scratch Feed.* C. W. Lines Co., New Britain	Sampled at factory	13.35	1.35	10.25	9.00	2.68	5.00	69.27	3.10	2.50
5369	*Millpride Fancy Scratch Feed.* C. W. Lines Co., New Britain	Sampled at factory	13.00	1.60	10.75	10.00	2.60	5.00	68.72	3.33	3.00
6013	*MillPride Milk Mash for Laying Hens.* C. W. Lines Co., New Britain	Sampled at factory	7.93	11.36	19.81	18.00	6.60	7.50	49.12	5.18	5.00
4872	*Uniform Fancy Scratch Feed.* C. W. Lines Co., New Britain	Sampled at factory	14.20	1.44	10.00	10.00	1.59	5.00	69.64	3.13	3.00
6566	*Common Sense Growing Mash.* Litchfield County Co-op. Assoc., Torrington	Sampled at factory	11.68	7.30	16.36	15.00	5.38	8.00	55.37	3.89	4.00
6565	*Common Sense Laying Mash.* Litchfield County Co-op. Assoc. Torrington	Sampled at factory	11.73	9.30	15.81	15.00	5.50	8.00	53.36	4.30	4.00
5600	*Square Deal Mash.* Long Hill Feed Store, Long Hill	Sampled at factory	8.83	9.90	20.13	20.00	6.70	7.00	48.84	5.60	5.00
5581	*Buttermilk Growing Mash.* E. Manchester & Sons, Winsted..	Sampled at factory	8.33	7.26	19.81	20.00	4.80	6.00	54.40	5.40	4.00
5575	*Red Star Scratch Feed.* E. Manchester & Sons, Winsted	Sampled at factory	11.48	1.58	10.38	12.00	2.95	5.00	70.88	2.73	3.00
6275	*Red Star Scratch Feed.* E. Manchester & Sons, Winsted	Sampled at factory	13.50	1.52	10.19	12.00	3.03	5.00	69.04	2.72	2.00
5573	*Storrs Egg Mash.* E. Manchester & Sons, Winsted	Sampled at factory	9.18	10.16	18.69	18.00	6.78	8.00	49.14	6.05	4.00
6569	*Bull Brand Chick Feed.* Maritime Milling Co., Buffalo, N. Y.	*New Milford:* Geo. E. Ackley & Co.	12.80	1.20	10.94	11.00	1.80	4.00	71.08	2.18	2.50
5571	*Bull Brand Chick Starter (with Dried Buttermilk).* Maritime Milling Co., Buffalo, N. Y. ..	*Riverton:* L. A. Coe	10.68	5.12	16.69	12.00	4.29	4.00	57.97	5.25	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1926—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25) Found	Protein (N x 6.25) Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat Found	Fat Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feeds—Continued.										
5572	*Bull Brand Laying Mash (with Dried Buttermilk).* Maritime Milling Co., Buffalo, N. Y. ..	*Riverton:* L. A. Coe	9.70	10.31	22.06	20.00	7.13	8.00	44.85	5.95	5.00
5724	*Bull Brand Scratch Feed.* Maritime Milling Co., Buffalo, N. Y.	*Stamford:* Clapboard Hill Feed Co.	12.50	1.38	10.50	11.00	1.90	4.00	71.22	2.50	2.50
5234	*Red E Mixt Scratch Feed.* Maritime Milling Co., Buffalo, N. Y.	*Thompsonville:* Geo. S. Phelps & Co.	12.23	1.41	9.94	10.00	2.55	4.00	70.82	3.05	2.50
6524	*Red Wing Special Buttermilk Chick Starter.* Meech & Stoddard, Inc., Middletown	Sampled at factory	11.18	9.17	17.56	13.00	5.18	5.00	52.03	4.88	4.00
5353	*Red Wing Special Buttermilk Growing Feed.* Meech & Stoddard, Inc., Middletown	*Middlefield:* Middlefield Grain & Coal Co.	9.23	13.83	18.88	17.00	5.85	8.00	46.93	5.28	5.50
5230	*Red Wing Special Buttermilk Laying Mash.* Meech & Stoddard, Inc., Middletown	*Meriden:* Meriden Grain & Coal Co.	8.05	7.79	20.88	17.00	6.00	7.00	50.68	6.60	5.50
6523	*Red Wing Special Chick Feed.* Meech & Stoddard, Inc., Middletown	Sampled at factory	13.23	1.66	11.19	10.00	1.80	5.00	68.32	3.80	3.00
5352	*Red Wing Special Intermediate Chick Feed.* Meech & Stoddard, Inc., Middletown	*Middlefield:* Middlefield Grain & Coal Co.	11.50	1.63	10.56	10.00	2.73	5.00	70.33	3.25	3.00
5181	*Red Wing Scratch Feed.* Meech & Stoddard, Inc., Middletown	*Plantsville:* Mehmel & Sarvi ...	12.35	1.51	10.25	10.00	2.38	5.00	70.21	3.30	3.00
5649	*Moon's Laying Mash with Dried Buttermilk.* Geo. Q. Moon & Co., Binghamton, N. Y.	*Norfolk:* Aug. P. Curtis	9.36	9.73	19.44	20.00	6.43	9.00	49.56	5.48	4.00
5603	*C-B Mash.* Moran-Patton Co., New Haven	Sampled at factory	9.89	8.07	20.19	18.00	7.04	7.00	48.79	6.02	4.00
5336	*Old Mill Buttermilk Laying Mash.* Fred C. Morse, Guilford	Sampled at factory	9.60	7.98	21.19	20.00	6.83	7.00	48.47	5.93	5.00
5334	*Old Mill Mash Feed.* Fred C. Morse, Guilford	Sampled at factory	9.25	8.33	22.00	20.00	6.69	7.00	47.83	5.90	5.00
5338	*Old Mill Scratch Feed.* Fred C. Morse, Guilford	Sampled at factory	12.65	1.45	10.06	10.00	2.49	4.00	70.65	2.70	3.00
6227	*Old Mill Scratch Feed.* Fred C. Morse, Guilford	Sampled at factory	15.50	1.51	9.50	10.00	2.53	4.00	68.01	2.95	3.00
3642	*Domino Baby Chick Starter with Buttermilk.* Nowak Milling Corp., Hammond, Ind.	*Waterville:* Wooster's Feed Store	9.15	7.92	20.88	20.00	5.28	6.00	51.39	5.38	4.50
6599	*Domino Baby Chick Starter with Buttermilk.* Nowak Milling Corp., Hammond, Ind.	*Higganum:* F. A. Petrofsky ...	11.05	7.42	20.81	20.00	5.60	6.00	49.79	5.33	4.50
3641	*Domino Chick Feed.* Nowak Milling Corp., Hammond, Ind.	*Waterville:* Wooster's Feed Store	11.65	1.52	12.13	11.00	1.98	5.00	69.79	2.93	2.00
6601	*Domino Chick Feed.* Nowak Milling Corp., Hammond, Ind.	*Higganum:* F. A. Petrofsky ...	13.88	1.32	10.00	11.00	1.91	5.00	70.46	2.43	2.00
5391	*Domino Developing Feed.* Nowak Milling Corp., Hammond, Ind.	*Manchester:* I. P. Campbell	11.90	1.37	11.13	10.00	2.10	5.00	71.05	2.45	2.50
5556	*Domino Growing Mash with Buttermilk.* Nowak Milling Corp., Hammond, Ind.	*Waterville:* Wooster's Feed Store	9.20	6.72	20.31	18.00	4.95	7.00	53.42	5.40	4.50
5557	*Domino Laying Mash with Buttermilk.* Nowak Milling Corp., Hammond, Ind.	*Waterville:* Wooster's Feed Store	9.05	8.67	20.25	18.00	4.98	7.00	52.22	4.83	3.50
6254	*Domino Pigeon Feed.* Nowak Milling Corp., Hammond, Ind.	*Waterville:* Wooster's Feed Store	10.90	1.79	12.50	10.00	2.60	5.00	70.21	2.00	2.50
5554	*Domino Scratch Feed.* Nowak Milling Corp., Hammond, Ind.	*Waterville:* Wooster's Feed Store	13.17	1.56	10.56	10.00	2.30	5.00	69.91	2.50	2.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1926—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feeds—Continued.										
5395	*Fidelity Scratch Feed.* Nowak Milling Corp., Hammond, Ind.	*Manchester:* I. P. Campbell	12.33	1.50	10.56	10.00	2.53	5.00	69.83	3.25	2.50
6253	*Marathon Chick Feed.* Nowak Milling Corp., Hammond, Ind.	*Waterville:* Wooster's Feed Store	11.80	1.56	11.44	11.00	1.89	5.00	70.03	3.28	2.00
5348	*Marathon Laying Mash with Buttermilk.* Nowak Milling Corp., Hammond, Ind.	*Higganum:* F. A. Petrofsky	8.88	6.74	20.56	20.00	6.85	9.00	51.89	5.08	4.50
5394	*Marathon Scratch Feed.* Nowak Milling Corp., Hammond, Ind.	*Manchester:* I. P. Campbell	11.78	1.51	10.19	10.00	3.35	5.00	70.02	3.15	2.50
5327	*Osborn Mash.* S. V. Osborn Est., Branford	Sampled at factory	10.83	3.43	14.63	12.00	6.35	8.00	61.23	3.53	3.00
5326	*Osborn Scratch.* S. V. Osborn Est., Branford	Sampled at factory	12.73	1.59	10.38	10.00	2.08	5.00	70.02	3.20	2.00
6271	*Baby Buster Chick Feed.* The Park & Pollard Co., Buffalo, N. Y.	*Putnam:* Bosworth Bros.	13.85	1.67	12.50	10.00	1.60	5.00	67.48	2.90	2.00
5723	*Bidwell Dry Mash.* The Park & Pollard Co., Buffalo, N. Y. ..	*Fairfield:* Samp Mortar Mill ...	9.60	11.53	21.25	18.00	5.49	12.00	47.68	4.45	1.50
5398	*Bonnie Booster.* The Park & Pollard Co., Buffalo, N. Y. ..	*East Hartford:* Meech Grain Co.	10.20	5.75	15.38	12.00	3.98	3.00	61.06	3.63	3.00

6319	*Bonnie Booster.* The Park & Pollard Co., Buffalo, N. Y. ..	*Hazardville:* A. D. Bridges Sons	12.83	5.00	14.25	12.00	3.70	3.00	61.29	2.93	3.00
5397	*Growing Feed.* The Park & Pollard Co., Buffalo, N. Y. ..	*East Hartford:* Meech Grain Co.	10.73	7.25	15.63	14.00	6.03	8.00	55.83	4.53	1.50
5262	*Intermediate Chick Feed.* The Park & Pollard Co., Buffalo, N. Y.	*Hazardville:* A. D. Bridges Sons	11.45	1.31	10.63	10.00	1.95	5.00	72.01	2.65	1.50
5423	*Lay or Bust Dry Mash.* The Park & Pollard Co., Buffalo, N. Y.	*Torrington:* F. L. Wadhams ...	9.60	10.04	17.50	18.00	5.39	10.00	53.47	4.00	1.50
5413	*Leghorn Special Dry Mash.* The Park & Pollard Co., Buffalo, N. Y.	*East Hartford:* Meech Grain Co.	9.10	11.06	22.13	21.00	6.60	10.00	46.18	4.93	1.50
5399	*Pigeon Feed.* The Park & Pollard Co., Buffalo, N. Y.	*East Hartford:* Meech Grain Co.	12.65	1.69	13.31	10.00	2.40	5.00	67.60	2.35	1.50
6407	*Red Ribbon Chick Feed.* The Park & Pollard Co., Buffalo, N. Y.	*West Cheshire:* Cheshire Grain & Coal Co.	14.30	1.46	10.69	10.00	1.63	5.00	69.14	2.78	2.00
5217	*Red Ribbon Scratch Feed.* The Park & Pollard Co., Buffalo, N. Y.	*New Britain:* S. P. Strople	12.15	1.49	10.25	10.00	2.58	5.00	70.15	3.38	1.50
5471	*P-H Mash.* Peterson-Hendee Co., Derby	Sampled at factory	10.70	5.31	17.94	17.00	4.09	7.00	57.83	4.13	4.00
5470	*P-H Scratch Feed.* Peterson-Hendee Co., Derby	Sampled at factory	13.15	1.73	10.56	10.00	2.40	5.00	68.56	3.60	2.00
5634	*Purgrain Breeding Feed.* Philadelphia Seed Co., Philadelphia, Pa.	*Shelton:* Shelton Feed Co.	11.08	1.95	15.00	15.00	3.83	3.50	63.49	4.65	3.00
5804	*Purgrain Pigeon Feed No. 4.* Philadelphia Seed Co., Philadelphia, Pa.	*New Haven:* R. G. Davis & Sons	9.78	1.67	12.50	12.50	2.20	4.00	70.45	3.40	3.00
5537	*Platco Laying Mash.* Frank S. Platt Co., New Haven	Sampled at factory	9.03	11.13	24.75	20.00	6.28	7.00	43.08	5.73	5.50
5536	*Platco Perfection Grain Mixture.* Frank S. Platt Co., New Haven	Sampled at factory	13.23	1.39	10.19	10.50	2.24	4.50	70.25	2.70	3.00
6005	*Platco Perfection Grain Mixture.* Frank S. Platt Co., New Haven	Sampled at factory	12.63	1.38	9.88	10.50	2.40	4.50	70.21	3.50	3.00
5538	*Platt's Pigeon Mixture.* Frank S. Platt Co., New Haven	Sampled at factory	11.50	2.09	15.00	13.00	4.03	5.00	62.95	4.43	4.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1926—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.* *Poultry Feeds—Continued.*										
6000	*Cak-Cak Laying Mash with Buttermilk, Oat Meal, Fish, Meat, etc.* Pratt Food Co., Buffalo, N. Y.	*New Milford:* Geo. E. Ackley & Co.	8.30	8.48	21.25	20.00	5.78	6.00	50.31	5.88	3.00
6320	*Iroquois Laying Mash.* Pratt Food Co., Buffalo, N. Y.	*New Britain:* S. P. Strople	10.30	8.47	20.00	20.00	5.73	8.00	49.59	5.91	5.00
6002	*Iroquois Poultry Mash.* Pratt Food Co., Buffalo, N. Y.	*Ridgefield:* Ridgefield Lumber Co.	8.90	5.44	17.19	15.00	7.03	6.00	56.49	4.95	4.00
6004	*Iroquois Scratching Grains.* Pratt Food Co., Buffalo, N. Y.	*Danbury:* C. S. Barnum & Son	12.58	1.45	10.13	10.00	2.50	5.00	70.59	2.75	3.00
6318	*Pratt's Baby Chick Food with Buttermilk.* Pratt Food Co., Buffalo, N. Y.	*Hazardville:* A. D. Bridges Sons	11.23	8.10	12.63	11.50	2.85	3.80	60.59	4.60	3.50
6234	*Pratt's Circle A Chick Scratch Feed.* Pratt Food Co., Philadelphia, Pa.	*Thompsonville:* Geo. S. Phelps & Co.	12.05	1.51	10.69	10.00	1.40	5.00	72.22	2.13	2.50
6410	*Pratt's Circle A Chick Scratch.* Pratt Food Co., Philadelphia, Pa.	*Thompsonville:* Geo. S. Phelps & Co.	12.55	1.41	10.63	10.00	1.50	5.00	71.86	2.05	2.50
5440	*Pratt's Circle A Large Scratch Feed.* Pratt Food Co., Philadelphia, Pa.	*Bristol:* Bristol Grain & Supply Co.	13.15	1.38	10.00	10.00	2.68	5.00	69.46	3.33	2.50
4809	*Pratt's Supreme Growing Mash.* Pratt Food Co., Philadelphia, Pa.	*Thompsonville:* Geo. S. Phelps & Co.	10.86	8.63	19.19	17.50	4.18	7.00	51.85	5.29	4.50
5251	*Pratt's Supreme Growing Mash with Buttermilk.* Pratt Food Co., Philadelphia, Pa.	*New Britain:* S. P. Strople	9.05	11.11	19.31	17.50	3.85	7.00	51.15	5.53	4.50
5250	*Pratt's Supreme Pigeon Feed with Flint Corn.* Pratt Food Food Co., Philadelphia, Pa.	*New Britain:* S. P. Strople	12.25	1.95	13.00	10.00	2.50	5.00	67.47	2.83	2.50
6321	*Pratt's Victory Chick Scratch Feed.* Pratt Food Co., Philadelphia, Pa.	*New Britain:* S. P. Strople	13.40	1.18	10.88	10.00	1.35	5.00	71.01	2.18	2.50
6596	*Pratt's Victory Chick Scratch Feed.* Pratt Food Co., Philadelphia, Pa.	*New Britain:* S. P. Strople	13.18	1.10	11.25	10.00	1.40	5.00	70.84	2.23	2.50
6594	*Pratt's Victory Large Scratch Feed.* Pratt Food Co., Philadelphia, Pa.	*Norwalk:* Frank Libner & Son	12.98	1.39	10.81	10.00	2.45	5.00	69.27	3.10	2.50
5432	*Pratt's Victory Intermediate Scratch Feed.* Pratt Food Co., Philadelphia, Pa.	*Hartford:* C. A. Pease & Co.	11.73	1.45	10.81	10.00	1.98	5.00	70.93	3.10	2.50
5249	*Pratt's Victory Laying Mash with Buttermilk.* Pratt Food Co., Philadelphia, Pa.	*New Britain:* S. P. Strople	9.08	7.78	21.75	20.00	6.35	8.00	49.61	5.43	4.00
5684	*Egg-Em-On Scratch Grains.* H. C. Puffer Co., Springfield, Mass.	*West Willington:* H. M. Hanson	11.55	1.46	10.81	10.00	2.58	5.00	70.77	2.83	1.50
5200	*Big Egg Scratch Grains, No Grit.* Quaker Oats Co., Chicago, Ill.	*Plainville:* W. S. Eaton	13.05	1.60	10.31	10.00	2.78	4.25	68.73	3.53	3.00
3635	*Ful-O-Pep Chick Starter.* Quaker Oats Co., Chicago, Ill.	*Plantsville:* C. A. Cowles	7.50	10.48	16.75	15.00	4.77	6.00	54.65	5.85	5.00
6406	*Ful-O-Pep Chick Starter.* Quaker Oats Co., Chicago, Ill.	*Hamden:* I. W. Beers	9.10	10.17	16.63	15.00	5.80	6.00	51.67	6.63	5.00
6408	*Ful-O-Pep Fine Chick Feed.* Quaker Oats Co., Chicago, Ill.	*Plainville:* W. S. Eaton	11.83	1.42	12.00	12.00	1.59	2.00	69.58	3.58	2.50
4801	*Ful-O-Pep Growing Mash.* Quaker Oats Co., Chicago, Ill.	*So. Norwalk:* Roodner Feed Co.	12.34	9.98	19.31	19.00	4.58	6.00	47.37	6.42	5.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1926—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feeds—Continued.										
5201	*Ful-O-Pep Growing Mash.* Quaker Oats Co., Chicago, Ill.	*Plainville:* W. S. Eaton	8.90	10.15	19.75	19.00	5.23	6.00	50.27	5.70	5.00
5156	*Ful-O-Pep Egg Mash.* Quaker Oats Co., Chicago, Ill.	*Hamden:* I. W. Beers	9.18	11.48	19.94	20.00	6.43	8.00	47.84	5.13	4.00
5203	*Ful-O-Pep Scratch Grains.* Quaker Oats Co., Chicago, Ill.	*Thompsonville:* Geo. S. Phelps & Co.	12.30	1.50	10.50	9.00	2.45	3.50	69.97	3.28	2.00
5559	*Schumacher's Little Chick Feed, No Grit.* Quaker Oats Co., Chicago, Ill.	*Long Hill:* Long Hill Feed Store	11.47	1.43	10.69	10.00	1.48	2.00	71.83	3.10	2.00
5558	*Schumacher's Scratch Grains, No Grit.* Quaker Oats Co., Chicago, Ill.	*Long Hill:* Long Hill Feed Store	11.90	1.58	10.69	10.00	2.73	3.50	69.25	3.85	2.00
6772	*Fine Ground Green Poultry Alfalfa Meal.* Ralston Purina Co., St. Louis, Mo.	*Norwich:* Norwich Grain Co.	8.27	12.19	18.56	17.00	21.17	25.00	37.61	2.20	1.60
5441	*Purina Baby Chick Chow.* Ralston Purina Co., St. Louis, Mo.	*Derby:* Peterson-Hendee Co.	11.95	1.70	11.25	10.00	2.08	4.00	69.43	3.59	2.00
5301	*Purina Chicken Chowder Feed.* Ralston Purina Co., St. Louis, Mo.	*Manchester:* Manchester Grain Co.	10.03	8.42	19.75	19.00	7.33	8.00	49.27	5.20	4.00
5422	*Purina Chicken Fat Chow Feed.* Ralston Purina Co., St. Louis, Mo.	*Hartford:* Olds & Whipple, Inc.	9.73	4.51	15.31	15.00	3.35	4.50	62.00	5.10	4.60
5421	*Purina Chicken Fatena Feed.* Ralston Purina Co., St. Louis, Mo.	*Hartford:* Olds & Whipple, Inc.	10.03	3.26	13.31	12.00	4.73	6.60	63.44	5.23	4.60
3633	*Purina Chick Growena Feed.* Ralston Purina Co., St. Louis, Mo.	*Middletown:* H. G. Wadhams Co.	9.23	8.73	18.00	18.00	5.68	7.00	52.76	5.60	4.00
5578	*Purina Chick Growena Feed.* Ralston Purina Co., St. Louis, Mo.	*New Haven:* Moran-Patton Co.	8.00	7.65	18.13	18.00	5.88	7.00	53.61	6.73	4.00
5442	*Purina Chick Startena Feed containing Buttermilk.* Ralston Purina Co., St. Louis, Mo.	*Derby:* Peterson-Hendee Co.	9.23	8.51	18.44	17.00	6.50	6.50	50.57	6.75	4.00
5233	*Purina Hen Chow Feed.* Ralston Purina Co., St. Louis, Mo.	*Meriden:* H. Grulich	12.38	1.53	10.06	10.00	2.25	4.00	70.68	3.10	2.50
5579	*Purina Intermediate Hen Chow Feed.* Ralston Purina Co., St. Louis, Mo.	*New Haven:* Moran-Patton Co.	11.23	1.64	10.63	10.00	2.03	4.00	71.24	3.23	2.50
5420	*Purina Pigeon Chow Feed.* Ralston Purina Co., St. Louis, Mo.	*Hartford:* Olds & Whipple, Inc.	12.70	1.98	15.63	14.00	2.83	4.00	64.41	2.45	2.00
5891	*Purina Pigeon Chow Feed containing Corn.* Ralston Purina Co., St. Louis, Mo.	*Middletown:* H. G. Wadhams Co.	11.10	1.76	14.88	14.00	3.13	3.80	66.48	2.65	2.40
5355	*Winner Scratch Feed.* Ralston Purina Co., St. Louis, Mo.	*Middletown:* H. G. Wadhams Co.	12.00	1.42	10.31	10.00	2.18	5.00	71.06	3.03	2.00
5837	*Diamond Scratch Feed.* Rockville Grain & Coal Co., Rockville	*Manchester:* Manchester Grain Co.	10.70	1.53	10.19	10.00	2.23	4.00	72.12	3.23	3.00
5605	*Advance Egg Mash with Buttermilk.* Rosenbaum Bros., Chicago, Ill.	*Stratford:* M. Blackley	8.55	9.80	17.56	18.00	7.38	8.00	50.47	6.24	4.00
5674	*77 Scratch Feed, No Grit.*. Rosenbaum Bros., Chicago, Ill.	*Stafford Springs:* Dennis Grain Mill	12.50	1.26	10.13	10.00	1.96	5.00	71.17	2.98	2.00
5675	*Vitality Chick Starter.* Rosenbaum Bros., Chicago, Ill.	*Stafford Springs:* Dennis Grain Mill	9.43	11.22	16.19	15.00	4.73	6.00	53.58	4.85	5.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1926—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feeds—Continued.										
5604	*Vitality Egg Mash.* Rosenbaum Bros., Chicago, Ill.	*Stratford:* M. Blackley	9.03	10.00	20.06	20.00	6.70	8.00	48.33	5.88	4.00
5253	*Vitality Growing Mash.* Rosenbaum Bros., Chicago, Ill.	*Suffield:* Spencer Bros.	9.83	6.13	17.38	15.00	5.93	6.00	55.23	5.50	5.00
5807	*Vitality Pigeon Feed, No Corn, No Grit.* Rosenbaum Bros., Chicago, Ill.	*East Bridgeport:* Kaplan Feed Co.	10.75	1.97	12.00	10.00	3.75	5.00	68.68	2.85	2.50
5683	*Vitality Scratch Feed-NG.* Rosenbaum Bros., Chicago, Ill.	*Stafford Springs:* Dennis Grain Mill	11.88	1.36	10.13	10.00	2.00	5.00	71.38	3.25	2.50
6285	*Homespun Mash.* Paty Schwartz Co., New London	Sampled at factory	10.80	7.57	14.63	15.00	10.05	10.00	51.92	5.03	5.00
5859	*Homespun Scratch Grains.* Paty Schwartz Co., New London	Sampled at factory	11.38	1.55	10.44	10.00	2.70	5.00	70.73	3.20	1.50
5487	*See-More-Egg Buttermilk Mash.* Seymour Grain & Coal Co., Seymour	Sampled at factory	8.90	7.51	21.69	18.00	5.18	7.00	51.24	5.48	4.50
5488	*See-More-Egg Scratch Feed.* Seymour Grain & Coal Co., Seymour	Sampled at factory	12.45	1.45	9.81	10.00	2.65	6.00	70.38	3.26	3.00
5473	*Nelson's Laying Mash.* Shelton Feed Co., Shelton	Sampled at factory	9.50	7.02	19.50	16.00	5.10	8.00	53.48	5.40	4.00
5474	*Nelson's Mixed Feed.* Shelton Feed Co., Shelton	Sampled at factory	13.09	1.44	10.00	10.00	2.02	5.00	70.42	3.03	1.50
5657	*Mill Streams "Fortune Hunter" Grains.* Winchell Smith, Inc., Farmington	Sampled at factory	11.92	1.53	11.06	10.00	2.48	3.00	69.96	3.05	2.50
5416	*Mill Streams "Lightnin" Laying Mash.* Winchell Smith, Inc., Farmington	Sampled at factory	9.25	10.22	21.19	16.00	5.93	8.00	48.16	5.25	3.00
6521	*Spratt's Chicgrain.* Spratt's Patent (American), Ltd., Newark, N. J.	*Manchester:* O. E. Bailey	10.93	3.63	15.63	14.00	2.83	4.00	64.00	2.98	3.00
6520	*Spratt's Mash Food with Buttermilk.* Spratt's Patent (American), Ltd., Newark, N. J.	*Manchester:* O. E. Bailey	9.70	4.16	19.88	20.00	3.95	4.00	58.02	4.29	3.50
6269	*King Baby Chick Food containing Buttermilk.* St. Albans Grain Co., St. Albans, Vt.	*Willimantic:* Willimantic Grain Co.	11.53	4.86	14.06	13.00	3.68	5.00	61.59	4.28	4.50
6268	*King Chick Feed.* St. Albans Grain Co., St. Albans, Vt.	*Willimantic:* Willimantic Grain Co.	12.10	1.58	11.31	10.50	1.34	4.00	70.17	3.50	2.50
5665	*King Intermediate Chick Feed.* St. Albans Grain Co., St. Albans, Vt.	*Willimantic:* Willimantic Grain Co.	11.50	1.33	10.81	10.00	1.73	3.50	71.28	3.35	3.00
5662	*King Mash Feed.* St. Albans Grain Co., St. Albans, Vt.	*Willimantic:* Willimantic Grain Co.	8.28	11.59	21.50	19.50	5.60	7.50	46.99	6.04	4.00
5664	*King Scratch Feed.* St. Albans Grain Co., St. Albans, Vt.	*Willimantic:* Willimantic Grain Co.	13.00	1.35	10.38	10.00	2.33	5.50	69.91	3.03	3.00
6531	*Paragon Scratch Feed.* St. Albans Grain Co., St. Albans, Vt.	*Stepney:* M. Nusbaum	15.20	1.50	9.56	10.00	2.78	5.00	67.78	3.18	2.50
6405	*Wirthmore Buttermilk Baby Chick Food.* St. Albans Grain Co., St. Albans, Vt.	*Hamden:* I. W. Beers	12.33	6.49	15.38	13.50	3.33	5.00	58.19	4.28	4.50
5155	*Wirthmore Buttermilk Mash Feed with Fish and Meat Scraps.* St. Albans Grain Co., St. Albans, Vt.	*Hamden:* I. W. Beers	10.23	9.99	20.94	20.00	5.70	7.00	47.79	5.35	4.00
6282	*Wirthmore Gritless Chick Feed.* St. Albans Grain Co., St. Albans, Vt.	*Norwich:* Yantic Grain & Products Co.	14.38	1.33	10.56	11.00	1.68	3.50	69.55	2.50	2.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1926—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feeds—Continued.										
5324	*Wirthmore Growing Feed with Dried Buttermilk and Beef Scrap.* St. Albans Grain Co., St. Albans, Vt.	*Branford:* S. V. Osborn Est.	10.60	8.80	18.44	15.00	5.30	4.50	51.56	5.30	4.50
5862	*Wirthmore Growing Feed with Dried Buttermilk and Beef Scrap.* St. Albans Grain Co., St. Albans, Vt.	*West Cheshire:* Cheshire Grain & Coal Co.	8.90	9.91	18.50	15.00	5.30	4.50	51.31	6.08	4.50
5688	*Wirthmore Intermediate Chick Feed.* St. Albans Grain Co., St. Albans, Vt.	*Willimantic:* Boston Grain Co.	11.55	1.24	10.31	10.00	1.98	3.50	71.77	3.15	3.00
5209	*Wirthmore Scratch Feed.* St. Albans Grain Co., St. Albans, Vt.	*North Haven:* W. L. Thorpe	12.90	1.54	10.06	10.00	2.63	5.00	69.42	3.45	3.00
5349	*Onondaga Scratch Grains.* Syracuse Milling Co., Syracuse, N. Y.	*Higganum:* F. A. Petrofsky	13.48	1.40	9.88	10.00	2.98	5.00	69.41	2.85	3.00
5602	*Symco Scratch Grains.* Syracuse Milling Co., Syracuse, N. Y.	*Long Hill:* Long Hill Feed Store	12.23	1.67	10.38	9.00	2.59	10.00	70.15	2.98	3.00
5761	*Syragold Chick Feed.* Syracuse Milling Co., Syracuse, N. Y.	*Saugatuck:* Saugatuck Grain Co.	10.53	1.72	11.50	10.00	1.50	5.00	70.70	4.05	2.50
5759	*Syragold Chick Starter.* Syracuse Milling Co., Syracuse, N. Y.	*Southport:* C. Buckingham & Co.	8.88	9.04	23.88	18.00	2.23	4.00	50.79	5.18	3.50
5498	*Syragold Egg Mash.* Syracuse Milling Co., Syracuse, N. Y.	*Torrington:* F. W. Wadhams	9.50	6.55	20.50	18.00	7.75	8.00	50.20	5.50	3.00
5758	*Syragold Growing Mash.* Syracuse Milling Co., Syracuse, N. Y.	*Southport:* C. Buckingham & Co.	9.48	5.10	19.00	16.00	3.88	7.00	57.41	5.13	4.00
5247	*Syragold Scratch Grains.* Syracuse Milling Co., Syracuse, N. Y.	*Kensington:* I. F. Labieniec	12.28	1.37	10.00	10.00	2.38	5.00	71.32	2.65	3.00
5887	*Syragold Scratch Grains.* Syracuse Milling Co., Syracuse, N. Y.	*Manchester:* O. E. Bailey	12.85	1.51	10.50	10.00	2.78	5.00	69.28	3.08	3.00
3638	*Thomaston Egg Mash.* Thomaston Supply Co., Thomaston	Sampled at factory	8.55	11.53	19.81	20.00	6.68	7.00	47.68	5.75	3.50
5499	*Thomaston Egg Mash.* Thomaston Supply Co., Thomaston	Sampled at factory	8.95	10.40	21.25	20.00	7.09	7.00	47.22	5.09	4.00
3640	*Thomaston Scratch Feed.* Thomaston Supply Co., Thomaston	Sampled at factory	11.25	1.61	10.63	10.00	2.89	5.00	70.72	2.90	3.00
5501	*Thomaston Scratch Feed.* Thomaston Supply Co., Thomaston	Sampled at factory	12.60	1.53	10.00	10.00	2.63	5.00	70.41	2.83	3.00
6575	*Chicatine.* Tioga-Empire Feed Mill, Waverly, N. Y.	*Hawleyville:* W. A. Honan	9.68	7.07	20.75	18.00	4.25	6.00	53.15	5.10	3.00
5590	*Egatine.* Tioga Mill & Empire Co., Waverly, N. Y.	*Hawleyville:* W. A. Honan	9.15	8.71	26.25	23.00	5.00	6.00	45.49	5.40	2.50
5586	*Tioga Growing Mash.* Tioga Mill & Empire Co., Waverly, N. Y.	*Hawleyville:* W. A. Honan	9.53	5.67	15.13	12.00	5.44	6.00	59.33	4.90	2.00
5589	*Tioga Laying Food.* Tioga Mill & Empire Co., Waverly, N. Y.	*Hawleyville:* W. A. Honan	9.68	8.02	21.00	17.00	4.98	6.00	50.94	5.38	2.50
5848	*Tioga Poultry Grains.* Tioga Mill & Empire Co., Waverly, N. Y.	*Glenbrook:* Davis-Schofield Co.	12.33	1.45	9.94	9.00	2.23	4.79	71.35	2.70	2.08
5588	*Derby Scratch Feed.* Tioga Mill & Empire Co., Waverly, N. Y.	*Hawleyville:* W. A. Honan	12.83	1.48	9.94	9.00	2.65	4.50	69.98	3.12	2.04

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1926—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feeds—Continued.										
6592	*Chicklet Intermediate Chick Feed.* United Flour & Feed Co., Albany, N. Y.	*Winsted:* C. R. Hawley	14.38	1.22	9.44	10.00	1.44	5.00	70.97	2.55	3.00
5569	*Rex Scratch Feed.* United Flour & Feed Co., Albany, N. Y.	*Winsted:* C. R. Hawley	12.63	1.50	10.31	10.00	2.30	5.00	70.03	3.23	3.00
5570	*United Laying Mash with Buttermilk.* United Flour & Feed Co., Albany, N. Y.	*Winsted:* C. R. Hawley	9.73	10.69	20.06	20.00	5.25	7.00	49.29	4.98	4.00
5438	*United Laying Mash, Storrs Formula.* United Flour & Feed Co., Albany, N. Y.	*Weatogue:* R. B. Eno	9.65	10.01	20.94	20.00	5.85	7.00	48.18	5.37	4.00
5585	*Eventually Gold Medal Vitamine Egg Mash.* Washburn-Crosby Co., Minneapolis, Minn.	*New Milford:* Geo. T. Soule	8.33	7.26	20.50	20.00	6.51	8.50	51.55	5.85	5.00
5892	*North Star Scratch Feed, No Grit.* Washburn-Crosby Co., Minneapolis, Minn.	*North Haven:* W. L. Thorpe	12.05	1.43	9.75	10.00	2.50	5.00	71.22	3.05	2.50
5744	*Big Y Growing Feed.* Yantic Grain & Products Co., Norwich	Sampled at factory	8.18	7.82	20.38	17.00	6.58	6.00	51.45	5.59	4.00
5737	*Big Y Laying Mash.* Yantic Grain & Products Co., Norwich	*Willimantic:* Boston Grain Co.	8.45	9.13	22.06	20.00	6.25	7.00	48.21	5.90	4.00
	Beef Scrap, etc.										
3631	*Capital Meat and Bone Scrap.* American Agricultural Chemical Co., New York	*New Haven:* Amer. Agric. Chem. Co.	6.75	31.50	45.56	45.00	....	3.00	6.52	9.67	6.00
5716	*Capital Beef Scrap.* American Agricultural Chemical Co. New York	*New Milford:* W. L. Richmond & Son	7.53	33.51	46.38	45.00	1.95	3.00	1.68	8.95	6.00
3630	*Protox Meat and Bone Scrap.* American Agricultural Chemical Co., New York	*New Haven:* Amer. Agric. Chem. Co.	6.08	24.07	55.25	55.00	....	3.00	3.60	11.00	6.00
5715	*Protox Beef Scrap.* American Agricultural Chemical Co., N. Y.	*New Milford:* W. L. Richmond & Son	6.95	24.55	54.75	55.00	2.40	3.00	....	11.35	6.00
5689	*Beach's Star Brand Beef Scrap.* Beach Soap Co., Lawrence, Mass.	*Willimantic:* Windham Grain Store	7.00	26.09	48.88	35.00	1.85	2.50	2.75	13.43	10.00
5337	*Collis Process Pure Dried Buttermilk.* Collis Products Co., Clinton, Iowa	*Guilford:* Fred C. Morse	10.48	11.47	32.25	30.00	....	....	38.77	7.03	5.00
5163	*Meat Scrap.* Conn. Fat Rendering & Fertilizer Corp., New Haven	*Hamden:* I. W. Beers	8.15	29.21	50.25	40.00	....	....	1.96	10.43	10.00
5341	*Cooked Meat Scrap.* Conn. Fat Rendering & Fertilizer Corp., New Haven	*Guilford:* F. H. Rolf	7.28	19.85	59.25	50.00	....	....	1.57	12.05	10.00
5372	*Chikora.* Dry Milk Co., New York	*New Britain:* C. W. Lines Co.	7.70	8.04	38.31[1]	35.00	....	....	49.72	1.23	1.00
5322	*Frisbie's Bone Meal 20/25% Protein (for Cattle and Poultry),* L. T. Frisbie Co., New Haven	*East Haven:* A. W. Forbes	7.60	15.33	24.88	20.00	....	....	51.39	0.80	2.00
5806	*Frisbie Bone and Meat Meal.* L. T. Frisbie Co., New Haven	Sampled at factory	2.80	42.47	30.44	35.00	....	....	7.71	16.58	8.00
6232.	*Frisbie's Bone and Meat Meal 35/45% Protein.* L. T. Frisbie Co., New Haven	Sampled at factory	5.80	25.75	49.38	35.00	....	....	4.99	14.08	8.00

[1] On a 3% moisture basis, protein 35%.

