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ON

Food Products

AND

Twelfth Report on Drug Products.

PART II (Diabetic Foods).

By E. M. BAILEY.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

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Part II (Diabetic Foods).

By E. M. Bailey.

INTRODUCTION.

Present knowledge of diabetes does not permit of an entirely satisfactory definition of the disease; it is generally defined in terms of its most conspicuous symptom, viz., the elimination of glucose in the urine. Joslin's[1] definition is so stated; he regards diabetes as an abnormal condition of metabolism in which the faculty of properly utilizing carbohydrates is partly or wholly lost, and in consequence of which glucose appears in excessive amounts in the urine. The excretion of sugar (called a condition of glycosuria) should not be regarded as synonymous with diabetes; it is a symptom, not the disease itself.

Another definition of diabetes has been formulated by Allen[2] based upon what he conceives to be the cause of the disease. He believes that, normally, sugar is combined with some substance, furnished by the pancreas, which makes it available to the body tissues. When not so combined, as in case of a deficiency of this pancreatic function, sugar is not utilized and glycosuria results. Diabetes, according to this conception, is a deficiency of internal secretion of the pancreas. This is the amboceptor hypothesis.

Tibbles[3] quotes Sir J. Rose Bradford who says "diabetes is not an entity, but a clinical label attached to a number of different conditions with varied origins, different morbid anatomy, and liable to follow different courses." This is known as the theory of multiple causes and permits of considerable latitude of application.

Rôle of carbohydrates. Whatever definition may be accepted, it is the metabolism of carbohydrates which, in diabetes, is most profoundly disturbed. With non-diabetic individuals the greater

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[1] Joslin, E. P., The Treatment of Diabetes Mellitus, New York, 1917.
[2] Allen, F. M., Glycosuria and Diabetes, Boston, 1913.
[3] Tibbles, Wm., Food in Health and Disease, New York, 1914.

the intake of carbohydrates the greater the utilization[1]; but with diabetics the reverse is true, i. e. the excretion of sugar increases with increased ingestion of carbohydrate-bearing foods, and therefore the limitation and control of this type of foods becomes a part of every plan of diabetic treatment. It is no longer considered necessary or advisable to uniformly exclude carbohydrates from the patient's diet but rather to allow as much of such material as he will tolerate. The claims often made that one kind of carbohydrate is better tolerated than another are generally without foundation, or based upon inadequate proof. There is no convincing evidence, for example, that starch from one source is better assimilated than that from another; and the advantages of certain sugars over others from the standpoint of utilization are often predicated upon apparent rather than real tolerance.

Rôle of fat. In diabetes of the more severe types impaired metabolism is not confined to carbohydrates but extends to fats and proteins. Although it appears that fats are absorbed quite as well by diabetics as by normal individuals they are not equally well utilized in metabolism. Consequently the introduction of increased amounts of fat into the diet to compensate for the withdrawal of carbohydrate is attended with danger of acidosis, i. e., incomplete oxidation of fatty acids with elimination of intermediate products, viz., β-oxybutyric acid and aceto-acetic acid. Acetone may also be eliminated.

Authorities differ as to whether sugar can arise from fatty foods. von Noorden[2] and others maintain that the liver possesses the power to effect such a transformation but that it is a facultative function exercised only as necessity requires. According to Ringer[3] glucose may be formed from certain fatty acids but there is no evidence that fat itself produces glucose in diabetes. The increased glucose elimination after fat feeding in diabetic treatment is probably due to the stimulating action of fat on protein metabolism.[4]

Rôle of protein. In the process of digestion protein is broken down into simpler substances called amino acids which are then

[1] Allen's Paradoxical Law.
[2] von Noorden, Carl, New Aspects of Diabetes. New York, 1912.
[3] Jour. Exp. Med., 12, 1910.
[4] Janney, N. W., Archiv Intern. Med., 18, 1916.

utilized for the various body requirements. The nitrogenous part of these protein derivatives is ultimately eliminated chiefly as urea; the non-nitrogenous portion is either burned as fuel or converted into carbohydrate and, directly or indirectly, into fat. In diabetes this protein-derived carbohydrate may be excreted just as in case of carbohydrate ingested as such.

Although the formation of glucose from protein in metabolism has been recognized it does not appear to have been adequately appreciated in practical diabetic treatment. Its origin was formerly attributed to a supposed carbohydrate complex in the protein molecule, but carbohydrate, as such, is no longer regarded as a constituent of protein; the insignificant amount sometimes found is looked upon as an impurity.

The work of Lusk, Dakin, Janney[1] and others has shown that the amino acids which arise from protein in digestion are the glucose-yielding materials and the amount of glucose formed is in direct proportion to the amino acid content of the particular protein ingested. There is no distinction between animal and vegetable proteins as regards sugar-producing capacity. Glucose arises not only from the protein as ordinarily ingested in food but also from the feeding of pure isolated proteins and from the breaking down of body protein as well. These facts are shown by the experiments of Janney with completely diabetic (phlorizinized) dogs, a condition which he considers, particularly as regards glucose-formation from protein, essentially comparable with severe human diabetes.

Protein-glucose factors. The glucose factors of a number of pure proteins, both animal and vegetable, as derived by Janney are given as follows:

TABLE I.—GLUCOSE YIELDS OF INGESTED PROTEINS (JANNEY).

	Casein.	Ovalbumin.	Serum albumin.	Gelatin.	Fibrin.	Edestin (Hemp protein).	Gliadin (Wheat protein).	Zein (Corn protein).
Glucose yield in per cent.	48	54	55	65	53	65	80	53

[1] Janney, N. W., Archiv. Intern. Med., 18, 1916.

Glucose yields of protein foods. The following data, taken from the same source, show the glucose yields of a variety of common protein foods.

TABLE II.—GLUCOSE FORMATION FROM PROTEIN FOOD; COMPARATIVE TABLE, (JANNEY).

	Water content per cent.	Glucose yield, per cent.	Amount equivalent to 100 gm. bread.	Calories per 100 gm.
			gm.	
Beef, raw	74.8	9.5	642	150
Beef, broiled	54†	17.5	348	208
Beef, dried or smoked	54.3	21	290	185
Beef, canned or corned	51.8	18.2	335	270
Beef, roasted	48.2	19.5	313	241
Chicken meat, raw	74.5	12	508	197
Chicken meat, roasted	59.9	19.2	317	245
Rabbit, raw	74.7	11	555	...
Rabbit, broiled	61.4†	16.8	363	...
Halibut steak, raw.	75.4	12	508	124
Halibut steak, fried	54.2†	22.3	255	173
Eggs, raw	73.7	10.3	592	153
Eggs, boiled	73.2	10.51	580	166
Eggs, fried	70.4†	11.6	526	160
Ovalbumin*	....	54	113	...
Gelatin*	....	65	94	366
Casein*	....	48	127	...
Corn protein, zein*	....	53	115	...
Wheat protein, gliadin*	....	80	76	...
Flour*	....	92.5	...	...
Bread	34‡	61	...	277

* Calculation based on water-free material.
† Writers' analysis.
‡ Analyses from Conn. Agric. Exp. Station Report, Sec. 1, Diabetic Foods, 1913.

Whether the factors given above may or may not be accepted as absolute by reason of the particular conditions under which the experiments were conducted, nevertheless it is evident that taking protein into account as a potential source of glucose places a very different aspect upon certain types of foods as regards their adaptability or usefulness in the diabetic dietary. For example, it is common practice to evaluate diabetic foods on the basis of a comparison between their carbohydrate content and that of a typical and staple carbohydrate food, viz., wheat bread, after the plan proposed by von Noorden. While, as generally stated, such comparisons are technically correct they are misleading in that they do not recognize the protein of the food as a possible contributing source of carbohydrate.

Bread equivalents. As an illustration of the application of the foregoing data in computing bread equivalents we make use of the same products as cited by Janney. His table has been modified by stating the protein on the basis of the factor 5.70 for wheat products which changes the carbohydrate content correspondingly; by the addition of a bread equivalent column as calculated after the plan of von Noorden which has been the usage in this laboratory; and also by applying the glucose factor .48 in estimating the glucose yield of the casein preparations Sanatogen and Plasmon which, by oversight, was not done in the original tabulation.

The factor derived by Janney for computing the glucose yield of the protein of wheat is .705. To obtain the bread equivalent by his method add to the carbohydrate content of the food the per cent. of glucose formed from the protein therein using the appropriate factor, i. e., .705 for wheat and .48 for casein. The standard of comparison is the glucose yield of bread in metabolism calculated to be 61. von Noorden equivalents are based on the average carbohydrate content of wheat bread, viz., 53 per cent.

TABLE III.—GLUCOSE FORMATION FROM DIABETIC FOODS.

	Protein.	Carbohydrate.	Glucose yield in metabolism.	Amount equivalent to 100 grams of bread.	
				Janney.	von Noorden.
	%	%	%		
Glidine	83.3	9.1	68	90	582
Sanatogen	80.1	4.2	43	142	1,262
Plasmon	78.7	0.0	38	160	....
Diabetic biscuit	23.1	61.2	77	79	87
40% Gluten biscuit	32.7	57.1	80	76	93
80% Gluten biscuit	75.1	11.7	65	94	453

Recognizing, as the author of these experiments does, that in actual practice many factors obtain which are absent or cannot be simulated in experiment, such, for example, as rate and extent of assimilation, influence of other food in the diet, texture of the food and the proportion of indigestible matter, and variations in carbohydrate tolerance, and that therefore protein-glucose factors

must be regarded as relative rather than absolute, yet the reduction of carbohydrate in any food or diet to a negligible minimum appears to be unwarranted effort when accompanied by correspondingly high protein. Thus we see from the above table that Glidine with 9 per cent. of carbohydrate and 83 per cent. of protein may in certain severe diabetic conditions yield but little less glucose in metabolism than diabetic biscuit with over six times as much carbohydrate and three-tenths as much protein.

If, then, carbohydrate foods aggravate the diabetic's most conspicuous symptom, i. e., glycosuria; and if from one-half to two-thirds of his protein intake may be converted into sugar in the course of metabolism; and if, directly or indirectly, fats contribute to his sugar elimination from the body, what may he eat? Since Janney has formulated the same question, we quote his answer:

"This question has indeed been logically answered by Allen, whose well-known treatment has emphasized the good results to be obtained from a complete fast. The rationale of the Allen treatment becomes more evident when one is mindful of the fact that not carbohydrates alone, but all the three great classes of foodstuffs may give rise to increased glucose formation. Thus it becomes apparent that only by total exclusion of all food, a complete rest can be given to the sugar-utilizing function of the organism.

"The diabetic, however, cannot refrain indefinitely from food. How, then, feed him? In view of the series of experiments here reported it is likely that a diet containing moderate amounts of protein and fat and low amounts of carbohydrate is after all the most judicious one to be employed. It seems that only by very discriminately balancing the various advantages and disadvantages of each kind of foodstuff can the proper quantity for a given case be best determined."

WHAT CONSTITUTES A "DIABETIC" FOOD.

The question of what a diabetic food is, or should be, becomes increasingly difficult to answer. There is no universal diabetic food. It becomes more and more apparent that diabetic diets must be arranged strictly according to individual tolerance. The efforts of manufacturers of foods particularly adapted to the

treatment of diabetes appear in many cases to be centered upon the production of an absolutely carbohydrate-free product. No doubt they have been catering to a popular belief, and a belief fostered in many instances by members of the medical and other professions. Probably Allen suggests the reason for this when he emphasizes the fact that the symptom, viz., glycosuria, and the disease, viz., diabetes, have been frequently confused; and again when he quotes Abderhalden, who says: "Up to the present time the most prominent symptom, that of glycosuria, has dominated the entire investigation of problems concerning diabetes, and it is very probable that this is the reason why the disease, as a whole, is so little understood."

Federal definition.[1] The Federal regulation regarding *"diabetic food"* is as follows:

"Although most foods may be suitable under certain conditions for the use of persons suffering from diabetes, the term 'diabetic' as applied to food indicates a considerable lessening of the carbohydrates found in ordinary products of the same class, and this belief is fostered by many manufacturers on their labels and in their advertising literature.

"A 'Diabetic' food contains not more than one-half as much glycogenic carbohydrates as the normal food of the same class. Any statement on the label which gives the impression that any single food in unlimited quantity is suitable for the diabetic patient is false and misleading."

The Federal definitions also describe the substance and quality of gluten products as follows:

"Ground gluten is the clean, sound product made from wheat flour by the almost complete removal of starch and contains not more than ten per cent. (10%) of moisture, and, calculated on the water-free basis, not less than fourteen and two-tenths per cent. (14.2%) of nitrogen, not more than fifteen per cent. (15%) of nitrogen-free extract (using the factor 5.7), and not more than five and five-tenths per cent. (5.5%) of starch (as determined by the diastase method).

"Gluten flour is the clean, sound product made from wheat flour by the removal of a large part of the starch and contains not more than ten per cent. (10%) of moisture, and, calculated on the water-free basis not less than seven and one-tenth per cent. (7.1%) of nitrogen, not more than fifty-six per cent. (56%) of nitrogen-free extract (using the protein factor 5.7), and not more than forty-four per cent. (44%) of starch (as determined by the diastase method).

"Gluten flour, self-raising, is a gluten flour containing not more than ten per cent (10%) of moisture, and leavening agents with or without salt."

[1] U. S. Dept. Agr., Food Inspection Decision 160.

Other desirable requirements. In addition to this, Street and Mendel[1] have formulated requirements which may well apply.

1. "The label should bear a correct statement of the percentages of protein, fat and carbohydrates present.
2. "The amounts of the different carbohydrates present should be declared on the label, i. e., starch, sucrose, levulose, lactose, etc.
3. "The process of manufacture should be so standardized that uniformity of composition, within reasonable limits, will be maintained from year to year."

These recommendations, particularly the first and third, are important. It is quite general for manufacturers to emphasize low carbohydrate or high protein, but it is essential for the physician to know both these constituents and the fat content as well. The desirability of uniformity needs no argument.

INSPECTIONS OF COMMERCIAL DIABETIC PRODUCTS.

Previous inspections. Since 1906 this laboratory has been interested in the subject of diabetic foods. At intervals since that time we have examined products of this class for the purpose of keeping in touch with progress and improvement in the manufacture of such foods. Our efforts have met with appreciative response both from the medical profession and from manufacturers as well. Both realize the importance of reliable information regarding the composition of various foods for the intelligent preparation of a diabetic diet.

Purpose and scope of present inspection. The present revision or resurvey of the field was made in response to frequent inquiries as to the present composition of various brands of these specialized foods; also to examine such new preparations as might be available.

The time chosen was perhaps unfortunate by reason of the fact that, on account of war conditions, some manufacturers had curtailed or suspended production, and that few imported brands were available. However, we believe that the majority of foods of this type used in this country to-day are represented in our new analyses.

In addition to the analyses of strictly commercial foods. we have examined other preparations which are of particular interest

[1] Conn. Agr. Exp. Sta. Report, Part 1, Sec. 1, 1913.

in diabetic treatment. Such include washed bran, thrice-cooked vegetables, diabetic broths and various substitutes for milk.

Besides our own new analyses, the valuable compilation contained in our Report for 1913 has been revised and enlarged to include our latest results as well as results obtained in other laboratories.

SOURCES OF MATERIALS EXAMINED.

Samples were obtained largely by our direct request addressed to manufacturers. We are indebted to them for their coöperation. We are also indebted to Prof. Lafayette B. Mendel, Referee on Diabetic Foods for the American Medical Association, who enlisted the aid of that Association, and with whom it has been our privilege to consult; to Dr. E. P. Joslin of Boston, who early volunteered to enlist the interest of his professional friends in our project, and who personally submitted samples; to Dr. N. W. Janney, Director of the Memorial Laboratory and Clinic, Santa Barbara, Calif., both for suggestions and for samples of soy bean milk and almond milk with formulas for preparing the same; to Dr. F. M. Allen, U. S. A. General Hospital No. 9, Lakewood, N. J., Dr. T. B. Osborne of this Station, and Mr. J. P. Street, formerly chief of this Laboratory, for suggestions and criticisms; and to Miss Geraghty, formerly Dietitian of the New Haven Hospital, and to her assistant, Miss Hoffman, for experimental work with recipes designed for diabetic dietaries.

METHODS OF ANALYSIS.

The methods used have been those authorized by the Association of Official Agricultural Chemists. The determination of fat has been modified in case of baked goods. It has been shown that the usual continuous extraction may not remove fat satisfactorily from baked products, e. g., bread. We have therefore used the following method in such cases:

Method for determination of fat in baked products[1]:—Treat 5 gms. of material in a loosely stoppered 200 cc. Erlenmeyer flask with a mixture of 10 cc. alcohol (95%), 2 cc. concentrated ammonia and 3 cc. of water, heating 2 minutes at the boiling point. Cool, add three successive portions of 25 cc. of ethyl ether, mixing thoroughly, and tamping the material

[1] Conn. Agr. Exp. Sta., Bull. 200, p. 133, 1917.

each time with a glass rod flattened at the end, pouring off the extracts into a 200 cc. beaker. The combined ether extracts are evaporated to dryness on the steam bath. The crude fat is extracted by washing out with several portions of anhydrous ether, or preferably petroleum ether, the extract collected in a tared flask, evaporated and dried for periods of 30 minutes at 100° C. until constant weight is obtained.

INTERPRETATION OF ANALYSES.

Protein. The proper basis for comparison of the nitrogenous material in diabetic or other foods is the nitrogen content. But proximate analyses require a statement of protein content and this is ordinarily obtained from the nitrogen figure by use of the conventional factor 6.25, which is based on the assumption that protein contains 16 per cent. of nitrogen.

The Federal definition and standard for "gluten" products is based upon the observation that wheat proteins contain about 17.5 per cent. of nitrogen which requires a factor of 5.70 to express the protein in wheat products.

This being the case, we have used the factor 5.70 to calculate the protein in such materials as are known, or declared, to be gluten products. In all other cases the conventional factor 6.25 has been used. It is recognized that 6.38 is a more correct factor for milk proteins, but a variation of 0.13 in the factor is almost within the limit of analytical error and certainly within the limits of variation in factory control of these products from time to time, so that no attempt has been made to apply this more accurate factor to casein preparations.

Nitrogen-free extract. The interpretation of this term has been made clear in previous reports but it may be briefly restated. In proximate analyses nitrogen-free extract is an expression used to cover the difference between 100 per cent. and the sum of the percentage amounts of moisture, ash, protein, fiber and ether extract (crude fat). In general it so closely approximates the total carbohydrates, i. e., starch, sugars, etc., that the term is used synonymously with carbohydrate. Obviously, the percentage of this constituent group varies according to the protein factor used. In other words, it will be higher if 5.70 is used to calculate protein than if 6.25 is employed.

In addition to starch, nitrogen-free extract includes carbohydrates which we may call available, accepting the term "available" to mean those materials which directly reduce Fehling's solution or do so after treatment with acid and therefore presumably yield glucose in metabolism, and carbohydrates which are non-available or less available in human metabolism. The first class includes soluble starch, dextrins, maltose, glucose, sucrose, invert sugar, raffinose, lactose and some other less common sugars. The second group includes substances, collectively termed hemicelluloses, which occur as vegetable cell-wall constituents, and soluble vegetable gums and mucilages sometimes called saccharo-colloids. Although these compounds yield sugars of the hexose and pentose types, it is doubtful if they play any considerable part in metabolism other than that of the ruminant animals.

The interpretation of nitrogen-free extract, represented by a figure obtained by difference, as synonymous with carbohydrate, does injustice to certain diabetic food products, notably casein preparations, which are free or practically free from carbohydrates.

In our tables of analyses starch is indicated as a part of the nitrogen-free extract; the remainder represents the difference from 100 per cent. as stated.

NEW ANALYSES OF COMMERCIAL DIABETIC PRODUCTS.

Our 1919 inspection of diabetic preparations may be classified as follows:

Commercial products		85
Commercial and experimental products:		
Washed bran	3	
Experimental recipes with bran	2	
Thrice-cooked and other vegetables	4	
Diabetic broths	9	
Artificial or modified milks	4	22
Total		107

The efficient coöperation of Messrs. R. E. Andrew, C. E. Shepard, H. D. Edmond and M. A. D'Esopo, to whom all analytical work is due, is gladly acknowledged. Acknowledgment is also made to Miss Alta H. Moss for her assistance in the work of compilation.

The analyses of eighty-five commercial products are given in Table IV.

TABLE IV.—ANALYSES OF DIABETIC FOODS.

Station No.	Manufacturer and Brand.	Weight declared.	Weight found.	Water.	Ash.	Nitrogen.	Protein. N x 6.25.	Protein. N x 5.70.	Fiber.	N-free extract. Starch.	N-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
		gms.	gms.	%	%	%	%	%	%	%	%	%	
	Herman Barker, Somerville, Mass.												
13096	Gluten Food "A"	368	363	9.86	0.29	13.50	.....	76.95	0.06	2.56	9.84	0.44	361
13097	Gluten Food "B"	368	354	9.72	0.33	12.98	.....	73.99	0.08	5.23	10.14	0.51	362
13098	Gluten Food "C"	368	343	10.00	0.42	12.79	.....	72.90	0.09	6.39	9.80	0.40	360
	The Cereo Co., Tappan, N. Y.												
13099	Soy Bean Gruel Flour	396	387	6.12	3.98	7.38	46.13	.....	2.38	0.90	21.86	18.63	443
	The Farwell & Rhines Co., Watertown, N. Y.												
13066	Genuine Gluten Flour 40%	1361	1388	10.65	0.75	7.10	.....	40.47	0.23	37.01	9.42	1.47	361
	Golden Rod Milling Co., Portland, Ore.												
13059	Acme Special Flour	4540	....	11.73	1.02	2.42	15.13	.....	0.33	61.48	8.56	1.75	356
	Health Food Co., New York.												
13076	Almond Meal	....	222	7.90	6.01	8.04	50.25	.....	2.40	none	18.00	15.44	412
13083	Alpha	93	142	9.48	5.76	10.97	68.56	.....	0.35	1.01	6.40	8.44	380
13244	Alpha No. 1 Best Diabetic Wafer. Casein	93	125	6.81	6.23	7.74	48.38	.....	0.17	none	4.89	33.52	515
13245	Alpha No. 2 Best Diabetic Wafer	93	140	12.88	5.09	11.28	70.50	.....	0.13	1.13	6.25	4.02	348
13091	Bran Biskue. Gluten Bran	426	442	9.19	3.38	4.85	.....	27.65	1.51	33.84	13.90	10.53	396
13077	Diabetic Casein Flour (self-raising)	227	267	11.93	9.16	11.56	72.25	.....	0.14	none	5.73	0.79	319
13073	Gluten Cracker-Dust	383	391	8.58	2.42	7.81	.....	44.52	0.71	23.18	11.83	8.76	398
13082	Glutona Bread Sticks	341	367	8.21	2.29	5.86	.....	33.40	0.29	30.60	14.10	11.11	412
13220	Glutosac Bread	....	252	28.28	1.72	4.86	.....	27.70	1.49	26.78	10.33	3.70	293
12604	Glutosac Bread	....	....	23.10	1.95	5.22	.....	29.75	0.84	29.53	12.26	2.57	309
13088	Glutosac Butter Wafers	256	256	10.30	1.89	5.46	.....	31.12	0.36	40.42	7.92	7.99	390
13079	Glutosac Gluten Flour	907	940	10.53	0.75	7.28	.....	41.50	0.29	36.20	9.05	1.68	362
13092	Gluten Nuggets	341	357	8.59	2.35	5.06	.....	28.84	0.33	32.18	15.38	12.33	417
13085	Glutosac Rusk	114	96	9.91	2.20	6.08	.....	34.65	0.83	34.26	12.53	5.62	376
13089	Glutosac Wafers Plain	142	210	10.47	2.55	7.20	.....	41.04	1.19	25.12	12.09	7.54	342
13090	Glutosac Zwieback	184	175	9.18	2.04	5.06	.....	28.84	0.83	33.34	15.24	10.53	405
13072	Manana Gluten Breakfast Food	....	213	8.49	2.47	7.86	.....	44.80	1.09	21.99	12.47	8.69	396
13081	Pronireu. A Gluten Griddle Cake Flour	907	908	10.81	4.26	6.64	.....	37.85	0.20	36.56	9.14	1.18	345
13221	Protosac Bread No. 1	....	209	28.85	2.42	6.31	.....	35.97	0.84	20.53	7.39	4.00	292
13222	Protosac Bread No. 2	....	234	28.49	1.83	4.73	.....	26.96	0.30	30.47	8.43	3.52	302
13074	Proto Puffs No. 1	114	87	9.32	2.73	12.12	.....	69.08	0.20	3.26	10.74	4.67	371
13219	Protosac Rusk	85	101	11.00	2.22	5.74	.....	32.71	1.95	39.26	7.84	5.02	364
13075	Protosoy (Cereal)	454	461	7.65	5.39	6.42	40.13	.....	3.78	trace	24.88	18.17	424
13084	Protosoy Diabetic Wafer	140	155	7.35	4.03	7.44	46.50	.....	1.80	10.58	14.23	15.51	421
13078	Protosoy Soy Flour	481	485	6.32	4.43	6.30	39.38	.....	4.33	1.86	25.10	18.58	433
13080	Pure Washed Gluten Flour	680	716	8.31	0.71	13.14	.....	74.90	0.30	3.77	10.04	1.97	373
13086	Salvia Almond Sticks	426	423	7.11	3.28	5.14	32.13	.....	0.85	21.40	9.10	26.13	486
13403	Snow Flake Diabetic Casein Flour	223	215	10.41	6.07	12.67	79.19	.....	....	none	3.18	1.15	340
	Huntley and Palmer, London.												
13326	Akoll Biscuits	227	278	7.00	3.28	8.98	56.13	.....	0.47	1.80	5.80	25.52	485

TABLE IV.—ANALYSES OF

Station No.	Manufacturer and Brand.
	The Kellogg Food Co., Battle Creek, Mich.
13069	40% Gluten Biscuit
13067	Gluten Flour 40%
13070	Thoroughly Cooked 40% Gluten Meal
13068	Pure Gluten Biscuit
13071	Pure Gluten Meal
	Lister Bros., Inc., New York.
13094	Diabetic Flour. Self-rising
	Loeb's Diabetic Food Bakery, New York.
13054	Aereated Gluten Bread
12426	Aereated Gluten Bread
13038	Almond Chocolate Bars
13044	Diabetic Almond Macaroons
13045	Diabetic Breadsticks
13046	Diabetic Breadsticks. Almond
13042	Diabetic Butter Cookies
13039	Diabetic Chocolate
13047	Diabetic Lady Fingers
13041	Diabetic Sponge Cookies
13050	Caseine Bread
12425	Caseine Bread
13380	Caseine Breakfast Cereal
13051	Caseine Muffins
13052	Genuine Gluten Bread
13379	Gluten Breakfast Cereal
13040	Gluten Cracker Meal
13043	Gluten Noodles
13048	Gluten Zwieback
13049	Gluten Almond Zwieback
13053	Pure Gluten Flour
	Mayflower Mills, Fort Wayne, Ind.
13062	Gluten Flour
	Norton-Truax, Chicago, Ill.
13325	Diaprotein
	Pieser-Livingston Co., Chicago, Ill.
13055	Genuine Gluten Flour
	Potter & Wrightington, Boston, Mass.
13093	Diet-Ease Gluten Flour
14397	Diet-Ease Gluten Flour

DIABETIC FOODS—(*Continued*).

Station No.	Weight declared.	Weight found.	Water.	Ash.	Nitrogen.	Protein. N x 6.25.	Protein. N x 5.70.	Fiber.	N-free extract. Starch.	N-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
	gms.	gms.	%	%	%	%	%	%	%	%	%	
13069	71	85	9.55	1.24	7.18	.....	40.92	0.23	35.55	10.89	1.62	364
13067	....	....	10.10	0.63	8.28	.....	47.20	0.26	30.66	10.17	0.98	261
13070	454	457	8.50	1.38	7.54	.....	42.98	0.31	33.38	12.00	1.45	380
13068	85	153	8.33	2.04	13.75	.....	78.38	0.35	2.87	6.53	1.50	365
13071	454	480	7.73	0.92	13.88	.....	79.12	0.19	2.56	8.74	0.74	368
13094	57	62	11.53	9.44	10.93	68.31	.....	0.05	none	9.72	0.95	321
13054	28	31	9.17	1.78	8.04	.....	47.83	0.18	26.78	3.18	11.08	411
12426	....	....	7.85	1.80	7.46	.....	42.52	0.22	27.71	8.76	11.14	416
13038	....	74	4.76	3.43	2.38	14.88	.....	2.81	5.34	15.55	53.23	622
13044	....	88	5.90	4.39	4.86	30.38	.....	1.93	0.59	10.48	46.33	713
13045	....	47	9.14	2.67	6.69	41.81	.....	0.20	35.44	6.93	3.81	331
13046	....	70	7.93	2.00	6.30	39.38	.....	0.70	31.22	7.08	11.69	416
13042	....	123	8.85	3.06	5.84	36.50	.....	0.13	31.05	8.38	12.03	412
13039	....	76	4.72	3.45	2.35	14.69	.....	2.62	7.26	15.52	51.74	716
13047	....	19	8.33	4.41	7.64	47.75	.....	0.05	1.91	3.50	34.05	519
13041	....	19	8.66	4.45	7.95	49.69	.....	0.11	1.91	1.41	33.77	516
13050	....	144	40.42	4.47	6.53	40.84	.....	0.08	none	3.35	10.84	274
12425	....	....	39.73	4.35	6.57	41.05	.....	0.09	trace	3.71	11.07	323
13380	....	....	4.52	4.61	5.86	36.63	.....	....	0.70	11.02[1]	42.52	576
13051	....	100	30.82	4.89	7.32	45.74	.....	0.15	none	7.03	11.37	313
13052	227	218	32.01	1.80	4.98	.....	28.39	0.28	28.56	6.86	2.10	273
13379	160	170	4.38	2.73	5.12	.....	29.18	1.04	25.51	17.78	19.38	464
13040	....	104	8.40	1.59	6.44	.....	36.71	0.28	30.66	11.48	10.88	417
13043	85	85	10.23	1.63	6.54	.....	37.28	0.15	36.84	10.28	3.59	370
13048	....	55	9.61	1.91	6.78	.....	38.65	0.14	36.06	10.64	2.99	368
13049	....	59	8.91	1.94	6.60	41.25	.....	0.58	32.57	6.97	7.78	392
13053	454	429	10.48	0.89	6.80	.....	38.76	0.15	38.22	10.30	1.20	360
13062	....	....	10.35	0.85	8.42	.....	47.99	0.30	28.63	10.23	1.65	365
13325	265	281	11.72	6.35	12.44	77.75	.....	....	none	2.72	1.46	335
13055	....	....	10.16	0.81	7.26	.....	41.38	0.20	36.31	9.79	1.35	362
13093	....	....	12.50	0.98	4.64	.....	26.45	0.73	46.89	10.29	2.16	354
14397	....	....	8.76	0.96	6.94	.....	39.56	0.42	36.20	11.78	2.32	371

[1] Includes fiber.

TABLE IV.—ANALYSES OF

Station No.	Manufacturer and Brand.
	The Pure Gluten Food Co., Columbus, Ohio.
13215	Hoyt's Gluten Breakfast Food 40% Protein
13212	Hoyt's Gluten Flour over 40% Protein
13214	Hoyt's Gluten Granules over 40% Protein
13213	Hoyt's Gluten Self-raising (Flour) over 40% Protein
13605	Hoyt's Gluten Special Flour 80% Protein
	Schulenburg Oil Mill, Schulenburg, Texas.
13058	Baumgarten Process Allison Flour
	Still Rock Spa, Waukesha, Wis.
13352	Curdolac Flour
	Soy Bean Food Products Co., San Francisco, Calif.
13696	Soy Bean Flour A
13697	Soy Bean Flour B
	Waukesha Health Products Co., Waukesha, Wis.
13064	Hepco Dodgers
13065	Hepco Flour
13063	Hepco Grits
	Wilson Bros., Rochester, N. Y.
13056	Genteel Brand Flour
13057	Gluten Flour
	Miscellaneous.
14291	Dia-Biskit. Genevieve Jackson, Los Angeles, Calif.
13381	Svea Wafers. Prepared for S. S. Pierce Co., Boston, Mass.
13060	Peanut Butter. Acme Brand, J. W. Beardsley's Sons, Newark, N. J.
13061	Peanut Butter. Beechnut Brand, Beechnut Packing Co., Canajoharie, N. Y.

DIABETIC FOODS—(*Concluded*).

Station No.	Weight declared.	Weight found.	Water.	Ash.	Nitrogen.	Protein.		Fiber.	N-free extract.		Fat.	Calories.
						N x 6.25.	N x 5.70.		Starch.	Other nitrogen-free extract, by difference.		
	gms.	gms.	%	%	%	%	%	%	%	%	%	
13215	454	463	9.23	0.93	8.07	.....	46.00	0.51	31.39	10.15	1.79	366
13212	454	479	10.68	0.82	7.34	.....	41.84	0.27	33.19	12.07	1.13	359
13214	454	466	9.75	0.97	7.68	.....	43.78	0.68	32.15	10.08	2.59	327
13213	454	462	10.18	3.85	7.28	.....	41.50	0.50	33.38	9.72	0.87	346
13605	454	464	6.82	1.10	13.54	.....	77.18	0.27	2.81	10.63	1.19	373
13058	5443	....	8.08	5.67	8.00	50.00	.....	3.47	1.13	21.61	10.04	381
13352	....	....	10.25	3.99	9.06	56.63	.....	3.79	5.09	17.89	2.36	335
13696	....	....	7.65	4.71	6.69	41.81	.....	1.98	0.34	24.07	19.44	440
13697	....	....	7.91	5.08	7.04	44.00	.....	2.07	0.76	25.98	14.20	411
13064	....	....	8.73	5.68	6.79	42.44	.....	3.85	1.01	21.56	16.73	411
13065	....	....	8.09	4.31	7.04	44.00	.....	2.15	0.90	21.41	19.14	438
13063	....	....	8.88	5.51	6.44	40.25	.....	4.19	0.87	23.91	16.39	408
13056	....	....	11.60	0.98	4.70	29.38	.....	0.26	49.16	6.23	2.39	361
13057	....	....	10.52	0.74	8.04	.....	45.83	0.36	28.63	11.91	2.01	364
14291	....	....	6.08	6.13	2.82	17.63	.....	11.99	6.13[2]	47.21	4.83	328
13381	50	....	10.58	2.85	1.04	6.50	.....	0.13	53.72	25.53	0.69	349
13060	....	....	1.82	3.07	5.00	31.25	.....	1.77	5.29	8.53	48.27	615
13061	....	....	1.99	3.32	4.86	30.38	.....	1.81	5.04	7.55	49.91	621

[2] Includes reducing substances derived from agar-agar.

COMMENTS ON INSPECTION AND ANALYSES.

Since the adaptability of any particular food to the diet of a diabetic patient is primarily a question of individual tolerance we do not propose to criticize the various products herein reported essentially from that standpoint except insofar as certain standards and regulations which have been formulated by Federal or other authorities may apply. We concur in the belief that a manufacturer offering a product as a diabetic food should declare its composition, within reasonable limits, for the guidance of practitioners and others interested. With reliable information as to the three essential food groups, viz., protein, fat, and carbohydrate, the physician can save himself much blind experiment in his efforts to establish a patient's tolerance.

Herman Barker's Gluten Food A is declared to contain "not over 4 per cent. carbohydrates and approximately 87 per cent. of protein"; Gluten Food B "not over 7 per cent. carbohydrates and approximately 85 per cent. of protein"; Gluten Food C "not over 12 per cent. carbohydrates and approximately 83 per cent. protein."

Our analyses show the constituents named in about the same proportion as declared in the several cases but the actual amounts stated appear to have been based upon the protein factor 6.25.

Farwell and Rhines' Gluten Flour 40 per cent. conforms to its label and to the Federal standard for gluten flour.

Golden Rod Milling Co. Acme Special Flour. We have no evidence that this product is sold specifically as a diabetic food. No analysis accompanied the sample analyzed but a tag attached thereto stated that analyses of the company's products are on file with the Dairy and Food Commissioner (of Oregon) and will be furnished by him or the Company upon application. We understand that the product has been used as a diabetic food, but it is evident that with 15 per cent. of protein and 70 per cent. of carbohydrate it could not be tolerated by any diabetic who could not also tolerate ordinary flour.

The Health Food Co. emphasizes the fact that their purpose is "to supply a diet ranging from an absolutely starchless to a full-tolerance diet," letting the physician decide upon that food or group of foods which is best adapted to the needs of his patient. Our analyses indicate that this perfectly rational plan is followed. In our opinion a statement of the limits of protein, fat, and carbohydrate on the label of each product would be a decided advantage.

The Kellogg Food Co. The chemical composition within reasonable limits is given on the labels of the several products examined which our analyses in the main substantiate. We commend this practice. However, some of their statements with regard to the advantages of high protein in general, and wheat protein in particular, are extravagant in the light of recent investigations referred to elsewhere in this bulletin.

Lister Bros. Inc. The composition of Lister's Diabetic flour, self-raising, is adequately stated on the label. Their analysis shows 9.72 per cent. of nitrogen-free extract which is ordinarily interpreted as carbohydrate in the usual proximate analysis. As this interpretation might appear to conflict with their claim that the product is free from starch and sugar, at the manufacturers' request we have tested the flour for water-soluble carbohydrates and find only negligible amounts of copper-reducing substances present. This particular group of constituents, other than starch, is obtained by difference as already explained and it obviously includes the accumulated variations of other determinations, which, in this case and that of other similar preparations, are enhanced by losses of leavening constituents in the process of ashing.