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1916—*Concluded.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25) Found	Protein (N x 6.25) Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat Found	Fat Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Concluded.* *Poultry Feeds—Concluded.* *Beef Scraps—Concluded.*										
5189	*Frisbie's Poultry Feed 45.* L. T. Frisbie Co., New Haven	*Plantsville:* C. A. Cowles	6.08	31.05	47.50	45.00	....	....	2.12	13.25	8.00
5472	*Frisbie's Poultry Feed 55/65% Protein.* L. T. Frisbie Co., New Haven	*Shelton:* Shelton Feed Co.	5.98	23.96	56.00	55.00	....	....	1.46	12.60	8.00
5673	*Cooked Meat Scrap.* A. G. Markham & Co., Springfield, Mass.	*West Stafford:* C. P. Bradway..	7.90	30.82	48.81	45.00	....	....	3.22	9.25	8.00
5676	*Cooked Meat Scrap.* A. G. Markham & Co., Springfield, Mass.	*Stafford Springs:* Dennis Grain Mill	5.65	28.26	51.50	50.00	....	....	1.79	12.80	8.00
6278	*Marsh's Pure Ground Scraps for Poultry.* Geo. E. Marsh Co., Lynn, Mass.	*Bloomfield:* Bloomfield Farmers' Exchange	5.70	32.01	41.63	40.00	....	....	6.96	13.70	8.00
3451	*Beef Scrap.* Middlesex Refining Co., Middletown	Sampled at factory	6.00	14.68	55.88	55.00	....	1.64		21.80	24.00
5191	*Blue Seal Meat Scraps.* New England By-Products Co., Lawrence, Mass.	*Plainville:* M. Kosenko	7.35	31.14	49.56	50.00	1.63	3.00	1.87	8.45	3.00
5592	*White Seal Meat Scraps.* New England By-Products Co., Lawrence, Mass.	*Hawleyville:* W. A. Honan	6.83	40.30	39.63	40.00	1.30	4.00	1.09	10.85	5.00
5320	*Norton's High Grade Meat and Bone.* Norton Tallow Co., Somerville, Mass.	*Rockville:* Rockville Grain & Coal Co.	6.20	33.96	43.44	45.00	....	....	4.72	11.68	8.00
5824	*Norton's High Grade Meat & Bone.* Norton Tallow Co., Somerville, Mass.	*New Canaan:* Clapboard Hill Feed Co.	5.43	36.57	38.94	45.00	....	....	5.68	13.38	8.00
3634[1]	*Norton's Meat and Bone Poultry Food.* Norton Tallow Co., Somerville, Mass.	*Plantsville:* C. A. Cowles	5.85	33.41	42.75	45.00	....	....	5.10	12.89	8.00
5199	*Meato.* E. Rauh & Sons, Indianapolis, Ind.	*Plainville:* M. Kosenko	4.98	6.93	74.56	75.00	0.65	2.00	....	12.88	8.00
5800	*Reardon's 45% Meat Scraps.* John Reardon & Sons Co., Cambridge, Mass.	*Westerly:* C. W. Campbell Co...	5.05	36.12	45.06	45.00	1.48	3.00	2.34	9.95	6.00
5799	*Reardon's 55% Meat Scraps.* John Reardon & Sons Co., Cambridge, Mass.	*Westerly:* C. W. Campbell Co...	6.00	30.16	53.94	55.00	1.70	3.00	0.35	7.85	6.00
6283	*Reardon's 55% Meat Scraps.* John Reardon & Sons Co., Cambridge, Mass.	*Westerly:* C. W. Campbell Co...	6.98	30.83	51.88	55.00	1.28	3.00	1.75	7.28	6.00
5631	*Chapman's Special Odorless Steamed Bone Meal.* Riverdale Products Co., Chicago, Ill.	*Guilford:* Fred C. Morse	2.10	88.84	5.13	5.00	....	2.00	3.44	0.49	1.50
6010	*Chapman's Special Odorless Steamed Bone Meal.* Riverdale Products Co., Chicago, Ill.	*Middletown:* Meech & Stoddard, Inc.	7.73	81.32	5.94	5.00	....	2.00	4.53	0.48	1.50
4796	*Bone Meal.* Springfield Rendering Co., Springfield, Mass.	*Stafford Springs:* Stafford Granary	5.84	65.83	16.31	20.00	....	....	3.08	8.94	6.00
5497	*Springfield Bone Meal.* Springfield Rendering Co., Springfield,, Mass.	*Torrington:* Litchfield Co-op. Assoc.	5.93	61.72	22.88	20.00	....	....	3.39	6.08	6.00
5184	*Springfield Ground Meat Scraps.* Springfield Rendering Co., Springfield, Mass.	*Plantsville:* Mehmel & Sarvi	8.53	30.45	50.13	45.00	....	....	1.74	9.15	8.00
6205	*Stanley's Meat Scrap.* John T. Stanley Co., Inc., New York..	*Long Hill:* Long Hill Feed Store	5.73	31.40	43.69	45.00	1.66	3.00	5.32	12.20	10.00
5686	*P & W Meat Scrap.* Worcester Rendering Co., Auburn, Mass.	*Merrow:* I. F. Wilcox	6.20	33.14	46.19	45.00	1.70	6.00	1.72	11.05	8.00
5685	*P & W Special Meat Scrap.* Worcester Rendering Co., Auburn, Mass.	*Merrow:* I. F. Wilcox	5.55	20.91	57.69	55.00	1.81	5.00	1.34	12.70	8.00

[1] Wire tags illegal.

Table II. Analyses of Feed Submitted by Individuals.

Station No.	Material	Submitted by	Pounds per Hundred: Water	Ash	Protein (N x 6.25)	Fiber	Nitrogen-free extract (starch, gum, etc.)	Ether extract (crude fat)	Remarks
	Brewers' and Distillers' Products.								
6348	Dried Corn Distillers' Grain	*Waterloo, N. Y.:* Waterloo Distilling Corp.	7.08	3.51	28.69	9.68	39.99	11.05	
6422	Corn Distillers' Grains	*New Canaan:* Clapboard Hill Feed Co.	6.63	1.82	25.88	10.65	45.67	9.35	
	Cottonseed Products.								
4847	Standard Brand Cottonseed Feed	*Middletown:* The Coles Co.	....	....	35.94	....	....	....	Guaranty: protein 36%.
	Proprietary Mixed Feeds. *Dairy Rations, etc.*								
4876	Dairy Feed, Own Formula	*Middletown:* H. O. Daniels	10.14	5.08	21.31	8.61	49.78	5.08	
3418	Dairy Feed	*Willimantic:* Reuben Fishbein	....	....	24.69	....	....	5.53	
3380	Dairy Ration A	*Torrington:* Litchfield County Co-op. Assoc.	10.45	6.50	20.88	8.00	48.69	5.48	
3381	Dairy Ration B	*Torrington:* Litchfield County Co-op. Assoc.	9.75	6.65	22.00	7.50	48.47	5.63	
3774	Eastern States Full Pail Dairy Ration	*Storrs:* Conn. Agr. College	5.38	7.08	21.88	7.16	53.42	5.08	
5641	Wirthmore Dairy Feed	*Newington:* Thomas Holt	9.98	6.07	21.44	7.01	50.32	5.18	
6028	Talcott's Economy Dairy Ration	*Torrington:* Louis B. Merriman	6.20	6.00	24.19	9.15	49.71	4.75	
3450	Dairy Feed	*Torrington:* Clark Weed	7.80	....	24.81	7.50	....	5.08	
3402	Lancaster 20% Dairy	*Norwalk:* Frank Libner & Sons	8.83	7.37	22.88	12.20	42.54	6.18	
	Stock Feed.								
5748	Rex Stock Feed	*Middletown:* Meech & Stoddard, Inc.	....	5.83	10.13	....	....	4.40	
	Poultry Feeds.								
4271	Beef Scrap No. 1	*Ballouville:* J. Z. LaBelle	6.66	....	47.63	none	....	10.55	
4272	Beef Scrap No. 2	J. Z. Labelle	5.95	....	48.50	none	....	15.05	
3387	Meat Scraps	*Middletown:* Middlesex Refining Co.	5.25	8.08	60.25	0.39		26.03	
5069	Meat Scraps	*Norwich:* The Yantic Grain & Products Co.	6.95	....	40.13	....	....	12.08	
6773	Norton's H. G. Meat and Bone	*So. Coventry:* E. W. Latimer	5.96	31.45	44.94	1.25	3.42	12.98	
4898	Albert Angell Jr. Chick Starter	*Brooklyn:* Victor Takanan	....	....	17.13	4.42	....	5.14	
4900	Albert Angell Jr. Chick Starter	Victor Takanan	....	....	16.44	4.51	....	4.94	
5424	Dry Mash (Home Mixed)	*No. Westchester:* Rev. A. W. Carney	10.48	6.71	16.06	5.86	55.51	5.38	
4260	Dry Mash	*Kensington:* S. F. Labieniec	8.65	....	19.94	7.63	....	5.80	
5993	Beacon Egg Mash with Buttermilk	*Little River:* Walnut Crest Poultry Farm	8.85	8.87	21.63	5.98	48.92	5.75	
6209	Fortune Egg Mash	*Middletown:* The Coles Co.	8.30	....	17.00	5.73	....	5.28	
5992	Park & Pollard Lay or Bust Egg Mash	*Little River:* Walnut Crest Poultry Farm	10.50	7.44	19.25	7.10	50.43	5.28	
4899	Albert Angell Jr. Growing Mash	*Brooklyn:* Victor Takanan	....	....	16.94	4.80	....	5.05	
3417	Laying Mash	*Willimantic:* Reuben Fishbein	....	....	21.88	....	....	6.80	
5909	Laying Mash (Own Mixture)	*Torrington:* Litchfield County Co-op. Assoc.	10.15	8.92	16.44	6.03	53.78	4.68	
	Miscellaneous.								
3621	Alfalfa Flour	*Norwich:* The Yantic Grain & Products Co.	2.93	....	20.75	15.25	....	3.08	
3433	Beet Pulp No. 1	*Shelton:* Wolf's Feed Store	6.45	....	10.88	18.33	....	1.24	
3434	Beet Pulp No. 2	Wolf's Feed Store	5.68	....	10.94	18.11	....	0.93	
3435	Beet Pulp No. 3	Wolf's Feed Store	4.70	....	10.50	18.49	....	1.08	
3436	Beet Pulp No. 4	Wolf's Feed Store	4.58	....	11.25	18.35	....	0.88	
3437	Beet Pulp No. 5	Wolf's Feed Store	4.68	....	11.31	24.63	....	1.43	
5314	By-Product from Cracking Corn	Station Agent (unofficial)	12.43	1.27	6.38	7.28	70.71	1.93	
6259	Cracked Corn	Station Agent (unofficial)	11.83	1.38	9.75	1.73	71.76	3.55	
5735	Cracked Corn	*Syracuse, N. Y.:* Syracuse Milling Co.	11.56	1.10	9.50	1.59	72.97	3.28	

TABLE II. ANALYSES OF FEED SUBMITTED BY INDIVIDUALS—*Concluded.*

Station No.	Material	Submitted by	Pounds per Hundred						Remarks
			Water	Ash	Protein (N x 6.25)	Fiber	Nitrogen-free extract (starch, gum, etc.)	Ether extract (crude fat)	
	MISCELLANEOUS—*Concluded.*								
34426	Dry Buttermilk No. 1	*Hartford:* Dairy and Food Commissioner	9.83	8.80	33.25	....	....	4.04	Acidity (calculated as lactic acid) 6.08%.
34426	Dry Buttermilk No. 2	Dairy and Food Commissioner	9.34	7.49	36.56	....	....	0.90	Acidity (calculated as lactic acid) 4.73%.
3910	Dried Buttermilk	Dairy and Food Commissioner	10.00	10.30	30.90	....	43.80	5.00	
3909	Powdered Skim Milk	Dairy and Food Commissioner	10.00	7.90	33.90	....	47.60	0.60	
5454	Harlax Semi-Solid Buttermilk	*Jewett City:* Red Wing Feed Store	66.60	2.14	22.14	0.00	7.49	1.63	
1289	Semi-Solid Buttermilk	*Ballouville:* J. Z. LaBelle	76.16	2.43	....	....	....	0.32	Solids: 23.84%.
6888	Feed-Ax7-I	*Gildersleeve:* John H. Fay	7.72	7.59	30.63	6.57	42.43	5.06	
6889	Feed-Ax7-II	John H. Fay	7.60	7.16	31.44	6.74	41.54	5.52	
6345	Feed	*Hartford:* Leonard H. Healey	10.53	....	17.94	5.92	....	5.88	
7005	Feed	*New Haven:* Moran-Patton Co.	9.05	6.75	17.44	12.39	50.08	4.29	
4821	Feed No. 1	*Bethany:* Sherman P. Woodward	11.79	....	20.63	8.18	....	4.96	
4822	Feed No. 2	Sherman P. Woodward	10.58	....	21.50	8.65	....	5.69	
7195	Feed No. 1	Sherman P. Woodward	9.50	7.18	21.31	7.70	49.10	5.21	
7196	Feed No. 2	Sherman P. Woodward	10.02	5.11	20.75	8.56	51.07	4.49	
7197	Feed No. 3	Sherman P. Woodward	10.17	7.89	21.88	7.32	47.99	4.75	
5986	Special Formula Feed	*Middletown:* The Coles Co.	8.48	10.65	18.06	4.28	52.90	5.63	
3798	Grain Mixture No. 1	*Middletown:* Long Lane Farm	7.73	....	21.44	7.58	....	5.29	
3799	Grain Mixture No. 2	Long Lane Farm	10.00	....	13.94	7.42	....	5.00	
6580	Grain Mixture	Long Lane Farm	7.80	6.39	21.25	8.53	51.35	4.68	

4230	Ground Oats	*Stepney:* H. Goldman	9.71	3.46	11.81	10.05	60.61	4.36	
3908	Ground Oats	*Newington:* Thomas Holt	8.83	....	12.38	10.63	....	5.35	
4921	Mixed Feed	*West Cheshire:* Cheshire Grain & Coal Co.	10.56	....	21.25	7.53	....	5.07	
3646	Austin's Puppy Bread	*New Haven:* Dr. DeVita	4.05	1.92	16.31	0.68	73.92	3.12	
3648	Cero-Meato	Dr. DeVita	4.78	5.21	16.50	0.95	69.23	3.33	
3647	Old Trusty "All Terrier Food"	Dr. DeVita	4.43	1.72	17.13	0.77	73.43	2.52	
3649	Old Trusty "Puppy Cakes"	Dr. DeVita	5.78	5.31	20.44	0.74	63.65	4.08	
3442	Milk-Bone Dog Food	Dr. DeVita	6.28	3.10	16.81	0.70	69.99	3.12	
3443	Milk-Bone Puppy Food	Dr. DeVita	6.18	4.15	17.00	0.78	68.15	3.74	
3445	Old Mother Hubbard Dog Biscuit	Dr. DeVita	6.30	2.84	18.38	0.85	68.11	3.52	
3441	Spratt's Cat Food—With Fish	Dr. DeVita	5.60	4.40	23.75	0.98	60.60	4.67	
3440	Spratt's Cod Liver Oil Cakes	Dr. DeVita	5.88	3.39	19.56	0.86	65.47	4.84	
3447	Spratt's Fibo	Dr. DeVita	5.98	3.39	20.63	0.68	65.86	3.46	
3439	Spratt's Meat-Fibrine Dog Cakes	Dr. DeVita	6.40	3.21	19.69	0.85	65.88	3.97	
3446	Spratt's Ovals	Dr. DeVita	5.90	2.85	19.50	0.68	67.61	3.46	
3438	Spratt's Puppy Meal	Dr. DeVita	6.25	3.33	20.00	0.90	65.86	3.66	
3444	Spratt's "Vito"	Dr. DeVita	4.93	6.23	24.81	2.30	57.18	4.55	
5315	Whole Wheat, Red Wheat	*Thomaston:* Thomaston Supply Co.	14.03	1.53	10.25	1.83	70.51	1.85	
6774	Dairy Feed No. 1	*Chester:* Leet Bros.	7.88	9.58	21.06	8.05	48.88	4.55	
6775	Dairy Feed No. 2	Leet Bros.	6.90	7.40	26.56	9.70	44.58	4.86	
6776	Dairy Feed No. 3	Leet Bros.	7.10	7.08	21.63	10.08	48.63	5.48	
6777	Dairy Feed No. 4	Leet Bros.	7.82	6.33	25.44	8.00	46.96	5.45	
6778	Chick Starter No. 5	Leet Bros.	7.70	7.55	16.69	2.95	60.33	4.78	
6779	Chick Starter No. 6	Leet Bros.	8.35	3.92	15.81	2.78	63.96	5.18	
6780	Calf Meal No. 7	Leet Bros.	8.70	4.12	24.00	3.41	54.74	5.03	
7226	Ground Corn (Farm Waste)	*Milford:* E. B. Clark Seed Co.	11.24	....	11.75	2.93	....	7.58	
7227	Reground Early Evergreen Corn	E. B. Clark Seed Co.	10.48	....	10.81	3.26	....	7.96	
7228	Reground Golden Bantam Corn	E. B. Clark Seed Co.	6.63	....	11.00	1.91	....	7.75	

Miscellaneous Examinations.

Miscellaneous materials submitted by individuals have been examined as follows:

No.	Material	Remarks
6177	*Alfalfa Meal.*	Compared with samples of authentic alfalfa, the sample submitted appeared to be genuine.
7030	*Bird Seed.*	Mixture consisted of canary seed and rape seed. Other seeds practically none.
7011 7071	*Chick Starting Feed.*	**7011.** The usual grains with a milk product and bone meal were present. Epsom salt also identified. **7071.** The usual grains with milk product, meat scrap, bone meal, were present. Calcium carbonate and salt also present. No Epsom salt.
5329	*Corn Meal.*	Finely ground meal. No foreign starch or other foreign material detected.
4048	*Dairy Ration.*	No ingredients other than those mentioned in the formula were found. No evidence of injurious materials detected.
5508	*Dairy Ration.*	Complaint that cows refused to eat the feed. Only standard ingredients detected. No salt was found. Cows accustomed to salt in ration might find feed unpalatable.
3797	*Feed.*	Suspected of containing a poisonous substance. Feeding tests on small animals over a period of 48 hours developed no unfavorable symptoms.
5362	*Meat Scrap.*	Odor and general appearance O. K. Salt content 1.00 per cent.
5004	*Poultry Mash.*	Thought to have caused injury to chicks. Microscopic examination negative; salt content low, 0.3 per cent.
4941	*Unknown substance found in carload of hay.*	Qualitative tests indicated that the material was probably clay.

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Report for 1926

NOTE—*The page numbers with the prefix T refer to the Reports of the Tobacco Substation, which immediately follow this index.*

Connecticut Agricultural Experiment Station
New Haven, Connecticut

THE PHOSPHORUS REQUIREMENTS OF OLD TOBACCO SOILS

P. J. ANDERSON, M. F. MORGAN, AND N. T. NELSON

PHOSPHORUS is necessary for the growth of tobacco but an acre of tobacco removes less than seven pounds annually.

Very little leaches away and, since it can get out in no other way, large quantities have accumulated in our old tobacco soils through continuous heavy fertilizer applications.

The unused supply does not revert to an unavailable form, forever beyond the reach of succeeding crops. The old tobacco fields show a larger supply of easily soluble phosphorus as well as of total phosphorus than is found in newer fields.

Plots which received no phosphorus (other than that in cottonseed meal and castor pomace) for five years produced just as much and just as good tobacco as plots which had various quantities of phosphorus applied.

On old tobacco fields it is reasonable to believe that the grower may greatly reduce or even eliminate phosphorus carriers from his fertilizer mixture for many years without harm.

There is no danger that this practice will deplete the soil of its phosphorus supply since the organic constituents of the usual fertilizer mixture contain four times as much of this element as is lost annually.

A very large part of New England's thirty-five thousand acres of tobacco is grown on old tobacco land. The annual bill for phosphorus on these acres is approximately a quarter of a million dollars. At least half of it is unnecessary.

The Phosphorus Requirements of old Tobacco Soils

P. J. ANDERSON,[1] M. F. MORGAN,[2] AND N. T. NELSON[3]

Phosphorus is an essential element for the growth of all plants and tobacco is no exception to the rule. The soil is the only source from which the plant can derive phosphorus. It is therefore essential that roots in this soil always be in contact with a sufficient supply of phosphorus in a form which they can take up. Tobacco, however, is not a very heavy feeder on phosphorus as compared with corn or most other crops. About 15 lbs. of phosphoric acid* is enough for an 1800 lb. crop of tobacco. The crop uses over 5 times as much nitrogen and 9 times as much potash as phosphoric acid. Yet the grower for many years has applied almost as much phosphorus to his soils as he has of nitrogen or potash. Is this necessary or has he been wasting his money to supply what is not needed? What is the minimum amount which he needs to produce a crop of good yield and quality?

In order to answer these questions, a series of plot experiments was begun at the Windsor Tobacco Substation in 1922. These experiments have been continued on the same plots for five years. The results of the first four years have been published previously in Bulletins 5 and 6 of the Tobacco Series of this station. In the present bulletin it is our purpose first to describe the results of the fifth year's trials, then to summarize the experiments of the 5 years. This will be followed by a more general discussion of the whole phosphorus problem as related to the growing of tobacco.

PLOT TESTS AT THE WINDSOR STATION

Plan of the field tests. Twelve plots, each containing one-fortieth of an acre, were located on Field I of the experiment station farm at Windsor. Tobacco has been grown most of the time on this field for a generation or more† before it was acquired by the station and it had a reputation of producing good tobacco. The

[1] In charge, Tobacco Station. [2] In charge, Soil Investigations at New Haven. [3] Physiologist at Tobacco Station.

* *Phosphorus* (P), the chemical element, does not occur in nature in a free state but always in combination. In the chemical analyses of fertilizers the percentage is expressed in terms of *phosphoric acid* (p. 205). Both this and the term *phosphorus* are in common use. To convert figures for *phosphoric acid* to *phosphorus,* multiply by .44; the reverse may be accomplished by multiplying by 2.3.

† We do not have an exact cropping record of this field previous to 1922. It was in grass in 1921.

soil is a sandy loam of the Merrimac series and appears quite uniform but a survey by the Soils Department showed some variation. With the object of overcoming variation which might be produced in yield or quality by soil differences, the three replicate groups of plots were located on different parts of the field. All plots received the same quantity of nitrogen, potash, and magnesia but there were four different rates of application of phosphoric acid as indicated in Table 1.

TABLE 1. COMPOSITION OF THE FERTILIZER MIXTURES AND QUANTITY OF PHOSPHORIC ACID.

Name of Carrier	Pounds of Carrier per Acre — Plots P_2, P_2*, P_2**	Plots P_3, P_3*, P_3**	Plots P_1, P_1*, P_1**	Plots P_4, P_4*, P_4**
Cottonseed meal	1,463.4	1,463.4	1,463.4	1,463.4
Castor pomace	588.2	588.2	588.2	588.2
Nitrate of soda	212.7	212.7	212.7	212.7
Precipitated bone ...	None	122.1	277.9	485.7
Sulf. of potash	172.2	172.2	172.2	172.2
Carb. of potash	132.5	132.5	132.5	132.5
Lbs. of P_2O_5	53†	100‡	160‡	240‡

In the P2 formula, all *special* carriers of phosphorus were omitted but it is not practical to reduce the phosphorus content to zero because nearly all growers use considerable organics such as cottonseed meal and castor pomace, all of which contain small quantities of phosphorus.

PLOT TESTS AT THE WINDSOR STATION IN 1926

The fertilizer was applied May 22. All plots were set on June 4 with Havana seed plants of uniform size. All cultural operations were the same throughout the growing season. All were harvested on August 16.

No differences in growth or development were observed during the summer. There was no hastening or retarding of maturity on any of the plots as compared with the others. The growing season was unusually dry until about time for harvesting. The curing season on the other hand was marked by long continued periods of rainy weather which caused some pole-sweat in these plots. It was especially bad in plots P1 and P2**. The cured tobacco was sorted in the sorting shop of the Tobacco Station by experienced sorters. Since the percentage of pole-sweat was not uniform in the different plots, it was necessary to sort the brokes into the respective grades to which they would have belonged if

* Asterisks are used throughout to denote first (*) and second (**) replications.

† Only that which is in the cottonseed meal and castor pomace.

‡ In precipitated bone, in addition to cottonseed meal and castor pomace.

they had not been spoiled by sweat. In the tables given below, the weight of these sorted brokes is added to that of their supposed respective grades because it is not at all probable that the degree of pole-sweat has any relation to percentage of phosphorus in the fertilizer.

Careful observations were made during the sorting to see whether there were any differences in color, body or veins. Although some slight differences between plots were recorded, they were not consistent when compared with replicates. In general the tobacco from plots which received no phosphorus seemed a little superior in having less prominent veins and the quality was just as good as, if not a little superior to, any of the others. Samples from the light wrappers, medium wrappers, dark wrappers and long seconds were kept from each plot and later were submitted to experts, Messrs. J. W. Alsop and Walter Edwards of the Connecticut Valley Tobacco Association, for judging and pooling. The forty-eight samples were assigned by them to three different pools but the differences were not consistently in favor of any one treatment when all the replicates were compared.

The sorting record, acre yield and grade index* are presented below in Table 2. The acre yields were calculated from the weights after sorting and sizing. If they had been calculated on the bundle weights they would have been somewhat larger. Since there was apparently a fertility difference in the different parts of the field, each group of four is averaged and the deviation from that particular average recorded for each plot. This brings out more clearly any difference due to the fertilizer treatment—as opposed to differences due to character of the soil.

From a study of the data presented in this table it is apparent that the differences both in yield and in quality (as indicated by the grade index) between the plots treated with different quanti-

* *The Grade Index.* In comparing the quality of tobacco grown on different plots it is very difficult to keep in mind the percentage of six to eight commercial grades of tobacco from one plot and compare with a like number from another. To simplify these comparisons a grade index was devised. The grade index is a single number expressing the quality of *all* the tobacco grown on a particular plot. It is based on the percentage of carefully assorted commercial grades and the relative price value of the different grades. Although market prices vary from year to year, it was found, after consultation with experienced dealers, that the ratios of prices between the different grades are fairly constant. These adopted price relationships for the different grades are as follows:

(L)	Light wrappers	1.00	(LD)	Long darks (19″ up)..	.30
(M)	Medium wrappers ...	.60	(DS)	Dark stemming (17″)	.20
(LS)	Long sec. (19″ up) ..	.60	(F)	Fillers	.10
(SS)	Short seconds (15″ and 17″)	.30	(Br)	Brokes	.01

The grade index of any plot is obtained by multiplying the percentage of each grade by the price in the above schedule and adding the products.

TABLE 2. FIELD TESTS AT WINDSOR, 1926. ACRE YIELD AND SORTING RECORDS.

Plot No.	Acre Yield: Pounds	Acre Yield: Group Average	Acre Yield: Deviation from Average %	Percentage of Grades: L	M	LS	SS	LD	DS	F	Br	Grade Index	Group Average	% Deviation from Average
P1	1802	1811	−0.5	17	12	22	1	35	0	9	4	.495	.482	+2.8
P2	1796		−0.8	15	11	28	1	35	0	9	1	.502		+3.9
P3	1823		+0.7	11	7	31	2	39	0	10	1	.472		−2.1
P4	1822		+0.6	10	4	34	2	37	1	11	1	.459		−4.7
P1*	1900	1896	+0.2	14	7	26	5	41	0	5	2	.483	.506	−4.5
P2*	1943		+2.5	25	10	18	4	33	0	8	2	.539		+6.5
P3*	1881		−0.8	18	7	23	3	37	1	10	1	.493		−2.5
P4*	1860		−1.9	19	9	23	3	35	1	9	1	.508		+0.4
P1**	1656	1724	−3.9	14	6	25	4	42	0	8	1	.473	.479	−1.3
P2**	1724		+0.0	15	8	25	2	39	1	9	1	.483		+0.9
P3**	1744		+1.2	19	11	20	4	34	0	10	1	.501		+4.6
P4**	1772		+2.8	14	11	18	3	41	1	11	1	.460		−3.9

SUMMARY OF TABLE 2

Plot No.	Pounds Phos. Acid per A.	Average Yield in lbs.	Average Grade Index
P1, P1*, P1**	160	1,786	.484
P2, P2*, P2**	53	1,821	.508
P3, P3*, P3**	100	1,816	.489
P4, P4*, P4**	240	1,818	.476

ties of phosphoric acid are too small to be significant and that they are not consistently in favor of any one treatment. Although we are not inclined to call any of these differences significant, nevertheless the fact that even these small differences are in favor of the plots which received no phosphoric acid (in special carriers) indicates, at least, that nothing was gained during 1926 by the addition of any quantity of phosphoric acid to the fertilizer.

SUMMARY OF THE FIVE YEAR EXPERIMENT ON RATE OF APPLICATION OF PHOSPHORIC ACID

Since this experiment has now been in progress for five years it is now possible to bring together the data and analyze the results. During this period each treatment has been replicated fifteen times. Since the quantity of fertilizer applied during the first three years was considered excessive, it was reduced during the fourth and fifth years. The reduction in the quantity of phosphoric acid thus effected was:

P2 plots reduced from 75 to 53 lbs. per acre.
P3 " " " 190 " 100 " " "
P1 " " " 225 " 160 " " "
P4 " " " 306 " 240 " " "

No *special* phosphorus carriers were used at any time on the P2 plots, while the quantity applied to the P4 plots was much in excess of common practice. Intermediate quantities were applied to the P1 and P3 plots.

The experiment was designed to answer two questions: (1) effect of varying rates of application of phosphoric acid on the *yield* and (2) effect on the *quality* of the tobacco. The answer to the first question may be found in Table 3 where the plot yields for the five years are recorded individually and the averages for each plot computed.

TABLE 3. FIELD TESTS AT WINDSOR. YIELD IN POUNDS PER ACRE FOR FIVE YEARS

Plot No.	Yield in Pounds per Acre: 1922†	1923†	1924	1925	1926	Average for 5 Yrs.	Average of the 15 Replications	Five Yr. Total P_2O_5 Lbs.
P1	1,419	1,919	1,493	1,894	1,802	1,705	1,662	995
P2	1,425	1,863	1,413	1,879	1,796	1,675	1,663	331
P3	1,456	1,826	1,493	1,742	1,823	1,668	1,649	770
P4	1,386	1,853	1,387	1,826	1,822	1,655	1,648	1,398
P1*	1,419	1,919	1,387	1,753	1,900	1,678	....	....
P2*	1,425	1,863	1,387	1,885	1,943	1,701	....	....
P3*	1,456	1,826	1,360	1,899	1,881	1,684	....	....
P4*	1,386	1,853	1,333	1,886	1,860	1,664	....	....
P1**	1,419	1,919	1,307	1,717	1,656	1,603	....	....
P2**	1,425	1,863	1,387	1,673	1,724	1,614	....	....
P3**	1,456	1,826	1,333	1,614	1,744	1,595	....	....
P4**	1,386	1,853	1,333	1,731	1,772	1,615	....	....

† During 1922 and 1923 we have only the records of the *average* yield of the three replications; in order to complete the table it is assumed that the yield was the same on the triplicates.

By comparing the final averages of each treatment (each representing fifteen trials) it is apparent that the differences are remarkably small. The greatest difference—comparing the highest with the lowest quantity of phosphorus—is only fifteen pounds and that in favor of entire omission of phosphorus carriers. This difference (about 1%) is too small to be significant. Thus we can safely conclude that the entire omission of phosphorus carriers for five years has not been attended by any decline in yield.

In order to answer the second question—relation of *quality* to phosphoric acid—the grade index was computed for each plot on the same basis for the years 1924, 1925 and 1926,† compared, and averaged in Table 4.

TABLE 4. FIELD TESTS AT WINDSOR. GRADE INDEX FOR 1924, 1925, 1926

Plot No.	Total Lbs. of P_2O_5 Applied in 5 Yrs.	1924	1925	1926	Average of 3 Yrs.	Average of 9 Replications
P1	995	.247	.472	.495	.405	.383
P2	331	.216	.478	.502	.399	.394
P3	770	.263	.422	.472	.386	.387
P4	1,398	.194	.427	.459	.360	.375
P1*	995	.241	.367	.483	.364	....
P2*	331	.247	.398	.539	.395	....
P3*	770	.258	.414	.493	.388	....
P4*	1,398	.269	.402	.508	.393	....
P1**	995	.252	.412	.473	.379	....
P2**	331	.266	.413	.483	.387	...
P3**	770	.249	.378	.501	.376	....
P4**	1,398	.243	.413	.460	.372	....

Comparison of the averages of the nine replications of each treatment show only small differences. The greatest difference is less than two cents a pound and this again is in favor of the no-phosphorus plots. The high-phosphorus plots had the lowest grade index. This corresponds with our observations during the sorting.

During the first year of this experiment, Chapman (26)‡ recorded the observation that the tobacco on the high-phosphorus plots had a distinct tendency to early ripening and the buds appeared fully a week before those on the other plots. This tendency was not evident during the succeeding four years. The writers watched for this carefully during the last two years but no such difference was observed. Certain objectionable colors were also observed in the tobacco from the high-phosphorus in

† Sorting data for the years 1922 and 1923 were not preserved in a form which admits of direct comparison with the data for the later years. However, it is probably preferable to confine the comparison to the later years of the experiment which reflects better the results of *continued* use of each treatment.

‡ Numbers in parentheses refer to bibliography on page 23 of this bulletin.

the early years but careful observation during the last two years failed to show this.

Conclusions. The effect of omitting all phosphorus carriers from the fertilizer ration has not been detrimental either to the yield or to the quality of the tobacco produced on this field. In fact there is some indication that both have been improved slightly. On the other hand the evidence that there has been a detrimental effect from the annual application of considerable quantities of phosphoric acid is not conclusive.

EFFECT OF RATE OF APPLICATION OF PHOSPHORUS ON THE BURN

Although no significant differences were noticed in the yield, grade index, or other points of quality which could be observed during the sorting, it was still conceivable that there might be some effect on the burn. Burn tests were therefore conducted in two ways on the samples from the twelve plots at Windsor after they had been fermented for two months in the force sweat room.

The first was a fire-holding capacity test on single leaves ignited with an electric match (cigar-lighter). From each plot, twenty individual tests were made on the seconds, light wrappers, medium wrappers and dark wrappers, making a total of 80 tests per plot or 240 tests for each treatment. The results are presented in Table 5. It will be observed from this table that the results are variable but certainly do not indicate a favorable influence from the high phosphorus. In fact the highest phosphorus plots have the lowest fire-holding capacity.

TABLE 5. RELATIVE FIRE-HOLDING CAPACITY. (ELECTRIC MATCH METHOD)

Plot No.	Lbs. P_2O_5 Per Acre	Average of 20 Tests in Seconds: Dark Wrappers	Medium Wrappers	Light Wrappers	Seconds	Average
P2	53	....	28.6	38.9	28.6	32.0
P2*	53	9.6	12.4	32.2	18.7	18.2
P2**	53	42.4	39.0	46.7	53.9	45.5
Ave.		26.0	26.6	39.2	33.7	32.0
P3	100	25.5	31.7	37.8	47.3	35.5
P3*	100	16.8	24.7	....	40.2	27.2
P3**	100	53.4	37.1	....	47.0	45.8
Ave.		31.9	31.2	37.8	44.8	36.1
P1	160	22.8	21.6	32.1	30.8	26.8
P1*	160	19.2	18.4	24.6	26.7	22.2
P1**	160	17.2	18.7	19.9	28.7	21.1
Ave.		19.7	19.6	25.5	28.7	23.3
P4	240	19.9	16.8	19.3	28.3	21.1
P4*	240	21.5	25.4	23.3	38.5	27.2
P4**	240	23.5	38.1	38.2	36.8	34.1
Ave.		21.6	26.7	26.9	34.5	27.5

In the second test, leaves from the fermented samples were used in making cigars. Some of the cigars from each plot were "clears," i. e., wrapper, binder and filler from the tobacco grown on that plot. Others had only the wrapper and binder from that plot put on a standard filler which was the same for all plots. All were smoked and records taken on the number of minutes during which they held fire when laid on the desk, the color and coherence of the ash and the evenness and closeness of burn.