Loeb's Diabetic Food Bakery products are without declaration of composition except that Sponge Cookies and Lady Fingers are declared to be "without flour or sugar." We find only 1.9 per cent. of starch in each of these cases and only 1.4 and 3.5 per cent. respectively of other nitrogen-free extract. Gluten Flour satisfies the Federal definition and standard for this product.

Mayflower Mills and *Pieser-Livingston Co.'s* Gluten Flours both exceed the Federal standard. The latter has a complete analysis printed on the sack which our analysis confirms when converted to the same (water-free) basis.

Norton-Truax Diaprotein, which is a casein flour, is declared to be free from starch and sugar and to contain 83 per cent. of protein. We find no starch and only 2.72 per cent. of other nitrogen-free extract, which would be lower still by the use of the protein factor 6.38, and which in any case probably contains not more than traces of copper-reducing materials. Eighty-

three per cent of protein requires about 13 per cent. of casein nitrogen. We find 12.44 per cent. of nitrogen in the material as analyzed. This discrepancy is due to a difference in moisture content; the declaration is based upon a moisture figure of 6.72 whereas we find 11.72 per cent. of moisture in the sample examined.

Potter and Wrightington. The first sample of Diet Ease Gluten Flour submitted was below standard. Apparently the manufacturers were misled by the reports of their analyst which showed the crude gluten content instead of protein based on the nitrogen content. A sample examined subsequently conformed to the Federal standard.

The Pure Gluten Food Co. Only declarations of protein, which our analyses confirm, are made on the labels of these products. Special flour 80 per cent. contains over 80 per cent. protein calculated on the water-free basis.

Schulenburg Oil Mill. Allison Flour (Cottonseed Flour) is a high-grade cottonseed product. It is practically free from starch and contains about the same amount of other carbohydrates as soy bean flour. It has been shown by Rather[1] that about 78 per cent. of the protein of cottonseed meal or flour is utilized in the metabolism of man; and that these proteins are utilized equally as well as the proteins of legumes, nine-tenths as well as those of cereals and eight-tenths as well as those of meat. As to the carbohydrates, while we know that 75 per cent. of the nitrogen-free extract is digestible by ruminant animals we do not know to what extent they are utilized in human digestion. One of the sugars present is raffinose, for the preparation of which cottonseed meal is commonly used. The low starch content and relatively low content of other carbohydrates has suggested this product as an adjunct to the diabetic diet. Knowledge of its protein-glucose yield in metabolism would be valuable in judging its suitability for this purpose.

Still Rock Spa. Curdolac Flour we understand has not yet been placed upon the open market, its use having been confined to the treatment of diabetic patients in the hospital where it originated, or of those who have been under treatment there.

Soy Bean Food Products Co., Waukesha Health Food Co. and

[1] Jour. Am. Chem. Soc. 36, p. 584, 1914.

Cereo Co. Analyses of their soy bean preparations are typical of products of their respective types. Available carbohydrates are relatively low; but the glucose yield of the proteins of the soy bean has not been determined.

Wilson Bros. We have no information that Genteel Brand Flour is recommended as a diabetic food; it requires practically as great carbohydrate tolerance as ordinary flour. Gluten Flour, however, satisfies the Federal standard for this product.

Miscellaneous Preparations. Dia-Biskit is made from washed bran and agar-agar and so labeled. The starch content is low and the carbohydrates of agar-agar are not appreciably available in human metabolism.[1] Svea Wafers, on the other hand, are very high in available carbohydrates.

No general examination of peanut butter has been attempted but the two samples submitted have been analyzed.

In general our inspection reveals an evident purpose on the part of manufacturers to maintain standards and market their products for what they are. The practice of controlling their output by chemical analysis is increasing. Inquiry generally reveals a knowledge, on their part, of the essential composition of their products; but this might, however, be better or more fully stated on the labels in many cases. Since there is no universal diabetic food, particular claims of merit for any product which might lead the patient to believe that he could safely introduce that article into his dietary should be discouraged. The production of a foodstuff of standard or declared composition, marketed under a label which adequately states what that composition is, should be the prime duty of the manufacturer, leaving the responsibility of recommending and prescribing that food to the attending physician.

SPECIAL PREPARATIONS OF INTEREST IN CONNECTION WITH DIABETIC DIETARIES.

The rigid dietary restrictions in cases of severe diabetes result in menus which are conspicuously monotonous. Since our mental attitude toward that which we eat, whether in health or disease, is now recognized as a factor in metabolism, food for the diabetic patient should be prepared with more than ordinary care as to

[1] Wardall. Jour. Am. Med. Assoc. 69, pp. 1859-62, 1917.

attractiveness and palatability. The need of greater variety in the diet is emphasized by Dr. Allen,[1] who is particularly interested in the introduction of uncommon fruits and vegetables wherever the climatic conditions permit of their culture, in the hope of finding something of interest and usefulness from this standpoint. The diet should also be adequate, not only from the quantitative point of view as represented by the calorie intake, but also from the qualitative side as represented by the important accessory diet factors or vitamines. Unfortunately the exclusion of certain types of foods by reason of their unsuitable carbohydrate content automatically excludes desirable sources of vitamines; and the modification of other types, as in the case of the thrice-cooking process, necessarily removes those essential diet principles which are soluble in water. The minimum calorie intake, which usually obtains in diabetic treatment, and the restricted range of choice in diet further reduce the possibility of adequate vitamine supply. In this connection the nutrition studies of Osborne and Mendel offer a practical suggestion. They have repeatedly demonstrated the practicability of administering vitamine concentrates to remedy natural or induced disturbances in metabolism, and the use of such preparations to supplement foods naturally low in, or artificially deprived of vitamines, and to insure a sufficient amount of these important diet factors in the low-calorie and restricted diet of the diabetic, is worthy of consideration in practical diabetic treatment.

Beyond these general suggestions we do not propose to go into the subject of diabetic menus and recipes which has been adequately treated by Joslin and others. But we have been interested in a number of preparations which clinical experience has shown to be of interest and value in the diabetic dietary. These include washed bran, thrice-cooked vegetables, diabetic broths and artificial or modified milks.

Washed Bran.

Bran is used in the diet of diabetic patients to an increasing extent. It is valuable both as an aid to digestion by reason of the bulk it adds to ingested foods and as a diluent for concentrated foods on account of its relatively low protein and limited

[1] Private communication.

availability of its carbohydrate. The glucose yield of bran in metabolism has not been established but the work of Swartz[1] and others with complex carbohydrates comparable to those of bran would suggest that its carbohydrates are not utilized to any considerable extent in human digestion.

Numerous so-called "health" brans are on the market. They are primarily for use to relieve constipation and are not generally marketed specifically as diabetic foods. However, the impression has been gained by many diabetic patients that such preparations are safe. This impression is unfortunate for, as Dr. Joslin has noted, many such brans contain more starch than the ordinary commercial bran commonly used as a fodder grain. This is illustrated in the analyses of bran given in the accompanying table.

In order to render bran suitable for use in the diabetic diet the simple process of washing it free from starch by a stream of water is recommended as a household method of treatment. The bran is placed in a cheese cloth bag and tied under the faucet, allowing a stream of water to run through it until the water comes through clear. Frequent kneading of the mass is necessary for effective washing.

This is, of course, a wasteful process and commercially the problem is approached in a different manner, the starch being first converted into soluble carbohydrate and then removed by suitable means.

For the purpose of finding the composition of bran washed by the household method outlined above and to give an idea of the comparative composition of the washed and unwashed material as well as information as to the losses involved, the following experiments were tried.

Three samples of bran were used. One, **13600,** was common bran sold as a commercial cattle feed. The others, **13601** and **13111,** were "health" brans intended for clinical use but not recommended particularly for diabetic patients.

One hundred grams of each were washed in running water until the washings were clear and gave negative or faint tests for starch by means of iodine solution. The samples were then spread out on trays, dried rapidly in a current of warm air, and

[1] Swartz, Mary D., Nutrition Investigations of the Carbohydrates of Lichens, Algae and Related Substances. Yale University Press, 1911.

the weight of the extracted and dried bran observed. The losses were found to be from 39 to 45 per cent.

Analyses of the original unwashed bran and the washed product are given in Table V. The analyses are also given on the water-free basis; and values representing the losses sustained have also been calculated.

TABLE V.—ANALYSES OF BRAN, UNWASHED AND WASHED.

Sample No.	Description of material.	Water.	Ash.	Protein, N. x 6.25.	Fiber.	Starch.	Total sugar.	Other nitrogen-free extract.	Fat, ether extract.
		%	%	%	%	%	%	%	%
13600	Common bran, original unwashed, *air dry*	9.02	6.24	15.63	10.49	9.00	7.16	37.52	4.94
	washed, *air dry*	4.25	4.34	14.00	15.94	2.08	0.52	54.56	4.31
	original unwashed, *water free*	....	6.86	17.18	11.53	9.89	7.87	41.24	5.43
	washed, *water free*	....	4.53	14.62	16.64	2.17	0.54	57.00	4.50
	original constituents remaining	....	2.89	9.32	10.61		1.73	36.33	2.87
	original constituents, washed away	....	3.97	7.86	0.92		16.03	4.91	2.56
13601	Health bran, B. original unwashed, *air dry*	9.84	5.29	19.38	7.57	20.81	6.52	27.25	3.34
	washed, *air dry*	4.57	5.17	21.69	13.82	6.58	0.54	43.93	3.70
	original unwashed, *water free*	....	5.87	21.49	8.40	23.08	7.23	30.23	3.70
	washed, *water free*	....	5.42	22.73	14.48	6.90	0.57	46.02	3.88
	original constituents remaining	....	3.15	13.23	8.43		4.35	26.78	2.26
	original constituents washed away	....	2.72	8.26	+0.03		25.96	3.45	1.44
13111	Health bran, C. original unwashed, *air dry*	7.92	5.60	19.00	7.54	22.25	5.88	27.77	4.04
	washed, *air dry*	3.61	7.09	22.69	11.30	8.41	0.56	41.54	4.80
	original unwashed, *water free*	....	6.08	20.63	8.19	24.16	6.38	30.17	4.39
	washed, *water free*	....	7.36	23.54	11.72	8.73	0.58	43.09	4.98
	original constituents remaining	....	4.70	15.03	7.48		5.94	27.51	3.18
	original constituents washed away	....	1.38	5.60	0.71		24.60	2.66	1.21

The analyses show that the common bran contained only about 16 per cent. of carbohydrates of the readily available types (starch and sugar), as compared with nearly 30 per cent. in the health brans.

The true comparison in composition of the unwashed and washed products is shown by their respective analyses calculated to the water-free basis. There is a conspicuous reduction in available carbohydrate but other constituents may or may not be reduced. Thus, for example, protein is higher in the unwashed material; yet considerable amounts of protein have been lost in material mechanically removed.

The actual losses sustained are estimated by calculating the analysis of the water-free washed material to the basis of the water-free unwashed material. Samples **13600, 13601** and **13111** lost 36.25, 41.80 and 36.16 per cent. respectively on washing; the respective factors are therefore 63.75, 58.20 and 63.84 on the water-free basis.

The effect of the washing in these trials was to remove from 70 to 83 per cent. of the available carbohydrate; the health brans still contained, however, between 5 and 10 per cent. of this material. Large and variable proportions of other constituents were also removed. For example, there was a loss of ash ranging from 23 to 58 per cent. and of protein ranging from 27 to 46 per cent.

The use of washed bran as a diluent for high protein flours is illustrated by the following recipes and analyses of the products made thereby.[1]

Gluten-Bran Bread:

120 cc. water
1 yeast cake
10 grams 40 per cent. gluten flour
15 grams washed bran (Sample No. 13600)
Salt
10 grams oleomargarine

Weight of loaf after baking 185 grams.

Gluten-Bran Muffins:

40 cc. water
8 grams baking powder

[1] Recipes and baked products submitted by Miss Hoffman of the Dietetic Department of the New Haven Hospital.

40 grams 80 per cent. gluten flour
20 grams washed bran (Sample No. 13600)
Salt
15 cc. cooking oil
50 grams egg

Weight of muffins (6) after baking 115 grams.

TABLE VI. ANALYSES OF GLUTEN-BRAN BREAD AND MUFFINS.

	Bread.		Muffins.	
	In air dry.	In original.	In air dry.	In original.
	%	%	%	%
Water	2.90	39.64	2.94	24.04
Ash	2.38	1.48	6.84	5.35
Nitrogen	6.49	4.03	7.20	5.63
Protein (N. x 5.7)	36.99	22.97	41.04	32.09
Fiber	2.22	1.38	3.47	2.72
Nitrogen-free Extract:				
Starch	29.93	18.60	6.50	5.09
Other N.-free Ext.	18.11	11.29	19.20	15.05
Fat	7.47	4.64	20.01	15.66

THRICE-COOKED VEGETABLES.

In many of the common vegetables the carbohydrate content is so low that they are tolerated without modification by diabetics. Vegetables which are eaten only after cooking and which are removed from the water in which they are cooked, lose considerable amounts of carbohydrate. This suggested to Allen[1] the more complete removal of carbohydrate material by repeated extraction with water which constitutes the so-called thrice-cooking process. Vegetables so treated are boiled with water, usually three times, and the water is drained off and discarded after each boiling. The number of treatments of this kind may be extended for substances particularly rich in sugar materials or in cases where such materials are slowly removed.

Wardall[2] has suggested and tried a modification of this process by which vegetables are extracted at 60° C. for periods of ten to fifteen minutes, repeating the extractions until carbohydrates are practically all removed as determined by actual reduction tests with Fehling's solution. She finds that the color, texture, and

[1] Boston Med. and Surg. Jour., p. 241, 1915.
[2] Jour. Am. Med. Assoc., 69, 1859-1862, 1917.

palatability of vegetables are less impaired by this process than by repeated treatments with boiling water, although the method is probably not adapted to the preparation of all vegetables, particularly cabbage.

Comparative analyses of cooked and uncooked vegetables are not readily available. Joslin[1] has compiled results which give comparisons from the standpoint of carbohydrate content.

TABLE VII.—CARBOHYDRATE CONTENT OF FRESH AND COOKED VEGETABLES, (JOSLIN).

	Fresh.	Cooked.
	%	%
Asparagus	3.3	2.2
Spinach	3.2	2.6
Beans, string	7.4	1.6
Beets	9.7	7.4
Carrots	9.2	6.8
Cabbage	5.6	3.8*
Greens, beet	...	3.2
Onions	9.9	4.9
Beets, boiled	...	10.0
Parsnips	...	13.2
Peas	16.9	14.6
Potatoes	18.4	20.9
Potato chips	...	46.7
Sweet potatoes	27.4	42.1

* Loss of 33 per cent.

It is quite evident that repeated extractions with water will remove from foods nutrient materials other than sugar, particularly ash constituents and water-soluble vitamines. The loss of these accessory diet factors is the more regrettable for the reason that in the restricted diet of the diabetic it cannot be readily compensated; but the practicability of administering vitamine concentrates to correct artificial or natural dietary deficiencies has already been referred to and would appear to be a logical remedy in this instance.

The distribution of losses in the several proximate groups of nutrients has been determined by analyses of several vegetables

[1] Treatment of Diabetes Mellitus, p. 212.

both in the fresh state and after extraction by the two methods already mentioned and now given in further detail.

Extraction at low temperature was carried out as recommended by Wardall.[1]

Place eight hundred grams of thinly sliced material in double cheese-cloth and immerse in 1600 cc. of water at 60° C. for 15 minutes. Drain off the water and add a fresh portion of water at the same temperature and allow to stand 15 minutes. Repeat the decantations and additions of fresh water until the water extract gives tests with Fehling's solution which are negative or inconsiderable, both before and after hydrolysis with acid. Dry rapidly in current of warm air.

The number of extractions required to reach a practically negative test is quite variable in different cases. With rhubarb the test was insignificant after three extractions, while with asparagus eleven extractions were necessary.

The thrice-cooking process was carried out as described by Joslin.[2]

Allow 800 grams of the finely sliced material contained in double cheese-cloth to soak in cold water for 30 minutes. Drain off the water. Add 1600 cc. of cold water, bring to boiling and boil for 3 to 5 minutes. Discard the water. Repeat the operation of boiling and adding water twice more, finally rinsing with cold water and drying rapidly in current of warm air.

For the purpose of comparison, in each case a portion of untreated material was air dried under the same conditions that prevailed in case of the extracted material. The analysis of this air-dry material was converted to the basis of the original, untreated substance and a similar loss due to water assumed for the same vegetable under the different methods of extraction. The analyses of the untreated and the extracted materials show the same respective water content and therefore other variations may be attributed to the effects of extraction.

The analyses of asparagus, rhubarb and chinese cabbage are given in Table VIII. Analyses of the edible portion and of the seeds and placenta of sweet green peppers, untreated, are included.

[1] Jour. Am. Med. Assoc., 69, 1859-1862, 1917.

[2] Treatment of Diabetes Mellitus, pp. 533-4.

TABLE VIII.—ANALYSES OF VEGETABLES, UNCOOKED, THRICE-COOKED AND EXTRACTED.

Description of material.	Water.	Ash.	Protein, N x 6.25.	Fiber.	Total sugar.	Other nitrogen-free extract.	Fat, ether extract.	Nitrogen.
	%	%	%	%	%	%	%	%
Asparagus, untreated	92.64	0.60	2.34	0.90	1.37	1.95	0.20	0.37
Extracted, Wardall method..	92.64	0.19	2.32	1.73	0.13	2.69	0.30	0.37
Thrice-cooked, Joslin method	92.64	0.23	2.36	1.68	0.18	2.56	0.35	0.38
Rhubarb, untreated	94.88	0.74	0.76	0.75	0.17	2.59	0.11	0.12
Extracted, Wardall method..	94.88	0.21	0.60	1.60	0.08	2.53	0.10	0.10
Thrice-cooked, Joslin method	94.88	0.24	0.69	2.06	0.05	1.98	0.10	0.11
Chinese cabbage, untreated	95.33	0.56	1.20	0.50	1.41	0.94	0.06	0.19
Extracted, Wardall method..	95.33	0.24	1.07	1.16	0.05	2.03	0.12	0.17
Thrice-cooked, Joslin method	95.33	0.25	1.17	1.16	0.11	1.85	0.13	0.19
Green peppers, sweet, untreated, edible portion[1]	93.81	0.36	0.83	0.82	1.85	2.23	0.10	0.13
Seeds and placenta.....	86.25	0.73	3.00	2.90	1.67	2.73	2.72	0.48

[1] Edible portion 87.2%, seeds and placenta 12.8%.

The actual losses of original solid matter in the several cases by the two methods of treatment was determined to be as follows:

	Wardall method. %	Joslin method. %
Asparagus	51.5	50.8
Rhubarb	57.0	66.0
Chinese cabbage	56.7	56.7

The analyses show a very complete removal of the more readily available portion of the nitrogen-free extract, i. e., reducing sugars; and a decrease also, though less conspicuous, in what is usually reckoned as carbohydrate, in this case sugar and other nitrogen-free extract. Protein is not substantially changed but there is a notable loss of mineral matter.

BROTHS.

Joslin[1] refers to the extensive use of broths upon fasting days in the treatment of diabetes. Their composition becomes of

[1] Treatment of Diabetes Mellitus, page 271.

interest and importance on account of their utilization for this purpose. Analyses made for Dr. Joslin by Mr. A. H. Smith in Professor Mendel's laboratory, have already indicated the substance and quality of these preparations.

Nine samples of various broths prepared at the New England Deaconess Hospital and sent to us at Dr. Joslin's request have been examined and the results appear in Table IX.

TABLE IX.—ANALYSES OF BROTHS USED IN DIABETIC TREATMENT.

Station No.	Kind of Broth.	Total solids.	Fat, ether extract.	Total nitrogen.	Total reducing sugars.	Total ash.	Salt (NaCl).
		%	%	%	%	%	%
13342	Mutton bone	2.10	0.04	0.23	none	0.28	0.05
13343	Veal bone	1.42	0.04	0.23	none	0.36	0.03
13344	Beef bone	1.32	0.04	0.20	none	0.30	0.05
13345	Beef bone	0.92	0.03	0.15	none	0.32	0.03
13346	Mutton bone	0.90	0.04	0.16	none	0.18	0.03
13347	Veal bone	1.85	0.02	0.28	none	0.30	0.05
13348	Chicken	0.69	0.04	0.10	none	0.19	0.03
13349	Clams chopped	1.60	0.03	0.24	none	0.48	0.06
13391	Clams unchopped	1.93	0.04	0.20	none	0.30	0.07

It is apparent that the gross amount of nutrient material in these preparations is small, the total solids ranging generally from 1 to 2 per cent. Fat is present in traces only. They are free from available carbohydrates as indicated by negative reduction tests with Fehling's solution. Appreciable amounts of mineral constituents are present but salt is satisfactorily low. According to Joslin, salt should not exceed 0.5 per cent. Nitrogenous matter is low. Smith determined the distribution of nitrogen and found that the proportion of total nitrogen which was in the form of protein varied considerably. Summarizing his results, Joslin states that nearly three-fourths of the total nitrogen may generally be considered to be in protein and amino combination, the remainder being due to extractives.

Joslin recommends the use of thin, clear, meat broths, agreeably seasoned, lightly salted and free from fat and sediment. Our analyses appear to be chemically descriptive of such broths.

ARTIFICIAL AND MODIFIED MILKS.

Cows' milk ordinarily contains from 4.2 to 4.8 per cent. of sugar. Skimmed milk and buttermilk are not essentially different from whole milk as regards sugar content but in cream, sugar will seldom exceed 3 per cent. Unrestricted use of these products is not allowable in cases of low carbohydrate tolerance and particularly when taken in conjunction with other food. For this reason various substitutes for milk have been suggested.

Williamson[1] recommends a preparation made from cream, egg white, salt and a trace of saccharin. Joslin has used commercial sugar-free milks with success. Janney has introduced soy bean milk as a milk substitute in the treatment of diabetes in children and finds it distinctly valuable. He also writes that almond milk is being used in his clinic with marked success in certain intestinal cases.

Methods for preparing these milk substitutes, other than sugar-free milk, are as follows:

Williamson's formula (as prepared in this laboratory). To one pint of water add four tablespoonfuls of 20 per cent. cream, mix thoroughly and allow to stand for twelve hours. Remove the cream layer and add to it the beaten white of one egg. Mix well and dilute with water to the consistency of milk. (A little salt and a trace of saccharin may be added if desired.)

Janney's formula, soy bean milk. To one quart of water add five ounces of soy beans and allow to stand twelve hours. Grind through a coarse grinder, strain through four thicknesses of gauze and heat to 100° C.

Janney's formula, almond milk. Shell and blanch the almonds and put them through a fine grinder. To 500 cc. of water add 30 grams of glycerol and 250 grams of almond meal. Allow to stand over night and strain through gauze.

Analyses of these preparations are given in Table X.

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[1] Williamson. Diabetes Mellitus and Its Treatment, The Macmillan Co., 1898.

TABLE X.—ANALYSES OF MILK SUBSTITUTES.

	Williamson's Formula.	Soybean Milk.	Almond Milk.[4]	Sugar-free Milk (Whiting's).
	%	%	%	%
Solids	6.21	2.49	13.09	16.70
Ash	0.11	0.33	0.49	0.76
Protein	1.50[1]	1.38[1]	3.03[1]	6.43[2]
Sugar	0.12	0.37	1.21	0.22
Fat	4.00	0.29	2.88[3]	9.34
Glycerol	....	....	5.48	....

[1] Factor 6.25.
[2] Factor 6.38
[3] May include some glycerol.
[4] Prepared by Miss Hoffman.

COMPILATION OF ANALYSES OF DIABETIC FOODS.

Table I of our report for 1913[1] contained analyses of diabetic foods made in this laboratory previous to that time, new analyses made that year and included also some data compiled from other sources. That tabulation has now been revised and enlarged to include many analyses made by us and published in our reports since 1913, our new analyses as given in Table IV of this report, and some analyses compiled from reports of other laboratories, and constitutes Table XI of this report.

In summary Table XI is made up as follows:

Analyses from Connecticut Report, 1913	387
Analyses from Connecticut Reports since 1913	107
New analyses made in 1919	85
Analyses compiled from other sources	51
Total	630

The analyses are identified by means of marginal symbols the interpretation of which will be found in the following list of references:

SOURCES OF COMPILED ANALYSES.

1. *California Agr. Exp. Station Report,* A, 1895, p. 161; B, 1902-3, p. 88; C, 1902-3, p. 97: 2. *Connecticut Agr. Exp. Station Report,* A, 1899, p. 138; B, 1901, p. 199; C, 1903, p. 140;

[1] Conn. Exp. Sta. Report of 1913, Part I, Section 1.

D, 1904, p. 188; E, 1906, p. 156-8; F, 1906, p. 165; G, 1907, p. 139; H, 1908, p. 603; I, 1908, p. 711; J, 1910, p. 550; K, 1911, p. 135; L, 1911, p. 161; M, 1912, p. 108; N, 1912, p. 197; O, 1912, p. 206; P, 1913, p. 18; Q, 1914, p. 146; R, 1915, p. 280; S, 1916, p. 193; T, 1917, p. 142-3; U, Bull. 218: 3. *Fetterolf, Univ. of Penn. Med. Bull.,* Sept., 1909: 4. *Inland Revenue Dept., Ottawa, Canada,* A, Bull. 354, pp. 6-9; B, Bull. 434: 5. *Janney, Münch. Med. Wochenschr.,* 40, 1910: 6. *König, Chem. Mensch. Nahr. u. Genussm.,* A, 1, 685, 1903; B, (Vers.-Stat. Münster); C, (Kornauth, Oesterr. Centralbl.); D, 1, 686 (Vers.-Stat. Münster); E, (Plagge and Lebbin); F, 1, 687 (Vers.-Stat. Münster); G, 1, 1463-4; H, 1, 1465; I, 1465 (Wintgen); J, 2, 535, 1904; K, 2, 883, 1904: 7. *König., Zeit. Nahr. u. Genussm.,* 1, 762, 1898: 8. *Kunz, Wein. klin. Wochenschr.,* 12, 509, 1899: 9. *Magnus-Levy, Berl. klin. Wochenschr.,* 47, 236, 1910: 10. *Maine Agr. Exp. Station,* A, Bull. 55, 1899, p. 96; B, Bull. 75, 99-101, 107, 1901; C, Bull. 158, p. 227-228, 1908; D, Off. Insp. 34, p. 123, 1911: 11. *Michigan Agr. Exp. Station,* Bull. 211, 1904, p. 18: 12. *New Hampshire State Board of Health,* A, 4, 5, 1916; B, 3, 65, 1914: 13. *North Dakota Agr. Exp. Station,* A, Report 1901, p. 20; B, Spec. Food Bull. 2, p. 184, 1912: 14. *Sandmeyer, Milch. Ztg.,* 29, 831, 1900: 15. *U. S. Dept. Agr., Notice of Judgment,* 1507: 16. *Wintgen, Zeit. Nahr. u. Genussm.* 5, 289, 1902: 17. *Zellner Pharm. Ztg.,* 46, 501, 1901.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	FLOURS AND MEALS.
	Acme Mills Co., Portland, Ore.
1910-15	Acme Diabetic Flour
	Amthor & Co., Halle.
1904-6j	Weizen-Protein
	Herman Barker, Somerville, Mass.
1906-2e	Barker's Gluten Food "A"
1912-2m	Barker's Gluten Food "A"
1919	Barker's Gluten Food "A"
1906-2e	Barker's Gluten Food "B"
1913-2p	Barker's Gluten Food "B"
1919	Barker's Gluten Food "B"
1906-2e	Barker's Gluten Food "C"
1913-2p	Barker's Gluten Food "C"
1919	Barker's Gluten Food "C"
	Battle Creek Sanitarium Co., Battle Creek, Mich.
1916-4a	Gluten Meal
1916-4a	Gluten Meal
1914-2q	Gluten Meal 80%
	Bischof & Co., London.
1907-2g	Gluten Flour
	Callard, Stewart & Watt, London.
1906-2e	Casoid Flour
1909-3	Casoid Flour
1916-4a	Gluten Flour
	Canada Cereal & Flour Co.
1919-4b	Gluten Flour
	Cereo Co., Tappan, N. Y.
1912-2m	Soy Bean Gruel Flour
1913-2p	Soy Bean Gruel Flour
1919	Soy Bean Gruel Flour
	The Dieto Food Co., New York City.
1914-2q	Flour, Pure Whole Wheat
	Empire Flour Mills.
1919-4b	Gluten Flour

OF DIABETIC FOODS.

Reference.	Water.	Ash.	Nitrogen.	Protein.		Fiber.	Nitrogen-free extract.		Fat.	Calories.
				N. x 6.25.	N. x 5.70.		Starch.	Other nitrogen-free extract, by difference.		
1910-15	9.40	1.10	1.50	9.40	.....	0.80	71.40	6.00	1.90	364
1904-6j	8.60	1.10	13.46	.....	76.70	....	12.20		1.40	368
1906-2e	10.10	0.20	13.66	.....	77.90	0.00	4.50[1]	6.70	0.60	362
1912-2m	7.40	0.40	13.90	.....	79.20	0.20	trace	12.30	0.50	370
1919	9.86	0.29	13.50	.....	76.95	0.06	2.56	9.84	0.44	361
1906-2e	10.10	0.20	13.50	.....	77.00	0.00	6.00[1]	6.10	0.60	362
1913-2p	6.30	0.40	13.62	.....	75.20	0.40	3.70	13.40	0.60	375
1919	9.72	0.33	12.98	.....	73.99	0.08	5.23	10.14	0.51	362
1906-2e	9.70	0.20	13.20	.....	75.20	0.00	8.30[1]	5.80	0.80	364
1913-2p	5.70	0.40	13.46	.....	76.70	0.60	3.40	12.60	0.60	377
1919	10.00	0.42	12.79	.....	72.90	0.09	6.39	9.80	0.40	360
1916-4a	7.55	1.35	4.61	.....	26.28	0.12	55.03	8.65	1.02	369
1916-4a	7.35	1.20	6.90	.....	39.33	....	41.12	10.08	0.92	370
1914-2q	6.83	....	13.44	.....	76.61	....	5.77	.....	.....	...
1907-2g	10.10	1.30	12.77	.....	72.80	0.20	12.00		3.60	372
1906-2e	10.00	2.50	13.70	85.60	.....	....	none	1.40[2]	0.50	353
1909-3	10.30	2.50	13.20	82.50	.....	....	none	3.10[2]	1.60	357
1916-4a	9.70	....	12.88	.....	73.40	....	none	.....	.....	...
1919-4b	12.02	2.61	3.26	.....	18.58	1.50	43.87	16.94	4.48	358
1912-2m	4.90	4.40	7.31	45.70	.....	1.90	0.60	22.00	20.50	458
1913-2p	4.20	4.20	6.90	43.10	.....	2.20	trace	24.90	21.40	465
1919	6.12	3.98	7.38	46.13	.....	2.38	0.90	21.86	18.63	443
1914-2q	7.85	1.15	2.36	.....	13.45	1.01	62.44	11.99	2.11	371
1919-4b	10.46	0.48	2.30	.....	13.11	0.25	59.08	15.48	1.14	3.61

[1] Includes water-soluble carbohydrates. [2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.	Water.	Ash.	Nitrogen.	Protein. N. x 6.25.	Protein. N. x 5.70.	Fiber.	Nitrogen-free extract. Starch.	Nitrogen-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
	FLOURS AND MEALS—(*continued*).										
	Farwell & Rhines, Watertown, N. Y.										
1906-2e	Cresco Flour	12.70	0.50	1.78	11.10	.....	....	.....	74.80	0.90	352
1913-2p	Cresco Flour	12.70	0.40	2.90	18.10	.....	0.40	57.20	10.20	1.00	351
1913-2p	Cresco Flour	.....	....	3.22	20.10	.....	....	.....	.....	.....	...
1904-2d	Gluten Flour	.....	....	1.50	.....	8.55	....	much	.....	.....	...
1906-2e	Gluten Flour	12.70	0.40	1.82	.....	10.40	0.30	71.50[1]	3.80	0.90	351
1906-2e	Gluten Flour	13.30	0.50	1.73	.....	9.90	0.10	72.00[1]	3.20	1.00	349
1909-3	Gluten Flour	10.70	0.50	1.92	.....	10.90	....	77.40[2]		0.50	358
1913-2p	Gluten Flour	8.30	0.60	6.90	.....	39.30	0.20	38.10	12.30	1.20	370
1913-2p	Gluten Flour	8.60	0.50	7.41	.....	42.20	0.60	32.80	14.20	1.10	367
1916-4a	Gluten Flour	10.65	0.45	3.06	.....	17.44	0.04	63.39	7.05	0.98	360
1916-4a	Gluten Flour	7.05	0.35	7.04	.....	40.13	....	41.35	10.12	1.00	366
1919-4b	Gluten Flour	10.93	0.34	3.64	.....	20.75	trace	54.09	12.55	1.34	362
1919-4b	Gluten Flour	11.14	0.57	3.84	.....	21.89	trace	55.71	9.41	1.28	360
1919-4b	Gluten Flour	9.34	0.52	7.16	.....	40.82	trace	32.17	15.75	1.40	368
1919-4b	Gluten Flour	9.09	0.55	6.90	.....	39.32	trace	37.75	12.03	1.26	368
1919	Gluten Flour 40%	10.65	0.75	7.10	.....	40.47	0.23	37.01	9.42	1.47	361
1904-2d	Genuine Gluten Flour 40%	.....	....	2.16	13.50	.....	....	much	.....	.....	...
1906-2e	Special Diabetic Food	12.00	1.90	2.29	14.30	.....	1.40	58.30[1]	9.10	3.00	354
1906-2e	Special Diabetic Food	10.30	1.60	2.27	14.20	.....	1.10	62.10[1]	7.90	2.80	362
1906-2e	Special Diabetic Food	12.40	1.30	2.05	12.80	.....	0.60	70.30		2.60	358
1906-2e	Special Diabetic Food	9.60	1.80	4.40	27.50	.....	1.70	40.00	16.60	2.80	362
1913-2p	Special Diabetic Food										
	Gericke, Potsdam										
1910-9	Aleuronat	9.30	0.90	13.34	.....	76.04	....	10.46[2]		3.30	376
	Golden Rod Milling Co., Portland, Ore.										
1913-2p	Acme Special Flour	10.00	0.70	2.53	15.80	.....	0.70	57.90	13.50	1.40	361
1919	Acme Special Flour	11.73	1.02	2.42	15.13	.....	0.33	61.48	8.56	1.75	356
1916-4a	Gluten Flour	12.12	....	2.47	.....	14.08	....	66.97	.....	1.25	...
	O. B. Gilman, Boston, Mass.										
1913-2p	Gluten Flour	8.70	1.00	7.57	.....	43.20	0.60	31.40	13.10	2.00	369
	Karl Goldscheider, Carlsbad.										
1909-3	Conalbin-Mehl No. 1	9.40	0.50	1.74	10.90	.....	....	78.80[2]		0.40	362
	Gumpert, Berlin.										
1910-9	Ultramehl	6.60	2.90	5.84	36.50	.....	....	9.40[2]		44.60	585
1908-10c	Wheat Protein, Hazard's	7.00	0.60	6.69	.....	38.10	0.30	52.80		1.20	374
	The Health Food Co., New York City.										
1906-2e	Almond Meal	8.50	6.40	8.10	50.60	.....	2.90	7.20[1]	8.80	15.60	407
1913-2p	Almond Meal	7.90	6.30	8.05	50.30	.....	2.80	trace	17.90	14.80	406

[1] Includes water-soluble carbohydrates. [2] Includes fiber.

OF DIABETIC FOODS—(*Continued*).