The burn was satisfactory on all of them. In over one hundred tests and direct comparison, all held fire more than five minutes and none of them over nine, the ash was light to medium gray, the burn was even and fairly close and there were no consistent differences between the plots treated with different quantities of phosphorus.

In summary, we may say that the entire omission of special phosphorus carriers from the fertilizer mixture for five years has had no injurious influence on the burn of the tobacco.

Phosphorus Tests in Other Tobacco Sections

Since our tests show no response to phosphorus it will be instructive to compare with them the results of tests conducted along the same line in other tobacco sections.

Virginia. Concerning the flue cured tobacco districts of Virginia, Mathewson (24) says "Phosphoric acid may be considered the most generally needed plant food material throughout this tobacco growing region. It not only increases growth but hastens maturity and also strongly tends to brighten the color because of its decided effect in ripening the leaf." In experiments where tobacco was grown every fifth year in rotation and was the only crop to receive any fertilizer, Hutchison and Berger (15) found that "Of the single element carriers, acid phosphate gave the highest acre value." It was used at the rate of 700 lbs. per acre (112 lbs. P_2O_5). A 3-8-3 fertilizer is recommended for tobacco (5, 15) in Virginia.

Tennessee. In a ten year experiment on dark tobacco, starting with a field which was very low in productiveness, grown continuously the first three years and then in a three year rotation, Moores and Milton (25), speaking of acid phosphate, conclude that "The results of the first three years show a profitable increase from the 300 lb. rate, as compared with the 200 lb. rate. Four hundred pounds per acre was indicated to be of doubtful value over 300 pounds."

"Of the three rates of application under trial for seven years in the three year rotation of tobacco, wheat and clover and grass, 300 pounds per acre of acid phosphate produced both the largest and most profitable yields."

Ohio. Here also it was found (27) in the three year rotation with wheat and clover (when all the fertilizers were applied to tobacco) that "when the phosphorus is increased to 720 lbs. acid phosphate per acre, there is a marked gain in yield, this plot producing a greater total yield and a greater net gain than any one in the series." The value of manure was increased when phosphate was added to it. There was also an increase from phosphorus when tobacco was grown continuously. Selby and Houser state (33) that "In nearly all Ohio soils, phosphorus is the most deficient element, and until this element is supplied, the application of nitrogen or potassium produces but little or no effect." "Phosphorus when used alone on the typical upland soil of this region will produce a decided increase in the yield for several years, after which the production decreases, attended with decided marginal dying or drying up of the leaves. The bad effect on the quality of tobacco is entirely corrected by the addition of potash salts or nitrate of soda." They recommend 720 lbs. of acid phosphate per acre. In all of these Ohio experiments, fertilizer was applied only once in three years.

Canada. Experiments by the Dominion Department of Agriculture (4, 7, 8, 11, 34) on Burley, on Bright Flue Cured Tobacco, and on cigar leaf tobacco have shown improvement both in yield and quality by application of acid phosphate at the rate of 350-600 lbs. (56-96 P_2O_5) per acre. Freeman (11) writes "In all our experiments phosphorus in the form of acid phosphate has been shown to be needed on all tobacco soils and, until this is supplied, an application of nitrogen or potash produced little effect." Tobacco is grown in their system of agriculture only once in three or four years and is in rotation with general farm crops. Usually fertilizer is applied only to the tobacco.

Wisconsin. Johnson (16) says "It is believed that the average soil when set to tobacco in Wisconsin will respond quicker to phosphoric acid fertilizer than to any other." Later, Johnson and Slagg (17) write that "most of our tobacco soils respond to fertilization with phosphate fertilizers, and this element can profitably be applied alone or in combination with barnyard manure at the rate of 400-800 lbs. per acre in the form of acid phosphate." They recommend a 2-12-2 fertilizer.

Georgia. Experiments at the Georgia Coastal Plain Experiment Station show that (2) "Of the three plant foods, the absence of phosphoric acid resulted in the smallest growth, indicating that this constituent is the first limiting factor of the soil of the Coastal Plain."

Kentucky. Early experimenters (32) in Kentucky found that phosphorus was beneficial. Later work (29), however, in the Burley section does not show any significant response to phosphorus, since the yield differences between phosphorus and no

phosphorus plots are no greater than those between two adjacent untreated plots. Neither do other crops in the blue-grass section of Kentucky show a significant response to phosphorus.

Pennsylvania. Concerning the tobacco fertilizer experiments in Pennsylvania, Frear (10) says "The soil showed a marked need for phosphoric acid . . . this constituent cannot be safely omitted."

Maryland. Concerning early experiments on tobacco fertilizers in Maryland, Patterson (28) writes: "Phosphoric acid seemed to have but little direct bearing upon the combustibility, but generally produced a marked increase in the yield." In more recent and more extensive field tests, however, Garner and Brown (12) got no response whatever to phosphates. "In no instance," they write, "has any of the phosphates given a marked increase in yield and when the results are averaged for the six year period, there are no substantial differences in yield, either between the plots receiving the various phosphates or between these and the plots receiving no phosphate."

Summary. With two exceptions every fertilizer field test dealing with the phosphorus need of tobacco in the above mentioned tobacco growing states has shown a definite response to phosphate fertilizers. Why do we not get the same response in Connecticut?

1. In the other sections tobacco is not grown continuously but is rotated with crops which carry away considerable phosphorus.
2. Phosphorus is applied only once in the rotation, since the other crops are not fertilized.
3. The amount applied is very small compared with our heavy applications.
4. In some of these sections the soil contained a smaller supply of phosphorus before tobacco was grown.
5. The fertilizer mixture commonly used in other sections does not include organic substances containing phosphorus.

The two exceptions are readily explained. The soil in the Burley section of Kentucky is naturally very rich in phosphorus (see table 7). Garner and Brown explain the Maryland results on the grounds of (a) the cottonseed meal used in their mixture, (b) low phosphorus requirement of tobacco and (c) a phosphorus reserve in this particular soil.

The Role of Phosphorus in Plants

The early experiments on the functions of phosphorus and other essential elements were conducted either on poor, non-productive soils or in water and sand cultures. The physiological effects as stated in standard texts apply more directly to results obtained on low planes of nutrition. Field experiments, with acid phosphate or precipitated bone, have indicated that growth, earliness of maturity and seed production have been promoted by addition to

phosphorus-deficient soils. The greater number of these experiments have been on small grains and corn. With these crops, seed production is more important to the farmer than leaf growth. In the growing of tobacco, on the other hand, we are more directly concerned with vegetative growth than with seed production. Also, since the tobacco soils of Connecticut are managed on a high plane of fertility, it is doubtful if the conclusions derived from such experiments apply in the same way to tobacco in this section as grown under present day methods.

An adequate available supply of phosphoric acid is absolutely necessary for cell division and growth. It has been observed that algae (21) supplied with all the soil nutrients except phosphoric acid made no growth over a period of two months but algae supplied with it during the same interval doubled in size. The starved plants at the end of eight weeks when given a dose of available phosphoric acid showed energetic cell division.

Phosphorus is also necessary for protein formation. Not only do certain proteins contain phosphorus but Kraybill has found in tomato plants that "nitrate nitrogen is not available for protein synthesis even in the presence of an abundance of carbohydrates if phosphates are deficient." Phosphorus enters into the composition of the nucleus and plastids of the plant cells, and is identified in substances such as neucleoproteins, lecithin, chromatin and plastin.

The early growth of a seedling depends on phosphorus stored in the seed. At the time of blossoming and seed formation there is a rapid movement of phosphorus to the seed-producing portion of the plant. This may explain why seed crops such as the grains respond so well to phosphorus treatment. The quality of the grain is also improved because an added amount of phosphoric acid tends to increase the protein content. It may be stated that anything which promotes an absorption of phosphorus is accompanied by an increase in the protein content of the plant (35).

When there is a phosphorus deficiency, maturity is delayed and growth stops. Excessive amounts of available phosphoric acid produce symptoms of prematurity. On a tobacco plant this is made evident by so-called "firing." The leaves prematurely dry up from the bottom of the plant. This condition would naturally be more pronounced in a hot-dry than in a cool-wet season.

Since tobacco is primarily a leaf producing rather than a seed producing plant, the inference would be that it is not a high phosphorus requiring plant. This idea is further substantiated by chemical analyses showing the actual amount taken into the plant. In comparison with nitrogen, potash and calcium, the amount of phosphorus assimilated is very low.

Phosphoric Acid Content of Tobacco Leaves

Experiments by Jenkins (18) showed that tobacco absorbs from the soil relatively small amounts of phosphoric acid. The average analyses of tobacco taken from thirteen of his fertilizer plots showed that an 1800 pound crop (30% moisture) contained only 7.4 pounds. This gives an average of only .58% phosphoric acid on the basis of dry matter. The highest was .84% and the lowest .47%. In his work there is no correlation between the amount of phosphoric acid applied to the soil and the amount recovered in the leaf. Analyses on the phosphoric acid content of tobacco grown in other sections show about the same variation found in Connecticut. Kissling (19) has made an extensive review of analyses of the ash constitutents in tobacco leaves and shows variations between .49% and .70% with an average about the same as that determined by Jenkins.

As a further check on the effects of increasing amount of phosphoric acid applied to the soil in the fertilizer, analyses of samples taken from the crop of 1925 as reported by Dr. E. M. Bailey, chemist in charge of the analytical laboratory, New Haven, are given in Table 6.

Table 6. Phosphoric Acid Content of Tobacco Leaves on Basis of Air Dry Material, 1925 Crop

Lbs. P_2O_5 Applied Per Acre	% of P_2O_5 in 23" Darks on Triplicate Plots				% of P_2O_5 in 21" Lights on Triplicate Plots			
		*	**	Ave.		*	**	Ave.
53	.64	.82	.89	.78	.56	.64	.65	.62
100	.64	.74	.77	.72	.66	.70	.54	.63
160	.82	.78	.88	.83	.57	.68	.70	.65
250	.64	.73	.73	.70	.61	.69	.54	.61

The results of the above analyses show that there is no consistent relation between the amount of phosphoric acid applied to the soil and the phosphoric acid content of the leaf. The darks, however, consistently had a higher phosphoric acid content than the lights.

The Functions of the Phosphorus Constituent of a Fertilizer

The primary value of the phosphoric acid contained in a fertilizer can be properly ascribed to its direct effect of supplying an adequate amount of available phosphorus when the soil is unable to furnish it. On soils containing a very small amount of available phosphorus before fertilization, the growing plant must depend almost entirely upon the fertilizer for a supply of phosphorus which can be absorbed in suitable amount during the

period when it is demanded. Vast areas of crop land in eastern United States have been inadequately fertilized with respect to phosphorus, and contain relatively small total amounts of this element. On such land, phosphatic fertilizers have produced great increases in crop, and the high response to phosphorus relative to that of nitrogen and potassium on field crops has been to a great measure responsible for the popularity of 2-12-2, 4-8-4 and similar ratios of nitrogen, phosphoric acid and potash.

But when the soil is well supplied with phosphorus in an available form, the value of fertilizers supplying phosphorus can be expected to produce relatively less direct benefit. Phosphorus fertilization shows remarkable returns on soils which are seriously deficient in an available supply of this element, but when there is a high natural supply or a considerable accumulation of the residues of previous phosphate applications, the soil may be in such condition that the additional amount of phosphorus supplied in the fertilizer may produce little or no effect.

Phosphorus fertilization may produce indirect effects of great importance. Chief of these is probably the benefits to the essential soil micro-organisms. But here, too, we are dealing with conditions where the phosphorus supply and availability must be taken into account. It is on the soil which liberates an inadequate amount of phosphorus for crop growth that the activities of micro-organisms might be impaired, since phosphorus is essential to their proper development.

Another outstanding indirect effect of phosphorus fertilization is its function on strongly acid soils, which contain considerable amounts of soluble aluminum, toxic to the growth of many plants. Hartwel and his co-workers (14, 3), as well as several other investigators, have shown quite conclusively that large quantities of phosphate, much in excess of the probable demands of the crop for plant food material, can produce great increases in crop through its action in precipitating the injurious soluble aluminum out of the soil solution. Under such conditions the same result can be brought about by lime, and it is questionable whether phosphorus fertilization primarily for the correction of the injurious effects of acid soil conditions will ever prove desirable.

The Supply and Availability of Phosphorus in Connecticut Tobacco Soils

In their natural unfertilized condition, the total supply of phosphorus in the soils of the Connecticut tobacco district probably ranges from 1,000 to 2,000 pounds of phosphorus (equivalent to 2,300 to 4,600 pounds of phosphoric acid) per acre within average plow depth. To investigate the cumulative effect of tobacco fertilization, a series of 68 soils from the tobacco section were ana-

lyzed for total and "available" phosphorus. Twenty-one of these soils, from fields either never in tobacco or less than 5 years in that crop ("new land") showed an average of 1,528 pounds of total phosphorus, with an average deviation of 281 pounds above or below this amount. Twenty-seven soils, in tobacco for from 5 to

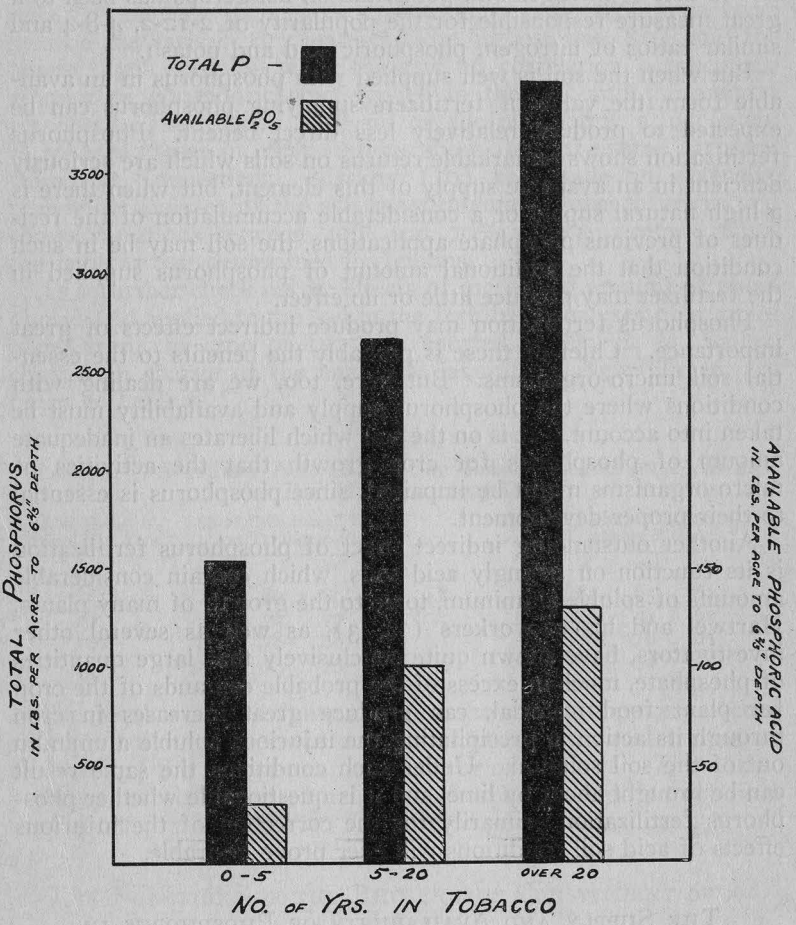

FIG. 1. The accumulation of phosphorus in heavily fertilized tobacco soils in Connecticut.

20 years, averaged 2,655 pounds (± 538 lbs.), 20 soils, in tobacco 20 or more years, averaged 3,855 pounds (± 566 lbs.). This is shown graphically in Figure 1.

The above very strikingly shows the rapid accumulation of phosphorus with the tobacco fertilization practice usually followed in Connecticut. Thus in less than 20 years the phosphorus con-

tent of the soil is built up to almost twice the original amount, and rapidly exceeds this with increasing years of fertilization. This result, while perhaps not anticipated, is not difficult to explain. If we assume the complete removal of both stalks and leaves of an 1,800 pound crop of tobacco, not more than 15 pounds of phosphoric acid is removed per year. The average fertilization is at least 150 pounds of phosphoric acid. There remains 135 pounds phosphoric acid, equivalent to about 60 pounds of phosphorus. Thus a soil originally containing 1,500 pounds of phosphorus could be built up to 3,000 pounds in twenty-five years of continuous fertilization.

Besides the fertilizer, other materials which contain phosphorus are added to the soil. A ton of tobacco stalks or stems contains at least 13 pounds of phosphoric acid (5.7 lbs. phosphorus). Ten tons of manure contains probably 50 pounds of phosphoric acid (about 22 lbs. phosphorus).

How much of the phosphorus which is not taken up by the crop is lost from the soil through leaching? Experiments at Rothamsted (20) and Cornell (22, 23) and at the Florida Station (6) have shown that the loss of phosphorus in this manner is practically nil. There is a lack of evidence on this point where heavy fertilization is applied to sandy soils, though Fraps (9) has shown that there is a possibility of a small loss under such conditions. Several samples of drainage water collected during the first year of an experimental type of lysimeter at Windsor has shown a concentration of 2 to 3 parts per million of P_2O_5, and if such a concentration is maintained throughout the year, this represents a possible loss of around 5 pounds of phosphorus (11.5 lbs. phosphoric acid) per acre per year. It is hoped that further evidence on this point will be obtained during the next two or three years.

The total phosphorus to be found in an old tobacco soil represents a rather high amount as compared with other soils of the country. A comparison is shown in Table 7.

TABLE 7. TOTAL PHOSPHORUS CONTENT OF SOME SOILS IN EASTERN UNITED STATES

State	Remarks	Total Phosphorus in Lbs. Per Acre to 6 2/3 in. Depth
Connecticut	Tobacco fields over 5 years in tobacco, 48 soils	3,260
	Tilled areas in general farm crops, never in tobacco, 58 soils	1,858
	Pasture fields, 52 soils	1,540
New Jersey	Types similar to Connecticut, 14 soils	1,452
New York	Average loam	1,480
Ohio	Average of 126 soils	1,125
West Virginia	Average of 485 soils	1,040
Illinois	Light colored silt loams	1,200
	Heavy black prairie soils	2,000
Kentucky	"Blue grass" soils	9,000

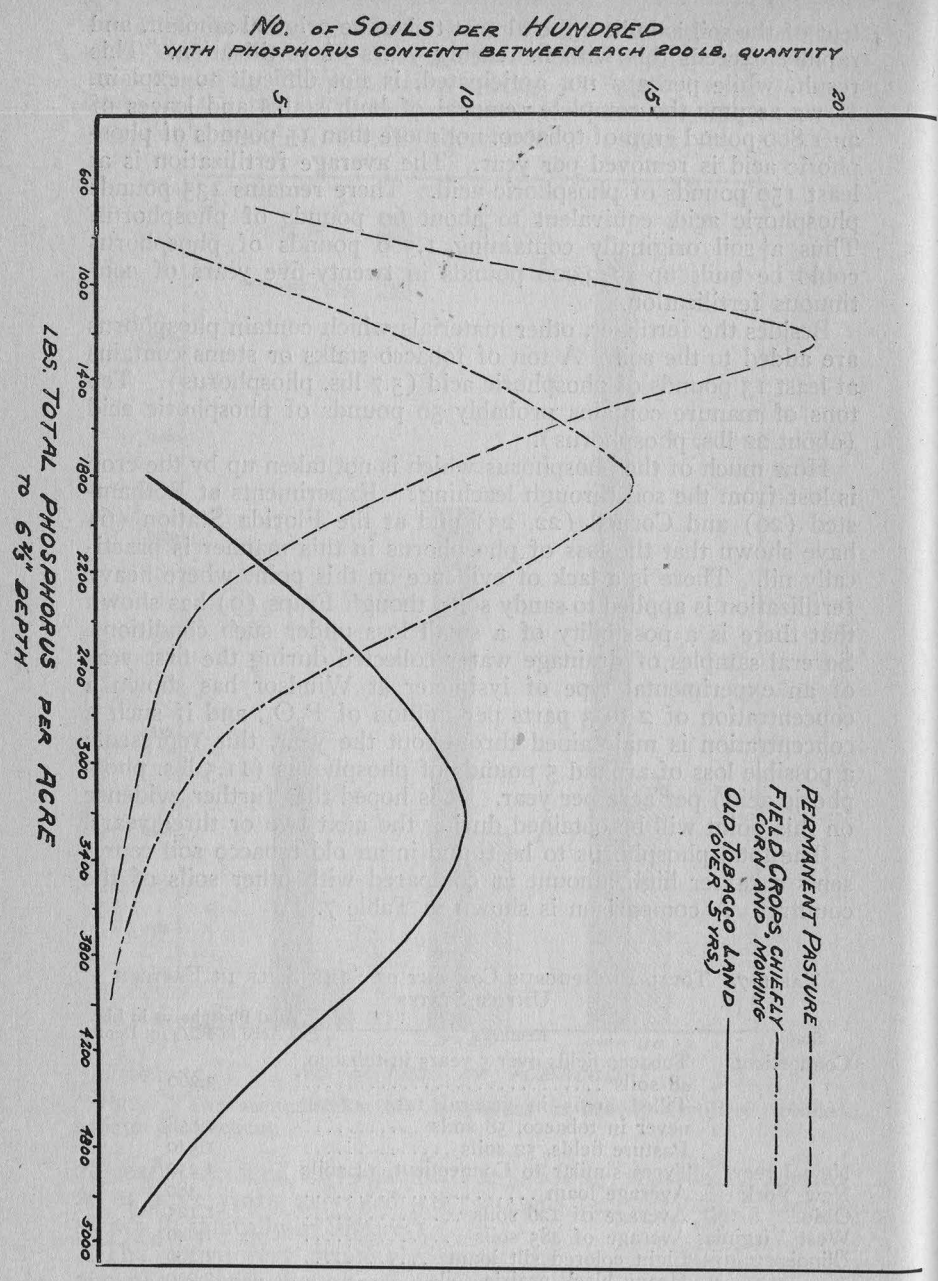

Fig. 2. The distribution of total phosphorus content in old tobacco soils as compared with other soils of Connecticut.

The distribution of total phosphorus in old tobacco soils in comparison with soils under other systems of management is shown graphically in Figure 2.

Since the residual effect of several years of tobacco fertilization at the rate of 150 to 200 pounds of phosphoric acid is sufficient to build up the soil to a relatively high total phosphorus content, one naturally asks if this accumulation is sufficiently available to provide subsequent crops with all the phosphorus they require for adequate yield and quality. The only absolute answer is found through trials such as have been made at Windsor during the last five years to ascertain whether or not there is a response to continued use of phosphatic fertilizers. The result on this particular field has shown conclusively that applications of phosphate in excess of that furnished by the organic ammoniates are no longer required.

Chemical tests of the availability of the soil phosphorus while furnishing us with valuable indications along this line must always be arbitrary in character. Phosphorus available for one species of plant may not be so for another, and the same amount of chemically "available" phosphorus may be easily obtained by the crop on a certain soil, and with difficulty on a different one. Such tests of Connecticut soils have shown that on the old tobacco fields there is a relatively high amount of phosphorus which is soluble in carbonated water and very dilute acids, of similar concentration to the soil solution. The following figures are significant:

21 soils, never in tobacco or less than 2 years in tobacco (new land) average *30 lbs.* phosphoric acid per acre soluble in dilute (N/100) sulfuric acid, ranging from 10 to 60 lbs.
20 soils, 5 to 20 years in tobacco average *100 lbs.* "available" phosphoric acid per acre, ranging from 70 to 140 lbs.
21 soils, over 20 years in tobacco, average *130 lbs.* "available" phosphoric acid per acre, ranging from 90 to 160 lbs.
This is also shown graphically in Figure 1.

The plots at Windsor upon which no response for phosphorus is obtained range from 100 to 160 pounds "available" phosphoric acid by this test.

In a series of plot experiments on different soils at New Haven, growing alfalfa, soils which show less than 60 pounds of "available" phosphorus have shown decided crop increases from phosphatic fertilizers, while an old tobacco soil in these trials, with 90 pounds of "available" phosphoric acid, showed no increased growth when phosphorus was applied, although it responded to both lime and potash. Alfalfa is a crop which is very sensitive to deficiencies of phosphorus.

The residual phosphorus from fertilizers in which precipitated

bone is the principal phosphorus carrier, while reverting very quickly to less soluble forms, remains absorbed in the soil in a condition from which it is much more easily liberated than the native phosphorus in the original soil, which is probably chiefly composed of particles of mineral phosphate (apatite) (13, 36). A considerable amount of this residual phosphorus may be in organic compounds (30) from the residues of tobacco roots and stalks and of the organic ammoniates applied. Much of such phosphorus is easily broken down into forms which are readily available to the plant (31).

Summary

Field plot tests over a period of five years on old tobacco land at Windsor show that tobacco is indifferent to the quantity of phosphorus used in the fertilizer. No significant differences could be found in the yield or quality of tobacco irrespective of quantity of phosphorus in the fertilizer.

Extensive burn tests failed to show that the burn was affected by the rate of application of phosphorus in the fertilizer.

These results are different from those secured from fertilizer tests in other tobacco-growing sections of the country. Of the numerous field tests reported in other states, only two fail to show definite favorable response from phosphorus application.

This difference in response between Connecticut soils and that in other sections is due to long continued heavy applications of phosphates which have built up an immense surplus more than adequate to supply the needs of the crop.

When additional phosphorus is added to old tobacco soils it is not taken up by the plant. Analyses of tobacco from the different plots showed that there was no correlation between the quantity of phosphorus in the leaves and that applied to the soil.

Very little of the phosphorus is removed by the plant (6½ lbs. per acre) and only a very small quantity is lost by leaching. Neither is it forever lost by forming unavailable combinations with the soil constituents. Analyses show that these old soils are well supplied with available as well as total phosphorus.

Special carriers of phosphorus could probably be omitted from the fertilizer mixture for an indefinite period of years without harm to the tobacco crop on fields where this crop has been grown continuously. The organic constituents alone in the ordinary tobacco mixture supply four times as much phosphorus as the plant needs. This alone should guard against depletion.

No secondary benefits from phosphorus (as a soil correctant) have been observed in these experiments. The corrective action on very acid soils (if needed) may be accomplished as well, if not better, by lime.

New Tobacco Fields

Although the great bulk of tobacco is raised where tobacco has been grown more or less continuously for many years, there are always some new fields which have not been previously cropped to tobacco or have grown tobacco for a short time. Unless previous crops on this land are known to have received considerable phosphates, it would seem advisable to apply considerable phosphorus in the fertilizer. We suggest about 160 pounds of phosphoric acid per acre. Up to the present we have not had any new land available for experimental work along this line, but it is hoped that this may be started in 1927.

By reference to Table 8 the grower who wishes to mix a fertilizer for new land may compute the quantity of carrier needed. This table of analyses was kindly prepared by Dr. E. M. Bailey of the Chemistry Department of this station and includes most of the materials containing phophorus which have been used on tobacco fields. Some of them are used for their phosphorus alone, while others contain other plant foods. Some which are used primarily as nitrogen carriers also contain some phosphorus. For this reason we have included all which contain more than a trace of phosphorus and have given also the percentage of nitrogen and potash as well as some other elements which are of interest to the tobacco grower.

TABLE 8. AVERAGE OR TYPICAL ANALYSES OF TOBACCO FERTILIZER MATERIALS CONTAINING PHOSPHORUS

Name	Phos. Acid		Nitrogen (N)	Ammonia (NH_3)	Potash		Chlorine (Cl)	Lime (CaO)	Magnesia (MgO)	Sulf. Acid (SO_3)
	Total P_2O_5	"Avail." P_2O_5			Total K_2O	Water-Sol. K_2O				
	%	%	%	%	%	%	%	%	%	%
Precipitate bone	38.3	37.7	....	....	....	....	....	45.3[1]	....	....
Bone meal	24.0	(2)	3.1	3.8	....	....	0.3	28.4[1]	....	....
Steamed bone	28.0	(2)	1.5	1.8	....	....	0.3	33.6[1]	....	....
Acid phosphate	17.2	16.0	....	....	....	....	....	20.4[1]	....	....
Rock phosphate	32.0	(3)	....	....	....	....	....	37.9[1]	....	....
Ammo-phosphate	22.3	21.7	16.4	19.9	....	....	trace	....	....	....
Dry ground fish	7.6	(5)	8.7	10.6	1.1	....	0.3	8.7	0.4	5.2
Tankage, high grade	9.2	(2)	7.6	9.2	....	....	0.4	11.0[1]	....	....
low grade	20.2	(2)	4.2	5.1	....	....	0.4	24.2[1]	....	....
Wood ashes	2.1	....	....	....	....	6.6	0.5	36.6	5.7	1.2
Cottonhull ashes	9.8	8.0	....	....	....	25.0	0.2	5.2	11.2	2.4
Tobacco stems	0.5[6]	....	2.1[6]	2.6	6.4[6]	....	0.5	3.8	0.5	0.5
Cottonseed meal	2.9	....	6.8	8.3	1.9	....	trace	0.3	0.7	....
Linseed meal	1.7	....	6.0	7.3	1.3	....	none	....	....	....
Castor pomace	2.2	....	5.0	6.1	....	....	0.1	0.9	0.8	....
Cow manure[7]	0.3	....	0.4	0.5	0.5	....	0.1	0.2	0.1	0.1
Horse manure[8]	0.4	....	0.7	0.9	0.6	....	0.1	0.5	0.2	0.1
Sheep manure	1.5	1.3	2.1	2.6	....	2.4	....	....	....	....

[1] Based on the calcium equivalent to phosphoric acid.
[2] Approximately ½ "available."
[3] From 1 to 2 per cent "available."
[5] About 5 per cent "available."
[6] Average of 50 analyses.
[7] Wet, 72 per cent water.
[8] Wet, 66 per cent water.

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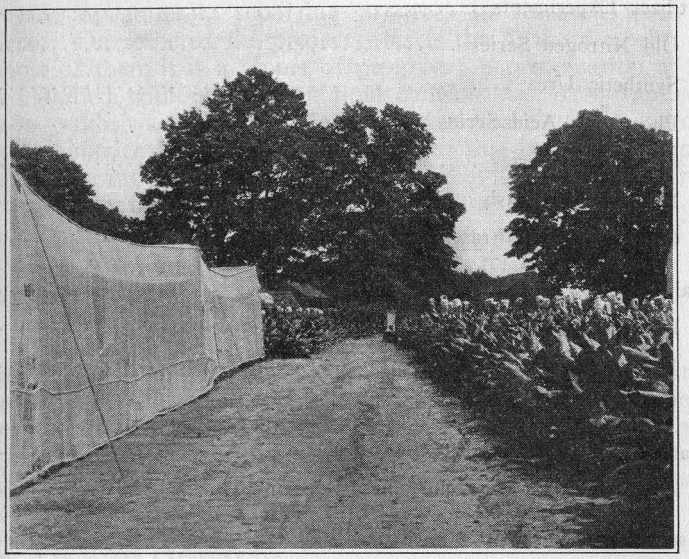
Connecticut Agricultural Experiment Station

New Haven, Connecticut



LOOKING SOUTH BETWEEN SHADE AND HAVANA BREEDING PLOTS.

REPORT OF TOBACCO STATION AT WINDSOR

1926

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

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Report of Tobacco Station—1926

P. J. ANDERSON[1] and N. T. NELSON[2]

This report represents a continuation of the policy established last year of annually reporting progress in research work on tobacco. On some of the projects this is the final statement. but on most of them it is a report of progress; a presentation of the data obtained without drawing final conclusions. It is our purpose to publish a separate bulletin on each phase of the work as soon as sufficient new information on that line has been accumulated to warrant it. In accord with this policy three bulletins from the tobacco station are now in press as follows:

"Phosphorus Requirements of Old Tobacco Soils"
"Chemical Preservation of Tobacco Shade Tent Poles"
"Influence of Height and Stage of Topping on the Quality and Yield of Cigar Leaf Tobacco"

These lines of work are not discussed in this report. Limitation of space also makes it advisable to postpone discussion on some of the other projects listed below, in order to cover more fully those which are complete or well along.

The projects which have been actively carried forward in 1926 are as follows:

1. FERTILIZER EXPERIMENTS.
   - *The old nitrogen series.* Fifth year. Final report and summary in this bulletin.
   - *Synthetic urea* as a sourse of nitrogen. Second year. All experiments to date described here.
   - *The phosphoric acid series.* Fifth year. Fully treated in Tobacco Bulletin No. 7.
   - *The old potash series.* Fourth year. Fully discussed to date below.
   - *Muriate of potash.* Discussed in full here.
   - *Carbonate and nitrate of potash.* Data on current year presented.
   - *Sulfur, magnesia, chlorine series.* (In coöperation with U. S. Dept. of Agriculture.)
   - *Fractional application series.* Not discussed at this time.
   - *Manure series.* Not discussed.
2. STRAIN TESTS.
   - *Havana seed strains.* Third year. Fully discussed below.
   - *Broadleaf strains.* Third year. Discussed below.

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3. IMPROVEMENT OF SHADE TOBACCO BY BREEDING AND SELECTION. No report.
4. COVER CROPS FOR TOBACCO. Report later.
5. BROWN ROOTROT EXPERIMENTS. Second year. Not reported
6. RELATION OF SOIL REACTION TO BLACK ROOTROT AND OPTIMUM GROWTH OF TOBACCO. Discussed briefly below.
9. TESTS OF CHEMICALLY TREATED SHADE CLOTH. Discussed fully here.
10. THE ROLE OF HUMIDITY AND TEMPERATURE IN CURING. Not discussed.
12. TOPPING AND SUCKERING EXPERIMENTS. Published in separate bulletin.
14. CONTROL OF WIREWORM. Progress report below.
15. MISCELLANEOUS TOBACCO DISEASES. Notes below.

FERTILIZER EXPERIMENTS

THE OLD NITROGEN SERIES

This series has now been continued for five years. All fertilizer treatments in 1926 were the same as for the 1925 crop except that the precipitated bone was omitted because this field has shown no need of phosphoric acid.[1] The twenty-one plots, each of one fortieth acre, are on Field 1 of the station farm which is a sandy loam of the Merrimac series and has always grown good tobacco. The field is fairly uniform but a survey by the Soils Department showed some inequalities. In order to overcome any differences in productiveness due to these irregularities, the triplicate groups of seven plots each were located on different parts of the field.

The objects of this series were to compare the yield and quality of Havana Seed Tobacco when:

1. One-fifth of the nitrogen is supplied in mineral carriers.
2. One-half the nitrogen in mineral carriers.
3. None of the nitrogen in mineral carriers.
4. One-half the nitrogen in dry round fish.
5. One-half the nitrogen in high grade tankage.

The other carriers of nitrogen are cotton seed meal and castor pomace, which are considered standard.

In 1926 the fertilizer was applied to all on May 22d and the plants set on June 4th. All were harvested on August 16th. No signficant differences in growth were noticed throughout the season. The early part of the growing season was dry and cold but the growth was fairly satisfactory. Long continued rainy periods during the harvesting and curing season, however, resulted in a rather poor cure with some pole-sweat. All the tobacco from these plots was sorted by experienced sorters in the station ware-

[1] See Tobacco Bulletins 5 and 6 for a more detailed description of this series and reports of results of the first four years.

house. The yield per acre, variation, percentages of grades and the grade index* for the various plots are presented in Table 1.

(L) Light wrappers	1.00	(LD) Long darks (19″ up)	.30
(M) Medium wrappers ..	.60	(DS) Dark stemming (17″)	.20
(LS) Long sec. (19″ up)	.60	(F) Fillers	.10
(SS) Short sec. (15 & 17″)	.30	(Br) Brokes	.10

The grade index of any plot is obtained by multiplying the percentage of each grade by the price in above schedule and adding the products.

TABLE 1. OLD NITROGEN SERIES, 1926. ACRE YIELDS AND PERCENTAGE OF GRADES.

Plot No.	Nitrogen treatment	Acre yield	% variation†	Percentage of grades L	M	LS	SS	LD	DS	Fil	Br	Grade index
N1	1/5 N in nitr. soda	1760	0	12	6	26	4	40	1	10	1	.457
N2	1/2 N in nitr. soda	1730	—2	11	9	32	4	34	1	8	1	.481
N3	1/5 N in sulf. am.	1668	+1	9	12	31	1	38	0	7	2	.474
N4	1/2 N in sulf. am.	1715	—3	10	12	23	1	42	1	9	2	.452
N5	All N in organics	1743	—1	13	11	22	2	42	0	9	1	.470
N6	1/2 N in fish	1827	+4	7	9	33	2	39	0	9	1	.455
N7	1/2 N in tankage	1737	—2	13	8	26	2	41	0	9	1	.473
N1*	1/5 N in nitr. soda	1759	—2	18	14	24	3	30	1	9	1	.519
N2*	1/2 N in nitr. soda	1765	—2	15	12	24	3	36	1	8	1	.494
N3*	1/5 N in sulf. am.	1860	+3	11	9	27	2	41	1	10	1	.468
N4*	1/2 N in sulf. am.	1762	—2	10	7	24	2	45	1	10	1	.440
N5*	All N in organics	1872	+4	9	5	31	2	43	0	9	1	.451
N6*	1/2 N in fish	1825	+2	10	5	30	1	44	0	9	1	.455
N7*	1/2 N in tankage	1744	—3	15	6	29	1	38	1	9	1	.489
N1**	1/5 N in nitr. soda	1932	—1	25	16	14	5	31	1	7	1	.548
N2**	1/2 N in nitr. soda	1889	—3	25	17	13	4	31	1	8	1	.546
N3**	1/5 N in sulf. am.	1940	0	23	9	20	3	33	2	9	1	.526
N4**	1/2 N in sulf. am.	1973	+1	17	8	20	3	43	0	8	1	.485
N5**	All N in organics	1961	+1	15	9	21	2	43	0	9	1	.475
N6**	1/2 N in fish	1994	+2	23	12	14	3	40	0	7	1	.523
N7**	1/2 N in tankage	1941	0	31	16	14	4	27	0	7	1	.591

* First replication.
** Second replication.
† Percentage of variation from the average of the group of seven in which it lies.