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.	Water.	Ash.	Nitrogen.	Protein. N. x 6.25.	Protein. N. x 5.70.	Fiber.	Nitrogen-free extract. Starch.	Nitrogen-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
	FLOURS AND MEALS—(*continued*).										
	The Health Food Co., New York City—(*continued*).										
1914-2q	Almond Meal	7.16	5.48	7.86	49.13	.....	0.48	none	15.91	21.84	457
1919	Almond Meal	7.90	6.01	8.04	50.25	.....	2.40	none	18.00	15.44	412
1919	Bran Biskue, Gluten Bran	9.19	3.38	4.85	.....	27.65	1.51	33.84	13.90	10.53	396
1911-2k	C. B. X. Cold Blast Flour, 25% Protein	8.70	0.50	1.62	10.10	.....	0.20	68.90	10.70	0.90	367
1919	Diabetic Casein Flour (self-raising)	11.93	9.16	11.56	72.25	.....	0.14	none	5.73	0.79	319
1914-2q	Gluten Flour No. 1	7.65	2.78	12.11	.....	69.03	0.21	7.09	12.36	0.88	362
1916-4a	Gluten Flour	7.70	....	7.28	.....	41.50	....	35.00	.....	.....	...
1919-4b	Gluten Flour 40%	8.48	0.65	6.88	.....	39.21	0.35	37.27	12.99	1.05	371
1906-2e	Glutosac Gluten Flour	10.10	1.10	5.45	.....	31.10	1.00	49.30[1]	5.80	1.60	359
1909-3	Glutosac Gluten Flour	8.00	1.10	5.65	.....	32.20	....	58.10[2]		0.60	367
1911-10d	Glutosac Gluten Flour	8.70	....	5.86	.....	33.40	....	.....	.....	.....	...
1913-2p	Glutosac Gluten Flour	8.20	1.40	6.38	.....	36.40	0.70	36.90	14.10	2.30	370
1914-2q	Glutosac Gluten Flour	8.18	1.20	6.08	.....	34.65	0.48	41.96	11.84	1.69	369
1919	Glutosac Gluten Flour	10.53	0.75	7.28	.....	41.50	0.29	36.20	9.05	1.68	362
1913-2p	Pronireu (Gluten Griddle Cake Flour)	8.80	4.90	5.97	.....	34.00	0.50	37.70	12.90	1.20	349
1919	Pronireu (Gluten Griddle Cake Flour)	10.81	4.26	6.64	.....	37.85	0.20	36.56	9.14	1.18	345
1906-2e	Protosac Gluten Flour	10.60	0.70	5.86	.....	33.40	0.30	50.00[1]	4.10	0.90	358
1913-2p	Protosac Gluten Flour	8.00	0.90	6.83	.....	38.90	0.30	36.30	13.90	1.70	372
1914-2q	Protosac Gluten Flour	8.16	1.30	7.35	.....	41.90	0.38	31.50	14.80	1.96	370
1913-2p	Protosoy Soy Flour	3.00	5.00	6.77	42.30	.....	5.40	trace	24.50	19.80	446
1914-2q	Protosoy Soy Flour	3.86	5.30	6.86	42.88	.....	2.75	1.86	24.17	19.18	448
1919	Protosoy Soy Flour	6.32	4.43	6.30	39.38	.....	4.33	1.86	25.10	18.58	433
1906-2e	Pure Washed Gluten Flour	6.20	0.80	9.98	.....	56.90	0.20	27.50[1]	7.50	0.90	376
1913-2p	Pure Washed Gluten Flour	6.10	0.50	12.85	.....	73.20	0.40	7.00	11.20	1.60	380
1914-2q	Pure Washed Gluten Flour	7.03	0.58	13.70	.....	78.09	0.40	2.81	10.08	1.01	373
1919	Pure Washed Gluten Flour	8.31	0.71	13.14	.....	74.90	0.30	3.77	10.04	1.97	373
1919	Snow Flake Diabetic Casein Flour	10.41	6.07	12.67	79.19	.....	....	none	3.18	1.15	340
	R. Hundhausen, Hamm.										
1892-6j	Aleuronat (pure)	8.50	0.90	13.78	.....	78.55	....	11.55		0.50	365
1892-6j	Aleuronat (less pure)	9.10	1.20	12.43	.....	70.85	0.20	17.45		1.20	364
	Hudon Hebert (furn'r).										
1919-4b	Gluten Flour	11.84	1.24	2.52	.....	14.36	1.30	52.20	16.84	2.22	354
	Jireh Diabetic Food Co., New York City.										
1906-2e	Diabetic Flour	9.30	1.30	2.29	14.30	.....	1.00	66.60[1]	5.30	2.20	365
1906-2e	Diabetic Flour	11.00	1.30	1.94	12.10	.....	1.10	72.70		1.80	355
1919-4b	Diabetic Flour	10.36	1.04	2.60	.....	14.82	1.00	50.13	20.69	1.96	360
1919-4b	Diabetic Flour	12.03	1.01	2.49	.....	14.22	1.05	50.62	18.55	2.52	356
1913-2p	Flour	7.60	1.40	2.30	14.40	.....	1.40	60.90	12.00	2.30	370
1919-4b	Gluten Flour	9.10	1.40	2.52	.....	14.36	1.20	50.00	21.86	2.08	371
1919-4b	Gluten Flour	11.34	1.34	2.50	.....	14.25	1.60	48.66	20.41	2.40	355

[1] Includes water-soluble carbohydrates. [2] Includes fiber.

OF DIABETIC FOODS—(*Continued*).

TABLE XI.—COMPILATION OF ANALYSES OF DIABETIC FOODS—(*Continued*).

FLOURS AND MEALS—(*continued*).

Reference.	Manufacturer and Brand.	Water.	Ash.	Nitrogen.	Protein. N. x 6.25.	Protein. N. x 5.70.	Fiber.	Nitrogen-free extract. Starch.	Nitrogen-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
	Jireh Diabetic Food Co., New York City—(*continued*).										
1913-2p	Patent Barley	5.00	1.10	1.82	11.40	.....	0.70	67.80	12.40	1.60	381
1913-2p	Patent Cotton Seed Flour	7.40	5.50	7.86	49.10	.....	4.00	6.00	15.30	12.70	396
1913-2p	Patent Lentils Flour	5.90	2.50	4.37	27.30	.....	3.30	42.60	17.20	1.20	359
1913-2p	Protein Flour	7.30	1.70	5.02	31.40	.....	0.90	48.50	8.20	2.00	370
1913-2p	Soja Bean Flour	4.40	4.60	6.77	42.30	.....	4.70	0.00	25.80	18.20	435
1906-2e	Wheat and Barley Flour	9.70	1.50	1.89	11.80	.....	1.60	66.20[1]	7.30	1.90	358
1906-2e	Wheat and Barley Flour	9.50	1.60	1.81	11.30	.....	1.40	74.40		1.80	359
	Johnson Educator Food Co., Boston, Mass.										
1906-2e	Educator Standard Gluten Flour	11.30	1.00	4.22	.....	24.10	0.40	56.80[1]	4.70	1.70	358
1911-2k	Educator Standard Gluten Flour	7.30	0.80	6.42	.....	36.60	0.20	40.90	12.80	1.40	374
1911-10d	Educator Standard Gluten Flour	8.80	....	6.42	.....	36.60	....	.....	.....	.....	...
	The Kellogg Food Co., Battle Creek, Mich.										
1904-11	20% Gluten Meal	10.50	1.00	2.53	.....	14.40	0.40	57.40	15.70	0.60	355
1909-3	20% Gluten Meal	8.90	1.10	3.36	.....	19.20	....	70.00[2]		0.80	364
1912-2m	20% Gluten Meal	9.80	1.40	4.40	.....	25.10	0.10	49.60	13.50	0.50	357
1916-2s	20% Gluten Meal	7.65	1.22	4.33	.....	24.68	0.12	51.24	14.17	0.92	369
1906-2e	40% Gluten Flour	10.50	0.50	6.45	.....	36.80	0.20	46.90[1]	3.90	1.20	361
1906-2e	40% Gluten Flour	8.50	1.40	6.14	.....	35.00	0.10	50.00[1]	3.80	1.20	366
1909-3	40% Gluten Flour	7.90	1.20	6.24	.....	35.60	....	53.50[2]		1.80	373
1912-2m	40% Gluten Flour	9.70	1.40	7.52	.....	42.90	0.20	31.90	13.00	0.90	359
1913-2p	40% Gluten Flour	8.00	1.20	6.99	.....	39.80	0.20	40.50	9.40	0.90	367
1916-2s	40% Gluten Flour	8.62	0.89	5.90	.....	33.63	0.08	48.04	7.31	1.43	369
1919	40% Gluten Flour	10.10	0.63	8.28	.....	47.20	0.26	30.66	10.17	0.98	261
1909-3	40% Gluten Flour, Self-Raising	8.80	1.30	6.19	.....	35.30	....	53.60[2]		1.00	365
1916-2s	40% Gluten Meal	7.30	1.36	7.29	.....	41.55	0.10	36.59	11.99	1.11	371
1919	40% Gluten Meal, Thoroughly Cooked	8.50	1.38	7.54	.....	42.98	0.31	33.38	12.00	1.45	380
1909-3	80% Gluten	7.20	0.60	12.61	.....	71.90	....	19.40[2]		0.90	373
1912-2m	80% Gluten	9.10	0.60	13.01	.....	74.20	0.20	6.20	8.80	0.90	365
1916-4a	Gluten Meal	5.10	0.45	12.90	.....	73.53	0.18	3.10	15.88	1.76	386
1916-2s	Pure Gluten Meal	4.60	0.96	13.47	.....	76.78	0.08	6.77	10.00	0.81	374
1919	Pure Gluten Meal	7.73	0.92	13.88	.....	79.12	0.19	2.56	8.74	0.74	368
	Lister Bros., New York City.										
1917-2t	Lister's Diabetic Flour, Self-rising	11.62	2.77	10.78	67.38	.....	0.17	none	17.20	0.86	346
1919	Lister's Diabetic Flour, Self-rising	11.53	9.44	10.93	68.31	.....	0.05	none	9.72	0.95	321
	Lyster Bros., Whitefield, N. H.										
1915-2r	Casein Flour	5.70	5.78	13.52	84.50	.....	0.05	none	0.37	3.60	381
1916-12a	Diabetic Flour	6.58	7.90	12.68	79.25	.....	....	none	.....	3.00	...

[1] Includes water-soluble carbohydrates. [2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES OF DIABETIC FOODS—(*Continued*).

Reference.	Manufacturer and Brand.	Water.	Ash.	Nitrogen.	Protein. N. x 6.25.	Protein. N. x 5.70.	Fiber.	Nitrogen-free extract. Starch.	Nitrogen-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
	FLOURS AND MEALS—(*continued*).										
	Eugene Loeb, New York City.										
1913-2p	Gluten Cracker Meal	9.70	1.00	4.45	.....	25.40	0.30	40.20	15.70	7.70	394
1913-2p	Imported Gluten Flour	9.20	1.40	12.21	.....	69.60	0.40	4.40	14.10	0.90	361
1913-2p	Pure Gluten Flour	10.10	0.60	6.45	.....	36.80	0.30	39.60	10.20	2.40	368
1913-2p	Whole Wheat Flour	11.10	1.10	2.34	.....	13.30	0.50	54.60	17.20	2.20	360
	E. Loeb & Co., New York City.										
1913-2p	Gluten Flour	9.80	0.50	7.02	.....	40.00	0.30	39.80	8.50	1.10	363
1919-4b	Gluten Flour	9.72	0.48	6.12	.....	34.86	0.20	39.87	14.11	0.76	362
	Loeb's Diabetic Food Bakery, New York City.										
1916-2s	Gluten Cracker Meal	8.22	1.07	6.82	.....	38.87	0.19	31.59	11.14	8.92	407
1919	Gluten Cracker Meal	8.40	1.59	6.44	.....	36.71	0.28	30.66	11.48	10.88	417
1919-4b	Gluten Cracker Meal	7.94	1.39	6.46	.....	36.82	0.30	32.17	12.43	8.95	406
1916-2s	Pure Gluten Flour	8.85	0.51	7.65	.....	43.61	0.13	35.78	10.11	1.01	333
1919	Pure Gluten Flour	10.48	0.89	6.80	.....	38.76	0.15	38.22	10.30	1.20	360
	Thos. Martindale & Co., Philadelphia, Pa.										
1913-2p	Special Gluten Flour	8.20	0.60	6.45	.....	36.80	0.30	41.40	11.20	1.50	371
	Maple Leaf Milling Co.										
1919-4b	Gluten Flour	12.52	0.38	2.22	.....	12.66	0.25	61.51	11.52	1.16	353
	Mayflower Mills, Fort Wayne, Ind.										
1913-2p	Bond's Diabetic Flour	9.40	0.60	6.43	40.20	.....	0.20	40.60	7.70	1.30	366
1919	Gluten Flour	10.35	0.85	8.42	.....	47.99	0.30	28.63	10.23	1.65	365
	A. McFarlane Co.										
1919-4b	Gluten Flour	11.09	0.47	2.16	.....	12.14	0.30	60.34	14.28	1.38	358
	P. McIntosh Co.										
1919-4b	Gluten Flour	10.65	0.45	2.64	.....	15.05	0.25	63.28	9.32	1.00	360
	Theo. Metcalf Co., Boston, Mass.										
1906-2e	Soja Bean Meal, 5.5% Starch	7.80	4.40	6.38	39.90	.....	3.90	9.00[1]	15.90	19.10	431
1906-2e	Soja Bean Meal, 7.6% Starch	.....	....	5.89	36.80	.....	...	.....	.....	.....	...
1913-2p	Soja Bean Meal, 18.0% Starch	6.50	4.10	6.56	41.00	.....	3.40	25.00		20.00	444
1906-2e	Vegetable Gluten, 20.0% Starch	7.90	0.70	9.82	.....	56.00	0.30	26.80[1]	6.70	1.60	372
1913-2p	Vegetable Gluten, 8.1% Starch	7.60	0.50	12.86	.....	73.30	0.20	5.90	11.00	1.50	374
	H. Niemöller, Gütersloh.										
1901-16	Roborat	9.50	1.40	13.17	82.30	.....	0.20	2.90		3.70	374

[1] Includes water-soluble carbohydrates.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	FLOURS AND MEALS—(*continued*).
	North Western Cereal Co., London, Ont.
1916-4a	Gluten Flour
1916-4a	Gluten Flour
1916-4a	Gluten Flour
1919-4b	Gluten Flour
1916-4a	Gluten Flour
1919-4b	Gluten Flour, 40%
	Norton-Truax, Chicago, Ill.
1919	Diaprotein
	Phospho Food Co., Los Angeles, Calif.
1914-2q	Phospho D. & D. Special
	Pieser-Livingston Co., Chicago, Ill.
1913-2p	Gluten Flour
1913-2p	Gluten Flour
1919	Genuine Gluten Flour
	Potter & Wrightington, Boston, Mass.
1919	Diet-Ease Gluten Flour
1919	Diet-Ease Gluten Flour
	The Pure Gluten Food Co., New York City.
1904-2d	Gum Gluten Flour
1911-2k	Gum Gluten Flour
1902-1b	Gum Gluten Ground
1904-11	Gum Gluten Ground
1906-2e	Gum Gluten Ground
1902-1b	Gum Gluten Self Raising
1906-2e	Gum Gluten Self Raising
1906-2e	Hoyt's Gum Gluten
1914-2q	Hoyt's Gum Gluten Flour, 50%
1914-2q	Hoyt's Gum Gluten Flour, Ground
1914-2q	Hoyt's Gum Gluten Self Raising Flour
1914-2q	Hoyt's Gum Gluten Special Flour
1901-10b	Plain Gluten Flour
1911-10d	Pure Gluten Flour
1911-10d	Pure Gluten Flour
	Pure Gluten Food Co., Columbus, Ohio.
1919	Hoyt's Gluten Flour over 40% Protein
1919	Hoyt's Gluten Self-raising Flour over 40% Protein
1919	Hoyt's Gluten Special Flour 80% Protein

OF DIABETIC FOODS—(*Continued*).

Reference.	Water.	Ash.	Nitrogen.	Protein.		Fiber.	Nitrogen-free extract.		Fat.	Calories.
				N. x 6.25.	N. x 5.70.		Starch.	Other nitrogen-free extract, by difference.		
1916-4a	8.50	....	2.07	.....	11.80	....	60.60	.....	.....	...
1916-4a	11.10	....	2.42	.....	13.79	....	54.68	.....	.....	...
1916-4a	9.30	....	2.03	.....	11.57	....	53.20	.....	.....	...
1919-4b	10.21	2.10	2.99	.....	17.07	1.58	42.10	21.95	4.99	369
1916-4a	12.77	....	1.78	.....	10.14	....	64.80	.....	2.02	...
1919-4b	11.66	2.27	2.49	.....	14.20	2.40	38.65	25.56	5.26	361
1919	11.72	6.35	12.44	77.75	.....	....	none	2.72	1.46	335
1914-2q	8.74	1.22	2.19	13.69	.....	1.24	58.57	14.35	2.19	366
1913-2p	8.50	0.60	6.93	.....	39.50	0.10	38.40	11.60	1.30	370
1913-2p	8.70	0.60	6.69	.....	38.10	0.20	36.50	14.50	1.40	369
1919	10.16	0.81	7.26	.....	41.38	0.20	36.31	9.79	1.35	362
1919	12.50	0.98	4.64	.....	26.45	0.73	46.89	10.29	2.16	354
1919	8.76	0.96	6.94	.....	39.56	0.42	36.20	11.78	2.32	371
1904-2d	.....	....	8.69	.....	49.53	....	.....	.....	.....	...
1911-2k	8.10	1.00	6.13	.....	34.90	0.20	42.40	11.80	1.60	371
1902-1b	11.90	0.90	4.29	.....	24.50	....	61.30[2]		1.40	356
1904-11	10.60	0.80	7.05	.....	40.20	0.40	30.00	16.70	1.30	359
1906-2e	6.90	1.00	8.02	.....	45.70	0.50	38.60[1]	5.40	1.90	376
1902-1b	9.80	3.80	5.04	.....	28.70	0.30	56.00		1.40	351
1906-2e	10.80	4.50	6.06	.....	34.50	0.50	42.90[1]	5.80	1.00	342
1906-2e	11.20	1.00	5.09	.....	29.00	0.30	52.00[1]	4.90	1.60	358
1914-2q	6.61	0.70	7.95	.....	45.32	0.33	37.07	8.82	1.15	375
1914-2q	8.21	0.60	6.71	.....	38.24	0.18	42.61	9.23	0.93	369
1914-2q	7.30	3.88	6.83	.....	38.93	0.40	38.98	9.76	0.75	357
1914-2q	5.63	0.93	14.51	.....	82.70	0.35	2.17	7.50	0.72	376
1901-10b	9.90	0.60	8.58	.....	48.90	0.20	34.50		5.90	363
1911-10d	.....	....	6.06	.....	34.54	....	.....	.....	.....	...
1911-10d	9.10	....	6.29	.....	35.54	....	.....	.....	.....	...
1919	10.68	0.82	7.34	.....	41.84	0.27	33.19	12.07	1.13	359
1919	10.18	3.85	7.28	.....	41.50	0.50	33.38	9.72	0.87	346
1919	6.82	1.10	13.54	.....	77.18	0.27	2.81	10.63	1.19	373

[1] Includes water-soluble carbohydrates. [2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	FLOURS AND MEALS—(*continued*).
	Rademann's Nährmittelfabrik, Frankfurt.
1913-2p	Diabetiker Mehl
	Ralston Health Food Co.
1895-1a	Gluten Flour
1902-1b	Gluten Flour
	Schulenburg Oil Mill, Schulenburg, Texas.
1915-2r	Allison's Cotton Seed Flour
1919	Baumgarten Process Allison Flour
	Soy Bean Food Products Co., San Francisco, Calif.
1919	Soy Bean Flour A
1919	Soy Bean Flour B
	Sprague, Warner & Co., Chicago, Ill.
1913-2p	Richelieu Gluten Flour
	Still Rock Spa, Waukesha, Wis.
1919	Curdolac Flour
	G. Van Abbott & Sons, London.
1913-2p	Almond Flour
1913-2p	Gluten Flour
1913-2p	Gluten Semola
	Waukesha Health Products Co., Waukesha, Wis.
1917-2t	Ayos, the Improved Soja Bean Flour
1914-12b	Hepco Flour
1919	Hepco Flour
	White Swan Spice Co., Toronto.
1916-4a	Diet Flour
1916-4a	Diet Flour
1919-4b	Diet Flour
1919-4b	Gluten Flour
1919-4b	Gluten Flour
1919-4b	Gluten Flour
	Wilson Bros., Rochester, N. Y.
1919	Genteel Brand Flour
1911-10d	Gluten Flour, 4/7 Standard
1911-10d	Gluten Flour, 4/7 Standard
1913-2p	Gluten Flour, 4/7 Standard
1913-2p	Gluten Flour, Self-Raising, 4/7 Standard
1919	Gluten Flour

OF DIABETIC FOODS—(*Continued*).

Reference.	Water.	Ash.	Nitrogen.	Protein.		Fiber.	Nitrogen-free extract.		Fat.	Calories.
				N. x 6.25.	N. x 5.70.		Starch.	Other nitrogen-free extract, by difference.		
1913-2p	9.60	0.80	6.06	37.90	.....	0.20	46.80	3.90	0.80	362
1895-1a	12.80	0.60	2.40	.....	13.70	0.60	70.30		2.00	354
1902-1b	11.90	0.90	2.53	.....	14.40	....	72.30[2]		0.50	351
1915-2r	9.38	5.95	8.06	50.38	.....	2.70	1.07	19.28	11.24	384
1919	8.08	5.67	8.00	50.00	.....	3.47	1.13	21.61	10.04	381
1919	7.65	4.71	6.69	41.81	.....	1.98	0.34	24.07	19.44	440
1919	7.91	5.08	7.04	44.00	.....	2.07	0.76	25.98	14.20	411
1913-2p	8.70	0.50	7.95	.....	45.30	0.20	31.60	12.50	1.20	368
1919	10.25	3.99	9.06	56.63	.....	3.79	5.09	17.89	2.36	335
1913-2p	4.00	3.00	3.94	24.60	.....	1.90	none	7.90	58.60	657
1913-2p	10.20	0.80	12.02	.....	68.50	0.40	12.40	6.80	0.90	359
1913-2p	10.10	2.80	8.22	.....	46.90	0.40	28.20	8.70	2.90	361
1917-2t	8.75	4.13	6.63	41.44	.....	3.82	0.56	24.43	16.87	458
1914-12b	6.96	5.05	6.72	42.00	.....	5.05	none	23.82[3]	17.12	417
1919	8.09	4.31	7.04	44.00	.....	2.15	0.90	21.41	19.14	438
1916-4a	10.20	....	2.06	12.90	.....	....	60.75	.....	.....	...
1916-4a	11.25	0.90	1.65	10.30	.....	0.10	67.84	7.95	1.66	359
1919-4b	11.47	0.70	1.52	.....	8.66	0.55	61.29	16.05	1.28	356
1919-4b	9.21	0.77	1.72	.....	9.80	0.44	62.30	16.00	1.48	370
1919-4b	10.50	0.75	1.56	.....	8.89	0.46	62.00	15.95	1.45	360
1919-4b	10.84	0.87	1.61	.....	9.18	0.44	61.60	15.47	1.60	359
1919	11.60	0.98	4.70	29.38	.....	0.26	49.16	6.23	2.39	361
1911-10d	11.10	....	3.18	.....	18.10	....	.....	.....	.....	...
1911-10d	9.70	....	3.12	.....	17.80	....	.....	.....	.....	...
1913-2p	11.00	1.20	3.33	.....	19.00	0.30	54.60	11.80	2.10	361
1913-2p	12.20	4.60	2.78	.....	15.80	0.30	51.80	13.30	2.00	342
1919	10.52	0.74	8.04	.....	45.83	0.36	28.63	11.91	2.01	364

[2] Includes fiber. [3] Includes soluble carbohydrates calculated as sugar 9.02 per cent.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	PROTEIN PREPARATIONS.
	The Bauer Chemical Co., Berlin.
1912-2n	Sanatogen
	Eiweiss Extrakt Co., Altona, Germany.
1900-6g	Soson
	Krecke & Co., Salzuflen.
1902-6i	Energin
	Menley & James, New York City.
1913-2p	Glidine
	Plasmon Co., London.
1899-6i	Plasmon (average 9 analyses)
1901-10b	Plasmon
1908-2h	Plasmon
1909-3	Plasmon
	Troponwerke, Mülheim.
1898-6g	Tropon (average of many analyses)
1901-10b	Tropon
	SOFT BREADS.
	Canada Bread Co., Toronto, Canada.
1919-4b	Gluten Bread
	The Dieto Food Co., New York City.
1914-2q	Dieto Bread, Pure Whole Wheat
	Ferguson Bakery, Boston, Mass.
1913-2p	Gluten Bread
	Frank & Co., Bockenheim.
1892-6f	Proteïn-Roggenbrot
1892-6f	Proteïn-Weizenbrot
	Fritz, Vienna.
....-6c	Aleuronatbrot
1910-5	Kleberbrot, Schwarz
1910-5	Litonbrot
	Fromm & Co., Dresden.
1910-5	Conglutinbrot
1910-5	Litonbrot

OF DIABETIC FOODS—(*Continued*).

Reference.	Water.	Ash.	Nitrogen.	Protein. N. x 6.25.	Protein. N. x 5.70.	Fiber.	Nitrogen-free extract. Starch.	Nitrogen-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
1912-2n	10.00	5.60	12.82	80.10	.....	....	4.20[2]		0.10	338
1900-6g	6.40	1.00	14.59	91.20	.....	....	1.10[2]		0.30	372
1902-6i	9.10	1.00	13.41	83.80	.....	0.30	1.30		4.50	381
1913-2p	5.70	0.90	14.62	.....	83.30	0.20	none	9.10	0.80	377
1899-6i	11.90	7.50	11.23	.....	64.00	....	15.90[2]		0.70	326
1901-10b	8.50	7.40	12.00	.....	68.40	....	15.50[2]		0.20	337
1908-2h	12.40	7.70	11.25	.....	64.10	....	15.40[2]		0.40	322
1909-3	10.90	7.60	12.59	.....	70.10	....	8.70[2]		2.70	339
1898-6g	9.30	1.20	13.86	86.60	.....	....	2.70[2]		0.20	359
1901-10b	9.20	0.80	14.16	88.50	.....	....	1.20[2]		0.30	362
1919-4b	35.00	2.34	1.73	.....	9.87	0.34	34.82	16.52	1.11	255
1914-2q	40.42	1.69	1.55	.....	8.84	0.71	36.57	11.41	0.36	231
1913-2p	37.20	1.70	3.87	.....	22.10	0.20	25.20	10.50	3.10	259
1892-6f	32.00	2.80	3.79	.....	21.60	2.30	35.10		6.20	283
1892-6f	31.90	2.70	3.74	.....	21.30	2.20	45.60		6.30	284
....-6c	35.50	1.30	2.50	.....	14.30	0.20	47.90		0.80	256
1910-5	.....	....	3.44	.....	19.60	....	50.50		.....	...
1910-5	.....	....	6.18	38.60	.....	....	15.40		.....	...
1910-5	.....	....	2.93	18.30	.....	....	47.30		.....	...
1910-5	.....	....	5.73	35.80	.....	....	14.30		.....	...

[2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	SOFT BREADS—(*continued*).
	Gericke, Potsdam.
1910-5	Doppel-Porterbrot
1910-9	Doppel-Porterbrot
1910-9	Dreifach-Porterbrot
1910-9	Einfach-Porterbrot
1910-9	Sifarbrot
	Karl Goldscheider, Carlsbad.
1910-9	Sinamylbrot
	Gumpert, Berlin.
1910-9	Diabetiker-Doppel-Schwarzbrot
1910-9	Diabetiker-Doppel-Schwarzbrot
1910-9	Diabetiker-Doppel-Weissbrot
1910-9	Einfach-Schwarzbrot
1910-9	Einfach-Weissbrot
1910-9	Ultrabrot
	F. Günther, Frankfurt.
1892-6d	Kleberbrot
	Health Food Co., New York City.
1906-2e	Glutosac Bread
1914-2q	Glutosac Bread
1919	Glutosac Bread
1919-2u	Glutosac Bread
1906-2e	Protosac Bread
1914-2q	Protosac Bread
1919	Protosac Bread, No. 1
1919	Protosac Bread, No. 2
	J. Heinbockel & Co., Baltimore, Md.
1914-2q	Diabeto Bread for Diabetes
	R. Hundhausen, Hamm.
1892-6a	Aleuronatbrot, low gluten
	Jireh Diabetic Food Co., New York City.
1906-2e	Whole Wheat Bread
1913-2p	Whole Wheat Bread (not fresh)
	Eugen Loeb, New York City.
1913-2p	P. & L. Genuine Gluten Bread
	Loeb's Diabetic Food Bakery, New York City.
1919	Caseine Bread
1919-2u	Caseine Bread

OF DIABETIC FOODS—(*Continued*).

Reference.	Water.	Ash.	Nitrogen.	Protein.		Fiber.	Nitrogen-free extract.		Fat.	Calories.
				N. x 6.25.	N. x 5.70.		Starch.	Other nitrogen-free extract, by difference.		
1910-5	38.60	....	4.30	26.90	.....	....	35.10		.....	...
1910-9	38.90	1.10	3.50	21.90	.....	....	36.60[2]		1.50	248
1910-9	35.10	1.30	4.91	30.70	.....	0.40	19.80	6.20	6.50	285
1910-9	30.50	1.60	2.85	17.80	.....	....	48.30[2]		1.80	280
1910-9	39.60	2.20	5.97	37.30	.....	0.60	12.30	2.70	5.30	257
1910-9	39.10	3.50	4.51	28.20	.....	4.40	17.30	2.90	4.60	235
1910-9	27.90	1.60	2.54	15.90	.....	0.50	39.40	2.60	11.80	348
1910-9	25.60	1.60	2.96	18.50	.....	....	41.90[2]		12.70	346
1910-9	23.70	2.30	3.01	18.80	.....	0.40	36.80	2.60	15.40	371
1910-9	30.10	1.40	2.50	15.60	.....	....	49.50[2]		3.40	291
1910-9	29.40	1.50	2.59	16.20	.....	....	46.40[2]		6.50	309
1910-9	27.90	3.10	4.51	28.20	.....	0.80	6.80	1.00	32.20	434
1892-6d	33.70	2.40	2.75	.....	15.68	0.70	47.02		0.50	255
1906-2e	31.50	1.90	4.38	.....	24.40	0.40	29.90[1]	9.20	2.70	278
1914-2q	37.20	1.64	4.34	.....	24.74	0.82	22.17	11.33	2.10	252
1919	28.28	1.72	4.86	.....	27.70	1.49	26.78	10.33	3.70	293
1919-2u	23.10	1.95	5.22	.....	29.75	0.84	29.53	12.26	2.57	309
1906-2e	27.30	1.40	5.20	.....	29.60	0.20	33.10[1]	6.80	1.60	292
1914-2q	30.70	2.11	4.77	.....	27.19	0.38	27.66	10.16	1.80	276
1919	28.85	2.42	6.31	.....	35.97	0.84	20.53	7.39	4.00	292
1919	28.49	1.83	4.73	.....	26.96	0.30	30.47	8.43	3.52	302
1914-2q	33.47	3.22	1.37	8.55	.....	1.15	40.39	11.73	1.49	256
1892-6a	39.60	1.60	2.77	.....	15.80	0.60	42.10		0.30	234
1906-2e	39.20	1.80	1.50	.....	8.60	0.60	43.80[1]	5.60	0.40	236
1913-2p	21.80	2.50	1.98	.....	11.30	0.60	44.90	18.20	0.70	304
1913-2p	31.40	1.60	1.66	.....	9.50	0.30	44.20	10.40	2.60	280
1919	40.42	4.47	6.53	40.84	.....	0.08	none	3.35	10.84	274
1919-2u	39.73	4.35	6.57	41.05	.....	0.09	trace	3.71	11.07	323

[1] Includes water-soluble carbohydrates. [2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES OF DIABETIC FOODS—(*Continued*).

Reference.	Manufacturer and Brand.	Water.	Ash.	Nitrogen.	Protein. N. x 6.25.	Protein. N. x 5.70.	Fiber.	Nitrogen-free extract. Starch.	Nitrogen-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
	SOFT BREADS—(*continued*).										
	Loeb's Diabetic Food Bakery, New York City—(*continued*).										
1919	Caseine Muffins	30.82	4.89	7.32	45.74	.....	0.15	none	7.03	11.37	313
1916-2s	Genuine Gluten Bread	27.72	1.51	5.66	.....	32.26	0.21	26.37	11.76	0.17	282
1919	Genuine Gluten Bread	32.01	1.80	4.98	.....	28.39	0.28	28.56	6.86	2.10	273
1914-2q	P. & L. Genuine Glubetic Bread	30.07	1.06	6.20	.....	35.34	0.36	19.15	9.97	4.05	294
	Lyster Bros., Whitefield, N. H.										
1915-2r	Casein Bread	38.27	4.24	5.85	36.57	.....	0.05	none	2.49	18.38	322
	Rademann's Nährmittelfabrik, Frankfurt.										
1910-9	Diabetiker-Grahambrot	31.70	1.80	1.57	9.80	.....	2.10	45.60	3.90	5.10	283
1910-5	Diabetiker-Schwarzbrot (dry)	.....	....	6.05	37.80	.....	....	33.30		.....	...
1910-9	Diabetiker-Schwarzbrot	29.10	1.90	2.32	14.50	.....	1.40	45.80	4.80	2.50	283
1910-9	Diabetiker-Schwarzbrot	33.60	1.90	2.38	14.90	.....	....	47.70[2]		1.90	267
1910-5	Diabetiker-Weissbrot (dry)	.....	....	6.94	43.40	.....	....	28.10		.....	...
1910-9	Diabetiker-Weissbrot	33.80	1.90	3.73	23.30	.....	0.40	37.00	3.10	0.50	258
1910-5	"D-K" Brot (dry)	.....	....	1.97	12.30	.....	....	58.90		.....	...
1892-6f	Erdnuss-Brot	24.60	3.80	5.38	33.60	.....	5.50	19.70		12.80	328
1910-9	Litonbrot	42.60	2.40	4.83	30.20	.....	0.70	17.50	4.10	2.50	230
	Schelte, Münster.										
1894-6b	Aleuronatbrot	38.80	1.30	2.93	.....	16.70	0.90	41.70		0.60	239
	Seidl, München.										
1910-5	Aleuronatbrot	28.00	....	3.50	.....	20.00	....	49.20		0.30	280
1910-5	Kleberbrot	24.20	....	2.98	.....	17.00	....	56.00		0.70	298
	Slinn-Shouldis Co.										
1919-4b	Gluten Bread	35.00	0.69	1.62	.....	9.20	0.17	39.00	13.36	2.58	269
	Troponwerke, Mülheim.										
1899-8	Tropon-Brot	42.10	....	3.12	19.50	.....	....	.....	.....	.....	...
	Weston Bakery, Boston, Mass.										
1915-2r	Gluten Bread	.....	....	3.34	.....	19.04	....	28.16	.....	.....	...
	HARD BREADS AND BAKERY PRODUCTS.										
	James Aird.										
1916-4a	Gluten Bread	8.10	2.05	2.25	.....	13.13	0.70	59.75	15.91	0.72	360
	Bichof & Co., London.										
1907-2g	Diabetic Gluten Bread	7.40	4.70	11.70	.....	66.70	0.00	20.70		0.50	354
1907-2g	Essentiel Bread for Super Alimentation	7.30	4.80	4.26	26.60	.....	0.10	59.60		1.60	359

[2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES OF DIABETIC FOODS—(*Continued*).

Reference.	Manufacturer and Brand.	Water.	Ash.	Nitrogen.	Protein.		Fiber.	Nitrogen-free extract.		Fat.	Calories.
					N. x 6.25.	N. x 5.70.		Starch.	Other nitrogen-free extract, by difference.		
	HARD BREADS AND BAKERY PRODUCTS—(*continued*).										
	Brusson Jeune, Villemur, France.										
1910-2j	Gluten Bread	7.80	1.10	5.14	.....	29.30	0.20	49.80	10.00	1.80	373
1912-2m	Gluten Bread	12.70	0.80	5.97	.....	34.00	0.30	40.10	10.30	1.80	354
	Callard, Stewart & Watt, London.										
1909-3	Almond Biscuit, Plain	3.70	3.20	4.53	28.30	.....	....	36.80[2]		28.00	512
1909-3	Almond Shortbreads	4.20	3.50	3.12	19.50	.....	....	20.70[2]		52.10	630
1916-4a	Casoid Biscuits	7.52	....	8.99	56.18	.....	....	trace	.....	27.10	...
1906-2e	Casoid Biscuits, No. 1	7.80	3.90	10.08	63.00	.....	....	8.10[1]	.....	17.30	440
1909-3	Casoid Biscuits, No. 1	7.20	2.50	10.37	64.80	.....	....	8.70[2]		16.80	445
1913-2p	Casoid Biscuits, No. 1	4.80	3.40	10.69	66.80	.....	0.40	4.00	1.80	18.80	460
1908-2i	Casoid Biscuits, No. 2	.....	....	9.30	58.10	.....	....	0.00	.....	.....	...
1909-3	Casoid Biscuits, No. 2	7.50	3.60	9.25	57.80	.....	....	5.60[2]		25.50	483
1908-2i	Casoid Biscuits, No. 3	.....	....	8.75	54.70	.....	....	trace	.....	.....	...
1909-3	Casoid Biscuits, No. 3	7.90	5.00	8.69	54.30	.....	....	7.80[2]		25.00	473
1908-2i	Casoid Dinner Rolls	.....	....	12.93	80.80	.....	....	3.30[1]	.....	.....	...
1909-3	Casoid Dinner Rolls	7.00	1.80	12.48	78.00	.....	....	2.10[2]		11.10	420
1909-3	Casoid Lunch Biscuit	4.20	3.80	4.08	25.50	.....	....	21.60[2]		44.90	593
1909-3	Casoid Rusk	5.40	4.50	5.92	37.00	.....	....	20.80[2]		32.30	522
1909-3	Cocoanut Biscuit + Saccharin	2.60	3.10	2.66	16.60	.....	....	16.40[2]		61.30	684
1909-3	Ginger Biscuit + Saccharin	2.50	3.70	2.74	17.10	.....	....	18.10[2]		58.60	668
1909-3	Kalari Batons	8.10	4.40	8.46	52.90	.....	....	0.90[2]		33.70	519
1913-2p	Kalari Batons	4.50	5.20	6.91	43.20	.....	0.70	none	7.40	39.00	553
1909-3	Kalari Biscuits	6.30	3.70	9.10	56.90	.....	....	1.70[2]		31.40	517
1909-3	Prolactic Biscuits	6.30	4.00	6.86	42.90	.....	....	19.30[2]		27.50	496
	Canada Bread Co., Toronto, Canada.										
1916-4a	Gluten Health Bread	7.45	1.95	2.70	.....	15.39	0.78	57.88	13.19	3.36	376
	The Dieto Food Co., New York City.										
1914-2q	Dieto Crackers	6.59	1.75	1.98	13.38	.....	0.98	54.84	13.92	9.24	409
1914-2q	Dieto Rusks	6.43	1.50	2.55	15.94	.....	0.98	52.09	13.95	9.11	410
	Frank & Co., Bockenheim.										
1892-6f	Erdnuss-Kakes	6.40	2.70	5.15	32.20	.....	3.10	36.50		19.10	447
	Fritz, Vienna.										
1910-5	Braunes Luftbrot "B"	.....	....	6.82	42.60	.....	....	19.80		.....	...
1910-5	Mandelbrot	.....	....	2.46	15.40	.....	....	23.10		.....	...
	Fromm & Co., Dresden.										
1913-2p	Almond-form Wafers with Chocolate	2.60	1.00	0.77	4.80	.....	0.30	14.00	48.30	29.00	529
1913-2p	Butterbrezeln	6.30	2.00	1.97	12.30	.....	0.20	43.10	19.60	16.50	449
1914-2q	Conglutin Drops	6.49	5.23	8.13	50.81	.....	0.23	29.19	6.94	1.11	358

[1] Includes water-soluble carbohydrates. [2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES

OF DIABETIC FOODS—(*Continued*).