Since this series of plots has now been continued for five years and will be discontinued in 1927, the results obtained can now be

* *The grade Index.* In comparing the quality of tobacco grown on different plots it is very difficult to keep in mind the percentage of six to eight commercial grades of tobacco from one plot and compare with a like number from another. To simplify these comparisons a grade index was devised. The grade index is a single number expressing the quality of *all* the tobacco grown on a particular plot. It is based on the percentage of carefully assorted commercial grades and the relative price value of the different grades. Although market prices vary from year to year, it was found, after consultation with experienced dealers, that the ratios of prices between the different grades are fairly constant. These adopted price relationships for the different grades are as follows:

summarized. In Table 2 the acre yields of all plots for the five years are recorded and summarized. Since there were some changes in the treatment beginning with 1925 (explained in Bul. 6, p. 6) the results for the first three years are averaged, then those of the last two and finally those for all five years (except for N3, N4 and N5 on which the change in treatment was so great as to make the results not comparable during the two periods). The grade indices for 1925 and 1926 are compared in Table 3. Indices for the first three years are not included because the sorting data were not recorded in a form suitable for computing indices on the same basis as for the other years.

TABLE 2. NITROGEN PLOTS. ACRE YIELDS, IN POUNDS, FOR FIVE YEARS

Plot No.	Nitrogen treatment	Acre yield 1922	1923	1924	1925	1926	Five year ave.	2 yr. 1925-1926	3 yr. 1922-1924
N1	1/5 N in nitr. soda	1396	1768	1307	1814	1760	1609	1787	1490
N2	1/2 N in nitr. soda	1204	1795	1360	1729	1730	1564	1730	1453
N3	1/5 N in sulf. am.	1456	1857	1387	1681	1668	....	1674	1633
N4	1/2 N in sulf. am.	1360	1789	1333	1747	1715	....	1731	1494
N5	All N in organics	1460	1955	1280	1709	1743	....	1726	1565
N6	1/2 N in fish	1382	1927	1440	1993	1827	1714	1910	1583
N7	1/2 N in tankage	1280	1919	1413	1771	1737	1624	1754	1537
N1*	1/5 N in nitr. soda	1396	1768	1387	1787	1759	1619	1773	1517
N2*	1/2 N in nitr. soda	1204	1795	1307	1844	1765	1583	1804	1435
N3*	1/5 N in sulf. am.	1456	1857	1440	1975	1860	....	1917	1584
N4*	1/2 N in sulf. am.	1360	1789	1440	1945	1762	....	1854	1529
N5*	All N in organics	1460	1955	1360	1863	1872	....	1868	1592
N6*	1/2 N in fish	1382	1927	1413	1826	1825	1675	1825	1574
N7*	1/2 N in tankage	1280	1919	1440	1879	1744	1652	1811	1549
N1**	1/5 N in nitr. soda	1396	1768	1493	1914	1932	1701	1923	1556
N2**	1/2 N in nitr. soda	1204	1795	1387	1851	1889	1625	1870	1462
N3**	1/5 N in sulf. am.	1456	1857	1387	1778	1940	....	1859	1567
N4**	1/2 N in sulf. am.	1360	1789	1467	2047	1973	....	2010	1539
N5**	All N in organics	1460	1955	1360	1884	1961	....	1922	1592
N6**	1/2 N in fish	1382	1927	1360	1857	1994	1704	1925	1556
N7**	1/2 N in tankage	1280	1919	1440	1888	1941	1694	1915	1546

SUMMARY OF TABLE 2. AVERAGE OF ALL PLOTS TREATED ALIKE.

Plot No.	Nitrogen treatment	Five years	Two years 1925-1926	Three years 1922-1924
N1	1/5 N in nitr. soda	1643	1828	1521
N2	1/2 N in nitr. soda	1591	1801	1450
N3	1/5 N in sulf. am.	....	1817	1576
N4	1/2 N in sulf. am.	....	1865	1521
N5	All N in organics	....	1839	1583
N6	1/2 N in fish	1698	1887	1571
N7	1/2 N in tankage	1657	1827	1544

TABLE 3. NITROGEN TREATMENT. GRADE INDEX FOR 1925-1926.

Plot No.	Nitrogen treatment	Grade index 1925	1926	Ave.	Ave. of 6 rep.
N1	1/5 N in nitr. soda	.427	.457	.442	.468
N2	1/2 N in nitr. soda	.420	.481	.450	.468
N3	1/5 N in sulf. am.	.431	.474	.452	.459
N4	1/2 N in sulf. am.	.422	.452	.437	.428
N5	All N in organics	.399	.470	.434	.426
N6	1/2 N in fish	.399	.455	.427	.448
N7	1/2 N in tankage	.460	.472	.466	.473
N1*	1/5 N in nitr. soda	.439	.519	.479	....
N2*	1/2 N in nitr. soda	.413	.494	.453	....
N3*	1/5 N in sulf. am.	.451	.468	.459	....
N4*	1/2 N in sulf. am.	.381	.440	.411	....
N5*	All N in organics	.373	.451	.411	....
N6*	1/2 N in fish	.397	.455	.426	....
N7*	1/2 N in tankage	.395	.489	.442	....
N1**	1/5 N in nitr. soda	.418	.548	.483	....
N2**	1/2 N in nitr. soda	.459	.546	.502	....
N3**	1/5 N in sulf. am.	.408	.526	.467	....
N4**	1/2 N in sulf. am.	.387	.485	.436	....
N5**	All N in organics	.389	.475	.432	....
N6**	1/2 N in fish	.462	.523	.492	....
N7**	1/2 N in tankage	.431	.591	.511	....

The following summary of results is based on the data accumulated for five years presented in the tables, our own observations, numerous burn tests (to be recorded in a later report) and the judgment of tobacco experts.

Effect of increasing the amount of nitrate of soda (N1 and N2 plots). In the N1 plots, *one-fifth* of the nitrogen is in the mineral carrier nitrate of soda while in the N2 plots *one-half* of the nitrogen is from nitrate of soda. By reducing thus the quantity of the more expensive organic nitrogen carriers and increasing the mineral carriers a saving of approximately $10.00 per acre is effected. What has been the effect on the quality and on the yield? Since during the first three years one-half of the mineral nitrogen was from sulfate of ammonia, we should probably compare only the figures for 1925 and 1926. During these years the N1 plots produced an average of 27 lbs. per acre more than the N2 plots. The grade index was exactly the same, .468. Multiplied by 27 this gives a difference of $12.64 in favor of the N1 plots which compensates for the $10.00 which was saved on the fertilizer. If we disregard the slight change in formula during the first three years and compare the average yields of 15 replications for each, there is a difference of 52 lbs. in favor of the N1 plots or a difference of 71 annually during the first three years.

Conclusions from the five years' tests. There has been no bad effects on the quality of the tobacco from increasing the nitrate of soda. There has, however, been a slight reduction in yield which approximately compensates for the saving in cost of fertilizer. In case the organic fertilizers become more expensive

and the mineral carriers less expensive (a tendency which may be anticipated) there seems to be no good reason why nitrate of soda cannot be used in larger quantities to replace the organics.

Comparison of nitrate of soda with sulfate of ammonia as a source of one-fifth of the nitrogen (N1 and N3 plots). The formula for the N3 plots was the same during the last two years as for the N1 plots except that sulfate of ammonia was used on the N3 plots. The average yield of six replications during these two years was 11 pounds per acre less on the sulfate of ammonia plots than on the nitrate of soda plots. The grade index was also lower, indicating that the quality was not quite as good. Notes taken at the time of sorting and burn tests also confirm the latter statement. The high percentage of sulfur in sulfate of ammonia makes it a less desirable source of nitrogen than nitrate of soda.

Conclusion. Nitrate of soda seems preferable to sulfate of ammonia to supply one-fifth of the nitrogen in the fertilizer formula.

Comparison of nitrate of soda with sulfate of ammonia as a source of one-half of the nitrogen (N2 and N4). This comparison was made only during 1925 and 1926. Averages of six replications of each during those two years show a gain in yield of 64 pounds by the use of sulfate of ammonia. It will be noticed, however, that the grade index for the sulfate of ammonia was the next lowest of all the plots. During both years the percentage of dark leaves was higher on these plots than for any other treatment. The quality at time of sorting was rated as low as any. There was considerable white and prominent vein. When burn tests were made, these plots rated the lowest of any in fire-holding capacity and color of ash.

Conclusions. Sulfate of ammonia keeps up the yield but produces tobacco of poor quality and poor burn.

All nitrogen from organic carriers compared with one-fifth of the nitrogen from mineral sources (N1 and N5 plots). The average yield of the six tests of each was nearly the same but the average grade index was lower for the organic plots. The tobacco on the latter plots was better during the second than during the first year.

Conclusions. Although the data are not entirely convincing we may at least conclude that no harm has come from supplying one-fifth of the nitrogen from nitrate of soda and there has certainly been no advantage in supplying it all from organic carriers.

One-half of the nitrogen from dry ground fish (N1 and N6 plots). Except for a small reduction in total quantity of fertilizer at the beginning of the fourth year (Bul. 6, p. 6) the treatment of these plots has remained the same throughout the five years of the experiment. We therefore have 15 replications of each. The average yield of these fifteen replications has been 55 pounds higher for fish plots. In fact the yield was the highest of any in the nitrogen series. The average grade index, however, has been somewhat higher for the plots in which there was no fish.

Conclusions. The fire-holding capacity was considerably lower in the fish plots. Apparently excessive use of fish has impaired the fire-holding capacity. Also the ash was not as white on the fish plots.

One-half the nitrogen from high grade tankage (N1 and N7 plots). The treatment of these plots also has remained practically unchanged during the five years. The average yield for the fifteen replications has been 14 pounds per acre higher for the tankage plots than for the N1 plots. The grade index is also slightly higher on the tankage plots. In the burn tests, the fire-holding capacity has been practically as good as for the N1 plots. The ash color has not been quite as good as for the N1 plots. No difference in aroma or other burn characters were observed.

Conclusions. In every other respect except a somewhat darker ash, the tobacco from the tankage plots has been just as good as, if not a little superior to, that from the N1 plots throughout the five years. Although we would not advocate the use of tankage as the only source of nitrogen, the very favorable results certainly indicate that it could be used more extensively to replace cottonseed meal than it has been, especially during years when cottonseed is high. The principal advantage in using tankage is its relatively low cost. The following information concerning tankage has been furnished by Dr. E. M. Bailey of the Chemistry Department:

For the last five years, the average price for nitrogen in tankage has been 26¢ per pound. During the same period the price for nitrogen in cottonseed meal has been 34½¢ per pound. Tankage comes from meat and bone refuse from slaughter houses and the nitrogen and phosphorus content varies according to the amount of bone included (bone raising the percentage of phosphorus). Low grade tankage contains less than 5% nitrogen and over 15% of phosphoric acid. High grade contains more than 5% nitrogen. Average analyses of the two for the five years shows the percentage of nitrogen in cottonseed meal and tankage to be about the same. Other ingredients found in tankage according to analyses made for the tobacco station are 5.1% calcium oxide, 0.29% magnesium oxide, 2.6% sulfate and 0.31% chlorine.

SYNTHETIC UREA AS A SOURCE OF NITROGEN

Synthetic urea and other forms of air nitrogen compounds give promise of becoming the cheapest and most plentiful source of fertilizer nitrogen. If they can be used to advantage they are certainly the most economical carriers of nitrogen on the market. Tests were started in 1925 on six one-fiftieth acre plots on Field IX of the Tobacco Station farm. The plan of the experiment

was to compare the yield and quality of Havana seed tobacco when the nitrogen of the fertilizer mixture was:

1. All from urea.
2. One-half from urea (other half from cottonseed meal and castor pomace).
3. None from urea (standard formula).

The composition of the fertilizer mixtures is given below:

Plot N1. Standard formula. No urea.

Carrier name	Lbs. per acre	Cost an acre	Lbs. plant nutrient per acre NH_3	P_2O_5	K_2O	MgO
Cottonseed meal	1,463.4	$36.59	120	42.4	21.9	10.2
Castor pomace	588.2	8.82	40	10.6	5.9	4.7
Nitrate of soda	212.7	7.23	40	....	....	....
Precipitated bone	277.9	8.34	....	107.0	....	....
Sulfate of potash	172.2	4.74	....	....	86.1	....
Carbonate of potash	132.2	9.94	....	....	86.1	....
Total	2,846.9	$75.66	200	160.0	200.0	14.9

Plot N8. 1/2 ammonia in synthetic urea.

Carrier name	Lbs. per acre	Cost an acre	Lbs. plant nutrient per acre NH_3	P_2O_5	K_2O	MgO
Cottonseed meal	914.6	$22.87	75	26.5	13.7	6.4
Castor pomace	367.7	5.52	25	6.6	3.7	2.9
Urea	178.4	13.38	100	....	....	....
Precipitated bone	329.6	9.89	....	126.9	....	....
Sulfate of potash	172.0	4.73	....	....	86.0	....
Carbonate of potash	132.3	9.92	....	....	86.0	....
Double sulfate	40.7	.71	....	....	10.6	4.6
Total	2,135.3	$67.02	200	160.0	200.0	14.9

Plot N9. All ammonia in synthetic urea.

Carrier name	Lbs. per acre	Cost an acre	Lbs. plant nutrient per acre NH_3	P_2O_5	K_2O	MgO
Urea	357.0	$26.78	200	....	....	....
Precipitated bone	415.5	12.47	....	160.0	....	....
Sulfate of potash	165.8	4.60	....	....	82.9	....
Carbonate of potash	127.4	9.55	....	....	82.8	....
Double sulfate	131.8	2.31	....	....	34.3	14.9
Total	1,197.5	$55.70	200	160.0	200.0	14.9

Thus by using the N8 formula the cost of the fertilizer would be reduced $8.64, while by using the N9 formula it would be reduced $19.96 per acre.

The fertilizer was applied May 26 and the plants set June 14, 1926. All plots were identical as to location and treatment in 1925 and 1926. The growth of the tobacco was not uniform but the poor spots showed no relation to the fertilizer treatment since no consistent differences in growth as between the plots were

observed during the season. All the tobacco was harvested on August 19, and when cured was sorted in the station warehouse. The cure was good with only a trace of pole sweat.

TABLE 4. UREA PLOTS. SORTING RECORD FOR 1926.

Plot No.	Source of nitrogen	Percentage of grade LW	MW	LS	SS	LD	DS	Fil	Br	Grade index
N1*****	Standard	24	7	10	9	35	1	12	2	.492
N1******	No urea	22	6	10	8	39	1	12	2	.473
N8	½ nitrogen	30	12	7	9	31	0	10	1	.545
N8*	from urea	9	5	20	9	40	1	12	4	.405
N9	All nitrogen	22	11	9	9	36	1	10	2	.489
N9*	from urea	17	5	14	7	41	1	12	3	.445

The sorting records are presented in Table 4. The yields per acre and grade indices are summarized for both 1925 and 1926 in Table 5. The quailty of the tobacco from all these plots in 1926 was rated as excellent at the time of sorting except that the veins were somewhat more prominent on the N9* plot.

TABLE 5. SYNTHETIC UREA PLOTS. ACRE YIELDS AND GRADE INDICES FOR 1925 AND 1926.

Plot No.	Nitrogen treatment	Acre yield 1925	1926	Ave. of 4 replications	Grade index 1925	1926	Ave. of 4 replications
N1*****	Standard, no urea	1364	1501	1534	.268	.492	.411
N1******	" " "	1561	1711		.411	.473	
N8	½ urea	1356	1488	1544	.325	.545	.395
N8*	" "	1597	1695		.303	.405	
N9	All urea	1347	1622	1561	.257	.489	.386
N9*	" "	1465	1810		.352	.445	

Comparing the averages of the four replications as presented in Table 5, it appears that the difference in yield as between the three (less than 2%) is too small to be significant. The grade index is slightly in favor of the standard formula but here again the difference is pretty small.

Although it would probably be unwise at present to derive all the nitrogen of the fertilizer formula from urea, there is no indication of harm from using it to furnish a part of the nitrogen.

PHOSPHORIC ACID SERIES

Results of the tests of 1926 and a review of the five-year test are published as a separate bulletin, **Phosphorus Requirements of Old Tobacco Soils,** Tobacco Bulletin 7 of this station. It was found that this soil, like many other tobacco soils, has such an accumulation of phosphorus that it gives no response whatever to phosphoric acid applications.

THE OLD POTASH SERIES

The purpose of this experiment was to compare sulfate of potash-magnesia (double manure salts) with high grade sulfate of potash as a source of potash (see Tobacco Station Bul. 5, p. 24, and Bul. 6, p. 22, for more detailed description of the experiment and composition of the fertilizer mixtures). The six plots of one-fortieth acre each are located on Field I on the Tobacco Station farm. The fertilizer mixture is a standard formula and the same for all plots except for the source of potash. For the K1 plots all potash was in sulfate of potash, for the K2 plots it was in double sulfate of potash-magnesia, and for the K3 plots it was derived equally from each of these carriers. No change was made in the formula for 1926 except for the omission of precipitated bone. Fertilizer was applied on May 22d and the plants set on June 4th. No difference in growth were apparent throughout the season. There was no indication of magnesia starvation. On account of unfavorable curing season, some of the plots had considerable pole sweat and although the brokes were sorted, the data on these plots are not as reliable as for the previous year. The yields and sorting records are presented in Table 6.

TABLE 6. OLD POTASH SERIES. YIELD AND SORTING RECORD FOR 1926.

Plot No.	Source of Potash	Acre yield	Percentage of grade LW	MW	LS	SS	LD	DS	Fil	Br	Grade index
K1	High grade	1739	11	7	31	1	40	0	9	1	.471
K1*	sulfate	1832	18	10	23	2	37	0	9	1	.505
K2	Sulf. of	1831	13	7	30	2	36	1	10	1	.479
K2*	pot.-mag.	1833	16	7	29	2	36	0	9	1	.500
K3	Half from	1712	12	6	31	2	39	0	9	1	.475
K3*	each	1648	11	6	30	2	39	.0	11	1	.461

The yields and the grade indices for the four years of this experiment are summarized in Tables 7 and 8. Every treatment has now been replicated eight times. The difference between the average yields are approximately 2% while the average grade indices show a difference of only 1% for the four years.

TABLE 7. OLD POTASH SERIES. ACRE YIELDS FOR FOUR YEARS.

Plot No.	Form of potash	Acre yields by years 1923	1924	1925	1926	Average	Ave of 8 replications
K1	High grade	2056	1333	2054	1739	1796	1815
K1*	sulfate	2056	1387	2061	1832	1834	
K2	Sulf. of	1966	1413	1932	1831	1786	1781
K2*	pot.-mag.	1966	1413	1892	1833	1776	
K3	Half from	2039	1467	2029	1712	1812	1775
K3*	each	2039	1333	1929	1648?	1738	

TABLE 8. OLD POTASH SERIES. GRADE INDICES FOR THREE YEARS.

Plot No.	Grade index 1924	1925	1926	Average	
K1	.281	.475	.471	.409	.415
K1*	.291	.475	.505	.422	
K2	.281	.476	.479	.412	.414
K2*	.273	.471	.500	.415	
K3	.316	.461	.475	.415	.410
K3*	.270	.483	.461	.405	

Since these differences are quite too small to be significant we may conclude that the yield and quality of the tobacco are not affected by the partial or complete substitution of sulfate of potash-magnesia for high grade sulphate. During these four years there has been no indication of magnesia hunger on any of the plots. Careful observations at the time of sorting and pooling by experts have failed to show any significant differences in quality. Apparently there is magnesia enough (15 lbs.) in the organic part of this fertilizer to satisfy the requirements of the crop. It does not necessarily follow that all tobacco soils will show this same indifference to magnesia, but since very few cases of "sand-drown" have been observed in Connecticut, we are inclined to believe that in general there is no need of using double manure salts wherever the mixture contains considerable organic material. Sulfate of potash-magnesia is a more expensive source of potash than is high grade sulfate and is more bulky. It also contains more sulfuric acid in proportion to the quantity of potash it carries. The sulfur content of the fertilizer mixture should be kept as low as possible.

Thus, unless the grower has had trouble from "sand-drown" on his field, there appears to be no advantage—and there are some disadvantages—in using sulfate of potash magnesia.

MURIATE OF POTASH

Muriate (chloride) of potash has been avoided by tobacco growers because chlorine was thought to injure the fire-holding capacity. Within the last few years, however, there has been a rekindled interest in muriate due to increased American production and to its use on some types of tobacco in the south. Since no field tests in New England are on record, two plots on Field I were treated with a fertilizer mixture exactly like the standard formula used on the N1 and P1 plots except that the potash was supplied in muriate instead of sulfate and carbonate. The plots were set at the same time as the rest of the field and all cultural operations were the same during the two years of the experiment, viz., 1925, 1926.

There were no noticeable differences in growth or other char-

acteristics in the field. When the tobacco from these plots was sorted it seemed heavier and darker and had a greasy feeling when handled. It came "into case" more quickly than the tobacco from the other plots. The sorting records for these along with the N1 and P1** plots, which were adjacent and may be regarded as controls for the K6 plots, are presented in Table 8A.

TABLE 9A. MURIATE OF POTASH AND PLOTS AND ADJACENT CHECKS. 1925-26. YIELD AND SORTING RECORDS.

Plot No.	Carrier of plot	Year	Percentage of grades L	M	LS	SS	LD	DS	Fil	Br	Grade index	Average	Acre yield	Average
K6	muriate	1925	3	2	24	5	45	7	3	11	.364	.378	1685	1739
		1926	9	7	23	3	47	0	10	1	.431		1880	
K6*		1925	2	4	20	6	44	12	4	8	.350		1799	
		1926	5	2	25	0	44	0	22	2	.368		1594	
N1	sulfate and carbonate	1925	12	9	19	4	32	7	6	11	.427	.442	1814	1732
		1926	12	6	26	4	40	1	10	1	.457		1760	
P1**		1925	11	11	16	7	26	12	8	9	.412		1717	
		1926	14	6	25	4	42	0	8	1	.473		1636	

According to the data presented in Table 8A, the yield is not affected by the substitution of muriate for a combination of sulfate and carbonate. There has been, however, a material lowering of the grade index; it will be noted that the percentage of dark grades has been increased by muriate.

In order to see what effect the muriate had on the fire-holding capacity, these leaves were tested along with those from plots where other forms of potash had been used. One hundred and sixty tests (electric match method) were made on the tobacco from each plot after fermentation. The results were as follows:

Tobacco fertilized with sulfate of potash burned	34.3 sec.
Tobacco fertilized with carbonate of potash burned	44.9 "
Tobacco fertilized with muriate of potash burned	4.8 "
Tobacco fertilized with 2/3 nitrate, 1/3 carbonate burned	43.1 "
Tobacco fertilized with ½ sulfate, ½ carbonate burned	38.0 "
Tobacco fertilized with 1/3 carbonate, 1/3 nitrate, 1/3 sulfate	43.5 "

It is thus apparent that muriate has had a very serious effect on the fire-holding capacity. This conclusion is confirmed by tests in other tobacco sections of America and in other countries. An excellent review of this subject has recently been published by Dr. E. H. Jenkins (Conn. Sta. Bul. 282:92-95, 1926) to which the interested reader may refer for more detail.. In the South where muriate is used, it is not so essential that these types of tobacco have good burning qualities. Also they use only small quantities of fertilizer and tobacco is frequently grown in rotation. With our conditions, no grower can afford to apply muriate of potash either on his tobacco or on crops grown where he may wish to grow tobacco later. Some growers, however, have become unnecessarily alarmed because some of the ingredients used in fertilizer mixtures contain small quantities (usually less than 1%) of chlorine. It seems unlikely that such small quantities could have an appreciable effect on the burn.

CARBONATE AND NITRATE OF POTASH

The series of plots in which these two carriers of potash are being compared with sulfate is only in the second year and is planned to run at least five years. The data on the 1926 crop is presented in Table 9. A more complete discussion will be postponed until the experiment has continued longer.

TABLE 9. CARBONATE AND NITRATE OF POTASH PLOTS, 1926. YIELD AND SORTING RECORDS.

Plot No.	Potash carrier	Acre yield	Percentage of grades LW	MW	LS	SS	LD	DS	Fil	Br	Grade index
K4	sulfate	1135	5	4	8	12	34	10	22	5	.307
K4*		1294	8	9	5	12	35	15	16	0	.351
K5	carbonate	1325	6	5	9	14	33	16	16	1	.331
K5*		1312	5	5	14	10	38	7	15	6	.343
K7	⅔ nitr.	1350	6	4	9	15	32	15	16	3	.328
K7*	⅓ carb.	1393	8	7	15	11	36	5	14	4	.381
K8	½ sulfate	1362	7	7	9	15	34	12	14	2	.353
K8*	½ carbonate	1403	6	11	15	13	38	2	12	3	.388
K9	⅓ sulf. ⅓ carb.	1373	7	10	8	13	37	11	13	1	.364
K9*	⅓ nitr.	1424	11	11	14	11	35	2	13	3	.388

The fertilizer was applied on May 25 and the plants set on June 5. The land here (Field V) is light and sandy; hence these plots suffered severely from the dry weather which prevailed during the early growing season and never made a satisfactory growth. All were harvested on August 10.

Thorough examination of the roots after harvesting the crop showed no serious rootrot infection on any of the plots. Occasional lesions could be found on roots from all the plots (a condition common in all old tobacco fields) but these were not more numerous on the carbonate plots than on the others. There were no differences in growth during the summer to indicate rootrot effects. The reaction of the soil on all plots was tested before application of the fertilizer in the spring and at the time of harvesting and the results compared with those taken at this time during the preceding year. During the two years of this experiment there has been no appreciable decrease in acidity on any of these plots.

The relative fire-holding capacity of the tobacco from each of these plots is indicated on p. 38. Some have objected to nitrate of potash because they said the tobacco burned with a crackling or sputtering due to the saltpetre which it was supposed to contain.

When cigars made from the crop of 1925 were smoked, however, they did not sputter or crackle although this fault was carefully watched for. Such a sputtering may frequently be observed in very "grainy" leaves in any crop of tobacco but it does not indicate that nitrate of potash was used in the fertilizer.

Strain Tests

Havana strains

The purpose of these tests, which have now been in progress for three years, is to find whether there are in our Havana seed tobacco certain strains which are superior to others, and if so, to pick out the best ones for seed distribution and for selection with the object of further improvement. (The plan of the experiment and progress of the first two years is described in Tobacco Station Bulletin 6, pp. 37-41.) For the tests of 1926, the original eighteen strains were reduced to nine by selecting those which had the best records of performance for the two preceding years. A new strain furnished by Clark Bros. of Windsor was added as well as three rootrot resistant strains, 148C, 142C3, 142A3, and a strain selected by Dr. James Johnson of Wisconsin, called Conn. 38. These were all grown side by side in single row series on three different fields on the station farm and on the farm of Mr. Frank Solkowski of Windsor.

The plants were set on the station farm on June 4 and on the Solkowski farm on June 8. The most striking differences observed throughout the summer were the stronger growth of the resistant strains, and the close setting and greater number of leaves. The Clark strain grew taller than the others and was readily distinguished by a peculiar crinkling of the leaves. The differences between the others were not very evident in the field. Each row on Fields I and III contained 60 plants, on Field II, 30 plans and on the Solkowski field, 120 plants. Due to the fact that some of the short rows on Field II were saved for seed, the data on this field are not complete and in making the averages below (Table 11) they are omitted. The tobacco on the station farm was harvested on August 9 and on the Solkowski farm on August 20. All strains were sorted in the station warehouse. Sorting data and acre yields are presented in Table 10. These data are summarized in Table 11.

Table 10. Acre Yield and Percentage of Grades in Havana Seed Strain Tests of 1926.

Source of Seed	Rep.	Acre yield	Percentage of grades LW	MW	LS	15″	17″	LD	DS	Fil	Br	Grade index
Shean		1599	7	17	14	3	6	36	1	10	6	.409
	*	1475	6	11	17	1	4	36	2	14	9	.378
	**	1513	13	13	18	1	4	34	1	13	3	.451
	***	1894	11	11	17	1	4	39	2	12	3	.431

Source of Seed	Rep.	Acre yield	Percentage of grades LW	MW	LS	15″	17″	LD	DS	Fil	Br	Grade index
Crafts		1654	4	16	17	2	7	35	2	12	6	.380
	*	1562	8	14	10	4	5	36	6	12	5	.388
	**	1600	7	9	22	0	4	34	3	16	5	.397
	***	1920	19	12	10	2	4	43	0	9	1	.479
Brown		1747	6	12	20	3	4	34	4	11	6	.400
	*	1489	20	13	13	2	5	30	5	13	5	.495
	**	....	..	..	..	..	..	..	..	..	..	....
	***	1894	21	16	13	1	3	35	1	9	1	.513
Pelissier		1551	5	10	7	4	6	40	9	17	2	.339
	*	1489	8	7	7	2	4	46	5	16	5	.351
	**	1524	7	15	13	1	7	37	3	14	3	.396
	***	1793	20	12	8	2	5	41	2	10	0	.480
Viets		....	..	..	..	..	..	..	..	..	..	....
	*	1445	6	18	12	2	5	33	4	16	4	.388
	**	1475	5	10	11	1	5	43	2	16	7	.350
	***	1829	19	12	9	2	4	42	1	9	2	.473
Duncan		1576	5	12	13	1	5	45	4	12	3	.376
	*	1696	10	12	14	1	4	37	3	16	3	.407
	**	1530	6	10	14	0	5	36	3	16	10†	.359
	***	1937	22	15	11	1	4	35	1	9	2	.509
Henshaw		1316	4	10	15	3	5	36	5	14	8	.354
	*	1460	4	10	22	1	4	41	1	12	5	.409
	**	1536	5	24	13	0	4	28	3	14	9	.427
	***	1879	13	12	22	1	3	37	1	8	3	.470
Peckham (?)		1623	3	17	29	1	4	32	1	15	7	.387
	*	1562	11	20	13	2	4	33	1	10	6	.443
	**	1600	12	24	9	0	4	31	2	12	6	.447
	***	1973	22	20	9	1	3	33	0	9	3	.517
Kendall		1484	4	14	17	4	7	36	4	12	2	.389
	*	1360	6	13	18	1	3	34	4	15	6	.389
	**	1579	16	27	3	2	2	25	2	16	6	.456
	***	1836	23	15	8	0	3	42	0	8	1	.512
Clark		1600	9	15	16	1	3	34	1	13	8	.413
	*	1562	12	12	14	1	5	37	1	13	5	.425
	**	....	..	..	..	..	..	..	..	..	..	....
	***	1915	15	18	10	1	3	42	1	8	2	.468
148 C		1807	9	12	29	1	2	21	1	9	16	.435
	*	1635	12	9	28	1	3	23	1	10	13	.458
	**	1666	10	8	20	0	2	24	3	17	16	.388
	***	2045	18	19	15	2	3	35	0	6	2	.512
142 C3		1791	15	5	22	2	3	34	1	14	4	.449
	*	1679	19	8	17	1	4	30	2	14	5	.470
	**	1666	6	8	17	0	4	30	10	19	6	.357
	***	2174‡	11	11	16	2	4	45	0	6	5	.436
142 A3		1806	8	4	21	1	5	27	0	12	22	.363
	*	....	..	..	..	..	..	..	..	..	..	....
	**	1457	8	11	14	0	6	22	8	22	9	.361
	***	1951	12	13	21	1	4	35	0	9	5	.458
Conn. 38		1697	5	9	20	0	3	28	3	12	20	.358
	*	1577	9	15	18	4	6	30	2	12	4	.430
	**	1600	6	13	16	0	6	25	6	20	8	.367
	***	1850	24	11	13	1	4	32	0	9	6	.510

† Bundle accidentally got wet on one side and high percentage of brokes due to this.

‡ This bundle was overdamp. Probably weight is too high, therefore some deducted in making the average.

TABLE 11. SUMMARY OF TABLE 10. BASED ON 3 REPLICATIONS.

Source of seed	Average yield	Average grade index
Shean	1656	.406
Crafts	1712	.416
Brown	1703	.469
Pelissier	1611	.390
Viets	1637	.403
Duncan	1736	.431
Henshaw	1552	.411
Peckham	1723	.449
Kendall	1560	.430
Clark	1692	.435
148 C	1829	.468
142 C3	1860	.452
142 A3	1878	.407
Conn. 38	1708	.433

As regards yield, it is apparent from these data that the resistant strains uniformly produce more tobacco than our ordinary strains. This same characteristic has been observed in other tests which we have made with these strains in previous years and other unrecorded tests of 1926. Among the other strains, the yield is good and practically equal for the Crafts, Brown, Duncan, Peckham and Conn. 38 strains. The difference between the highest and lowest of these five is less than 2% and could hardly be considered significant.

In respect to grade index, the following strains rank in the order named: Brown, 148C, 142C3, Peckham, Duncan, Kendall, Crafts. Leaving out of consideration the resistant strains (to be discussed below) it is thus seen that the four strains, Brown, Duncan, Crafts and Peckham, are in the first five both as to grade index and yield. When the samples were pooled for quality by the judges, the first six were rated in the following order: Brown, Viets, Crafts, Peckham, Kendall and Pelissier (the last three being rated equally). The Duncan strain was graded down on account of rather prominent vein in 1926. Considered from the triple standpoint of yield, grade index and judgment of quality, the Brown strain easily heads the list as it did also in the tests of 1924. The Crafts, Duncan and Peckham strains follow in the order named.

Conclusions from the three year test on Havana seed strains. As previously indicated, the first question to be answered in this series of tests was whether there are certain superior strains in the Havana seed tobacco which is grown in Connecticut and Massachusetts. To be sure, certain growers have always had the reputation of growing better tobacco, but it has not previously been shown by accurate experiment whether this was due to better land, better fertilization or cultural practices, or whether it was inherent in the strain of seed which they had. Such a problem could be answered only by growing seed from these different

growers side by side on the same land, under the same fertilization and culture and finally by keeping careful records as to yield, and sorting data and submitting the samples to expert judges of tobacco who had no knowledge of the source of the tobacco they were judging. This program has been followed now for three years as described in this and the previous report. In all the replications during this time, *no one* strain has invariably been at the top. There are, however, three, or possibly four, strains which have consistently been better and have always appeared among the highest six, viz., Brown, Crafts and Duncan, with Peckham close behind. Certain other strains have not shown up near the top in any of the tests. These trials have been conducted on different fields and under varying weather conditions. Judgment has been on the triple basis of yield, grading and quality.

These experiments prove conclusively, we believe, that there are certain strains in our Havana seed type which are inherently better than others (as well as some that are worse) and that this superiority may be depended on to remain relatively constant under varying conditions of culture, weather and soil.

Rootrot resistant strains of Havana seed. Three of the strains in this test, 148C, 142C3, 142A3, are strains which are very highly resistant to black rootrot. They have been under test at the station and in various parts of the Connecticut Valley for the last three years. In these tests it has been demonstrated beyond any question that they are very highly resistant (although not immune) to rootrot and will produce a crop where our ordinary strains will not grow tobacco worth harvesting. It has also been demonstrated that they will produce more weight per acre even on land where rootrot is not causing trouble. It will be noted in Table 10 that they produced more than a hundred pounds per acre more than any of the other strains. The only question about these strains is whether the quality is such as to meet the requirements of the trade. In the tests of the present year the experts did not rate them as high as the strains discussed above. Strain 148C in all the tests was somewhat too thin and papery. Probably if the plants were set further apart, this defect would have been less noticeable. All three of them suffered considerably from pole-sweat. This seems to be due to their ranker growth and the close setting of the leaves on the stalk. We are not yet ready to recommend that these strains be grown generally over the valley, but they should be tried out in a small way by those who have fields badly affected with rootrot.

JOHN WILLIAMS BROADLEAF STRAINS

These strain tests which have now been in progress for three years were continued in row tests on the farm of Mr. Richard P. Jones of South Windsor and on the station farm. At the latter

place the growth was not entirely satisfactory on account of the very dry weather. Growth was better on the Jones farm but the tobacco was considerably damaged by storms and delay in harvesting because of continuous rain periods and by some pole-sweat.

The sorting records are presented in Table 12. According to the judgment of the experts, the Bancroft strain was best in quality. This was also true in the 1924 tests and in one of the 1925 tests. Taking into consideration all the tests of the three years, this seems to be the best strain but with the Riordan strain a close second. These are followed in order by Hambach, Vibert and Cannon. The Miskell strain has yielded heaviest but has not been rated in quality like the others. The Jones strain was very good in 1926 but has not been tested enough times to draw any conclusions yet.

TABLE 12. JOHN WILLIAMS BROADLEAF TESTS, 1926. J, ON JONES FARM, SOUTH WINDSOR. S, ON TOBACCO STATION FARM.