Reference.	Manufacturer and Brand.	Water.	Ash.	Nitrogen.	Protein. N. x 6.25.	Protein. N. x 5.70.	Fiber.	Nitrogen-free extract. Starch.	Nitrogen-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
	HARD BREADS AND BAKERY PRODUCTS—(*continued*).										
	Fromm & Co., Dresden—(*continued*).										
1914-2q	Conglutin-Zwieback	4.48	2.00	2.28	14.25	.....	0.40	29.70	27.92	21.25	479
1913-2p	Crackers	7.40	3.40	2.06	12.90	.....	0.20	58.20	10.20	7.70	395
1913-2p	Eierbiscuit	7.70	1.30	3.01	18.80	.....	0.20	37.50	23.10	11.40	420
1910-5	Eiweissbrot	.....	....	7.28	45.50	.....	....	37.50		.....	...
1913-2p	Hazelnuss-Stangen	5.20	2.90	2.14	13.40	.....	1.70	none	60.80	16.00	441
1913-2p	Luft Bread	8.30	8.90	8.14	50.90	.....	0.20	23.40	7.30	1.00	335
1913-2p	Makronen	6.00	3.00	2.26	14.10	.....	1.30	none	56.20	19.40	456
1913-2p	Salz-Stangen	6.20	3.60	2.08	13.00	.....	0.40	39.10	22.10	15.60	437
1913-2p	Stangenin	6.60	1.60	2.24	14.00	.....	0.40	51.60	12.80	13.00	431
1910-5	Uni Bread	.....	....	11.41	71.30	.....	....	8.60		.....	...
1913-2p	Uni Bread	8.10	5.60	11.47	71.70	.....	3.50	2.90	6.50	1.70	340
	Gericke, Potsdam.										
1910-5	Doppel-Porterzwieback	.....	....	3.06	19.10	.....	....	41.00		.....	...
1910-9	Doppel-Porterzwieback	4.90	1.70	5.47	34.20	.....	....	39.70[2]		19.50	471
1910-5	Mandelbrot	.....	....	2.59	16.20	.....	....	43.30		.....	...
1910-5	Porterbiskuits	.....	....	2.58	16.10	.....	....	63.00		.....	...
1910-5	Porterzwieback	.....	....	4.22	26.40	.....	....	72.00		.....	...
1910-5	Sifarbiskuits	.....	....	3.23	20.20	.....	....	35.30		.....	...
	Karl Goldscheider, Karlsbad.										
1914-2q	Aleuronat-Conglutin Cakes	5.17	1.25	4.26	26.63	.....	0.08	31.67	19.63	15.57	452
1914-2q	Butter-Brezeln	5.16	1.83	1.68	10.50	.....	0.08	43.93	23.64	14.86	446
1914-2q	Feinste Cocosnuss-Biskuits für Diabetiker "3.6% carbohydrates"	2.71	2.73	5.50	34.44	.....	0.88	0.00	13.86	45.38	602
1914-2q	Feinste Vanille-Biskuits für Diabetiker, "3.6% carbohydrates"	3.14	2.85	7.42	46.38	.....	0.55	none	16.75	30.33	525
1914-2q	Honigküchen für Diabetiker, "3.6% carbohydrates"	2.98	3.05	6.45	40.31	.....	1.00	none	13.91	38.75	566
1914-2q	Saccharin-Oblaten ohne Zucker	5.42	2.43	2.64	16.50	.....	1.95	33.47	17.63	22.60	474
1914-2q	Tee-Gebäck	3.44	1.28	1.12	7.00	.....	0.23	18.00	42.79	27.26	517
1914-2q	Zwieback	6.85	2.70	3.41	21.31	.....	0.23	51.69	13.61	3.61	379
	Groetzsch, Frankfurt.										
1910-9	Diabetiker-Salzbrezch	14.00	3.30	5.81	36.30	.....	....	17.10[2]		29.30	477
1910-9	Diabetiker-Salzbrezch	5.30	1.60	5.52	34.50	.....	0.30	22.90		35.40	548
1910-9	Pfeffernüsse	25.20	2.80	6.19	38.70	.....	....	9.30[2]		24.00	408
1910-9	Pfeffernüsse	15.20	2.60	6.27	39.20	.....	0.70	10.30		32.00	486
	Gumpert, Berlin.										
1910-9	Diabetiker-Stangen	5.50	2.90	4.98	31.10	.....	....	11.00[2]		49.50	614
1910-9	Doppel-Diabetiker-Zwieback	4.60	2.50	5.20	32.50	.....	0.80	27.10	0.40	32.10	529
	F. Gunther, Frankfurt.										
1892-6d	Aleuronat-Kakes	5.10	0.80	2.38	.....	13.60	0.40	70.80		9.30	421
1892-6d	Aleuronat-Kakes	4.50	1.60	2.85	.....	16.30	0.90	68.80		7.90	412
1897-6e	Aleuronat-Kakes	4.50	1.50	2.45	.....	14.00	....	71.30[2]		8.70	420

[2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES OF DIABETIC FOODS—(*Continued*).

HARD BREADS AND BAKERY PRODUCTS—(*continued*).

Health Food Co., New York City.

Reference.	Manufacturer and Brand.	Water.	Ash.	Nitrogen.	Protein. N. x 6.25.	Protein. N. x 5.70.	Fiber.	Nitrogen-free extract. Starch.	Nitrogen-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
1919	Alpha	9.48	5.76	10.97	68.56	.....	0.35	1.01	6.40	8.44	380
1913-2p	Alpha Best Diabetic Wafer	4.90	3.60	10.58	66.10	.....	0.50	trace	11.30	13.60	432
1914-2q	Alpha Best Diabetic Wafer	7.61	5.03	10.73	67.06	.....	0.16	1.26	10.47	8.41	391
1919	Alpha No. 1 Best Diabetic Wafer, Casein	6.81	6.23	7.74	48.38	.....	0.17	none	4.89	33.52	515
1919	Alpha No. 2 Best Diabetic Wafer	12.88	5.09	11.28	70.50	.....	0.13	1.13	6.25	4.02	348
1906-2e	Diabetic Biscuit	4.70	3.10	4.50	28.10	.....	0.30	51.10[1]	13.70	9.00	413
1913-2p	Diabetic Biscuit	8.90	2.50	4.00	25.00	.....	0.20	46.50	7.70	9.20	400
1914-2q	Diabetic Biscuit	5.80	2.55	5.75	35.94	.....	0.35	39.77	6.76	8.83	409
1919	Gluten Cracker Dust	8.58	2.42	7.81	.....	44.52	0.71	23.18	11.83	8.76	398
1913-2p	Gluten Nuggets	5.70	2.80	4.83	.....	27.50	0.20	38.60	12.40	12.80	429
1914-2q	Gluten Nuggets	5.32	2.75	5.07	.....	28.90	0.27	34.93	13.53	14.30	438
1919	Gluten Nuggets	8.59	2.35	5.06	.....	28.84	0.33	32.18	15.38	12.33	417
1906-2e	Glutona	4.80	2.50	3.38	.....	19.30	0.30	54.90[1]	6.40	11.80	429
1919	Glutona Bread Sticks	8.21	2.29	5.86	.....	33.40	0.29	30.60	14.10	11.11	412
1906-2e	Glutosac Butter Wafers	4.70	3.80	4.42	.....	25.20	1.60	41.20[1]	10.60	12.90	424
1914-2q	Glutosac Butter Wafers	5.44	2.10	4.98	.....	28.39	0.38	38.93	10.82	13.94	438
1919	Glutosac Butter Wafers	10.30	1.89	5.46	.....	31.12	0.36	40.42	7.92	7.99	390
1906-2e	Glutosac Rusks	4.50	2.70	5.84	.....	33.30	0.90	42.50[1]	12.30	3.80	387
1914-2q	Glutosac Rusks	6.66	2.50	6.29	.....	35.85	1.13	33.64	16.78	3.44	376
1919	Glutosac Rusks	9.91	2.20	6.08	.....	34.65	0.83	34.26	12.53	5.62	376
1906-2e	Glutosac Wafers, Plain	6.10	3.50	4.70	.....	26.80	1.50	41.60[1]	10.90	9.60	404
1914-2q	Glutosac Wafers, Plain	7.24	2.55	6.82	.....	38.87	1.58	29.55	18.47	1.74	363
1919	Glutosac Wafers, Plain	10.47	2.55	7.20	.....	41.04	1.19	25.12	12.09	7.54	342
1906-2e	Glutosac Zwieback	7.60	2.50	5.20	.....	29.60	1.20	40.90[1]	11.30	6.90	389
1914-2q	Glutosac Zwieback	5.92	2.50	5.82	.....	33.17	0.85	32.46	17.39	7.71	401
1919	Glutosac Zwieback	9.18	2.04	5.06	.....	28.84	0.83	33.34	15.24	10.53	405
1906-2e	No. 1 Proto Puffs	8.60	1.30	12.14	.....	69.20	0.10	9.90[1]	9.90	1.00	365
1913-2p	No. 1 Proto Puffs	7.20	2.70	12.21	.....	69.60	0.20	4.30	13.10	2.90	374
1914-2q	No. 1 Proto Puffs	8.71	2.80	11.56	.....	65.89	0.40	9.23	10.15	2.82	366
1919	No. 1 Proto Puffs	9.32	2.73	12.12	.....	69.08	0.20	3.26	10.74	4.67	371
1911-2k	No. 2 Proto Puffs	8.20	1.80	8.38	.....	47.80	0.20	27.20	13.30	1.50	367
1913-2p	No. 2 Proto Puffs	7.90	2.50	9.06	....	51.60	0.20	19.00	16.70	2.10	368
1914-2q	No. 2 Proto Puffs	9.16	2.60	9.40	.....	53.58	0.40	20.70	11.47	2.09	362
1906-2e	Protosac Rusk	5.90	2.00	6.54	.....	37.30	0.50	43.90[1]	8.40	2.00	376
1914-2q	Protosac Rusk	7.21	2.93	6.35	.....	36.19	0.48	35.89	14.30	3.00	373
1919	Protosac Rusk	11.00	2.22	5.74	.....	32.71	1.95	39.26	7.84	5.02	364
1913-2p	Protosoy Diabetic Wafer	3.90	5.00	6.90	43.10	.....	1.90	4.70	16.50	24.90	481
1914-2q	Protosoy Diabetic Wafer	4.76	3.50	5.93	37.07	.....	1.80	14.40	14.94	23.53	477
1919	Protosoy Diabetic Wafer	7.35	4.03	7.44	46.50	.....	1.80	10.58	14.23	15.51	421
1906-2e	Salvia Almond Sticks	6.60	7.50	6.27	39.20	.....	1.90	18.70[1]	5.30	20.80	440
1914-2q	Salvia Almond Sticks	2.63	3.38	3.57	22.31	.....	0.70	28.29	12.75	29.94	523
1919	Salvia Almond Sticks	7.11	3.28	5.14	32.13	.....	0.85	21.40	9.10	26.13	486

[1] Includes water-soluble carbohydrates.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	HARD BREADS AND BAKERY PRODUCTS—(*continued*).
	Heintz Food Co., Chicago, Ill.
1912-13b	Gluten Biscuits
1913-2p	Gluten Biscuits
1913-2p	Glutin Biscuits
	Ch. Heudebert, Paris.
1914-2q	Pain d'Aleurone pour Diabétiques, "5% carbohydrates"
1914-2q	Pain "Essentiel" en Biscottes
1914-2q	Pain de Gluten pour Diabétiques
	R. Hundhausen, Hamm.
1892-6k	Aleuronatzwieback, high gluten
1892-6k	Aleuronatzwieback, low gluten
1894-6b	Aleuronat-Biskuits
1891-6b	Aleuronat-Kakes.
	Huntley & Palmer, London.
1912-2m	Akoll Biscuits
1913-2p	Akoll Biscuits
1916-2s	Akoll Biscuits
	Jireh Diabetic Food Co., New York City.
1906-2e	Diabetic Biscuits
1906-2e	Diabetic Biscuits
1913-2p	Diabetic Biscuits
1906-2e	Diabetic Rusks
1913-2p	Diabetic Rusks
1906-2e	Wheat Nuts
1906-2e	Wheat Nuts
	Johnson Educator Food Co., Boston, Mass.
1906-2e	Almond Biscuits
1906-2e	Diabetic Biscuits
1906-2e	Educator Crackers, Greseni Gluten
1913-2p	Educator Gluten Bread Sticks
1911-2k	Gluten Cookies
1919-4b	Gluten Cookies
1906-2e	Gluten Rusk, Greseni Gluten
1906-2e	Gluten Wafers
1906-2e	Glutine, Greseni Gluten
1899-10a	Glutine, Greseni Gluten
	The Kellogg Food Co., Battle Creek, Mich.
1912-2m	Avena-Gluten Biscuit
1906-2e	Potato Gluten Biscuit

OF DIABETIC FOODS—(*Continued*).

Reference.	Water.	Ash.	Nitrogen.	Protein.		Fiber.	Nitrogen-free extract.		Fat.	Calories.
				N. x 6.25.	N. x 5.70.		Starch.	Other nitrogen-free extract, by difference.		
1912-13b	.....	....	2.10	.....	11.97	....	.....	.....	.....	...
1913-2p	6.40	3.50	2.05	.....	11.70	1.30	21.40	37.40	18.30	447
1913-2p	7.30	3.00	2.32	.....	13.20	1.00	45.50	22.80	7.20	391
1914-2q	8.18	4.43	12.17	.....	69.21	0.71	4.22	11.80	1.45	354
1914-2q	7.67	2.33	4.22	26.38	.....	0.20	49.89	12.33	1.20	365
1914-2q	7.85	3.96	12.90	.....	73.53	0.16	3.38	10.28	0.84	356
1892-6k	8.50	2.60	10.59	.....	60.40	....	23.50[2]		5.00	381
1892-6k	6.50	1.60	3.66	.....	20.90	0.80	61.60		8.60	407
1894-6b	6.60	4.70	3.97	.....	22.60	0.50	54.40		11.20	409
1891-6b	3.40	1.10	3.22	.....	18.40	1.20	66.50		9.40	424
1912-2m	9.30	3.90	8.51	53.20	.....	0.40	trace	6.30	26.90	480
1913-2p	7.20	3.40	8.72	54.50	.....	0.70	trace	6.80	27.40	492
1916-2s	7.97	3.43	8.57	53.56	.....	0.49	trace	6.22	28.33	493
1906-2e	6.30	2.00	2.37	14.80	.....	0.90	65.40[1]	6.90	3.70	382
1906-2e	8.90	2.30	2.10	13.10	.....	1.20	70.60		3.90	370
1913-2p	5.40	2.00	2.11	13.20	....	1.20	49.60	21.20	7.40	403
1906-2e	8.70	3.10	2.34	14.60	.....	0.90	67.70		5.00	374
1913-2p	5.40	1.90	2.38	14.90	.....	1.10	47.00	21.00	8.70	410
1906-2e	7.60	2.30	3.04	19.00	.....	1.00	50.10[1]	4.40	15.60	434
1906-2e	6.00	3.20	3.36	21.00	.....	1.20	46.30		22.30	470
1906-2e	5.30	2.10	4.64	29.00	.....	0.50	50.00[1]	4.30	8.80	412
1906-2e	5.90	1.90	4.05	25.30	.....	0.40	54.90[1]	4.10	7.50	405
1906-2e	6.20	2.90	3.68	.....	21.00	0.20	57.90[1]	7.20	4.60	386
1913-2p	8.40	2.40	5.74	.....	32.70	0.30	37.50	11.50	7.20	392
1911-2k	4.80	2.70	4.22	.....	24.10	0.30	37.80	14.30	16.00	449
1919-4b	5.94	3.16	5.08	.....	28.96	0.40	36.49	13.45	11.60	422
1906-2e	6.20	3.00	3.54	.....	20.20	0.30	63.30[1]	6.70	0.30	364
1906-2e	6.90	0.90	4.85	.....	27.60	0.30	57.00[1]	6.90	0.40	370
1906-2e	6.40	2.60	3.50	.....	20.00	0.40	63.10[1]	6.50	0.80	366
1899-10a	10.20	1.10	2.21	.....	12.60	....	75.20[2]		0.90	359
1912-2m	7.90	2.10	3.42	.....	19.50	0.40	41.10	16.30	12.70	422
1906-2e	8.20	0.80	12.80	.....	73.00	0.00	9.80[1]	7.80	0.40	366

[1] Includes water-soluble carbohydrates. [2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	HARD BREADS AND BAKERY PRODUCTS—(*continued*).
	The Kellogg Food Co, Battle Creek, Mich.—(*continued*).
1909-3	Potato Gluten Biscuit
1913-2p	Potato Gluten Biscuit
1906-2e	Pure Gluten Biscuit
1909-3	Pure Gluten Biscuit
1916-2s	Pure Gluten Biscuit
1919	Pure Gluten Biscuit
1913-2p	Taro-Gluten Biscuits
1906-2e	40% Gluten Biscuit
1909-3	40% Gluten Biscuit
1911-2k	40% Gluten Biscuit
1912-2m	40% Gluten Biscuit
1913-2p	40% Gluten Biscuit
1916-2s	40% Gluten Biscuit
1919	40% Gluten Biscuit
1912-2m	80% Gluten Biscuit
	Kirche, Düsseldorf.
1895-6b	Aleuronat-Kakes
	Klopfer Chemische Fabrik, Dresden.
1910-9	Glidinebrot
	Eugene Loeb, New York City.
1913-2p	Gluten Luft Bread
	Loeb's Diabetic Food Bakery, New York City.
1919	Aereated Gluten Bread
1914-2q	Diabetic Almond Macaroons
1916-2s	Diabetic Almond Macaroons
1919	Diabetic Almond Macaroons
1914-2q	Diabetic Bread Sticks
1916-2s	Diabetic Bread Sticks
1919	Diabetic Bread Sticks
1919-4b	Diabetic Bread Sticks
1919	Diabetic Bread Sticks, Almond
1916-2s	Diabetic Butter Cookies
1916-2s	Diabetic Butter Cookies
1919	Diabetic Butter Cookies
1914-2q	Diabetic Lady Fingers
1916-2s	Diabetic Lady Fingers
1919	Diabetic Lady Fingers
1914-2q	Diabetic Sponge Cookies
1916-2s	Diabetic Sponge Cookies

OF DIABETIC FOODS—(*Continued*).