Source of seed		Acre yield	Percentage of grades L	M	LS	SS	2S	LD	DS	Fil	Br	Grade index†
Cannon	J	1578	2	6	32	3	22	19	3	4	9	.432
	S	....	..	..	..	..	..	..	..	..	..	....
Hambach	J	1415	3	6	25	4	20	20	5	10	7	.400
	S	1243	8	9	14	5	11	25	12	16		.385
Vibert	J	1415	2	11	34	3	16	23	2	6	3	.465
	S	1323	7	8	20	6	9	21	15	14		.400
Riordan	J	1663	8	9	28	6	13	23	2	8	3	.473
	S	1245	5	8	17	2	17	17	13	21		.358
Bankroft	J	1536	2	5	31	6	17	17	6	8	8	.419
	S	1230	9	10	15	7	15	20	9	15		.410
Miskill	J	1479	0	3	31	1	21	11	8	12	13	.369
	S	1330	3	4	16	5	14	26	13	19		.340
Grant	J	1505	0	7	37	1	19	12	2	13	9	.423
	S	1343	2	2	14	3	16	19	20	24		.292
Jones	J	1592	6	11	36	5	12	18	2	6	4	.499

† Grade index is computed on the basis of the following values for the grades.

LW ..... .90	SS ..... .50	DS ..... .10
MW ..... .60	LD ..... .30	Fil. ..... .10
LS ..... .70	2S ..... .30	Br. ..... .10

BANTLE BROADLEAF TESTS OF 1926

This test was on the experiment station farm at Windsor and was in duplicate. There were included five strains of seed furnished originally by:

A. E. Bidwell, East Hartford
Jacob Bantley, Glastonbury
Sherman Fox, Hockanum
J. W. Bantle, Glastonbury
Fritz Ekstrom, Glastonbury

The strains tested in 1925 from Hickey Bros. and from Benton Bros. were omitted because both had been obtained in recent years from Mr. J. W. Bantle and did not offer much chance of showing different characteristics. Yields and sorting records are presented in Table 13 and the summary of the tests of the last two years in Table 14. The low yields are due to the dry early season and to the fact that the experiment station farm is apparently not adapted to the growing of broadleaf. It will be observed from the data in the tables that the Bantley strain has been the highest yielder and also has the best grade index. The judgment of the experts placed the strain from the J. W. Bantle seed a little above but with the Bantley a close second. Judging from every standpoint we are inclined to put the strains of the Bantle broadleaf type which we have tested in the order of Bantley, Bantle, Ekstrom, with little choice between the others. Altogether, the differences between the various seed strains of this type have not been very marked. When grown side by side under the same conditions they are remarkably uniform. The rather marked differences which the dealer finds in the leaf shape and other characteristics of this type are due, we believe, more to differences in soil, culture and other environmental factors than to inherent seed differences.

TABLE 13. BANTLE BROADLEAF TEST STATION FARM, 1926.

Sourse of seed	Acre yield	Percentage of grades L	M	LS	SS	2S	LD	DS	Fil & Br	Grade index
Bidwell	1429	13	14	16	1	14	23	6	13	.448
Bantley	1439	13	14	15	2	17	20	4	15	.446
Fox	1473	11	10	17	3	14	25	7	13	.430
Bantle	1385	12	12	16	2	13	22	7	16	.430
Ekstrom	1395	11	15	16	2	11	29	5	11	.417

TABLE 14. BANTLE BROADLEAF. SUMMARY OF TESTS OF 1925-26.

Source of seed	Acre yield 1925 Sta.	1925 Handel	1926 Sta.	Ave.	Grade index 1925 Sta.	1925 Handel	1926 Sta.	Ave.
Bidwell	1140	1244	1429	1271	.248	.416	.448	.371
Bantley	1395	1454	1439	1429	.325	.519	.446	.430
Fox	1163	1415	1473	1350	.227	.505	.430	.387
Bantle	1183	1352	1385	1307	.311	.465	.430	.402
Ekstrom	1209	1490	1395	1365	.284	.485	.417	.395

FRANK ROBERTS BROADLEAF STRAIN TESTS

These tests in 1926 were on the farm of Mr. Howard Thrall of Windsor. The same eight strains which were tested during the two preceding years were grown on three different fields of the farm in single row tests. The sorting data and yields of the three tests are presented in Table 15. These strains have now been

tested on seven different fields in three years. The yields of all are compared in Table 16. The differences between the strain yields are so small when the averages of the seven tests are compared that (for at least 6 or 8) they cannot be considered significant. When the grade indices for all the tests are computed we get the same result. No strain is consistently better than the others; one is a little better on one field while a different one is better on the next. The experts who have judged this tobacco during the three years have also been unable to find consistent differences in quality.

TABLE 15. FRANK ROBERTS BROADLEAF 1926 TESTS ON THRALL FARM.

Sash No.	Source of seed	Acre yield	Percentage of grades L	M	LS	SS	2S	LD	DS	F & B	Grade index
20	Roberts	1615	9	21	32	3	10	19	2	4	.539
21	Hills	1615	14	18	22	8	8	23	4	3	.528
22	Heller	1615	14	25	23	7	5	20	4	2	.553
23	McIlvane	1563	10	20	25	7	9	20	4	5	.516
24	Ensign	....	..	..	..	..	..	..	..	..	....
25	Vogel	1537	5	16	23	5	8	31	5	7	.453
26	Forbes	1492	15	18	27	4	3	20	9	4	.534
27	Evans	1537	10	21	30	3	9	16	5	6	.527
20*	Roberts	1301	4	7	33	0	21	16	9	10	.439
21*	Hills	1508	8	10	33	3	14	18	8	6	.488
22*	Heller	1346	3	7	29	3	16	23	11	8	.423
23*	McIlvane	1301	2	6	30	0	24	18	10	10	.410
24*	Ensign	1191?	7	5	27	0	24	12	8	17	.415
25*	Vogel	1279	2	5	26	1	16	16	13	21	.364
26*	Forbes	1305	9	10	25	0	20	15	7	14	.442
27*	Evans	1140	7	8	31	0	19	20	8	7	.460
20**	Roberts	1324	6	12	32	3	12	21	6	8	.478
21**	Hills	1492	1	7	33	3	18	20	11	7	.429
22**	Heller	1344	5	4	32	0	28	16	5	10	.440
23**	McIlvane	1398	1	5	27	1	15	24	14	13	.377
24**	Ensign	1344	4	5	29	2	14	24	12	10	.415
25**	Vogel	1473	2	9	30	3	13	22	11	10	.433
26**	Forbes	1499	7	13	32	3	11	16	10	8	.479
27**	Evans	1395	2	3	33	1	23	14	15	9	.374

TABLE 16. FRANK ROBERTS BROADLEAF TESTS. YIELD FOR 7 TESTS OF 1924-26.

Strain	Ensign's 1924	Ensign's 1925	Handel's 1925	Station 1925	Thrall field 1 1926	Thrall field 2 1926	Thrall field 3 1926	Average of 7 tests
Roberts	1690	1626	1381	1219	1615	1301	1324	1446
Hills	1925	1494	1230	1110	1615	1508	1493	1482
Heller	1610	1747	1331	1190	1615	1346	1344	1455
McIlvane	1610	1560	1390	1103	1563	1301	1398	1418
Ensign	1855	1698	1181	1230	1569†	1191?	1344	1438
Vogel	1680	1647	1348	1231	1537	1279	1473	1456
Forbes	1890	1682	1196	1143	1492	1305	1199	1458
Evans	1680	1693	1268	1095	1537	1140	1395	1401

† Assuming the average on this field for 1926.

RELATION OF SOIL REACTION TO BLACK ROOTROT AND GOOD TOBACCO

M. F. Morgan[1] *and P. J. Anderson*

Over 1000 soils have now been tested for acidity. The sampling and testing of these soils has been greatly expedited through the coöperation of Messrs. B. F. Southwick of the Hartford County Farm Bureau and J. F. Owens of the Extension Service. In general, the conclusions from the first year's work (Bul. 6, p. 65) have been substantiated by the tests of the second year. We are inclined, however, to locate the safety point slightly lower on the scale than the 1925 tests would indicate. In 1925 we found all rootrot cases on soils testing above 5.95 pH (i. e., less acid than 5.95). In the early summer of 1926 (which was abnormally cold), however, we found cases in shade tobacco where the soil was slightly more acid, indicating that, for shade tobacco at least, the safety point is near 5.6. Broadleaf is more resistant and grows a good crop where shade is moderately affected. No cases of damage from rootrot have been found on soils as acid as 5.6 or below. The fact that this point is lower than in 1925 is probably due partly to the abnormally cold spring and early summer. As stated in our last report, the dividing line between rootrot and safety may be expected to shift slightly with the temperature of the soil. Again, the difference may be partly explained by the fact that a different method of testing is in use for 1926. The double wedge comparator method used in 1925 has been found to be less sensitive in the more acid range than the Morgan block method described below. Recommendations as to use of lime on soils tested are indicated in Figure 1 which has been distributed to growers who were interested in the reaction of their soils.

As far as growth alone is concerned, there have been only a few places found during this survey where the soil was too acid. On one of these, on the farm of J. E. Phelps of Suffield, experimental plots were treated with varying quantities of lime and some with acid phosphate. The response to both lime and to acid phosphate was very marked since the plots to which either considerable lime or acid phosphate had been added could be distinguished even at a considerable distance by their better growth. This response to both lime and acid phosphate lead us to believe that the active alumina liberated by the extreme acidity of the soil was the direct toxic agent in retarding growth. Further experiments with this soil, however, are in progress and will be discussed more fully at a later date.

It is a general belief that even though growth on very acid soils

[1] In charge, Soils Investigations, New Haven.

is satisfactory, the quality and burn may be improved by bringing the soil into a less acid condition through the use of lime or wood ashes. This belief seems to be substantiated by the practical experience of many farmers, but there is a great lack of scientific experiment bearing on this phase of the lime problem. Experiments which it is hoped will throw more light on this subject are now in progress at the station, but are not yet ready to report.

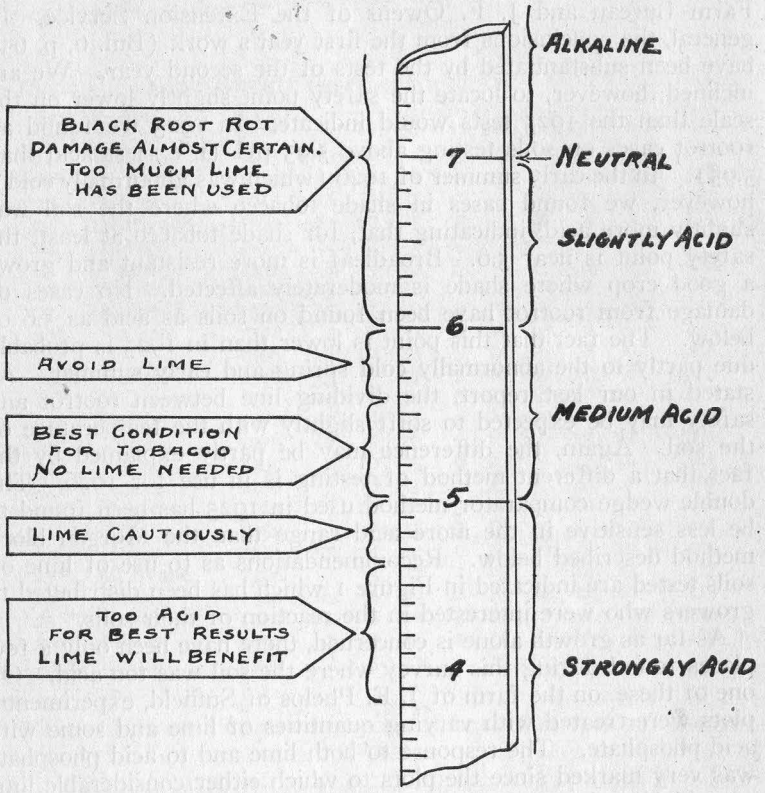


FIG. 1. The pH scale—"The Yardstick of Soil Acidity."

A NEW METHOD FOR DETERMINING SOIL ACIDITY

During the winter of 1925-26 a new method was developed by M. F. Morgan, of the Soils Department, for the rapid and accurate determination of the soil reaction in the field. This method has been used for all the soils tested at Windsor during the past year. Most of the samples have subsequently been sent to New Haven and the pH values determined by the highly accurate elec-

trometric method. The correlation has usually been very satisfactory, and the occasional discrepancies between the two methods were usually found to be due to faulty mixing or accidental contamination of the samples.

Figure 2 shows the special porcelain block used in this field test.

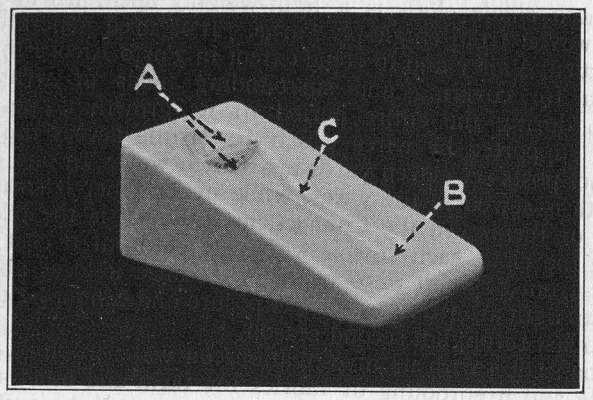


FIG. 2. Porcelain block used for soil reaction test.

Indicator solutions used are as follows:

Brom-thymol blue	(.04%)—6.0 to 7.4 pH
Brom-cresol purple or Chlor-phenol red	(.04%)—5.2 to 6.4 pH
Brom-cresol green	(.04%)—4.0 to 5.4 pH

By means of a spatula, the lower portion of depression "A" is filled with soil. By means of a medicine dropper which fits into the bottle of indicator solution, a few drops of the indicator is run into the upper portion of depression "A" until it has soaked through the soil mass and begins to run down the channel "C." If the liquid does not flow down into the depression "B" readily, it can be guided down by means of a small glass rod.

When the depression "B" is nearly full of liquid, its color is compared with a color chart showing the range of colors and pH values for the indicator used. If the color is beyond the range for that indicator, the test is repeated with the indicator for pH range above or below, as indicated.

This apparatus is being placed on the market through a commercial concern, under the name "The Morgan Soil Testing Set." It can be used by anyone who can follow directions closely, and should prove of considerable value to large tobacco growers who are interested in keeping their tobacco soils at the proper reaction.

Preservative Treatments for Tobacco Shade Cloth

H. P. Holman and T. D. Jarrell

Bureau of Chemistry, U. S. Department of Agriculture

Tobacco shade cloth is a light-weight, open, net-like, cotton fabric woven from single-ply yarns. It is used generally in the Connecticut Valley and to some extent in Porto Rico, Florida and Georgia for covering and surrounding fields of wrapper-leaf tobacco during the entire period of its growth. The cloth is usually supported by wires which are strung across the tops of nine-foot posts set eleven yards apart each way. In one direction the cloth is sewed to the wires, while in the other it simply rests on top of them. In the Connecticut Valley it is the practice to replace the cloth each season with new cloth, at a cost varying usually from $150 to $250 per acre, because it loses about half of its strength after one season's exposure and cannot be depended upon to last through a second season.

In connection with its investigations on waterproofing, mildew-proofing and fireproofing of fabrics for farm and other uses, the Bureau of Chemistry of the U. S. Department of Agriculture has for several years been trying to develop preservative treatments for tobacco shade cloth that would make it serviceable for two or three seasons instead of one. In the light of previous experience with waterproofed canvas[1] and cotton yarn[2] exposed to weather, and in view of the fact that mildew causes little damage to exposed cloth in the Connecticut Valley, it was believed that the deterioration in strength is caused by sunlight. Four years ago, in coöperation with the Tobacco Substation of the Connecticut Agricultural Experiment Station, exposure tests which continued through two seasons were started on shade cloth that had been subjected to four treatments designed primarily for protection from sunlight. Each treatment was applied to a piece of shade cloth large enough to cover two of the 11-yard squares known as "bents." Two of the treatments consisted of simply dyeing the fabric with vat dyes, in one case yellow and in the other case black. These treatments were applied by a firm manufacturing dyestuffs which firm kindly consented to coöperate to this extent. In the other two treatments pigments were used in combination with waterproofing materials that were expected to hold the pigments on the fabric. In one case burnt umber was used in conjunction with petroleum asphalt and in the other zinc oxide was used in conjunction with beeswax. Hot mineral spirits (V. M. & P. Naphtha)

[1] Industrial and Engineering Chemistry, Vol. 15, No. 6, page 607, June, 1923.

[2] *Ibid.*, 15 (1923), 236.

was used for dissolving the waterproofing material and for holding the pigment in suspension.

During the same seasons about thirty small pieces of shade cloth subjected to various experimental treatments were exposed to the weather in the vicinity of Washington, D. C.

Tensile strength tests made at the conclusion of the exposure tests, which covered a total period of about 7 months, indicated that of the treatments applied to the large pieces of cloth used for shading tobacco, the pigment treatments were better than the vat-dye treatments, and that of the latter, the black was better than the yellow. Results on the small samples exposed near Washington showed that four of the treatments were better than the others. These included azulmic acid dye, oxidized azulmic acid dye, lead chromate, and burnt umber with petroleum asphalt, the last being the same treatment as was used on one of the large pieces.

No further experiments were made with the azulmic acid products because they are not generally available. But during the seasons of 1925 and 1926 exposure tests over growing tobacco were made on large pieces of shade cloth treated with lead chromate and with petroleum asphalt solution containing lampblack in place of burnt umber. The reasons for using lampblack were that this material had been found particularly effective in reducing the injurious effect of sunlight when combined with waterproofing materials for canvas, and also because it is lighter in weight than burnt umber and therefore less likely to dust off the fabric.

The treatments were applied in the laboratory with such equipment as was available. This consisted of large copper and enameled kettles and a large clothes wringer. During treatment the cloth was manipulated with the hands, protected by rubber gloves, in order to get uniform impregnation. The treated goods were dried simply by spreading out upon the grass-covered ground. In applying the lead chromate treatment the wet cloth, after being desized with malt diastase solution, was thoroughly impregnated with a 14 per cent solution of lead acetate slightly acidified with acetic acid and, after wringing but without drying, was impregnated with a 5 per cent solution of potassium bichromate. It was then rinsed and wrung out several times to remove excess of bichromate before drying. Lead chromate amounting to about 10 per cent of the weight of fabric after desizing was put on in this way. A small piece of cloth similarly treated without previously desizing gained about 17½ per cent in weight. It might, therefore, be possible to apply the lead chromate treatment without desizing. The asphalt and lampblack treatment was applied to the dry fabric, without previously desizing, by immersing the cloth in cold mineral spirits containing about one pound of petro-

leum asphalt and six ounces of lampblack per gallon and then passing it through the wringer. The treatment added about 50 per cent to the weight of the fabric.

It was thought that the color of the treated fabric might affect the character of growth and quality of the tobacco, and in order to permit observations being made to determine the possibility of such effects areas 22 yards by 22 yards square, or 4 bents, were covered with the experimental cloth. The office of Tobacco Investigations of the Bureau of Plant Industry, U. S. Department of Agriculture, and the Tobacco Substation of the Connecticut Agricultural Experiment Sstation coöperated by placing the cloth for the exposure tests and by making observations on growth and quality of the tobacco. These observations showed that there was no noticeable effect from the color of the treated cloth.

Tests of tensile strength after one season's exposure indicated that the cloth treated with lead chromate had lost 5 per cent of its strength, that the cloth treated with asphalt and lampblack had lost 14 per cent, and that untreated cloth had lost 47 per cent. After two seasons' exposure, cloth treated with the lead chromate was still considerably stronger than untreated cloth after one season's exposure. These results show that the lead chromate treatment is the better and that shade cloth heavily treated with lead chromate can undoubtedly be used a second season.

Further experiments with the lead chromate treatment are contemplated to ascertain the effectiveness of lighter treatments and to determine the practicability of the lead chromate treatment as a process for preserving tobacco shade cloth when modified as required for commercial application. It is not practicable to apply the treatment by hand. In any further exposure tests that may be made, it is hoped that larger areas, of at least one acre, can be covered with the experimental cloth.

Tobacco Insects in 1926.

FURTHER EXPERIMENTS ON WIRE WORM CONTROL.

W. E. Britton[1] *and P. J. Anderson.*

The experiments of 1925 (Bul. 6, p. 78) proved that the tobacco wire worms will congregate in a bait crop such as germinating corn, leaving the surrounding soil practically free from worms and that calcium cyanide ("cyanogas") kills them in the soil even when not directly in contact with them. These preliminary tests, however, were on a small scale and it still remained to be demonstrated that such a method is practicable on a large scale in the field. With this as the principal object, the experiments were

[1] Entomologist, New Haven.

continued in 1926 in coöperation with Mr. A. A. Clark of Windsor and with the American Cyanamid Company of New York. The experiments were located on the shade plantation of Mr. Clark.

Most of the fields on this plantation were fall plowed and wire worms were found in the furrows in September and October. In view of the fact that fall plowing has been advocated as a means of controlling wire worms, it is interesting to note that in so far as we could judge this had no effect on their prevalence the following year. During the latter part of April, 1926, worms were found at a depth of 8-10 inches but none above this. In order to see which fields were most infested, a few rows of corn were drilled across each field on May 7. On May 20, worms were found thickly congregated in the corn on some of the fields but not on others. They were especially numerous on a field where sod had been turned under a year previously. Corn was now drilled on all of this five-acre field. A careful examination was made a week later and the worms found in great numbers (20 to 30 worms in one corn hill was not uncommon) in and around the corn, but siftings between the rows showed that there were very few there. The number of worms was much larger in the corn drilled three weeks before than in that drilled one week before.

Since it was now believed that the maximum number had congregated, the cyanogas was applied on May 31 by means of the same 2-row drill which was used in drilling the corn. The cyanogas was placed in the fertilizer attachments of the drill, from which it flowed very uniformly and was buried in the soil at a depth of 3 to 4 inches in the same rows and approximately the same depth as the corn. The rate of application was a little less than 100 pounds per acre. Two grades of cyanogas were tried, one known as the G grade and the other a coarser, cheaper grade known as granular or crude. The latter grade did not flow quite so freely and therefore the application was not quite so heavy. One strip of land 33 x 132 feet in the center of the field was left untreated as a control. Examination four days later showed that 95% of the worms were dead where the cyanogas was applied but all alive in the control. Those which were found alive on the treated part were usually in "pockets," *i.e.,* usually a bunch of live ones together. This condition led us to believe that they had escaped because a stone or some other obstruction had caused the drill to slide up to the surface of the land in places and these pockets had not come into contact with the fumes. (This land is very stony.)

In order to see whether the fumes were still toxic to the tobacco plants, some were set at this time directly in the rows where the cyanogas had been applied. From the fact that these showed no ill effect but grew normally, we are led to believe that a delay of four days between "cyaniding" and setting may be enough.

On June 7, the field was harrowed and all set to tobacco. Five days later the field was examined and the number of dead plants counted on the treated and untreated rows. It was assumed that all dead plants were so on account of wire worm attack, although close examination showed that some had died from other causes such as broken stems or insufficient roots. The percentages obtained are therefore all slightly too high. Thirty-four per cent of the untreated plants were dead. Eight per cent of the treated had died. The record for the grade G was somewhat better than for the crude cyanogas. All were restocked at that time. When they were restocked a second time at the end of another week, 12% on the control had to be replaced as compared with 2½% on the treated.

From this experiment on a large practical scale it appears that the loss from wire worms may be very materially reduced but not completely eliminated with cyanogas.

Using tobacco plants as baits. In another field which had been set three days, Mr. Clark found the infestation severe. Thinking they must have all been attracted to these plants, he set other rows directly between the original ones and at the same time cyanided the old rows. When examined a few days later, however, the new plants were found infested almost as badly as the original rows. The worms in the original rows had been killed but apparently they had not all had time yet to congregate in the early rows or else they came up from the lower strata.

In another field, corn was planted in hills of 3 or 4 grains directly in the tobacco rows several days after setting. When the worms had collected in the corn the hills were cyanided individually. Although this method was quite successful, the labor involved is rather large. It was learned during the course of this experiment, however, that when wire worms are given a choice between corn and tobacco plant they will congregate in the corn and leave the tobacco plant untouched. As many as forty worms were found in some of these hills of corn but tobacco plants no more than a foot distant were untouched. This has suggested the possibility of baiting the worms away from the growing tobacco plants until after the latter are too large to suffer from attack. If this can be done, it may not be necessary to use cyanide at all. Meanwhile the season had advanced and the worms disappeared before we had an opportunity to make an adequate test of the suggested method. It will be tried out more extensively in 1927.

GRASSHOPPERS.

Grasshopper injury was fairly common in 1926. It is always more serious where the tobacco field is adjacent to grass or other forage crops. Since in Wisconsin these pests cause a great deal more trouble than in New England, considerable experimental work has been done there to find methods of control. They have found there that they can be successfully poisoned with sodium arsenite. Dr. J. J. Johnson of the Department of Horticulture, University of Wisconsin, recommends the following formula to be used on tobacco fields:

Sawdust	100 lbs.
Sodium arsenite	1 qt.
Molasses	1 gal.
Salt	5 lbs.
Water	7-10 gals.

Ten to twenty pounds of this bait are used per acre. depending on the abundance of grasshoppers. It is spread on the ground along the edges of the field or, if the grasshoppers are numerous all over, it may be spread throughout the field.

Tobacco Diseases Observed in 1926.

G. P. Clinton[1] and P. J. Anderson.

As far as prevalence of disease was concerned, the season of 1926 was an average one, not characterized by any serious epidemic on the one hand or by extreme freedom from disease on the other. Continuing our custom established in 1925, the following records are made on the diseases observed.

Wildfire. In the early seed bed period no wildfire was known to be present. The first cases were found in the broadleaf section on May 28. Altogether the seed-bed infection in the Connecticut Valley was the lightest of any year since the disease first became prevalent. Not more than fifteen cases were known up to the end of June. The first infection in the field was found in Poquonock on June 15. Very few field infections were observed in the early growing season. During the continuous rains of the harvesting season, however, the little which was present spread enormously. It was more prevalent in the Housatonic Valley than usual, some fields there being totally ruined (Fig. 7).

Frost injury in the field. On the night of June 16, there was a heavy frost which caused considerable damage in the fields in some localities. Many fields were harrowed up at once and reset. When the plants were left. one to four leaves showed damage. Only the tender growing leaves were affected while the older leaves seemed normal. Seriously frozen leaves turned brown and died within a few days after the frost while less seriously frozen ones turned brown only in part. The bud was not killed except in the most serious cases and the leaves which had not

[1] Botanist, New Haven.

started at the time of the frost developed normally afterward. Some growers did not notice any injury at the time but after some weeks were perplexed by after-effects in the form of leaves curiously distorted and pinched in the lower half but normal toward the tips. The midribs were flanked by broad blanched or entirely white bars. The appearance of such plants is represented in figures 5 and 6. These leaves did not die but failed to develop normally. The rest of the plant developed normally and apparently the damage to the crop was not serious.

Rain bruise. This injury is caused by the beating of heavy rains on the underside of the leaves when they are turned over in a storm. It became especially prominent after some of the rains of late July and August. It is usually worse on one half of the leaf because the leaves are rarely turned completely over. In severe cases, irregular water-soaked patches of dark green to nearly black are evident immediately after the storm (Fig. 3-4). As the leaves dry out, however, the black areas gradually take on a purplish brown color which is retained until harvest and in severe cases shows up on the sorting bench and is the cause of considerable loss. In less severe cases the spots are apparent on the leaves in the field and may cause considerable worry but are not evident when the tobacco is cured.

Stem-rot and pole sweat. The curing season of 1926 was characterized by long continued rains which did not give sufficient opportunity for the sheds to dry out. This resulted in a considerable amount of pole sweat and stem-rot in all three types of tobacco. Charcoal fires were used very freely and prevented a great deal of trouble which otherwise would have developed but many started the fires too late to save the leaves which had already become affected.

The **bacterial angular leaf spot** (Fig. 9) was seen in less than a dozen fields about equally divided in the two valleys but not causing serious injury in either.

Various **leaf spot injuries** such as marbling, white ring, white speck (Fig. 10) were seen in various fields in about the average amount. The causes of these troubles have not as yet been determined. The evidence so far seems to indicate mechanical or chemical rather than parasitic agents.

The Fusarian spot (*F. affine*) is a leaf trouble somewhat similar to rain bruise but with more evident bronze or purplish-brown spots. It is found most frequently on the old leaves that have been in contact with the soil, especially on the broadleaf plants. It rarely causes any serious injury, being one of the minor fungous diseases of tobacco (Fig. 8). This year it was observed at three farms in Hockanum and Glastonbury.

Other diseases. Bed-rot was found in a few places. **Black rootrot** (Figs. 11-12) was observed in some beds and was unusually prevalent in the field in the abnormally cold early growing season. Not many serious cases of **brown rootrot** were observed because when the acreage of New England was reduced by 10,000, most of the fields which had previously grown poor tobacco were eliminated. There were a few cases of **sore shin. Curly dwarf** was found in the same locality as previously. **Calico** was about as prevalent as usual, as well as the "rust" injury that often follows it. (In the interest of clarity the writers apply the term "rust" only to the dead spotted condition of the leaves following calico.)

The Heber Process of Sweating Tobacco.

P. J. Anderson

A new process of sweating by which the time is shortened to eight days—and involving certain other advantages mentioned below—has been developed by Dr. J. T. Heber of Germany and has been demonstrated at various times during the last year at the Tobacco Station where Dr. Heber has been working. Since this has received considerable publicity through the press and has created much discussion among the packers, it seems advisable that the whole process be described here and the results of the experiments conducted at Windsor briefly stated.

After tobacco leaves are cured they must go through a process of fermentation—commonly called sweating—before they are suitable for manufacture into cigars. Heat, moisture and time are required for this process. Two methods of sweating are in common use. In the first method, "bulk sweating," the tobacco is piled in large bulks of five thousand pounds and more. When it heats up to approximately 120°, the tobacco is shaken out and repiled. This process may be repeated from three to ten times and requires from three to six weeks for completion. It also involves considerable labor in shifting the bulks, and there is a shrinkage of from 5 to 10%. The above method is used mostly for shade tobacco. Other types are usually, but not always, "case" sweat. The tobacco is packed tightly in wooden cases of about 300 to 500 pounds capacity and the cases stacked up in rooms which are artificially heated to a temperature around 100°. The minimum time required for such a temperature is about six weeks.

The Heber Process may be used either for bulk or case sweating. While the hands of tobacco are being packed in the cases or laid on the bulk, each layer is lightly sprayed with the solution which contains the "active principle" of this process. The temperature of the room is then kept at 110° to 120° F. and with a humidity sufficient to keep the tobacco from drying out. This is continued for eight days and the process is complete. Experiments with up to 1000 pounds of tobacco of various pickings have been made at Windsor, some of which were taken from old tobacco soil, while others came from new soil.

The repiling of the bulk is not necessary. It would probably be necessary, however, in practice, to make the bulks smaller than they ordinarily are. The loss of weight during this process was approximately 1% during the tests conducted at Windsor.

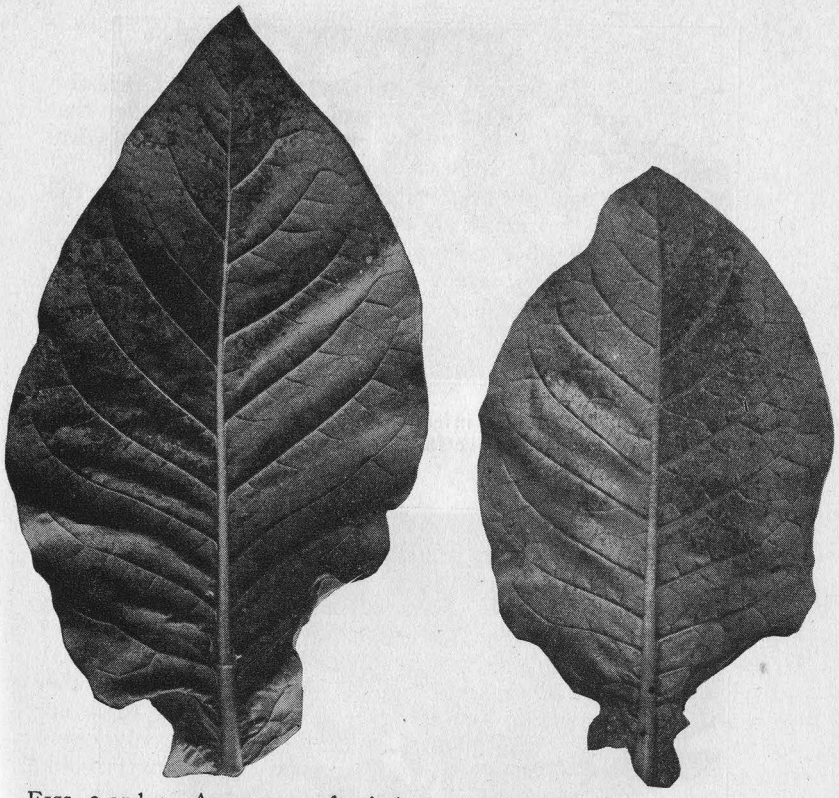
For the trade, the all important question in regard to this process is: Does it sufficiently ferment the tobacco and how does the finished product compare with that fermented by the regular process? Since there is no chemical test by which one may determine whether tobacco is or is not sufficiently fermented, it was necessary to rely on the judgment of dealers and other tobacco experts.

Shade tobacco thus treated was examined by many such experts and their opinion obtained. There was some difference of opinion; some believed that it was not fermented enough, some thought it was fermented too much. This difference in opinion may be explained by the fact that some tobacco men like the tobacco less fermented than others. The general opinion was that it was fermented about the same as when "bulked" by the ordinary process. It was also the general opinion that the leaves were lighter in color than when passed through the ordinary process. This difference in shade of color was brought out very strikingly when single leaves were divided and one half of each treated by the ordinary process and the other half by the Heber process. All agreed that the Heber process had kept the color lighter. Judged from the other points, uniformity of color, general appearance of the leaf, aroma, burn, etc., the experts could not find any consistent differences between the leaves cured by the two processes.

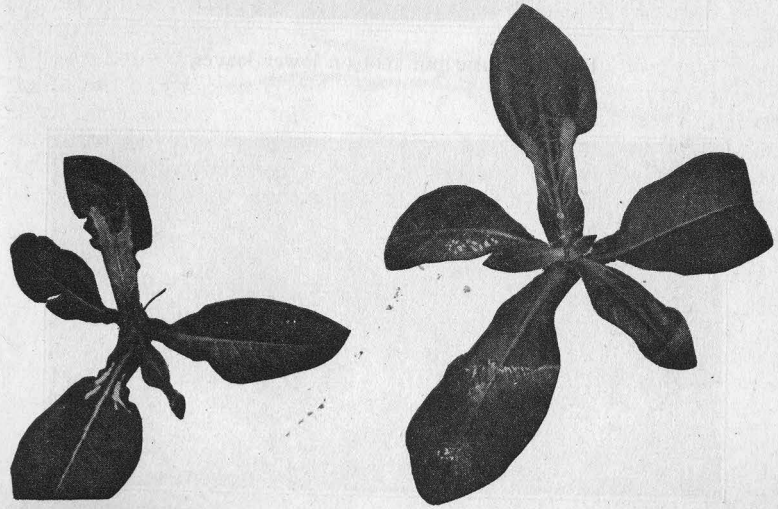
In order to determine whether the effect was due solely to the heat and moisture—rather than the Heber solution—an experiment was tried in which two boxes of tobacco were treated exactly alike except that one was sprayed with the solution and the other with an equal amount of water. When the two boxes were opened at the end of eight days, the tobacco sprayed with the Heber solution was fermented while that sprayed with water was obviously very raw and was so pronounced by the various experts who examined it.

The advantages which the Heber process may offer are:

1. Lighter shades of color
2. Less time required
3. Less loss in weight
4. Less labor
5. Less breakage



FIGS. 3 and 4. Appearance of rain-bruised leaves a few hours after storm.



FIGS. 5 and 6. Frost injury in field three weeks after the frost.

PLATE 1. RAIN BRUISE AND FROST INJURY.

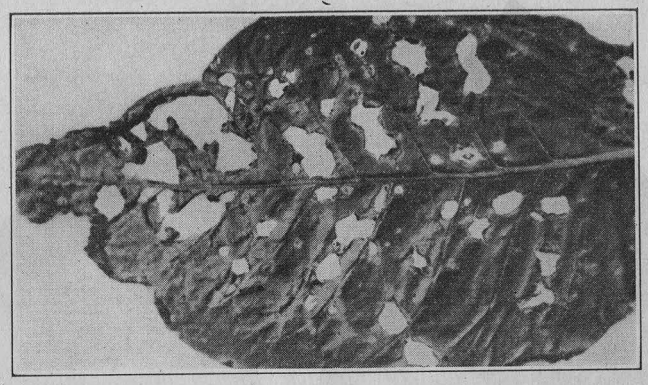


FIG. 7. Severe wildfire infection where the diseased parts have fallen out.

FIG. 8. Fusarium spot on lower leaves.

FIG. 9. Bacterial angular leaf spot.

PLATE 2. BACTERIAL AND FUNGOUS LEAF SPOTS IN THE FIELD.

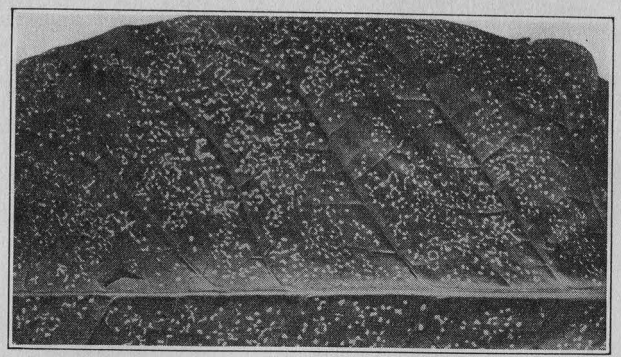


FIG. 10. White speck in the field.

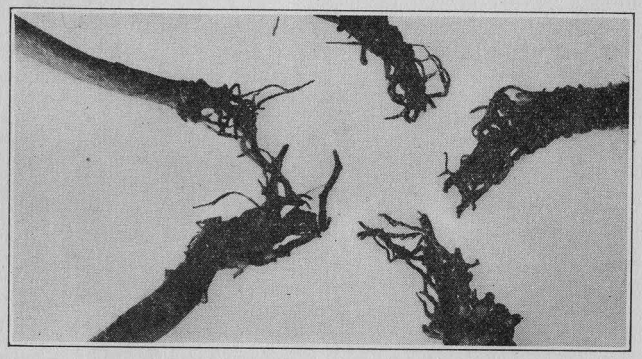


FIG. 11. Young plants with root systems totally destroyed by rootrot.

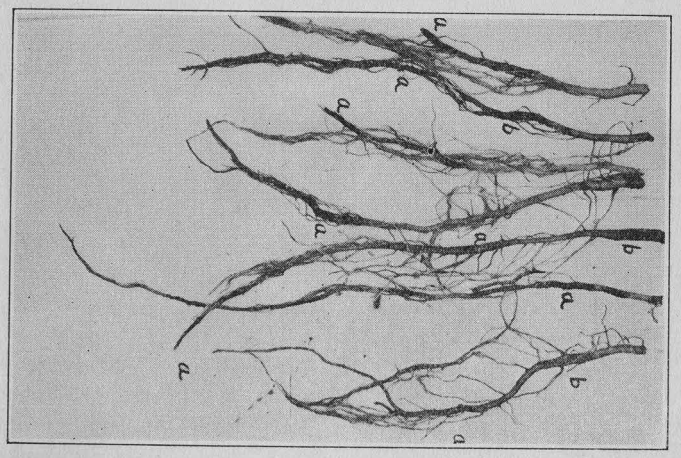


FIG. 12. Black rootrot lesions, swollen type at B, ordinary type at A.

PLATE 3 BLACK ROOTROT AND WHITE SPECK.

Bulletins

OF

Immediate Information

Numbers 55 to 60

BULLETIN OF IMMEDIATE INFORMATION No. 55

NOVEMBER 10, 1926

Connecticut Agricultural Experiment Station
New Haven, Connecticut

The Asiatic Beetle Quarantine

(Revision Effective November 10, 1926)

W. E. BRITTON, *State Entomologist*

The Asiatic Beetle, *Anomala orientalis* Waterhouse, has appeared during the past few years in the western or Westville section of the City of New Haven, and the grubs have caused considerable

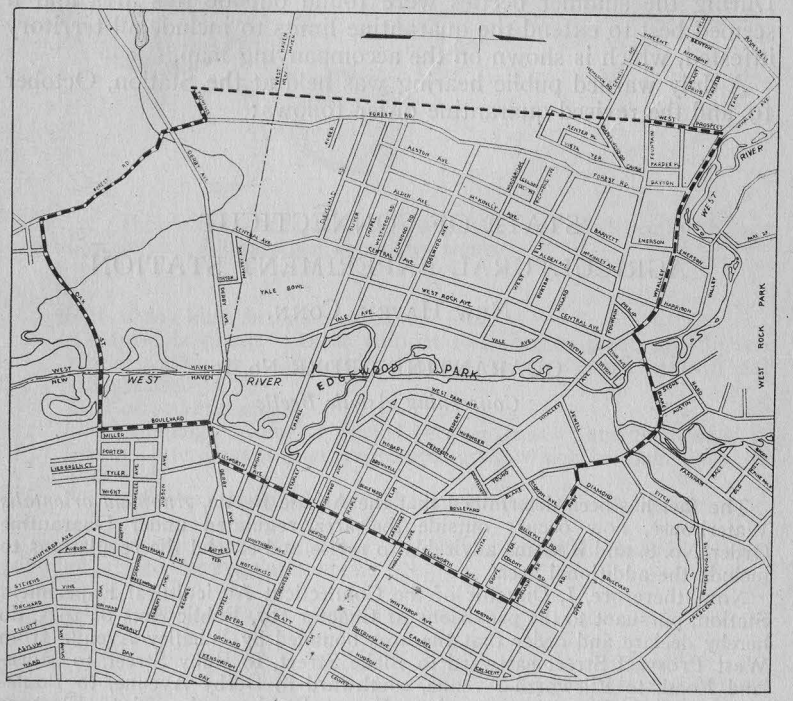


FIG. 1. Map of the Westville section of the City of New Haven. The area enclosed by the heavy dotted line is now quarantined on account of the Asiatic Beetle.

injury to lawns by eating the roots of the grass. We have called it the Asiatic Beetle to distinguish it from the green Japanese beetle, *Popillia japonica* Newman, which for ten years has been present in New Jersey and around Philadelphia, and which has now spread over nearly 12,000 square miles, even into the southwest corner of Connecticut.

The Asiatic Beetle is now believed to be a native of eastern Asia but in some way it was introduced into Hawaii, where it has caused severe injury to the sugar cane crop. When control measures were first inaugurated against this pest last spring, the insect was not known to occur elsewhere in the United States, but during the summer infestations were discovered at Jericho, Long Island, and at Mount Vernon, N. Y.

Quarantine Order No. 8 was issued in the spring, effective April 15, restricting the movement of plants, soil, ground litter, etc., from the area bounded by Yale Avenue, Chapel Street, Central Avenue, Cleveland Road, Forest Road and Willard Street. During the summer beetles were found outside this area and it seemed best to extend the quarantine limits to include all territory infested, which is shown on the accompanying map.

A duly warned public hearing was held at the Station, October 19, and the revised quarantine order follows:

STATE OF CONNECTICUT
AGRICULTURAL EXPERIMENT STATION
NEW HAVEN, CONN.

QUARANTINE ORDER No. 10
Concerning Asiatic Beetle

The fact has been determined that the Asiatic Beetle, *Anomala orientalis* Waterhouse, now occurs outside the area regulated under Quarantine Order No. 8, and it seems advisable to revise and extend the regulations to include the additional area.

Now, therefore, I, Director of the Connecticut Agricultural Experiment Station, pursuant to the provisions of Chapter 107, Public Acts of 1925, do hereby declare and order that the area bounded by Whalley Avenue from West Prospect Street eastward to Blake Street, to Ruby Street, to Moreland Road, to Ellsworth Avenue, southward to Derby Avenue, to Boulevard, to Oak Street, westward to Forest Road, northward to Florence Avenue, westward to the end of Florence Avenue (a point about 400 feet west of Forest Road), thence on a straight line northward to West Prospect Street, to Whalley Avenue, and all territory within these boundaries being partly in New Haven and partly in West Haven, shall be a regulated area out from which, until further notice, the movement of certain articles and materials will not be permitted except where inspection or treatment is practicable and permits are issued by some person or persons authorized by me to issue such permits. The restricted articles and materials are as follows:

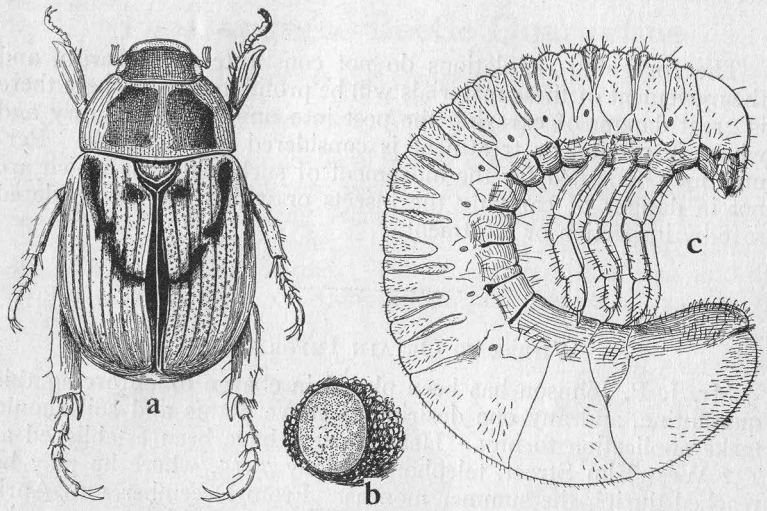


FIG. 2. The Asiatic beetle, *Anomala orientalis*. a. adult beetle. b. egg. c. grub or larva. All enlarged about five times.

1. Soil of any kind, including sand and loam.
2. All out-door plants with or without soil; potted plants which have been set on or in the ground out of doors between June 1 and September 30.
3. Turf or sod trimmings.
4. Lawn clippings during the period between June 15 and September 15.
5. Ground litter, weeds, manure, and compost which has lain upon the ground.
6. All cut flowers during the period between June 15 and September 15.

This order does not affect such materials originating outside of and passing through the regulated area.

This order shall take effect November 10, 1926.

W. L. SLATE, JR.,
Director, Connecticut Agricultural Experiment Station.

Approved:

JOHN H. TRUMBULL,
Governor.

PENALTY

Chapter 107, Public Acts of 1925, contains the following provision: "Any person interfering with the performance of such duty or violating the quarantine regulations established under this act shall be fined not less than ten nor more than fifty dollars."

The foregoing regulations do not constitute an embargo, and the movement of these materials will be prohibited *only* where there is great danger of carrying the pest into uninfested territory and where inspection or treatment is considered impracticable. Permits may be issued for the movement of such materials which are not in danger of carrying the insects or which may be rendered safe by inspection or treatment.

WHERE TO OBTAIN INFORMATION

Mr. J. P. Johnson has been placed in charge of enforcing this quarantine, and any one desiring to move plants and soil should make application to him. Headquarters have been established at 132 West Elm Street, telephone Colony 7215, where he may be reached during the summer months. From December 1 to April 1, the headquarters office will be closed and Mr. Johnson may be reached at the Agricultural Experiment Station, 153 Huntington Street, or by telephone, Pioneer 6450, or Liberty 1253.

BULLETIN OF IMMEDIATE INFORMATION No. 56 NOVEMBER 10, 1926

Connecticut Agricultural Experiment Station

New Haven, Connecticut

The Japanese Beetle Quarantine

(Effective November 10, 1926)

W. E. BRITTON, *State Entomologist.*

Late in the summer, Federal scouts discovered a rather general infestation of the Japanese beetle, *Popillia japonica* Newman, on the western end of Long Island, and at several points in Westchester County, New York. One of these was at Port Chester near the Connecticut border. The scouts were then sent into the southwestern corner of Connecticut and proceeded as far as

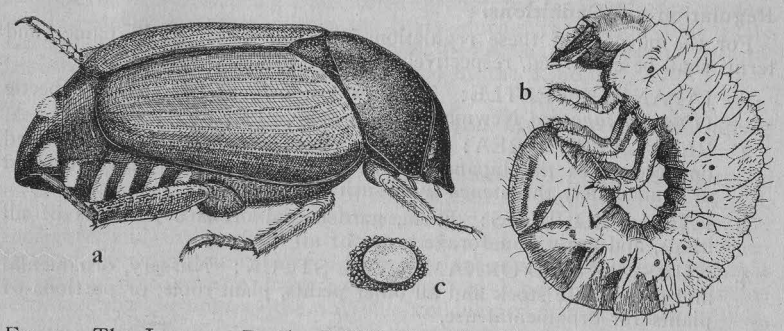


FIG. 1. The Japanese Beetle *Popillia japonica* Newman. a, adult beetle; b, grub or larva; c, egg. All enlarged about five times.

Norwalk. In the center of the city of Stamford, on Broad Street, several adult Japanese beetles were discovered on rose bushes and other shrubs and flowers, eighteen in all being taken over a period of about two weeks. On account of the spread of the Japanese beetle, not only in New York and Connecticut but also in Pennsylvania and New Jersey, it seemed necessary to revise the Federal quarantine, and a hearing was held in Washington September 25; a revised quarantine order was afterward issued, effective October 11. As the Federal quarantine applies only to interstate shipments, and as it seemed best to issue regulations governing possible shipments from Greenwich and Stamford to other points in Connecticut, notice of a hearing was distributed and published, as provided by law. The hearing was held at the Station October 19, and no one appeared in opposition. The quarantine order No. 11, effective November 10, is as follows:

STATE OF CONNECTICUT
AGRICULTURAL EXPERIMENT STATION

NEW HAVEN, CONN.

QUARANTINE ORDER No. 11
JAPANESE BEETLE QUARANTINE

The fact has been established by the Agricultural Experiment Station that an injurious insect known as the Japanese beetle (*Popillia japonica*) exists in the town of Stamford, Conn., and in Port Chester, N. Y.

Now, therefore, I, Director of the Connecticut Agricultural Experiment Station, pursuant to the provisions of Chapter 107, Public Acts of 1925, do hereby proclaim the towns of Stamford and Greenwich to be under State quarantine, and that it shall be unlawful to move from these towns to other points within the State (1) farm, garden, and orchard products of all kinds; (2) grain and forage crops of all kinds; (3) nursery, ornamental, and greenhouse stock, and all other plants; and (4) sand, soil, earth, peat, compost, and manure, except under the conditions prescribed in the following rules and regulations supplemental to this quarantine.

RULES AND REGULATIONS

Regulation 1.—Definitions.

For the purpose of these regulations, the following words, names and terms shall be construed, respectively, to mean:

1. JAPANESE BEETLE: The insect known as the Japanese beetle (*Popillia japonica* Newman) in any stage of its life cycle.
2. REGULATED AREA: Those portions of the State quarantined on account of the Japanese beetle and designated as being infested or immediately threatened with such infestation.
3. FARM PRODUCTS: Farm, garden and orchard products of all kinds, and grain and forage crops of all kinds.
4. NURSERY AND ORNAMENTAL STOCK: Nursery, ornamental and greenhouse stock and all other plants, plant roots, or portions of plants for ornamental use.
5. SAND, SOIL, EARTH, PEAT, COMPOST AND MANURE: Sand, soil, earth, peat, compost and manure of any kind, and as to either bulk movement or in connection with farm products or nursery and ornamental stock.
6. INSPECTOR: An inspector of the Connecticut Agricultural Experiment Station or the United States Department of Agriculture.

Regulation 2.—Regulated Area.

The towns of Stamford and Greenwich, in Fairfield County, and including any cities or borough within their limits.

Regulation 3.—Extension or Reduction of Regulated Area.

The area designated in Regulation 2 may be extended or reduced, as found necessary by the Connecticut Agricultural Experiment Station. Due notice of any extension or reduction of the areas affected thereby will be given in writing to the transportation companies doing business in the areas, and by publication in newspapers selected by the Connecticut Agricultural Experiment Station.

Regulation 4.—Regulation of Movement of Farm Products.

Regulation 5.—Regulation of Movement of Nursery and Ornamental Stock.

All movement of nursery and ornamental stock from the regulated area to other points outside such area, but within the State, shall be subject to the details of regulation and control indicated in the Appendix of Federal Quarantine No. 48 (Fifth Revision), and shall be permitted only upon full compliance with Regulations 6, 7 and 8 of this order: Provided, that such movement of nursery stock originating within or being transported through the regulated area during the period June 15 to October 15, inclusive, is prohibited to points outside such area within the State, unless protected from possible infestation in a manner or by a method approved by the inspector. All movement of nursery stock within the regulated area shall be subject to the details of regulation and control indicated in the Appendix of Federal Quarantine No. 48 (Fifth Revision).

Regulation 6.—Regulation of Movement of Sand, Soil, Earth, Peat, Compost and Manure.

(1) As a condition of certification of sand, soil, earth, peat, compost or manure for shipment both within the regulated area and from the regulated area to other points within the State, all such movements of such articles shall be subject to the details of regulation and control indicated in the Appendix of Federal Quarantine No. 48 (Fifth Revision).

(2) The movement of any sand, soil, earth, peat, compost and manure originating within, or being transported through the regulated area to other points outside such area within the State, during the period June 15 to October 15, inclusive, is prohibited unless protected from possible infestation in a manner or by a method approved by the inspector.

Regulation 7.—Inspection, Certification and Marking a Condition of Transportation.

Each car, vehicle, box, basket, or other container of any of the articles, in process of any movement which is restricted by Regulations 4, 5 and 6, shall be plainly marked with the name and address of both consignor and consignee, and shall bear a certificate stating that the contents have been certified by the inspector, as free from the Japanese beetle: Provided, that in case of such article moved in carload or other bulk shipments the certificate shall accompany the way-bills, conductors' manifests, memoranda, or bills of lading, or in case of truck or other road vehicles, the certificate shall accompany the vehicle. Any certificate, provided for in this act, which is forged, counterfeited, altered or defaced shall be considered as invalid and any person who shall forge, counterfeit, alter or deface such certificate shall be deemed guilty of violating the requirements of the order of the Connecticut Agricultural Experiment Station applying to the Japanese beetle and shall be liable to the penalty as outlined in Chapter 107, Public Acts of 1925.

Regulation 8.—Conditions Governing Inspection and Issuance of Certificate.

Whenever it is intended to move any of the articles or materials restricted by this quarantine order from the regulated area to points outside such area within the State, application for inspection and certification shall be made as far as possible in advance of the probable date of shipment, specifying the article and quantity to be shipped, method of shipment, and the names and addresses of both consignor and consignee.

Applicants will be required to assemble the articles and materials at such points as the inspector shall designate and to place them so that they may be readily inspected. All charges for storage, cartage, and labor incident to inspection other than the services of the inspector shall be paid by the shipper.

In case of any of the articles enumerated, where absolute freedom from infestation cannot be determined by the inspector, certification will be refused.

Regulation 9.—Cleaning of Cars, Trucks, Boats, Wagons and Other Vehicles.

Railway cars, trucks, boats, wagons, and other vehicles which have been used in transporting any article covered by this quarantine within the regulated area, must be thoroughly swept and cleaned before they will be allowed to move in transportation to other points outside the regulated area within the State.

Regulation 10.—Moving or Receiving Articles in Violation of Regulations.

No person shall move or direct any other person to move any article in violation of these regulations. No person shall receive or direct any other person to receive any article moved in violation of these regulations.

Regulation 11.—Carrying or Transporting Living Japanese Beetles outside the Regulated Area.

No person shall move or carry, or direct any other person to move or carry a living Japanese beetle to any point outside the regulated area.

This order shall take effect November 10, 1926.

W. L. SLATE, JR.,
Director, Connecticut Agricultural Experiment Station

Approved:
JOHN H. TRUMBULL,
Governor

PENALTY

Chapter 107, Public Acts of 1925, provides that "Any person interfering with the performance of such duty or violating the quarantine regulations established under this act shall be fined not less than ten nor more than fifty dollars."

APPENDIX

Copies of the Appendix to Federal Quarantine No. 48 (Fifth Revision), which relates specifically to shipments of nursery or ornamental stock, and sand, soil, manure, etc., may be obtained by applying to any of the following:

Japanese Beetle Office, 42 West First Street, Mount Vernon, N. Y.
Japanese Beetle Laboratory, Riverton, N. J.
Federal Horticultural Board, Washington, D. C.

APPLICATIONS FOR INSPECTIONS

Applications for inspections and certificates or permits to move nursery or ornamental stock, sand, soil, manure, etc., should be made to the Japanese Beetle Office, 42 West First Street, Mount Vernon, N. Y.

BULLETIN OF IMMEDIATE INFORMATION No. 57

NOVEMBER 20, 1926

Connecticut Agricultural Experiment Station
New Haven, Connecticut

REGULATIONS CONCERNING THE TRANSPORTATION OF NURSERY STOCK IN THE UNITED STATES AND CANADA*

Compiled by W. E. BRITTON, State Entomologist.

At the present time nearly every State in the Union has laws and regulations in regard to the inspection, certification and transportation of nursery stock. These all have one object in view, namely, the control of plant pests. But conditions are not uniform throughout the United States, and each State has established such requirements as seem to give it the best protection, with the result that there are many different regulations.

This situation assumes a serious aspect to the nurseryman who may wish to fill orders received from eighteen or twenty or more different States. In order to tabulate and bring together these varying regulations in convenient form for the use of Connecticut nurserymen, this bulletin has been prepared. It should be understood that it presents only a brief digest in each case, and if any points are not clear, the nurseryman should write to the officer in charge of inspection in that State, for more information.

In addition to the various State laws and regulations, there are several Federal quarantines regulating the shipment of nursery stock. A digest of these has been included in this bulletin, together with the regulations of the District of Columbia and of the Dominion of Canada.

FEDERAL QUARANTINES

The following Federal Quarantines concern the shipment of nursery stock:

White Pine Blister Rust: Quarantine No. 63 prohibits the interstate movement of all five-leaved pines from the District of Columbia, all States east of the Mississippi River, Louisiana, Arkansas, Missouri, Iowa and Minnesota, into any State lying

* Revised edition of Bulletin of Immediate Information, No. 51, October 1, 1925.

west of the western boundary of this area, or from one of these States into another except as they are grouped by areas. The New England States comprise one area. Five-leaved pines may not be shipped out of New England but may be shipped from one New England State to another by complying with Regulation 5 (a) and (e); viz.: each car, box or container shall be marked to show contents, names of both consignor and consignee, and must be accompanied by a certificate executed by a responsible inspection official, and based on a recent inspection of stock and premises, and showing freedom from blister rust; where any State has legally established a blister rust control area, then such stock cannot enter without a permit from that State. Black currants are prohibited from interstate movement in all of the Northeastern States. Currants and gooseberries (other than black currants) except in compliance with Regulation 5 (c) and (e); each car, box or container shall be marked to show contents, names of both consignor and consignee, and must be accompanied by a certificate executed by a responsible inspection official, and based on a recent inspection of stock and premises and showing freedom from blister rust; stock must be shipped only when dormant and must be dipped (except roots) in a mixture of one part lime-sulphur, testing not less than 32° Baumé, to eight parts water; where any State has legally established a blister rust control area, then such stock cannot enter without a permit from that State.

Narcissus Bulbs: Quarantine No. 62 provides that all varieties of narcissus bulbs can be shipped interstate only after inspection (and treatment if found infested) and certification in the State where grown. Each car, box, or other container must bear names and addresses of both consignor and consignee, list of contents, and certificate to the effect that such bulbs were found free from bulb flies and eelworms, or that such bulbs have been treated according to regulations.

Black Stem Rust of Grains: Quarantine No. 38, as amended, prohibits the interstate movement of the common species of barberry and their horticultural varieties, except the Japanese barberry; also *Mahonia* from about three-fourths of the States.

European Corn Borer: Quarantine No. 43 (third revision, as amended) provides that the stalks of common host plants of the European corn borer (which include some herbaceous perennials) cannot be shipped interstate outside of the infested areas unless inspected and provided with a Federal certificate.

Gipsy Moth and Brown-Tail Moth: Quarantine No. 45, as amended, regulates the interstate shipment of all nursery stock, forest products, stone and quarry products from the infested area in the New England States, and from the generally infested to the lightly infested areas within those States. Nursery stock must be inspected and certified by Federal inspectors.

Japanese Beetle: Quarantine No. 48, as revised, regulates the interstate shipment of all nursery stock out of the infested area which includes New Jersey and certain portions of the States of Pennsylvania, Delaware, New York and Connecticut. Such stock can be shipped only after it has been examined and certified by Federal inspectors.

Satin Moth: Quarantine No. 53, as revised, prohibits the interstate shipment from the infested areas in Maine, Massachusetts, New Hampshire, Rhode Island, Connecticut and Washington of all species and varieties of willow and poplar trees or parts thereof capable of propagation.

For further information regarding Federal quarantines and regulations address: Federal Horticultural Board, U. S. Department of Agriculture, Washington, D. C.

District of Columbia

Each package of nursery stock entering the District must bear a valid certificate of inspection, must be marked "plants," with name and address of both consignor and consignee. No package shall be delivered to the consignee until authorized by the inspector of the Federal Horticultural Board.

Federal quarantines prohibit the entry of all five-leaved pines and *Ribes* grown in the New England States, and the States of New York and Washington.

Federal Horticultural Board, Washington, D. C.

Dominion of Canada

Nursery stock from the United States can enter Canada only after a permit has been secured from the Secretary, Destructive Insect and Pest Act Advisory Board, Ottawa, Can. Applications must specify kind, quantity, value, source and destination of stock, with name and address of consignee and the customs port. All shipments must bear certificates of inspection issued by a State or Federal officer, and where required, certificates of fumigation. Unless these certificates are attached, the shipments will not be released by the Collector of Customs. Plants exempt from fumigation requirements include greenhouse plants, roses grown under glass (up to three inches), herbaceous plants, strawberry plants, blackberry plants, grape vines, conifers, bulbs and corms, if accompanied by the consignor's certificate regarding contents of shipment. Fruit and nut scions are exempt from fumigation only when forwarded by mail under official labels requiring their reinspection at Montreal or Vancouver.

Quarantines prohibit the entrance of conifers and decorative plants (such as holly and laurel), and Christmas greens from New England: all five-leaved pines, chestnuts and chinquapin, all species of currants and gooseberries, European buckthorn and all varieties of *Berberis vulgaris,* all varieties of *Corylus* into British Columbia, all peach stock and fresh peaches from the States of Wisconsin, Illinois, Missouri, Arkansas, Mississippi and eastward to the Atlantic Ocean.

Arthur Gibson, Chairman; L. S. McLaine, Secretary, Destructive Insect and Pest Act Advisory Board, Department of Agriculture, Ottawa, Canada.

Postal Regulations Regarding Nursery Stock Shipped by Parcel Post

The U. S. Postal Laws and Regulations, Section 467, paragraph 2, governing the mailing of plants and plant products, reads as follows:

"Nursery stock, including all field-grown florists' stock, trees, shrubs, vines, cuttings, grafts, scions, buds, fruit pits and other seeds of fruit and ornamental trees or shrubs, and other plants and plant products for propagation, except field, vegetable and flower seeds, bedding plants and other herbaceous plants, bulbs and roots, may be admitted to the mails only when accompanied with a certificate from a State or Government inspector to the effect that the nursery or premises from which such nursery stock is shipped has been inspected within a year and found free from injurious insects, and plant diseases, and the parcel containing such nursery stock is plainly marked to show the nature of the contents and the name and address of the sender."

State Regulations

FILING OF CERTIFICATES IN OTHER STATES

In order to ship nursery stock into the following States, it is necessary to file duplicate inspection certificates:

Alabama	Massachusetts	Oklahoma
Arkansas	Michigan	Oregon
Connecticut	Minnesota	Pennsylvania
Florida	Mississippi	South Carolina
Georgia	Missouri	South Dakota
Illinois	Montana	Tennessee
Indiana	New Mexico	Texas
Iowa	New York	Utah
Kentucky	North Carolina	Virginia
Louisiana	North Dakota	Wisconsin
Maryland	Ohio	Wyoming

Though not absolutely required by law, certificates may be filed in the following States:

Kansas Nebraska

FILING OF BONDS

Bonds are required in the following States:

Arkansas	$1,000.00	Montana	$1,000.00	Oklahoma	$1,000.00
Georgia	1,000.00	North Dakota	500.00	Oregon	1,000.00
Idaho	5,000.00	Ohio	1,000.00	Utah	500.00
Michigan	1,000.00			Washington	1,000.00

Tennessee requires a bond of $5,000.00 where trees are planted by outside nurserymen under contract to prune and spray for a period of years.

PAYMENT OF FEES

The payment of fees is required for registration in certain States, as follows:

State	Registration Fee	Agent's Fee	State	Registration Fee	Agent's Fee
Alabama	$10.00	$1.00	Ohio	$5.00	$1.00
	(Dealer's)—10.00		Oklahoma	5.00	
Arkansas	5.00	1.00	Oregon	10.00	1.00
Georgia	5.00	1.00	South Dakota	1.00	1.00
Idaho	10.00	1.00	Tennessee (Dealer's)		5.00
Indiana	1.00	1.00	(Agent's)		1.00
Kentucky	5.00	5.00	Texas	5.00	
Maine	5.00		Virginia	5.00	1.00
Michigan	5.00		Washington	5.00	1.00
Montana	25.00*		West Virginia	20.00	
North Dakota	10.00		Wyoming	15.00	

FUMIGATION

All deciduous nursery stock subject to the attack of San José scale must be fumigated with hydrocyanic acid gas and labeled with a certificate or affidavit stating that this has been done before it will be allowed to enter the following States:

Colorado	Michigan	North Carolina
Delaware	Mississippi	Tennessee
Florida		Utah

STATE TAGS

State tags are required and will be furnished at the shipper's expense, by the following States:

Alabama	Louisiana	Virginia
Arkansas	Mississippi	West Virginia
Florida	North Carolina	Wyoming
	South Carolina	

* Covering all Montana agents. Agents for unlicensed nurseries must pay annual fee of $10.00 and file bond of $1,000.00. Inspection fees $10.00 per car lot, smaller lots in proportion. Unlicensed nurseries, 10 per cent. of invoice price, with minimum of 50 cents per package.

Special Inspection and Certification of Raspberry Plants

In an attempt to control mosaic and allied diseases of raspberry plants, certain states require two summer inspections; one in June, and the other a month later, and after all mosaic plants discovered at the first inspection have been removed. If the plants are then free from mosaic diseases, a certificate to that effect may be granted. The following states require this special inspection and certification for shipping raspberry plants:

Michigan
Minnesota
New York
Vermont

Requirements of Various States

Alabama: Nurserymen in other States wishing to ship stock into Alabama must obtain an Alabama license by filing a signed copy of inspection certificate, with fee of $10.00. Each package of nursery stock entering the State must bear an Alabama tag which is furnished at cost. Dealers must register, file list of all nurseries from which they purchase stock, pay fee of $10.00, and obtain a dealer's certificate. An agent's certificate (cost $1.00) must be obtained through the principal for each agent selling nursery stock in Alabama. Nursery stock infested with San José scale, new peach scale, woolly aphis, brown-tail moth, gipsy moth, crown gall, black knot, citrus canker, peach yellows, pear blight, apple blotch, root nematode, peach borer, grape phylloxera or nut grass, must not be sold in Alabama.

B. P. Livingston, Chief, Division of Plant Industry, Montgomery, Ala.

Arizona: All nursery stock and plant products entering Arizona through the U. S. mails or transported in any manner shall be prominently labeled, showing (a) name and address of consignor; (b) name and address of consignee; (c) certificate of inspection; (d) locality where grown, and (e) contents of shipment. Common carriers shall not deliver to consignee any shipment of nursery stock or plant products until inspected by the State Entomologist or his agent and a certificate of release issued in each case to the common carrier and to the consignee. Postmasters are required to forward all parcels of nursery stock or plant products to the nearest Post Office Inspection Station, and cannot forward from these stations to point of destination any parcel of nursery stock or plant products unless accompanied by an inspected plant shipment tag.

Quarantines prohibit the entrance of: Olive nursery stock and olive root cuttings from all other States and foreign countries; peach, nectarine or apricot trees or cuttings, grafts, scions, buds or pits, or trees budded or grafted upon peach stock from Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, Ohio, Indiana, Michigan, Illinois, West Virginia, Tennessee, North Carolina, Arkansas, Nevada, Florida, and Ontario, Can., and any other section in which peach yellows or rosette are known to exist; peach, nectarine, almond, apricot, plum, cherry, choke-cherry, quince, pear, and apple trees or plants or parts thereof including the fresh fruits and all barrels, boxes, baskets or other containers that have been used to hold the same from the States of Alabama, Arkansas, Connecticut, Delaware, Florida, Georgia, Indiana, Louisiana, Maryland, Mississippi, North Carolina, New Jersey, New York, Pennsylvania, South Carolina, Tennessee, Texas, Virginia, West Virginia, and the District of Columbia on account of the Oriental fruit moth. Pecan, hickory and Japanese walnut trees, cuttings, grafts, scions and buds from all outside sources on account of the pecan leaf case-bearer.

O. C. Bartlett, State Entomologist, Box 1857, Phoenix, Ariz.

Arkansas: In order to ship nursery stock into Arkansas, it is necessary (1) to file a nursery inspection certificate, pay a fee of $1.00 and secure a permit-certificate, and (2) every shipment into the State must bear a copy of the permit-certificate with chief inspector's facsimile signature, and tags must be purchased of the chief inspector.

Out-of-state nurserymen having agents or representatives soliciting orders, or doing other nursery business in Arkansas must (1) file a bond of $1,000.00, (2) pay $5.00 for a license to do business in the State, and (3) pay $1.00 for a license for each agent in the State.

Quarantines prohibit entrance of chestnut trees from all States east of the Mississippi River.

P. H. Millar, Acting Chief Inspector, Little Rock, Ark.

California: All shipments of nursery stock, plants, seeds, etc., into California, must be conspicuously marked with name and address of both consignor and consignee and declaration of contents and origin. All stock entering the State held until inspected.

Peach, nectarine or apricot trees or cuttings, grafts, scions, buds or pits of such trees, or any trees budded or grafted upon peach stock or roots from districts where contagious peach rosette is known to exist are refused entry and will be destroyed or returned to point of shipment at option of consignor and at his expense. The States known to be infected with this disease are as follows: Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, Pennsylvania, West Virginia, Virginia, North Carolina, South Carolina, Georgia, Alabama, Florida, Tennessee, Kentucky, Mississippi, Ohio, Michigan, Indiana, Arkansas, Oklahoma, and the Province of Ontario, Canada.

Quarantine order No. 36 prohibits entry of all five-leaved pines, currant and gooseberry plants from all States and districts east of and including Minnesota, Iowa, Missouri, Arkansas and Louisiana, and from the State of Washington. Quarantine order No. 38 prohibits entry of all trees, plants, grafts, cuttings or scions of all species and varieties of the cultivated filbert or hazelnut and American wild hazel (*Corylus americana*) from all States and districts east of and including Wyoming, Colorado and New Mexico. Quarantine order No. 43 prohibits entry of citrus trees and citrus fruits. Quarantine order No. 44 prohibits all chestnut and chinquapin (*Castanea* sp. and *Castanopsis* sp.) trees from all States east of east line of Idaho, Utah and Arizona. Pecan trees, hickory and Japanese walnut trees are prohibited from all states. Quarantine order No. 46, pertaining to the Oriental fruit moth, prohibits all species and varieties, including the flowering forms, of peach, nectarine, almond, apricot, plum, cherry, choke cherry, quince, pear and apple trees and parts thereof, including the fruits and all containers of such fruits, from the States of New York, Connecticut, Pennsylvania, New Jersey, Maryland, Delaware, Virginia, West Virginia, Indiana, North Carolina, South Carolina, Florida, Georgia, Alabama, Mississippi, Tennessee, Arkansas, Louisiana and Texas, and the District of Columbia.

A. C. Fleury, Supervising Quarantine Officer, Sacramento, California.

Colorado: Each package of nursery stock entering the State must bear a certificate of inspection signed by a duly authorized inspector in the State from which it was shipped, and a certificate of fumigation signed either by an inspector or by the shipper of the nursery stock. On arrival, shipments are turned over to the County Inspector who in turn, if they pass inspection, releases them to the consignee.

Quarantines prohibit the entrance of the common barberry, white pines, currants and gooseberries, the potato tuber moth and alfalfa weevil.

C. P. Gillette, State Entomologist, Fort Collins, Colo.

Connecticut: Nurseries are inspected annually and nurserymen and dealers must register: nurserymen receive registration and inspection certificates and dealers receive permits. Out-of-state nurserymen must make application and file signed copies of their valid inspection certificates and receive permits before shipping stock into the State. All stock entering the State must be accompanied by both certificate and permit, and all stock transported within the State must be accompanied by either a certificate or by a permit, and transportation companies are subject to prosecution for accepting shipments without valid certificates or permits. Nursery stock imported from foreign countries must be held

unopened until inspector arrives. Have authority to inspect any stock at destination.

Quarantine prohibits the shipment of all nursery stock and forest products, unless inspected and certified, from the gipsy moth infested area to the area uninfested.

W. E. Britton, State Entomologist, New Haven, Conn.

Delaware: Shipments of nursery stock entering the State must each bear a certificate of inspection and also a certificate stating that the stock has been properly fumigated. All shipments not provided with proper certificates will be held by the transportation companies until inspected.

Quarantines exclude all five-leaved pines and all species of *Ribes* from Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, Minnesota, Wisconsin, Ohio and Michigan.

Ralph C. Wilson, Secretary, State Board of Agriculture, Dover, Delaware.

Florida: In order to ship nursery stock into Florida, duplicate inspection certificates must be filed in Florida and permit-certificate tags obtained which, together with valid inspection certificates issued in the States where the stock was grown, must accompany each box, bundle or package. All host plants of San José scale must be fumigated with hydrocyanic acid gas at the rate of one ounce of 98 per cent cyanide, two ounces sulphuric acid (sp. gr. 1.83) and four ounces water per 100 cubic feet, or thoroughly scrubbed with fish-oil soap and water (1 lb. in 3 gallons), immediately before shipment to a Florida point. Shipments of plants infected with nematode root knot, crown gall, hairy root or any insect pest or disease or markings thereof are excluded. Club orders entering Florida must have a Florida permit-tag attached to each individual order. When using a Florida permit-tag, the nurseryman must at once mail to the nursery inspector (Gainesville, Fla.) a duplicate invoice showing name and address of both consignor and consignee, itemized list of plants in shipment and serial number of Florida permit-tag used on it. All certificates on expiration and all mutilated, spoiled or unused permit-tags must be returned to the nursery inspector.

Shipments of stock liable to carry European corn borer, Japanese beetle, gipsy moth and brown-tail moth from areas under Federal quarantine for these pests will be admitted in Florida when accompanied by Federal inspection certificates, but are also subject to inspection by Florida authorities.

J. C. Goodwin, Nursery Inspector, State Plant Board, Gainesville, Fla.

Georgia: Each nurseryman, dealer, agent, salesman or solicitor must apply to the State Board of Entomology, giving (1) the

name and location of the nursery, and (2) the approximate acreage and kinds of stock grown, and receive from the Board a license: annual fee for nurserymen and dealers $5.00: annual fee for each agent, salesman or solicitor $1.00. Where a sale amounts to $100.00 or over, a duplicate of the complete invoice (without price) must be filed with the State Board of Entomology, within thirty days of shipment, with the name and address of the salesman and of the purchaser, and name and quality of all nursery stock sold in the State or for delivery in the State.

All nurserymen, corporations, firms or individuals selling or offering to sell nursery stock in Georgia must file with the Board of Entomology, and maintain for three years, a bond of $1,000.00 made out to the Secretary of the Georgia State Board of Entomology.

Quarantines prohibit shipment into the State of all five-leaved pines, currants and gooseberries; all varieties of chestnut and chinquapin nursery stock, grafts, scions or nuts for propagation from infested States; and from all States infested with the Oriental peach moth, all trees, nursery stock, fruit, twigs, cuttings, scions and other parts of peach, apple, plum, quince, cherry and all other host plants of this insect, except apple fruit; all nursery stock from sections of States where Japanese camphor scale is present. Shipments of plants from areas infested by the Japanese beetle, European corn borer, gipsy moth and brown-tail moth admitted only in strict accordance with the requirements of the Federal quarantine.

Haliard De La Parelle, State Entomologist, State Board of Entomology, Atlanta, Ga.

Idaho: No person, firm or corporation shall import or sell nursery stock by agents within the State without first applying to the Department of Agriculture, filing a bond for $5,000.00 and obtaining an annual license by paying a fee of $10.00. All shipments into the State must show name of shipper, locality where grown, variety of nursery stock and an official certificate of fumigation from the State where the stock was grown. Imported trees are fumigated before distribution, and all nursery stock shipped into the State must be inspected upon arrival at the expense of the consignee. Each nursery firm doing business in the State must annually pay an additional $1.00 for each agent. Duplicate certificates should be filed.

State quarantines exclude the entrance of all five-leaved pines, currants, gooseberries, peach, nectarine, prune, almond or other trees worked on peach stock and all pits, cuttings, buds or scions grown in a district where peach yellows or other detrimental diseases exist. There are special quarantines against the potato tuber moth and the alfalfa weevil.

M. L. Dean, Director, Bureau of Plant Industry, Boise, Idaho.

Illinois: Before shipping nursery stock into Illinois, a signed duplicate copy of the certificate of inspection must be filed with the Division of Plant Industry. Nurseries and dealers employing salesmen must file in the office of the Chief Inspector a complete list of such salesmen representing them within the State, and apply, after July 1, for an agent's permit for each salesman employed in the State. All nursery stock entering the State must bear a valid certificate of inspection, names and addresses of consignor and consignee, nature of stock and place where grown. If stock arrives without such certificate it must be reported immediately to the Division of Plant Industry, and held until released.

Quarantine orders exclude from the New England States all five-leaved pines, all species and varieties of currants and gooseberries; common barberry (*Berberis vulgaris*) and all its horticultural varieties, and all species of *Castanea.* Stock shipped into Illinois in violation of quarantines is destroyed or returned to the consignor at the discretion of the owner.

P. A. Glenn, Chief Inspector, Division of Plant Industry, Urbana, Illinois.

Indiana: Nursery stock entering or shipped within the State must bear an official inspection certificate, and give the names of both the consignor and the consignee. All out-of-state nurseries must file with the State Entomologist a copy of their valid inspection certificate, pay $1.00, and obtain a license good for one year from date of issue, before shipping stock into the State. Each dealer and agent selling or soliciting sales of nursery stock in Indiana must pay $1.00, and obtain a license from the State Entomologist. All foreign grown stock must be inspected at destination.

Frank N. Wallace, State Entomologist, Department of Conservation, Indianapolis, Ind.

Iowa: Copy of inspection certificate must be filed with and approved by the State Entomologist, and must accompany each shipment into the State.

Quarantine against European corn borer prohibits all the usual host plants entering the State from the infested areas in Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, Ohio and Michigan.

Carl J. Drake, State Entomologist, Ames, Iowa.

Kansas: Nurseries are inspected annually and all certificates and dealers' permits lapse on June 1, following date of issue. Nursery stock may be shipped into the State when accompanied by a recognized certificate of inspection. Duplicate certificates may be filed.

Quarantine prohibits the entrance of five-leaved pines, currants and gooseberries from certain middle and eastern States.

James N. Farley, Secretary, Entomological Commission, Topeka, Kans.

Kentucky: Kentucky nurseries are inspected annually and certificates are issued when stock is found free from dangerous pests. All nurserymen, resident or non-resident, file, annually, credentials at this office and if in good standing receive a permit on payment of a fee of five dollars.

Agents and dealers must file credentials annually, including names of "nurseries, nurserymen, or persons represented," and on payment of a fee of five dollars are issued a permit. Agents while soliciting orders must carry their permits, to show to prospective buyers, county officials, or agents of the State Entomologist, on demand. Quarantines are provided for. Effective on and after July 1, 1926.

H. Garman, State Entomologist, Lexington, Ky.

Louisiana: Before shipping nursery stock into Louisiana, application must be made to the Entomologist for permit by filing copy of valid certificate, and order for certificate tags accompanied by money to pay for them (price on application). The Louisiana tag and the inspection certificate of the State where the stock was grown must both accompany each shipment. The invoice stub of each permit tag must be filed with the Entomologist once a week, showing the number and varieties of plants shipped.

W. E. Anderson, State Entomologist, Department of Agriculture, Baton Rouge, La.

Maine: All individuals or firms selling or soliciting sales of nursery stock which they have not grown shall annually obtain a license from the State Horticulturist by paying a fee of $5.00. All stock entering the State shall bear on each box or package a valid inspection certificate; such stock may be inspected at destination and if found infested with dangerous pests may be destroyed or returned to the consignor.

Quarantine prohibits entrance of currant or gooseberry plants. Five-leaved pines cannot enter without a permit from the Forest Commissioner.

George A. Yeaton, State Horticulturist, Augusta, Me.

Maryland: Nurseries are inspected twice each year. Nursery stock subject to attack of San José scale must be fumigated before shipment. Shipments entering the State must bear certificates of inspection besides names of consignor and consignee. Duplicate certificate should be filed with the State Entomologist.

Quarantines prohibit the shipment of five-leaved pines, currants and gooseberries from New York, the New England States, Pennsylvania, New Jersey, Michigan, Wisconsin, Minnesota and Washington; also into the non-infested counties of Maryland, of any

nursery stock of peach or sweet cherry from areas infested with the Oriental peach moth.

Ernest N. Cory, State Entomologist, College Park, Md.

Massachusetts: All growers and agents who sell nursery stock for delivery within the State must have a grower's certificate or an agent's license, and a copy of such certificate or license must accompany each car, box or package of stock shipped or delivered. Agents must apply to Director, Division of Plant Pest Control, Boston, Mass., and file list of nursery firms from which they purchase stock before receiving agent's license. Authority is granted to inspect at destination all stock entering the State, and if found infested may be destroyed, treated, or returned to the consignor at his expense.

Quarantines prohibit *Ribes* from entering the State except under permit.

R. H. Allen, Director, Division of Plant Pest Control, Boston, Mass.

Michigan: Shipments of nursery stock entering the State must bear on each package a valid certificate of inspection showing that the contents have been inspected by a State or Government officer, and that they have been fumigated in the usual manner with hydrocyanic acid gas, together with statement of contents and names of consignor and consignee. Nurserymen of other States who employ agents to sell nursery stock in Michigan, must first file a certificate of inspection, file a bond of $1,000, pay a fee of $5.00, and obtain a license.

Quarantines prohibit raspberry plants from entering the State unless they have had two inspections, one prior to July 31, and the other in August or September at least thirty days later; also five-leaved pines and black currants from New York and the New England States, though red and white currants and gooseberries may be shipped from the vicinity of Rochester, Geneva, Fredonia and Newark, New York, provided the white pine blister rust has not been found in the vicinity within two years. Neither barberry in any of its upright forms, nor sweet chestnuts grown east of Ohio, can be shipped into Michigan, and a quarantine against the European corn borer prohibits the entrance from infested localities of the common hosts of that pest, including hardy perennials with stems.

E. C. Mandenberg, In Charge of Orchard and Nursery Inspection, Department of Agriculture, Lansing, Mich.

Minnesota: All nursery stock entering the State must bear valid certificates of inspection and any transportation companies accepting stock not so tagged are liable to prosecution. Outside nurserymen and dealers must file certificates with the State Entomologist before shipping stock into the State.

Quarantines prohibit the entry of all five-leaved pines and black currants from the New England States, New York, New Jersey, Pennsylvania, Ohio, Michigan and Wisconsin; other species of *Ribes* from these States are allowed to enter if stripped of leaves: all barberry except Japanese (*Berberis thunbergii*); raspberry plants unless certified that they have been properly inspected and found apparently free from mosaic and other systemic diseases: the usual host plants of European corn borer.

A. G. Ruggles, State Entomologist, University Farm, St. Paul, Minn.

Mississippi: Outside nurserymen and shippers must file valid inspection certificates and obtain (at cost) permit tags, which together with inspection certificate of State where stock was grown, names and addresses of consignor and consignee, nature and quantity of contents, and locality where grown must be attached to each package. State certificate must also affirm that the nursery is properly equipped for fumigating plants with hydrocyanic acid gas, and the proprietor or manager of the nursery must file an affidavit that all host plants of San José scale will be fumigated immediately before being delivered for shipment into Mississippi.

Agents or salesmen must register with and obtain certificates from the Nursery Inspector before selling, delivering or taking orders for nursery stock in the State.

Plants infected with root knot (caused by nematodes), crown gall, or showing any other evidence of pest infestation, must not be shipped into Mississippi.

All plants capable of defoliation must be defoliated. Soft ornamental plants are classed as nursery stock in Mississippi.

Quarantines provide that nursery stock classed as host plants of the European corn borer and Japanese beetle can be shipped to this State from infested districts only when the shipments are made in conformity with the United States Department of Agriculture regulations and in addition are accompanied by permit tags of the State Plant Board of Mississippi.

Geo. F. Arnold, Nursery Inspector, A. and M. College, Mississippi.

Missouri: Outside nurseries must file necessary papers including certificate and apply for a permit certificate which will be issued without fee. All agents or salesmen must apply for agent's certificate. Each package of nursery stock entering the State must bear the names of both consignor and consignee, statement of contents, and a certificate showing that the stock therein contained has been inspected where grown by a duly authorized inspector and found to be apparently free from dangerously injurious insect pests and plant diseases. Transportation companies are not permitted to deliver nursery stock unless so labeled.

Leonard Haseman, State Entomologist and Chief Inspector, State Plant Board, Columbia, Mo.

Montana: All nursery stock entering the State must be unpacked and inspected at one of the following designated quarantine stations: Billings, Butte, Miles City, Missoula, Sanders or Fairview. All shipments entering the State are subject to inspection with fees as follows: licensed nurseries, car lots $10.00, smaller lots proportionate; unlicensed nurseries, ten per cent of invoice price of shipment with minimum of 50 cents per package. Notice of shipment including list of stock and names of transportation company, consignor and consignee must be sent to the Chief, Division of Horticulture, Missoula, Montana, five days prior to shipment.

Nurserymen are required to pay an annual fee of $25.00 and file a bond of $1,000.00 in favor of the State of Montana; this includes licenses for all Montana agents. Agents for unlicensed nurseries must pay an annual fee of $10.00 and file bonds of $1,000.00.

Quarantines prohibit the entrance of the common barberry from all States, and of all five-leaved pines, currant and gooseberry plants from the States east of and including Minnesota, Iowa, Missouri, Arkansas and Louisiana and all of the State of Washington.

Edward Dickey, Chief, Division of Horticulture, Missoula, Mont.

Nebraska: All nursery stock entering the State shall bear the names of consignor and consignee and an inspection certificate issued since the preceding July 1. It is desired that duplicate certificates be filed.

Quarantine prohibits the entrance of five-leaved pines.

Myron H. Swenk, State Entomologist, University of Nebraska, Lincoln, Neb.

Nevada: All nursery stock entering the State must bear on each car, bale, or package a copy of a valid official inspection certificate, and names of consignor and consignee. Transportation companies shall not deliver nursery stock lacking such certificate.

Quarantine prohibits entry of any pine trees, currant or gooseberry plants or cuttings from east of the Mississippi River or from foreign countries, and of fruit trees, and fresh fruits and their boxes or containers, from any States infested by the Oriental fruit moth.

Edward Records, State Quarantine Officer, University of Nevada, Reno, Nev.

New Hampshire: All nursery stock entering the State must bear on each container a copy of a valid inspection certificate, or an affidavit showing that susceptible plants have been fumigated.

Quarantines prohibit the entrance of all five-leaved pines, currant and gooseberry plants, except that such pines may be admitted if certified that no pine blister rust is known to occur in the nursery and that all *Ribes* had been removed from within 300 yards of the nursery; also that plants susceptible to attack of the European corn borer, gipsy moth and satin moth from infested regions cannot enter uninfested territory without inspection certificates.

W. C. O'Kane, Deputy Commissioner of Agriculture, Durham, N. H.

New Jersey: Each car or parcel of nursery stock entering the State must bear a copy of a valid inspection certificate, with a statement from the shipper that the contents are a part of the stock inspected and whether or not it had been fumigated with hydrocyanic gas. Transportation companies shall refuse for transportation within the State all nursery stock not accompanied by a certificate of inspection. All such stock entering the State may be inspected wherever found, and if infested with dangerous pests, will be destroyed.

Common carriers and New Jersey nurserymen who bring nursery stock into the State shall send notice of each shipment with full data prior to, or within twenty-four hours after, its arrival.

Quarantines prohibit the entrance of five-leaved pines from all States where the pine blister rust occurs.

Harry B. Weiss, Chief, Bureau of Statistics and Inspection, State Department of Agriculture, Trenton, N. J.

New Mexico: Before shipping nursery stock into New Mexico, a duplicate copy of a valid certificate of inspection must be filed and a permit obtained.

Quarantine prohibits the entrance of *Ribes* and *Grossularia.*

H. L. Kent, President, Agricultural College, State College, N. Mex.

New York: Nursery stock cannot enter the State or be moved within the State unless a valid certificate is attached issued by the New York State Department of Farms and Markets or by the State in which the shipment originated. Transportation companies and all persons bringing nursery stock into the State must send notice to the Department of Farms and Markets. Blanks will be furnished for such notices. An exact copy of the certificate must be attached to each package sent by mail. Stock received from abroad or from other States must not be unpacked or distributed until after inspection and release by Department of Farms and Markets.

Quarantines prohibit the entrance of five-leaved pine trees from New England, New Jersey, Pennsylvania, Ohio, Indiana, Illinois, Wisconsin and Minnesota; also of Christmas trees and woody greens from New England, except from those areas lightly or not infested by gipsy moth and then only under certificates of inspection; of raspberry plants unless apparently free from mosaic diseases and are so certified after two inspections and the removal of all diseased plants, as is practiced in New York State; other regulations concern the European corn borer, and the usual host plants can be transported from within to without the infested areas only after being inspected and certified; currants and gooseberries cannot be grown in certain pine-growing areas of the State.

George G. Atwood, Director, Bureau of Plant Industry, Department of Farms and Markets, Albany, N. Y.

North Carolina: Nursery stock can enter the State only when shipments bear North Carolina official permit tags, which will be supplied at cost on request, and the filing of a duplicate inspection certificate accompanied by an affidavit that all fruit stock will be fumigated.

Quarantines prohibit the entrance of five-leaved pines and *Ribes* from Canada, the New England States, New York, New Jersey, Pennsylvania, Ohio, Wisconsin, Minnesota and Washington.

W. V. Reed, Inspector, State Department of Agriculture, Raleigh, N. C.

North Dakota: Nursery stock entering the State must bear inspection certificates. Every person employing agents or salesmen or who solicits for the sale of nursery stock, must obtain a license by paying a fee of $10.00, filing a duplicate inspection certificate, and a $500.00 bond. License is good for one year.

Director, North Dakota Experiment Station, Agricultural College, N. D.

Ohio: Out-of-state nurserymen must file copies of their inspection certificates and obtain an Ohio certificate permitting them to solicit orders for nursery stock. Each dealer within or without the State shall obtain annually a dealer's certificate, by furnishing an affidavit that he will buy and sell only inspected stock and will maintain with the Secretary of Agriculture a list of all sources from which he obtains nursery stock. Each affidavit shall be accompanied by a fee of $5.00. All agents soliciting orders for nursery stock shall file annually a statement that he will sell only inspected stock, and pay a fee of $1.00. He shall carry an agent's certificate and a copy of the certificate held by his principal.

Each shipment entering the State shall be accompanied by a tag or poster giving an exact copy of the valid certificate. Altered certificates are prohibited.

Quarantines prohibit the entrance or shipment within the State of the common barberry and its horticultural varieties, and the common host plants of the European corn borer.

Richard Faxon, Chief, Division of Plant Industry, Department of Agriculture, Columbus, Ohio.

Oklahoma: Nursery stock entering the State must bear on each package of each shipment an inspection certificate. Nurserymen must each file a duplicate copy of his valid inspection certificate, and furnish a surety bond of $1,000.00 in favor of the State Board of Agriculture. A permit will be issued on payment of the fee of $5.00, and a copy of this permit must be attached to all shipments entering the State of Oklahoma.

All dealers within or outside the State must attach to each package of each shipment a copy of the dealer's certificate issued to them by the Board of Agriculture.

Thomas B. Gordon, State Nursery Inspector, Oklahoma City, Okla.

Oregon: The unlicensed sale or distribution of nursery stock is unlawful. The applicant must pay a fee and furnish a bond. The fee for a nurseryman, dealer or importer is $10.00, and for any agent, solicitor or salesman, $1.00. The bond shall be for $1,000.00 and shall be conditional that all stock delivered shall be true to name.

Quarantines prohibit the entry of all five-leaved pines and all species and varieties of currants and gooseberries from States east of the Mississippi River and from the State of Washington; of all hazel and filbert nursery stock from all territory east of the Province of Alberta, Canada, and the States of Idaho, Utah and Arizona; grape vines and cuttings from most of the eastern States and portions of California; cranberry nursery stock from the New England States, New York, New Jersey and Pennsylvania.

Chas. A. Cole, Secretary, State Board of Horticulture, Portland, Ore.

Pennsylvania: Nurserymen from outside the State must file duplicate copies of their valid inspection certificates, each certified by the State official in charge, and each non-resident nurseryman must supply a statement giving the exact acreage which he is growing in nursery stock and the acreage which is being grown for him under contract. Then a Pennsylvania certificate must be obtained before shipping stock into the State. Dealers are granted certificates on application and receipt of a statement from each that he will buy stock only from nurseries holding valid certificates of inspection. Agents soliciting for the sale of nursery stock in the State must obtain and carry agents' duplicate certificates. All shipments of nursery stock entering the State will be rejected unless accompanied by certificates of inspection.

Quarantines prohibit the entrance of chestnut trees, black currants, five-leaved pines, all barberry plants except Japanese barberry, and shipments of Christmas trees or woody greenery from the gipsy moth district of New England.

C. H. Hadley, Director, Bureau of Plant Industry, Harrisburg, Pa.

Rhode Island: All stock entering the State must bear a valid official certificate of inspection, but is subject to further inspection and may be destroyed or returned to the consignor if found infested. Agents must obtain agents' licenses, on stating where they expect to purchase their stock.

Five-leaved pines and *Ribes* can be shipped into the State or planted in certain parts of the State only on permission.

A. E. Stene, State Entomologist, State House, Providence, R. I.

South Carolina: Each package of nursery stock entering the State must bear a permit tag of the South Carolina State Crop Pest Commission, which may be obtained at cost by filing a duplicate certificate of inspection and fumigation.

Quarantines prohibit the entrance of chestnut plants or cuttings, five-leaved pines, currants, gooseberries and all host plants of the European corn borer. Citrus stock is allowed to enter only by special permit. Fumigation of host plants of San José scale is required.

South Carolina State Crop Pest Commission, Clemson College, S. C.

South Dakota: Out-of-state dealers may obtain certificates permitting them to solicit and fill orders in the State, by filing with the Secretary of Agriculture a certified copy of their official inspection certificates and by paying a fee of $1.00 each. All agents shall likewise obtain and carry agents' certificates bearing copies of the certificates held by their principals, and paying fees of $1.00 each.

Quarantines prohibit the entrance of all five-leaved pines and *Ribes;* of all poplars and willows from areas infested by the satin moth; all host plants of the European corn borer.

B. F. Myers, Secretary of Agriculture, Pierre, S. D.; John Hetland, Nursery Inspector, Brookings, S. D.

Tennessee: Out-of-state nurseries must file duplicate inspection certificates and the following agreement regarding fumigation:

> "We, the undersigned, agree to fumigate with hydrocyanic acid gas, according to the required strength, all nursery stock subject to attack from San José scale and other dangerous insect pests. We also agree to attach a fumigation tag to each and every shipment going into the State of Tennessee."

Every shipment must bear a valid inspection certificate and a fumigation tag, and failure to comply with these requirements subjects the stock to confiscation.

Nursery agents and dealers must file sworn statements on official Tennessee blanks which will be supplied. Each agent operating in Tennessee must pay a license fee of $1.00 and each dealer or jobber must pay $5.00.

Nurserymen selling trees under contract to prune and spray the same for a period of years are required to take out a bond of $5,000.00 before selling trees under such special contract.

State quarantines prohibit the entrance of all five-leaved pines, currants and gooseberries; all varieties of barberry except *Berberis thunbergii;* all varieties of chestnut and chinquapin from all States where chestnut blight occurs. Other restrictions apply to Japanese beetle, European corn borer, gipsy moth, sweet potato weevil and pink bollworm of cotton. Peach and pecan seedlings are allowed entrance only by special permit for experimental purposes.

G. M. Bentley, State Entomologist and Plant Pathologist, Knoxville, Tenn.

Texas: Nurserymen, florists and other shippers of nursery stock desiring to do business in Texas, must file with the Texas State Department of Agriculture a certified copy of certificate of inspection from the State Inspector of the State in which the shipment originates, and also in addition to this, a fee of $5.00 is required which must be remitted in post-office money order, cashier's check, or bank draft. This permit is good for one year, expiring on August 31 of each year.

All shipments of nursery and floral stock originating outside of the State must bear shipping tags showing the exact copy of certificate of inspection from the State Inspector of the State in which the shipment originated, and in addition thereto must have a tag showing the exact copy of permit from Texas. These tags the shipper must have printed.

Texas freight and express companies are prohibited from receiving or delivering all shipments which do not bear proper tags, showing copies of necessary permits.

Nurserymen and florists of all States who ship nursery and floral stock into Texas, are requested to file with the Department of Agriculture a copy of invoice or memorandum of each and every shipment of stock made into the State, giving the date, consignor, consignee and a list of stock shipped. The price need not be given.

Those intending to ship orange and citrus seed of all kinds into Texas must furnish the Texas Department with a certified statement from their State Plant Board, that the seed was gathered from citrus-canker-free territory, and also an affidavit that the

seeds to be shipped were treated in a corrosive sublimate solution of a strength of 1-1000.

Agents or dealers operating in Texas for nurserymen and florists outside of the State must procure proper credentials as agents from the nurserymen they represent. The form for this credential approved by the Commission of Agriculture is furnished free of charge. Each agent or dealer must be prepared to present such credential at all times.

Dealers are classed as nurserymen and are required to take out permits. Greenhouses and greenhouse plants are included for inspection by the Texas laws and all State Inspectors should advise their nurserymen, florists or owners of greenhouses that each must have a Texas certificate before they can make shipments into the State of Texas.

G. J. Scholl, Chief Nursery Inspector, Department of Agriculture, Austin, Texas.

Utah: Out-of-state nurserymen must file with Board of Agriculture a valid official inspection certificate, and names of their agents in Utah, and obtain (without fee) an annual license; file a bond for $500.00 that they will comply with the law and to cover cost of inspection, fumigation, or destruction of stock shipped into the State or sold by their agents. Agents and salesmen representing out-of-state firms must carry proper credentials.

All nursery stock entering the State must bear a valid official inspection certificate and an official certificate that the shipment has been given a cyanide fumigation for 45 minutes at the rate of one ounce to each 100 cubic feet of enclosed space. Also a notice of each shipment giving duplicate invoice, list of contents, date, and names of both consignor and consignee must be mailed to the State Agricultural Inspector. Any out-of-state shipment not bearing the proper license and certificate tags will be placed in quarantine and inspected and disinfected at the owner's expense.

H. J. Webb, State Agricultural Inspector, State Board of Agriculture, Salt Lake City, Utah.

Vermont: All nursery stock entering the State must bear valid official inspection certificates and the names and post office addresses of both consignor and consignee.

Quarantines restrict the free movement of raspberry plants on account of mosaic, leaf roll and rosette, hosts of the European corn borer, and all uninspected and non-nursery grown trees and forest products on account of the gipsy and brown-tail moths.

M. B. Cummings, State Nursery Inspector, Burlington, Vt.

Virginia: All nurseries must file valid inspection certificates, pay fee of $10.00 (checks must be certified and made payable to the Treasurer of Virginia) and obtain a certificate of registration;

duplicates for agents' use $1.00 each. State tags will be furnished at cost and one must accompany each package of stock entering the State or sold within the State.

Commissioner of Agriculture, Richmond, Va.

Washington: No person shall sell, solicit sales, or distribute nursery stock, except berry plants, without first obtaining a license ($5.00 for nurserymen and tree dealers, $1.00 for agents). Nurserymen and dealers must file a bond of $1,000.00 for compliance with the law that the stock be true to name. All licenses expire July 1st. The State is divided into eleven horticultural districts, with an inspector-at-large in charge of each district. Notice of nursery stock entering Washington must be sent to the inspector-at-large into whose district the shipment is made, and a duplicate notice sent to the Department of Agriculture, Olympia, Wash.

J. I. Griner, Supervisor of Horticulture, Olympia, Washington.

West Virginia: All nursery stock entering the State must bear a valid certificate of inspection and a West Virginia permit tag. No nursery stock shall be sold, offered for sale or delivered, without first obtaining from the Commissioner of Agriculture, a certificate of registration, annual fee $20.00.

Quarantines prohibit the entrance of all five-leaved pines, and all species and varieties of gooseberries.

W. E. Rumsey, State Entomologist, Morgantown, W. Va.

Wisconsin: Each out-of-state nurseryman must file valid certificate of inspection and obtain State license before shipping stock into the State. Each car, or package, must bear certificate tags. Each agent selling nursery stock in the State must carry an agent's duplicate certificate bearing the same number and date as that of his principal. No fees are charged.

Quarantines prohibit entrance of all five-leaved pines and all barberry bushes (except Japanese barberry) and host plants of European corn borer from infested areas; also nursery stock from gipsy moth infested areas except under Federal Certificate.

S. B. Fracker, State Entomologist, Madison, Wis.

Wyoming: Each out-of-state nurseryman must file valid certificate of inspection and deposit fee of $15.00 and receive license good until the following July 1st. Authorized shipping tags are furnished at cost, and carriers are forbidden to deliver unless each shipment bears such a tag.

Quarantines prohibit entrance of all five-leaved pines, currants and gooseberries.

C. L. Corkins, State Entomologist, Laramie, Wyoming.

OFFICERS IN CHARGE OF INSPECTION AND QUARANTINE SERVICE

Alabama .....B. P. Livingston, Chief, Division of Plant Industry, Montgomery, Ala.

Arizona .....O. C. Bartlett, State Entomologist, Phoenix, Ariz.

Arkansas .....P. H. Millar, Acting Chief Inspector, Little Rock, Ark.

California .....A. C. Fleury, Supervising Quarantine Officer, Sacramento, Cal.

Colorado .....C. P. Gillette, State Entomologist, Fort Collins, Colo.

Connecticut .....W. E. Britton, State Entomologist, New Haven, Conn.

Delaware .....Ralph C. Wilson, Secretary, State Board of Agriculture, Dover, Del.

Florida .....J. C. Goodwin, Nursery Inspector, State Plant Board, Gainesville, Fla.

Georgia .....Haliard De La Parelle, State Entomologist, Atlanta, Ga.

Idaho .....M. L. Dean, Director, Bureau of Plant Industry, Boise, Idaho.

Illinois .....P. A. Glenn, Chief Inspector, Division of Plant Industry, Urbana, Ill.

Indiana .....Frank N. Wallace, State Entomologist, Indianapolis, Ind.

Iowa .....Carl J. Drake, State Entomologist, Ames, Iowa.

Kansas .....James N. Farley, Secretary, Entomological Commission, Topeka, Kans.

Kentucky .....H. Garman, State Entomologist, Lexington, Ky.

Louisiana .....W. E. Anderson, State Entomologist, Baton Rouge, La.

Maine .....Geo. A. Yeaton, State Horticulturist, Augusta, Me.

Maryland .....E. N. Cory, State Entomologist, College Park, Md.

Massachusetts ...R. H. Allen, State Nursery Inspector, State House, Boston, Mass.

Michigan .....E. C. Mandenberg, In Charge of Orchard and Nursery Inspection, Department of Agriculture, Lansing, Mich.

Minnesota .....A. G. Ruggles, State Entomologist, University Farm, St. Paul, Minn.

Mississippi .....Geo. F. Arnold, Nursery Inspector, Agricultural College, Miss.

Missouri .....Leonard Haseman, State Entomologist and Chief Inspector, State Plant Board, Columbia, Mo.

Montana .....Edward Dickey, Chief, Division of Horticulture, Missoula, Mont.

Nebraska .....Myron H. Swenk, State Entomologist, Lincoln, Neb.

Nevada .....Edward Records, State Quarantine Officer, University of Nevada, Reno, Nev.

New Hampshire..W. C. O'Kane, Deputy Commissioner of Agriculture. Durham, N. H.

New Jersey .....Harry B. Weiss, Chief, Bureau of Statistics and Inspection, State Department of Agriculture, Trenton, N. J.

New Mexico ....H. L. Kent, President, Agricultural College, State College, N. Mex.

New York .....Geo. G. Atwood, Director, Bureau of Plant Industry, Department of Farms and Markets, Albany, N. Y.
North Carolina ..W. V. Reed, Inspector, State Department of Agriculture, Raleigh, N. C.
North Dakota ...Director, Experiment Station, Agricultural College, N. D.
Ohio .....Richard Faxon, Chief, Division of Plant Industry, Department of Agriculture, Columbus, O.
Oklahoma .....Thomas B. Gordon, State Nursery Inspector, Oklahoma City, Okla.
Oregon .....Chas. A. Cole, Secretary, State Board of Horticulture, Portland, Ore.
Pennsylvania ....C. H. Hadley, Director, Bureau of Plant Industry, Harrisburg, Pa.
Rhode Island ....A. E. Stene, State Entomologist, State House, Providence, R. I.
South Carolina ..South Carolina State Crop Pest Commission, Clemson College, S. C.
South Dakota ....John Hetland, Nursery Inspector, Brookings, S. D.
Tennessee .....G. M. Bentley, State Entomologist and Plant Pathologist, Knoxville, Tenn.
Texas .....G. J. Scholl, Chief Nursery Inspector, Department of Agriculture, Austin, Tex.
Utah .....H. J. Webb, State Agricultural Inspector, State Board of Agriculture, Salt Lake City, Utah.
Vermont .....M. B. Cummings, State Nursery Inspector, Burlington, Vt.
Virginia .....Commissioner of Agriculture, Richmond, Va.
Washington .....J. I. Griner, Supervisor of Horticulture, Olympia, Wash.
West Virginia ...W. E. Rumsey, State Entomologist, Morgantown, W. Va.
Wisconsin .....S. B. Fracker, State Entomologist, Madison, Wis.
Wyoming .....C. L. Corkins, State Entomologist, Laramie, Wyo.

Federal Quarantines and District of Columbia .....Federal Horticultural Board, U. S. Department of Agriculture, Washington, D. C.

Dominion of Canada .....L. S. McLaine, Secretary, Destructive Insect and Pest Act Advisory Board, Department of Agriculture, Ottawa, Can.

BULLETIN OF IMMEDIATE INFORMATION No. 58

MAY 1, 1927

Connecticut Agricultural Experiment Station
New Haven, Connecticut

The Japanese Beetle Quarantine

(Revision Effective May 1, 1927)

W. E. BRITTON, *State Entomologist*

Late in the summer of 1926, Federal scouts discovered a rather general infestation of the Japanese beetle, *Popillia japonica* Newman, on the western end of Long Island, and at several points in Westchester County, New York. One of these was at Port Chester near the Connecticut border. The scouts were then sent into the southwestern corner of Connecticut and proceeded as far as Norwalk. In the center of the city of Stamford, on Broad Street, several adult Japanese beetles were discovered on rose bushes and other shrubs and flowers, eighteen in all being taken over a period of about two weeks. On account of the spread of the Japanese beetle, not only in New York and Connecticut but also in Pennsylvania and New Jersey, it seemed necessary to revise the Federal quarantine, and a hearing was held in Washington September 25; a revised quarantine order was afterward issued, effective October 11. As the Federal quarantine applies only to interstate shipments, and as it seemed best to issue regulations governing possible shipments from Greenwich and Stamford to other points in Connecticut, notice of a hearing was distributed and published, as provided by law. The hearing was held at the Station October 19, and no one appearing in opposition, Quarantine Order No. 11, effective November 10, was issued. The Federal quarantine has since been further revised, effective April 1, 1927, and corresponding rules and regulations have been adopted in State Quarantine Order No. 12, as follows:

STATE OF CONNECTICUT
AGRICULTURAL EXPERIMENT STATION
NEW HAVEN, CONN.

QUARANTINE ORDER No. 12
JAPANESE BEETLE QUARANTINE

The fact has been established by the Agricultural Experiment Station that an injurious insect known as the Japanese beetle (*Popillia japonica*) exists in the town of Stamford, Conn., and in Port Chester, N. Y., and that certain rules and regulations seem necessary in addition to those established in Quarantine Order No. 10, effective November 10, 1926.

Now, therefore, I, Director of the Connecticut Agricultural Experiment Station, pursuant to the provisions of Chapter 107, Public Acts of 1925, do hereby proclaim the towns of Stamford and Greenwich to be under State quarantine, and that it shall be unlawful to move from these towns to other points within the State (1) farm, garden, and orchard products of all kinds; (2) grain and forage crops of all kinds; (3) nursery, ornamental, and greenhouse stock, and all other plants; and (4) sand, soil, earth, peat, compost, and manure, except under the conditions prescribed in the following rules and regulations supplemental to this quarantine.

RULES AND REGULATIONS

Regulation 1.—Definitions.

For the purpose of these regulations, the following words, names and terms shall be construed, respectively, to mean:

(a) JAPANESE BEETLE: The insect known as the Japanese beetle (*Popillia japonica* Newman) in any stage of its life cycle.

(b) REGULATED AREA: Those portions of the State quarantined on account of the Japanese beetle and designated as being infested or immediately threatened with such infestation.

(c) FARM PRODUCTS: Farm, garden and orchard products of all kinds, and grain and forage crops of all kinds.

(d) NURSERY AND ORNAMENTAL STOCK: Nursery, ornamental and greenhouse stock and all other plants, plant roots, or portions of plants for ornamental use.

(e) SAND, SOIL, EARTH, PEAT, COMPOST AND MANURE: Sand, soil, earth, peat, compost and manure of any kind, and as to either bulk movement or in connection with farm products or nursery and ornamental stock.

(f) INSPECTOR: An inspector of the Connecticut Agricultural Experiment Station or the United States Department of Agriculture.

(g) CERTIFIED SAND, SOIL, EARTH, PEAT, COMPOST AND MANURE: Sand, soil, earth, peat, compost, or manure determined by the inspector as uninfested by the Japaneses beetle, and so certified.

(h) CERTIFIED GREENHOUSE: A greenhouse which has complied to the satisfaction of the inspector with the conditions imposed in Regulation 6. This term may apply also to potting beds, heeling-in areas, hotbeds, cold-frames, or similar plots safeguarded and treated in manner and method satisfactory to the inspector.

Regulation 2.—Plants and Plant Products Subject to Restriction.

The restrictions on the movement of plants and plant products and other articles enumerated in the following regulations will be limited to such articles when originating in or moving from the areas now or hereafter designated by the Secretary of Agriculture as regulated or quarantined.

Regulation 3.—Regulated Area.

The towns of Stamford and Greenwich, in Fairfield County, and including any city or borough within their limits.

Regulation 4.—Extension or Reduction of Regulated Area.

The area designated in Regulation 3 may be extended or reduced, as found necessary by the Connecticut Agricultural Experiment Station. Due notice of any extension or reduction of the areas affected thereby will be given in writing to the transportation companies doing business in the areas, and by publication in newspapers selected by the Connecticut Agricultural Experiment Station.

Regulation 5.—Control of Movement of Farm Products and Cut Flowers.

No restrictions are placed by these regulations on the movement of farm products and cut flowers between October 16 and June 14 inclusive.

(a) Farm Products and Cut Flowers for Which Certification Is Not Required between June 15 and October 15, inclusive.

(1) No restrictions are placed by these regulations on the movement of Irish potatoes and sweet potatoes when free from soil, watermelons, dried fruits, dried vegetables, seeds, grains, and, when used for packing articles other than fruits and vegetables, hay and straw.

(b) Farm Products and Cut Flowers for Which Certification Is Required between June 15 and October 15, inclusive.

Between June 15 and October 15, inclusive, farm products and cut flowers shall not be moved to points outside the regulated area, except as provided in this and the following regulations.

(1) Farm products and cut flowers which have been handled or treated in manner and by method satisfactory to the inspector, to free them from any infestation, may be certified for movement to points outside the regulated area. The number of inspection points for such certification will be limited and their location determined by shipping needs and further conditioned on the establishment at such point of provisions satisfactory to the inspector for the handling and safeguarding of such shipments during inspection.

(2) Farm products and cut flowers originating outside of and concentrated within the regulated area may be certified by the inspector for reshipment to points outside the regulated area when such shipment is made directly from the freight yards or unloading docks, subject to compliance by the shipper with provisions satisfactory to the inspector for the handling and safeguarding of such shipments pending certification and reshipment.

(3) Farm products and cut flowers, when grown in districts where the fact has been established to the satisfaction of the inspector that no infestation exists, may be certified by such inspector for direct shipment from the farms where grown to points outside the regulated area.

(4) Certification of farm products and cut flowers, for movement from freight yards, docks or markets in the regulated area to points outside such area may be withheld by the inspector during the periods of general or unusual flight, resulting in large numbers of beetles in such freight yards, docks, or markets.

Regulation 6.—Control of Movement of Nursery and Ornamental Stock.

(a) No restrictions are placed on the movement of smooth bulbs of tulip, hyacinth, gladiolus, and narcissus from the regulated area to points outside thereof.

(b) No restrictions are placed on the movement of nursery and ornamental stock originating within the regulated area to points *within* such area, except as a condition of maintaining class rating of nurseries and greenhouses [see paragraph (d)].

(c) No restrictions are placed on the movement of nursery and ornamental stock imported under permit in accordance with the provisions of the "Rules and Regulations Supplemental to Notice of Quarantine No. 37, Governing the Importation of Nursery Stock and Other Plants and Seeds into the United States" which may be entered at a port within the regulated area, when reshipped directly from the docks or freightyards of such port in the original container and marked as to each container as required in the aforesaid rules and regulations as a condition of shipment; namely, to show the general nature and quantity of the contents, the name and address of the consignee, and the country and locality where grown.

(d) Nursery and ornamental stock, other than cut flowers (see Regulation 5) shall not be moved from the regulated area to points outside of such area until certified by the inspector for such movement. For the purpose of such certification, nurseries and greenhouses within the regulated area will be classified as indicated below:

Class I.—Nurseries and greenhouses in districts included in the regulated area but in which districts neither grubs in the soil nor beetles have been found.

Class II.—Nurseries and greenhouses in districts recently or scantily infested by the beetle, but in which nurseries or greenhouses no beetles have been found and in which it has not been possible to determine any soil invasion.

Class III.—Nurseries and greenhouses in which either grubs in the soil or beetles occur, or located in districts known to be generally infested.

(e) Conditions necessary for the maintenance of the classification of nurseries and greenhouses. Nurserymen, florists, dealers, and others, in order to maintain the classified status of their nurseries and greenhouses, shall meet the following requirements governing sales and purchases:

(1) Report immediately in writing to the inspector all their sales or shipments of nursery and ornamental stock to points *outside* the regulated area, and similarly report all sales or shipments of such stock destined to other classified nurseries and greenhouses *within* the regulated area.

(2) Report immediately in writing all purchases of nursery and ornamental stock and of sand, soil, earth, peat, compost, or manure from nurserymen, florists, dealers, or others *within* the regulated area.

(3) Nurserymen, florists, dealers, or others shall restrict their purchases of nursery and ornamental stock within the regulated area to stock which is certified as to each purchase, by the inspector, as free from infestation, and the said certificate shall accompany the article when moved.

Forms for reporting sales and purchases will be supplied by the inspector and will provide for the following information: Name and address of the consignee; name and address of the consignor; date of shipment; kinds of plants and number of each kind; class and quantity of other restricted articles. The forms, when filled out, shall be sent immediately to the nearest local office of the Japanese beetle project.

(f) Control of movement from nurseries and greenhouses in Class I. Upon compliance with the requirements of Section (e) of this regulation, nursery and ornamental stock may be certified by the inspector for shipment from nurseries and greenhouses in Class I to points outside the regulated area without meeting the safeguards prescribed as a condition of shipment of plants originating in nurseries or greenhouses of Classes II and III.

(g) Control of movement from nurseries and greenhouses in Class II. Upon compliance with the requirements of Sections (e) and (i) of this regulation, nursery and ornamental stock may be certified by the inspector for shipment from nurseries and greenhouses of Class II to points outside the regulated area under the following safeguards:

(1) Outdoor-grown nursery and ornamental stock shall be examined by the inspector at the time of digging, as follows: Immediately before digging, surface soil to the depth of four inches shall be removed from about each plant and examined; the plants shall then be lifted and a careful examination made of the exterior of the soil ball and of the sides of the hole from which the plant is removed.

(2) Azaleas, rhododendrons, and other plants which are of such a nature that the removal of the soil may be harmful to the plants may, after October 10, be subjected to the following procedure in lieu of the requirements in paragraph (1): Intensive examination, by the inspector, of the soil in the block concerned; entire removal of the soil from at least 5 per cent of the plants by the shipper or owner, and a careful examination, by the inspector, of the soil removed.

(h) Control of movement from nurseries and greenhouses in Class III. No movement of nursery and ornamental stock from nurseries and greenhouses of Class III to points *outside* the regulated area shall be allowed except upon compliance with the following restrictions:

(1) Plants with soil: Plants or classes of plants which shall be determined by the inspector as possible of effective treatment with carbon disulphide emulsion or other means may be certified by the inspector for shipment when such treatment is performed under the direction and supervision of, and in manner and method satisfactory to, such inspector.

(2) Plants without soil: Nursery and ornamental stock from which the soil has been entirely removed by washing or shaking may be certified by the inspector for shipment: *Provided,* That plants having roots of such a nature that the inspection thereof is impracticable, shall not be certified until such plants have been treated in accordance with the requirements of the previous paragraph (1).

(3) Removal of soil from plants: The removal of soil from plants offered for inspection and shipment must be performed by the persons, firms, or corporations, or others offering such stock for shipment or sale, under the direction and supervision of, and in manner and method satisfactory to, the inspector.

(i) Conditions governing the certification of stock from greenhouses, including hotbeds, potting beds, heeling-in areas, cold-frames, etc.

The issuance of permits for movement of stock from certified greenhouses, including potting beds, heeling-in areas, hotbeds, cold-frames, or similar plots, will be conditioned on compliance with the following requirements:

(1) Ventilators, doors and all other openings in greenhouses or cold-frames on premises in Class II or Class III shall be kept screened during the period of flight of the beetle, namely, between June 15 and October 15, inclusive, in manner satisfactory to the inspector.

(2) Prior to introduction into nurseries or greenhouses, sand, soil, earth, peat, compost, or manure taken from areas in which Class II or Class III nurseries or greenhouses are located, or which may have been exposed to infestation, must be sterilized or fumigated under the direction and supervision of, and in manner and method satisfactory to, the inspector. If such treated sand, soil, earth, peat, compost, or manure is not to be immediately used in such greenhouses, it must be stored in a tightly closed building or container.

(3) Plants potted in certified soil (see Regulation 7) in nurseries or greenhouses of Class II or Class III and placed in outdoor screened frames during the period June 15 to October 15, inclusive, may be certified by the inspector for shipment to points *outside* the regulated area under the following conditions: A careful inspection shall be made of the soil from not less than 10 per cent of the pots. The soil in and including an area not less than 3 feet wide surrounding the frames shall be treated not later than the preceding October 1 with arsenate of lead powder, applied uniformly at the rate of 1,500 pounds to the acre. The soil examination and treatment shall be made under the direction and supervision of, and in manner and method satisfactory to, the inspector.

(4) Plants potted in certified soil (see Regulation 7) in nurseries or greenhouses of Class II or Class III and placed in beds in the open during the period October 16 to June 14 may be certified by the inspector for shipment to points outside the regulated area upon compliance with the following conditions performed under the direction and supervision of, and in manner and method satisfactory to, such inspector: A fine mesh screen must be placed in the bottom of each pot; the soil in beds on which

the pots are placed must have been treated, not less than three months previous to the time the pots are placed in the beds, with arsenate of lead powder applied uniformly at the rate of 1,500 pounds to the acre, under the direction and supervision of, and in manner and method satisfactory to, the inspector; no pots shall be placed within 3 feet of soil which has not been treated; before pots are placed on treated beds, careful soil examination shall be made of the beds and their freedom from infestation determined by the inspector.

(5) Nurserymen, florists, dealers, or others ordering for use in certified greenhouses, nursery and ornamental stock, or sand, soil, earth, peat, compost, or manure from other growers, dealers, or individuals within the regulated area, shall immediately report their orders to the inspector and obtain approval before such articles are received on their premises or placed in certified greenhouses.

(6) Nurserymen, florists, dealers, or others shall not move, or allow to be moved, plants from the open on their own premises into certified greenhouses until the approval for such movement has been obtained from the inspector.

Regulation 7.—Control of Movement of Sand, Soil, Earth, Peat, Compost and Manure.

(a) The movement of *fresh manure* to points outside the regulated area will be allowed without other requirements than inspection and certification by the inspector.

(b) Certification for movement of *sand, soil, earth, peat, compost, or manure* (*except fresh manure*) from the regulated area to points outside such area will not be allowed except upon compliance with the conditions hereinafter enumerated.

(1) The movement of the articles enumerated from districts included in the regulated area, but in which neither beetles nor grubs in soil have been found, to points outside the regulated area will be allowed without other requirement than certification by the inspector. This requirement shall apply throughout the year.

(2) The movement of the articles enumerated from districts included in the regulated area which are known to be generally infested, to points outside the regulated area, shall not be allowed except upon compliance with the following conditions:

(aa) Surface material of the articles enumerated, when removed from above a depth of 12 inches, shall be fumigated with carbon disulphide under the direction and supervision of, and in manner and method satisfactory to, the inspector before such shipments may be certified by the said inspector for such movement.

(bb) The articles enumerated, when removed under the supervision of the inspector from a depth of more than 12 inches below the exposed surface of the ground, may be so certified by the inspector without treatment for movement between October 16 and June 14, inclusive.

(cc) The articles enumerated, when removed, under the supervision of the inspector, from a depth of more than 12 inches below the exposed surface of the ground, may be certified by the inspector between June 15 and October 15, inclusive, as follows: (1) When the inspector shall determine that a general infestation of adult Japanese beetles exists at the loading and shipping points, certification shall be withheld until either the article which it is proposed to ship shall have been fumigated with carbon disulphide or until the cars and loading operations are protected by screening under the direction of, and in manner and method satisfactory to, the said inspector; (2) When the inspector shall determine that no such infestation of adult Japanese beetles exists in the vicinity of the loading and shipping points, the articles may be certified for movement without the requirement of fumigation or screening.

Regulation 8.—Conditions Governing the Protection of Restricted Articles from Japanese Beetles While in Transit.

Farm products, nursery and ornamental stock, and sand, soil, earth, peat, compost, and manure, moving between June 15 and October 15, inclusive, shall be screened, covered, or otherwise protected in manner or method determined by the inspector as necessary to prevent infestation by adult Japanese beetles of the articles listed. This requirement shall apply to each automobile, truck, wagon, car, and boat, hauling such articles from the regulated area to points outside thereof.

Regulation 9.—Marking and Certification a Condition of Transportation.

Every car, vehicle, box, basket or other container of the articles listed, the movement of which is restricted in Regulations 5, 6, and 7, shall be plainly marked with the name and address of the consignor and the name and address of the consignee and shall bear a certificate stating that the contents have been examined by the inspector and found to be apparently free from the Japanese beetle.

The inspection certificate in the case of carload and other bulk shipments shall accompany the waybill, conductor's manifest, memorandum, or bill of lading, pertaining to such shipment, or in the case of truck or other road vehicle, the certificate shall accompany the vehicle.

Misuse or transfer of certificates or use of void certificates is prohibited and may result in the refusal of further certification to the grower or shipper concerned.

Regulation 10.—Conditions Governing Inspection and Issuance of Certificates.

Persons intending to move or allow to be moved any of the articles the movement of which is restricted in Regulations 5, 6, and 7, shall make application for inspection and certification as far as possible in advance of the probable date of shipment, specifying in the application the article and quantity to be shipped, method of shipment, name and address of the consignor, and name and address of the consignee.

Applicants for inspection will be required to assemble the articles at such points as the inspector shall designate and to so place them that inspection may readily be made; if not so placed, inspection may be refused. All charges for storage, cartage, and labor incident to inspection, other than the services of the inspector, shall be paid by the shipper.

Where the apparent absolute freedom from infestation of any of the articles enumerated cannot be determined by the inspector, certification will be refused.

Regulation 11.—Inspection of Restricted Articles in Transit.

Any car, vehicle, basket, box, or other container of articles moved or offered for movement which contains or may contain articles the movement of which is prohibited or restricted by Federal Quarantine No. 48 and these regulations, shall be subject to inspection by duly authorized inspectors at place of shipment or destination or at any point en route.

Regulation 12.—Thorough Cleaning Required of Trucks, Wagons, Cars, Boats and Other Vehicles Before Moving.

Trucks, wagons, cars, boats, and other vehicles, which have been used in transporting any article covered by Federal Quarantine No. 48 within the regulated area shall not thereafter be moved or allowed to be moved until they have been thoroughly swept and cleaned by the carrier at the point of unloading or destination.

Regulation 13.—Shipments by the Connecticut Agricultural Experiment Station of the United States Department of Agriculture.

Plants and plant products and other articles, the movement of which is restricted by these rules and regulations may be moved by the Connecticut Agricultural Experiment Station or the United States Department of Agriculture, when intended for experimental or scientific purposes, on such conditions and under such safeguards as may be prescribed by the Federal Horticultural Board.

Regulation 14.—Moving or Receiving Articles in Violation of Regulations.

No person shall move or direct any other person to move any article in violation of these regulations. No person shall receive or direct any other person to receive any article moved in violation of these regulations.

Regulation 15.—Carrying or Transporting Living Japanese Beetles Outside the Regulated Area.

No person shall move or carry, or direct any other person to move or carry a living Japanese beetle to any point outside the regulated area.

These rules and regulations shall take effect May 1, 1927, shall supersede all previous rules and regulations issued in connection with Quarantine Order No. 11, effective November 10, 1926, and shall be in force until further notice.

WILLIAM L. SLATE,
Director, Connecticut Agricultural Experiment Station

Approved:

JOHN H. TRUMBULL,
Governor.

PENALTY

Chapter 107, Public Acts of 1925, provides that "Any person interfering with the performance of such duty or violating the quarantine regulations established under this act shall be fined not less than ten nor more than fifty dollars."

PUBLISHED RULES AND REGULATIONS

Copies of the revised rules and regulations connected with the quarantines established on account of the Japanese Beetle may be obtained from any of the following sources:

Connecticut Agricultural Experiment Station, New Haven, Conn.
Japanese Beetle Office, 2000 Bronx Street, West Farms, New York City.
Japanese Beetle Laboratory, Riverton, New Jersey.
Federal Horticultural Board, Washington, D. C.

APPLICATIONS FOR INSPECTIONS

Applications for inspections and certificates or permits to move nursery or ornamental stock, sand, soil, manure, etc., should be made to the Japanese Beetle Office, 2000 Bronx Street, West Farms, New York City.

BULLETIN OF IMMEDIATE INFORMATION No. 59

JUNE 1, 1927

Connecticut Agricultural Experiment Station
New Haven, Connecticut

The European Corn Borer Quarantine

W. E. BRITTON, *State Entomologist*

Each year since 1923, a few infestations of European corn borer, *Pyrausta nubilalis* Hubn., have been found by Federal scouts in Connecticut, all being at points along the coast. In each case, corn stalks, stubble, weeds and rubbish have been burned around each infestation, and in some instances no infestation has since been found in the locality. Most of the infestations have occurred in New London County. In 1927, the infested towns were found

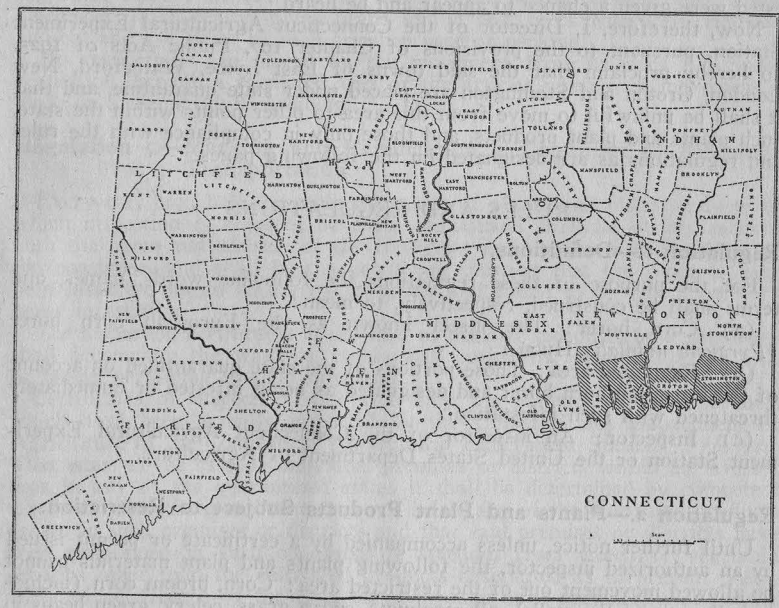


FIG. 1. Map of Connecticut; shaded area shows towns now under Federal and State quarantine on account of European corn borer.

to be connected through Rhode Island with the large infestation in eastern New England, and it seemed best to place this territory under quarantine. The Federal quarantine on the towns of East Lyme, Waterford, New London, Groton, and Stonington became

effective March 1, 1927, and applies to interstate shipments from these infested towns. After due notice, a hearing was held at New London, May 13, 1927, and a State quarantine placed on these towns by the following Quarantine Order:

STATE OF CONNECTICUT
AGRICULTURAL EXPERIMENT STATION
NEW HAVEN, CONN.

QUARANTINE ORDER No. 13
EUROPEAN CORN BORER QUARANTINE

The fact has been determined by the Secretary of Agriculture that an injurious insect, the European corn borer, *Pyrausta nubilalis* Hubn., not heretofore prevalent or widely distributed in Connecticut, exists in the towns of East Lyme, Waterford, New London, Groton and Stonington, now, since March 1, 1927, under Federal quarantine. After due notice, a public hearing was held at New London, May 13, 1927, where all persons interested were given a chance to appear and be heard.

Now, therefore, I, Director of the Connecticut Agricultural Experiment Station, pursuant to the provisions of Chapter 107, Public Acts of 1925, do hereby proclaim that the said towns of East Lyme, Waterford, New London, Groton and Stonington are placed under state quarantine, and that it shall be unlawful to move from this area to other points within the state, such plants and plant products, and those only in compliance with the rules and regulations as are designated on the following pages.

RULES AND REGULATIONS

Regulation 1.—Definitions.

For the purpose of these regulations the following words, names, and terms shall be construed, respectively, to mean:

(a) Corn borer: The insect known as the European corn borer (*Pyrausta nubilalis* Hubn.).

(b) Regulated area: Those portions of the state quarantined on account of the European corn borer and designated as being infested or immediately threatened with such infestation.

(c) Inspector: An inspector of the Connecticut Agricultural Experiment Station or the United States Department of Agriculture.

Regulation 2.—Plants and Plant Products Subject to Restriction.

Until further notice, unless accompanied by a certificate or permit issued by an authorized inspector, the following plants and plant materials cannot be allowed movement out of the restricted area: Corn, broom corn (including all parts of the stalk), all sorghums, sudan grass, celery, green beans in the pod, beets with tops, rhubarb, oat and rye straw as such or when used as packing, cut flowers or entire plants of chrysanthemum, aster, cosmos, zinnia, hollyhock, and cut flowers or entire plants of gladiolas and dahlia, except the bulbs thereof.

No restrictions are placed by this quarantine on the movement of the articles enumerated, when they shall have been manufactured, processed, or treated in such manner that in the judgment of the inspector no infestation could be transmitted.

Regulation 3.—Infested Areas.

The towns of East Lyme, Waterford, New London, Groton and Stonington, in New London County, Connecticut.

Regulation 4.—Control of Movement of the Restricted Plants and Plant Products.

The movement of the articles enumerated shall not be allowed to any point outside of the areas designated as infested by the corn borer, unless and until such articles have been inspected by an inspector and certified to be free from the corn borer: *Provided,* That certification for movement of corn and broom corn shall be restricted to clean shelled corn and clean seed of broom corn: *Provided further,* That with respect to any article found to be infested with the European corn borer disinfection or treatment may be authorized by the inspector as a condition of certification for interstate movement when in the judgment of the said inspector such disinfection or treatment will eliminate all risk of transmission of infestation—such treatment to be under the supervision of and satisfactory to the said inspector.

The restrictions of these regulations shall apply throughout the year to corn, broomcorn (including all parts of the stalk), all sorghums and sudan grass, cut flowers or entire plants of chrysanthemum, aster, cosmos, zinnia, hollyhock, and cut flowers or entire plants of gladiolus and dahlia, except the bulbs thereof without stems; and for the period between June 1 and December 31 to celery, green beans in the pod, beets with tops, rhubarb, and oat and rye straw as such or when used as packing.

No restrictions are placed on the movement from an area not under regulation through a regulated area of the articles when such movement is made on a through bill of lading.

Regulation 5.—Marking and Certification a Condition of Interstate Transportation.

Every car, box, bale, or other container of plants and plant products of which inspection is required by these regulations shall be plainly marked with the name and address of the consignor and the name and address of the consignee, and shall bear a certificate showing that the contents have been inspected by an authorized inspector and found to be free from corn borer infestation.

The inspection certificates in the case of carload and other bulk shipments shall accompany the waybills, conductors' manifests, memoranda, or bills of lading pertaining to such shipments.

Certificates of inspection will issue only for plants and plant products which have been actually inspected by the United States Department of Agriculture of the Connecticut Agricultural Experiment Station: *Provided,* That when in the case of individual premises or districts within an infested area in any of the quarantined states it shall be determined by competent inspection that the corn borer does not infest any of the cultivated products grown in such premises or districts and that said premises or districts have been maintained in such condition of freedom from weeds or vegetable growths other than the cultivated products designated as to prevent possibility of occurrence of the corn borer through such agencies, a certificate good for not to exceed 30 days may be issued by the inspector stating that such premises or districts have been inspected and found free from the corn borer and free from weeds or other extraneous vegetation capable of harboring the corn borer, and authorizing the shipment from said premises or districts of any of the articles subject to this quarantine grown therein. Copies of such certificate shall be attached to small packages, or, in the case of bulk shipments, to waybills, conductors' manifests, memoranda, or bills of lading pertaining thereto. Reinspection of the premises or district shall be a condition of the granting of further certification.

Regulation 6.—Conditions under Which Plants and Plant Products Originating Outside of the Infested Areas May Be Shipped from Points Within the Infested Areas.

Plants and plant products of which the movement is restricted by these regulations which originate outside of the infested area quarantined for the corn borer may be shipped from points within the infested areas to points outside such areas under permit from the inspector. Permits will issue only for plants and plant products which are not infested with the corn borer, and transportation companies shall not accept or move from within the infested areas such plants and plant products originating outside the infested areas unless each shipment is accompanied by a permit issued by an authorized inspector.

Regulation 7.—Conditions Governing Inspection and Issuance of Certificates.

Persons intending to move or allow to be moved plants and plant products for which certificates of inspection are required by these regulations will make application therefor as far as possible in advance of the probable date of shipment. Applications should show the nature and quantity of the plants or plant products which it is proposed to move, together with their exact location and, if practicable, the contemplated date of shipment. Applicants for inspection will be required to assemble the articles to be inspected and so to place them that they can be readily examined. If not so placed, inspection may be refused. All charges for storage, cartage, and labor incident to inspection other than the services of inspectors, shall be paid by the shipper.

Regulation 8.—Thorough Cleaning Required of Cars, Boats, and Other Vehicles before Moving Interstate.

Cars, boats, and other vehicles which have been used in transporting within the infested areas plant products covered by these regulations or any other articles which may hereafter be made subject thereto shall not be moved or allowed to move unless the same shall have been thoroughly swept out and cleaned by the carrier at the point of unloading or destination of all litter and rubbish from such regulated articles. No litter, rubbish, or refuse from any such plants and plant products shall be moved or allowed to move.

Regulation 9.—Provision for Inspection of Restricted Plants and Plant Products in Transit.

Any car, box, bale, or other container of plants or plant products moved or offered for movement, which contains or may contain plants or plant products the movement of which is prohibited or restricted by this quarantine and these regulations, shall be subject to inspection by duly authorized inspectors, at place of shipment or destination or at any point en route.

Regulation 10.—Shipments by the Connecticut Agricultural Experiment Station or the United States Department of Agriculture.

Plants and plant products the movement of which is restricted by these rules and regulations may be moved by the Connecticut Agricultural Experiment Station or the United States Department of Agriculture, when intended for experimental or scientific purposes, on such conditions and under such safeguards as may be prescribed by the Federal Horticultural Board.

This order including rules and regulations shall take effect June 1, 1927, and shall be in force until further notice.

W. L. SLATE,
Director, Connecticut Agricultural Experiment Station

Approved:
JOHN H. TRUMBULL,
Governor.

Of course the purpose of the quarantine is to prevent the shipment of infested material, and it will be unlawful to transport any of the plants or plant material named in the quarantine order to any point outside of the infested area without a permit or certificate. No certificate will be needed for such shipments within the quarantined area.

PENALTY

Chapter 107, Public Acts of 1925, provides that "Any person interfering with the performance of such duty or violating the quarantine regulations established under this act shall be fined not less than ten nor more than fifty dollars."

PUBLISHED RULES AND REGULATIONS

Copies of the revised rules and regulations connected with the quarantines established on account of the European corn borer may be obtained from the following sources:

Connecticut Agricultural Experiment Station, New Haven, Conn.
Mr. R. S. Clifton, 12 South Market St., Boston, Mass.
Federal Horticultural Board, Washington, D. C.

INSPECTIONS

Arangements have been made to have a Federal inspector stationed in New London, and he will inspect both interstate and intrastate shipments. His name, address, and telephone number are given below. Applications for inspection should be made to

MR. ANDREW B. ANDERSON,
Fisher Florist, Inc.,
104 State Street,
New London, Conn.

Telephone 44

Connecticut Agricultural Experiment Station
New Haven, Connecticut

REGULATIONS FOR CARRYING OUT THE PROVISIONS OF THE LAW CONCERNING CONCENTRATED COMMERCIAL FEEDING STUFFS.

By the authority of Section 6 of the Act Concerning Concentrated Commercial Feeding Stuffs, Chapter 196, Public Acts of 1925, as amended by Chapter 29, Public Acts of 1927, the following regulations have been adopted for carrying out the provisions of the act. The sections cited under each regulation refer to sections of the law wherein the term defined, or the clause interpreted, occurs.

WM. L. SLATE,
Director of the Connecticut Agricultural Experiment Station.
THOMAS HOLT,
Dairy and Food Commissioner.

REGULATION 1. FEEDS NOT CLASSED AS CONCENTRATED COMMERCIAL FEEDING STUFFS.

(Section 1.)

It is held that the law exempts from classification as concentrated commercial feeding stuffs and therefore from registration (1) roughages such as hays, straws, corn stover, ensilage and all materials containing over 60 per cent of water; (2) whole grains and mixtures thereof; (3) meals made from whole grains when not mixed with other materials or with each other; (4) feed ground from whole grains and sold by the manufacturer directly to the consumer; (5) feed ground from materials furnished by the consumer; or (6) feed mixed according to a formula furnished by the consumer, for his own use.

Under the provision of clause 6 above, a feed must be sold as a formula only, without a private brand name and without analysis. But a feed cannot be offered for general trade as a formula in order to avoid registration and the registration fee.

Regulation 2. Method of Labelling.

(Section 2.)

All concentrated commercial feeding stuffs must be labelled either by a statement printed on the bag or upon a properly attached tag; except that in the case of cottonseed meal sold for fertilizer, or of any concentrated feeding stuff sold in bulk, a certificate which shall contain the information otherwise required to appear upon the bag or upon the tag, may be issued by the dealer in lieu thereof.

The use of wire or any metal in affixing tags is prohibited by law.

Regulation 3. Form of Label.

(Section 2.)

The law requires a statement of (1) the net weight of the feed contained in the package; (2) the name, brand or trademark under which the feed is sold; (3) name and address of the manufacturer or importer; (4) the minimum percentages of (a) crude protein and (b) crude fat, and the maximum percentage of (c) crude fiber contained in the feed; and (5) the separate ingredients of which the feed is composed.

While the law requires only a statement of the items enumerated above no objection will be raised to more complete statements of chemical composition.

Regulation 4. Duties of Manufacturers, Jobbers and Dealers with Reference to Registration.

(Section 3.)

All concentrated commercial feeding stuffs must be registered with the Connecticut Agricultural Experiment Station annually on January 1st, or before they are offered for sale.

Manufacturers, jobbers or individuals shipping feeds into Connecticut will be expected to register their brands and pay the necessary fees thereon. Connecticut dealers should assure themselves that the brands they handle are properly registered and labelled. In case the manufacturer or jobber outside the State neglects or refuses to register, the dealer who handles such feeds will be held responsible for such registrations, registration fees and other legal requirements.

Dealers within the State who mix their own brands are responsible for the registration and proper labelling thereof.

Regulation 5. Concerning Cottonseed Meal.

Cottonseed meal sold as a fertilizer is required to be registered under the terms of the fertilizer law; if sold also as a feeding stuff it is required also to be registered under the provisions of the feed law; if sold exclusively for one or the other of these purposes, it may be registered only under that law which applies.

Regulation 6. Definitions of Terms Used in the Law, and of Other Terms.

Person. The term "person" is accepted as defined in General Statutes, Chapter 128, Section 2448; it imports the singular or the plural as the case demands; and includes corporations, companies, societies and associations.

Importer. The term "importer" is defined in the Act.

Brand. It is held that a distinct brand name, or a distinct analysis, constitutes a distinct brand.

Nitrogen-free-extract. The term "nitrogen-free-extract" when used in a statement of chemical composition is held to mean that constituent group of substances represented by the percentage obtained when the sum of the percentages of moisture, ash, crude protein, crude fiber and crude fat is subtracted from 100 per cent.

Carbohydrates. The term "carbohydrates" is held to mean nitrogen-free-extract plus crude fiber.

Definitions for Feeding Stuffs. The definitions and standards for feeding stuffs adopted from time to time by the Association of Feed Control Officials of the United States are accepted as official in carrying out the provisions of this law; and the rules and regulations as adopted by that association are accepted as far as possible and when not inconsistent with the Statutes.

Regulation 7. Methods of Analysis.

(Section 2.)

The methods of analysis employed shall be those prescribed by the Association of Official Agricultural Chemists, wherever such methods have been adopted for the determinations desired.

Regulation 8. "Stock Tonics."

The law does not include those medicated products used as conditioners for stock and poultry, and which consist essentially of substances possessing, or claimed to possess, medicinal or condimental properties.

Regulation 9. Concerning the Change in Registration Date.

In order to adjust registrations of feeding stuffs to the basis of the new registration period which is by calendar years, all registrations of record with this Station for the period September 1st, 1926 to August 31st, 1927, will be held to be in force until January 1st, 1928.

TEXT OF THE LAW

An Act Concerning Concentrated Commercial Feeding Stuffs.

(Chapter 196, Public Acts of 1925, as revised by Chapter 29, Public Acts of 1927.)

Section 1. The term "concentrated commercial feeding stuffs" within the meaning of this act shall include linseed meals, cottonseed meals, pea meals, bean meals. cocoanut meals, gluten meals, gluten feeds, dried brewers' grains, dried distillers' grains, malt sprouts, dried beet pulp, hominy feeds, cerealine feeds, rice meals, alfalfa meals, oat feeds, corn and oat chop, corn and oat feeds, scratch feeds, digestor tankage, ground meat scraps, ground fish scraps, mixed feeds, provenders, bran, middlings and mixed feeds made wholly or in part from wheat, rye or buckwheat, and all materials of a similar nature intended for the feeding of domestic animals, including poultry; but shall not include hays, straws, corn stover, ensilage, whole grains or the unmixed meals made directly from the whole grains of wheat, rye, barley, oats, Indian corn, broom corn, rice, buckwheat and flaxseed, or feed ground from whole grain and sold directly from the manufacturer to the consumer.

Sec. 2. Each lot or parcel of concentrated commercial feeding stuffs sold, offered or exposed for sale shall have conspicuously affixed thereto a plainly printed statement certifying (1) the number of net pounds of feeding stuff contained therein, (2) the name, brand or trademark under which the article is sold, (3) the name and address of the manufacturer or importer, (4) a statement of the minimum percentages of (a) crude protein, and (b) crude fat, and (c) the maximum percentage of crude fiber contained in the feeding stuff, all constituents to be determined by the methods adopted by the Association of Official Agricultural Chemists of the United States and in force at the time, and, (5) in the case of feeds composed of two or more ingredients, the name of each ingredient contained therein; provided such statement shall not be affixed by wire or other metallic device, and provided, in the case of cottonseed meal which shall be sold for fertilizer or in the case of any concentrated feeding stuff sold in bulk, the dealer may issue, in lieu of the printed statement herein described, a certificate which shall contain the information required by this section.

Sec. 3. Before any concentrated commercial feeding stuff shall be sold or offered or exposed for sale in this state the person who shall cause it to be sold or offered or exposed for sale shall file with the Connecticut Agricultural Experiment Station, on January 1, 1928, and annually thereafter, two certified copies of the statement prescribed in section two of this act, on forms supplied by the Connecticut Agricultural Experiment Station, and shall pay a registration fee of fifteen dollars for each brand to be sold or offered or exposed for sale in this state. When any feeding stuff shall have been registered and the fee paid thereon, the director of said station shall issue a certificate of registration for such feed, and a list of the brands so registered shall be published annually in the station report. Fees so paid to said station shall be used toward defraying the

expense of inspection. Whenever registration and payment as prescribed herein shall have been made on any brand of feeding stuff by any person, no other person shall be required to register such brand or to pay a registration fee thereon. The director may refuse registration of any feeding stuff, or may cancel any registration which shall have been made, if it shall appear or shall be found that all the provisions of this act have not been fulfilled, or if the feeding stuff shall bear any statement, design or device which shall be false or misleading as regard to materials of which it is composed. No feeding stuff on which registration shall have been refused or cancelled shall be permitted to be sold or offered or exposed for sale in this state.

Sec. 4. Every manufacturer, importer, agent or person selling or offering or exposing for sale any concentrated commercial feeding stuff in relation to which all the provisions of sections two and three of this act shall not have been complied with, shall be fined not more than one hundred dollars for the first offense and not more than two hundred dollars for each subsequent offense.

Sec. 5. The Connecticut Agricultural Experiment Station may collect a sample, not exceeding two pounds in weight, for analysis, from any lot, parcel or package of concentrated commercial feeding stuff or unmixed meals, brans or middlings, which may be in the possession of any manufacturer, importer, agent or dealer, but such sample shall be taken in the presence of the parties in interest or their representatives, and taken from a number of parcels or packages which shall not be less than five per centum of the whole lot inspected, and shall be thoroughly mixed, divided into two samples, placed in glass vessels or other suitable containers, carefully sealed and a label placed on each stating the name or brand of the feeding stuff or material sampled, the name of the party from whose stock the sample was taken and the time and place of taking the same. Such label shall be signed by the station chemist or his deputy and one of such samples shall be retained by such chemist or his deputy and the other by the party whose stock shall have been sampled. Said station shall cause at least one sample of each brand of feeding stuff so collected to be analyzed annually by or under the direction of such chemist. Such analysis shall include a determination of crude fat, crude protein and crude fiber and any such other determination as may be advisable. Said station shall cause the analysis so made to be published in station bulletins, together with such additional information in relation to the character, composition and use thereof as may be of importance and shall issue the same annually or more frequently if advisable.

Sec. 6. The dairy and food commissioner and the director of the Connecticut Agricultural Experiment Station may make rules and regulations for carrying out the provisions of this act.

Sec. 7. The dairy and food commissioner shall enforce the provisions of this act and when evidence shall be submitted by the Connecticut Agricultural Experimental Station that any provision of this act shall have been violated, he shall make complaint to the prosecuting officer having jurisdiction thereof.

Sec. 8. The term "importer" shall include such persons as shall bring into or offer for sale within this state concentrated commercial feeding stuffs manufactured without this state.

Sec. 9. Sections 4774, 4775, 4777, 4778, 4779, 4780 and 4781 of the general statutes are repealed.