Reference.	Water.	Ash.	Nitrogen.	Protein.		Fiber.	Nitrogen-free extract.		Fat.	Calories.
				N. x 6.25.	N. x 5.70.		Starch.	Other nitrogen-free extract, by difference.		
1909-3	7.60	0.90	12.10	.....	69.00	....	19.90[2]		2.60	379
1913-2p	8.80	0.80	6.64	.....	37.90	0.40	39.50	12.10	0.50	363
1906-2e	7.50	1.00	12.85	.....	73.20	0.20	9.10[1]	8.20	0.80	369
1909-3	8.20	1.10	7.73	.....	44.10	....	43.30[2]		3.30	379
1916-2s	8.30	2.04	12.96	.....	73.87	0.12	4.02	10.82	0.83	362
1919	8.33	2.04	13.75	.....	78.38	0.35	2.87	6.53	1.50	365
1913-2p	9.40	0.70	5.01	.....	28.60	0.40	48.20	12.20	0.50	361
1906-2e	7.50	1.60	5.73	.....	32.70	0.10	52.60[1]	4.50	1.00	368
1909-3	7.50	1.40	5.82	.....	33.20	....	55.10[2]		2.80	378
1911-2k	8.00	1.60	6.93	.....	40.40	0.20	35.30	13.30	1.20	367
1912-2m	10.20	0.50	7.60	.....	43.30	0.20	35.00	10.30	0.50	359
1913-2p	7.20	1.30	5.95	.....	31.90	0.30	45.00	13.50	0.80	369
1916-2s	8.50	1.48	7.22	.....	41.15	0.08	36.98	10.83	0.98	365
1919	9.55	1.24	7.18	.....	40.92	0.23	35.55	10.89	1.62	364
1912-2m	10.10	2.10	13.18	.....	75.10	0.10	4.70	7.00	0.90	355
1895-6b	5.00	0.90	2.72	.....	15.50	1.60	63.30		13.70	439
1910-9	12.70	2.30	7.62	.....	43.40	0.30	32.80	6.30	2.20	350
1913-2p	7.30	1.00	4.46	.....	25.40	0.40	44.10	12.60	9.20	411
1919	9.17	1.78	8.04	.....	47.83	0.18	26.78	3.18	11.08	411
1914-2q	3.22	2.98	7.44	46.50	.....	1.53	0.64	7.36	37.77	558
1916-2s	4.55	4.01	5.48	34.25	.....	1.72	trace	10.46	45.01	584
1919	5.90	4.39	4.86	30.38	.....	1.93	0.59	10.48	46.33	713
1914-2q	8.72	2.28	8.07	50.44	.....	0.60	24.64	9.88	3.44	371
1916-2s	8.15	2.87	7.41	46.31	.....	0.19	35.02	7.17	0.29	339
1919	9.14	2.67	6.69	41.81	.....	0.20	35.44	6.93	3.81	331
1919-4b	7.99	3.87	6.72	42.00	.....	0.15	35.23	10.32	0.44	314
1919	7.93	2.00	6.30	39.38	.....	0.70	31.22	7.08	11.69	416
1916-2s	6.14	2.22	6.29	39.31	.....	0.15	32.18	5.07	14.93	471
1916-2s	4.07	2.86	5.02	31.38	.....	0.35	30.66	8.39	22.29	482
1919	8.85	3.06	5.84	36.50	.....	0.13	31.05	8.38	12.03	412
1914-2q	6.01	2.75	9.05	56.56	.....	0.35	1.81	4.23	28.29	505
1916-2s	5.97	3.46	7.68	48.00	.....	0.07	2.14	7.57	32.79	527
1919	8.33	4.41	7.64	47.75	.....	0.05	1.91	3.50	34.05	519
1914-2q	6.92	2.75	8.75	54.69	.....	0.55	1.24	3.74	30.11	510
1916-2s	5.82	3.49	7.14	44.63	.....	0.23	1.91	6.75	37.17	548

[1] Includes water-soluble carbohydrates. [2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.	Water.	Ash.	Nitrogen.	Protein. N. x 6.25.	Protein. N. x 5.70.	Fiber.	Nitrogen-free extract. Starch.	Nitrogen-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
	HARD BREADS AND BAKERY PRODUCTS—(*continued*).										
	Loeb's Diabetic Food Bakery, New York City—(*continued*).										
1919	Diabetic Sponge Cookies	8.66	4.45	7.95	49.69	.....	0.11	1.91	1.41	33.77	516
1919-2u	Gluten Bread	7.85	1.80	7.46	.....	42.52	0.22	27.71	8.76	11.14	416
1914-2q	Gluten Luft Bread	5.68	2.05	8.38	.....	47.77	0.63	22.89	7.74	13.24	433
1916-2s	Gluten Luft Bread	7.05	1.20	7.12	.....	40.58	0.18	29.93	11.28	9.78	415
1916-2s	Gluten Zwieback	8.27	2.34	7.27	.....	41.44	0.20	35.72	9.64	2.39	369
1915-2r	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
1915-2r	Gluten Almond Zwieback	7.84	2.38	6.81	42.56	.....	0.60	19.13	6.90	20.59	620
1916-2s	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.										
1913-2p	Charasse Biscuits Croquettes au Gluten	7.30	0.50	5.49	.....	31.30	0.20	30.60	14.70	5.40	395
1913-2p	Charasse Biscottes Lucullus	7.50	1.80	1.82	11.40	.....	0.20	59.20	14.20	5.70	391
1913-2p	Charasse Gluten Exquis Biscuits aux Amandes	5.30	1.60	2.90	.....	16.50	0.60	25.50	26.70	23.80	489
1913-2p	Charasse Gluten Fleur de Neige Pain	6.10	2.30	5.74	.....	32.70	0.40	25.10	20.90	12.50	427
1913-2p	Charasse Mignonettes au Gluten	8.20	2.10	6.42	.....	36.60	0.30	27.30	19.80	5.70	386
1913-2p	Charasse Pain de Gluten	8.10	2.10	6.53	.....	37.20	0.20	27.20	19.90	5.30	385
1913-2p	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.										
1916-4a	Diabetic Bread	8.15	1.75	1.82	11.38	.....	....	63.71	13.77	1.24	331
	Pure Gluten Food Co., New York City.										
1914-2q	No. 1 Dainty Fluffs	7.04	0.75	12.79	79.94	.....	0.45	10.74	0.54	0.54	370
1914-2q	No. 2 Dainty Fluffs	7.45	0.68	10.60	66.25	.....	0.28	21.85	3.02	0.47	369
1916-4a	Dainty Fluffs	7.15	1.25	12.81	80.04	.....	0.12	7.65	2.97	0.82	370
1913-2p	Gum Gluten Biscuit Crisps	5.30	1.70	6.86	.....	39.10	0.90	39.30	13.00	0.70	372
1914-2q	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.										
1893-6f	Diabetiker-Biscuits	2.90	3.50	7.06	44.10	.....	....	10.00	9.70	29.80	523
1913-2p	Diabetiker-Biscuits	5.00	1.10	4.74	29.60	.....	0.20	25.90	18.60	19.60	473
1913-2p	Diabetiker-Bretzel	6.80	3.00	5.02	31.40	.....	0.20	40.70	9.40	8.50	402
1910-5	Diabetiker-Cakes	.....	....	2.02	12.60	.....	....	39.80		.....	...
1913-2p	Diabetiker-Cakes	6.50	3.00	4.74	29.60	.....	0.20	39.10	8.10	13.50	429
1893-6b	Diabetiker-Chokolade-Biskuits	1.80	3.80	7.18	44.90	.....	....	11.80	10.10	27.60	516
1913-2p	Diabetiker-Dessert-Gebäck	4.30	2.50	3.55	22.20	.....	1.10	5.90	21.60	42.40	580
1910-5	Diabetiker-Makronen	.....	....	1.97	12.30	.....	....	11.30		.....	...
1910-9	Diabetiker-Makronen	4.50	3.20	3.57	22.30	.....	1.10	8.80	12.10	48.00	605
1913-2p	Diabetiker-Makronen	4.00	3.00	3.71	23.20	.....	1.20	3.00	17.60	48.00	607
1910-5	Diabetiker-Stangen	.....	....	3.63	22.70	.....	....	17.00		.....	...
1910-9	Diabetiker-Stangen	10.50	2.10	4.77	29.80	.....	....	24.60[2]		33.00	515
1913-2p	Diabetiker-Stangen	4.50	3.60	2.83	17.70	.....	0.50	21.40	8.10	44.20	586

[2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.	Water.	Ash.	Nitrogen.	Protein. N. x 6.25.	Protein. N. x 5.70.	Fiber.	Nitrogen-free extract. Starch.	Nitrogen-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
	HARD BREADS AND BAKERY PRODUCTS—(*continued*).										
	Rademann's Nährmittelfabrik, Frankfurt—(*continued*).										
1910-5	Diabetiker-Zwieback	.....	....	2.62	16.40	.....	....	37.60		.....	...
1910-9	Diabetiker-Zwieback	9.40	2.20	4.03	25.20	.....	....	47.00	4.30[2]	11.90	413
1893-6b	Erdnuss-Biskuits	1.90	2.70	5.57	34.80	.....	....	9.00	30.10	21.50	489
1910-9	Käsestangen	6.90	2.20	1.79	11.20	.....	....	50.49[2]		29.30	511
1913-2p	Käsestangen	6.70	3.80	1.49	9.30	.....	0.10	38.00	8.40	33.70	524
1910-5	Sanitätszwieback	.....	....	2.80	17.50	.....	....	58.40		.....	...
	Schelle, Braunschweig.										
1897-6e	Aleronat-Kakes	4.90	1.30	3.18	.....	18.10	....	64.90[2]		10.80	429
	Seidl, München.										
1910-5	Kleberzwieback	6.30	....	2.37	.....	13.50	....	67.90		7.80	396
	James Strachen.										
1916-4a	Gluten Bread	6.20	2.20	2.96	.....	16.87	0.10	52.74	21.29	0.60	369
	Roman Uhl, Karlsbad.										
1913-2p	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.										
1913-2p	Caraway Biscuits for Diabetics	6.70	3.60	5.70	35.60	.....	0.70	8.60	7.30	37.50	544
1913-2p	Diabetic Rusks for Diabetics	10.80	1.20	11.34	70.90	.....	0.30	12.60	3.40	0.80	355
1913-2p	Euthenia Biscuits	5.50	3.40	5.73	35.80	.....	1.40	6.90	6.30	40.70	562
1913-2p	Gluten Biscottes or Rolls	10.50	2.40	8.26	.....	47.10	0.20	29.80	7.70	2.30	359
1913-2p	Gluten Bread or Slices	10.60	2.00	8.66	.....	49.40	0.20	27.40	8.20	2.20	361
1913-2p	Gluten Butter Biscuits for Diabetics	6.10	3.00	7.06	.....	40.20	0.90	9.00	7.60	33.20	526
1913-2p	Ginger Biscuits for Diabetics	4.10	3.40	5.54	34.60	.....	1.80	10.90	5.80	39.40	560
1913-2p	Midolia Biscuits	6.00	4.30	2.82	17.60	.....	4.10	13.40	18.20	36.40	524
1913-2p	Walnut Biscuits for Diabetics	4.40	2.90	3.34	20.90	.....	2.30	trace	12.30	57.20	648
	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.										
1915-2r	Gluten Cookies	.....	....	4.86	.....	27.70	....	19.59	.....	.....	...
	BREAKFAST FOODS.										
	Brusson Jeune, Villenur, France.										
1913-2p	Farine au Gluten	10.90	0.60	5.42	.....	30.90	0.20	48.80	8.00	0.60	356
1910-2j	Gluten Semolina	9.70	0.70	2.75	.....	15.70	0.30	64.90	8.20	0.50	360
	Dieto Food Co., New York City.										
1914-2q	Dieto Nut Cereal	5.00	1.95	3.46	21.63	.....	1.22	39.54	12.28	18.38	459
1914-2q	Wheat and Barley Cereal	6.77	1.68	1.86	11.63	.....	2.00	61.42	14.35	2.15	359

[2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	BREAKFAST FOODS—(*continued*).
	Farwell & Rhines, Watertown, N. Y.
1913-2p	Barley Crystals
1913-2p	Cresco Grits
	William Hazard Co., New York City.
1908-10c	Hazard's Wheat Protein Breakfast Food
	Health Food Co., New York City.
1913-2p	Manana
1914-2q	Manana Gluten Breakfast Food
1919	Manana Gluten Breakfast Food
1919	Protosoy (Cereal)
	Jireh Diabetic Food Co., New York City.
1913-2p	Whole Wheat Farina
1913-2p	Frumenty
	Kellogg Food Co., Battle Creek, Mich.
1911-2k	Granola
	Loeb's Diabetic Food Bakery, New York City.
1919	Caseine Breakfast Cereal
1919	Gluten Breakfast Cereal
	Pure Gluten Food Co., New York City.
1919-4b	Gluten Breakfast Food
1904-11	Gum Gluten Breakfast Food
1906-2e	Gum Gluten Breakfast Food
1911-2k	Gum Gluten Breakfast Food
1911-2k	Gum Gluten Granules
1916-4a	Gum Gluten Granules
1914-2q	Hoyt's Gum Gluten Breakfast Food
1914-2q	Hoyt's Gum Gluten Granules
1901-10b	Pure Gluten Breakfast Cereal
	Pure Gluten Food Co., Columbus, Ohio.
1919	Hoyt's Gluten Breakfast Food, 40% Protein
1919	Hoyt's Gluten Granules, over 40% Protein
	Waukesha Health Products Co., Waukesha, Wis.
1919	Hepco Grits
	MACARONI, NOODLES, ETC.
	Brusson Jeune, Villemur, France.
1910-2k	Pâtes aux Oeufs Macaroni
1910-2k	Pâtes aux Oeufs Nouillettes

OF DIABETIC FOODS—(*Continued*).

Reference.	Water.	Ash.	Nitrogen.	Protein.		Fiber.	Nitrogen-free extract.		Fat.	Calories.
				N. x 6.25.	N. x 5.70.		Starch.	Other nitrogen-free extract, by difference.		
1913-2p	9.90	1.20	1.84	11.50	.....	0.90	62.70	12.50	1.30	359
1913-2p	11.10	0.60	2.85	17.80	.....	0.50	54.10	14.50	1.40	358
1908-10c	8.50	0.70	6.42	.....	36.60	....	53.20[2]		1.00	368
1913-2p	10.20	2.40	6.02	37.60	.....	1.10	31.00	15.80	1.90	355
1914-2q	7.56	2.53	6.82	.....	38.87	1.73	29.87	17.45	1.99	363
1919	8.49	2.47	7.86	.....	44.80	1.09	21.99	12.47	8.69	396
1919	7.65	5.39	6.42	40.13	.....	3.78	trace	24.88	18.17	424
1913-2p	6.20	1.80	2.06	.....	11.70	2.20	59.50	16.30	2.30	371
1913-2p	6.20	1.40	1.97	12.30	.....	1.10	65.40	11.90	1.70	374
1911-2k	6.10	2.30	2.22	13.90	.....	0.60	45.20	31.10	0.80	368
1919	4.52	4.61	5.86	36.63	.....	....	0.70	11.02[2]	42.52	576
1919	4.38	2.73	5.12	.....	29.18	1.04	25.51	17.78	19.38	464
1919-4b	9.17	1.32	7.16	.....	40.75	0.10	35.70	12.28	0.68	361
1904-11	9.50	0.90	8.70	.....	49.60	0.50	30.40	8.30	0.80	360
1906-2e	9.10	1.10	8.54	.....	48.70	0.30	31.00[1]	8.20	1.60	366
1911-2k	7.50	1.20	6.05	.....	34.40	0.40	37.90	17.30	1.30	370
1911-2k	7.50	1.50	7.28	.....	41.50	0.30	32.30	15.30	1.60	371
1916-4a	6.95	0.80	6.90	.....	39.33	0.08	40.50	11.42	0.92	363
1914-2q	6.48	0.60	7.26	.....	41.38	0.28	39.21	11.19	0.86	375
1914-2q	6.64	0.73	6.83	.....	38.93	0.45	41.93	10.63	0.69	372
1901-10b	9.30	0.70	6.99	.....	39.80	0.30	48.30		1.60	367
1919	9.23	0.93	8.07	.....	46.00	0.51	31.39	10.15	1.79	366
1919	9.75	0.97	7.68	.....	43.78	0.68	32.15	10.08	2.59	327
1919	8.88	5.51	6.44	40.25	.....	4.19	0.87	23.91	16.39	408
1910-2k	8.80	0.70	2.22	13.90	.....	trace	69.20	7.00	0.40	364
1910-2k	8.70	0.70	2.30	14.40	.....	trace	68.90	6.80	0.50	365

[1] Includes water-soluble carbohydrates. [2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	MACARONI, NOODLES, ETC.—(*continued*).
	Brusson Jeune, Villemur, France—(*continued*).
1913-2p	Petites Pâtes au Gluten
1910-2k	Vermicelle au Gluten
	The Dieto Food Co., New York City.
1914-2q	Whole Wheat Brand Macaroni
	Jireh Diabetic Food Co., New York City.
1913-2p	Macaroni
	Eugene Loeb, New York City.
1913-2p	Home Made Noodles
	Loeb's Diabetic Food Bakery, New York City.
1916-2s	Gluten Noodles
1919	Gluten Noodles
	The Marvelli Co., Detroit, Mich.
1901-2b	Macaroni
1912-20	Spaghetti
	Pure Gluten Food Co., New York City.
1906-2f	Gum Gluten Macaroni
1911-2k	Gum Gluten Noodles
1914-2q	Hoyt's Gum Gluten Noodles
	PEANUT BUTTER.
	Atlantic Peanut Refinery, Philadelphia, Pa.
1899-2a	Peanut Butter
	J. W. Beardsley's Sons, New York City.
1913-2p	Acme Red Brand
1919	Acme Brand
	Beech-Nut Packing Co., Canajoharie, N. Y.
1913-2p	Beech-Nut
1919	Beech-Nut
	A. C. Blenner & Co., New Haven, Conn. (distributed by).
1913-2p	Peanut Butter
	D. W. Brooke, Newark, N. J.
1913-2p	Peanut Butter
	Dillon & Douglass, New Haven, Conn. (distributed by).
1913-2p	Perfection

OF DIABETIC FOODS—(*Continued*).

Reference.	Water.	Ash.	Nitrogen.	Protein.		Fiber.	Nitrogen-free extract.		Fat.	Calories.
				N. x 6.25.	N. x 5.70.		Starch.	Other nitrogen-free extract, by difference.		
1913-2p	9.00	0.80	2.98	.....	17.00	0.20	61.20	10.80	1.00	365
1910-2k	8.00	0.80	2.94	.....	16.80	trace	65.80	8.20	0.40	367
1914-2q	9.81	0.90	2.22	13.88	.....	0.57	58.72	14.98	1.14	361
1913-2p	8.80	1.10	2.70	16.90	.....	0.90	58.80	12.60	0.90	361
1913-2p	9.80	1.00	6.69	41.80	.....	0.20	36.70	5.00	5.50	384
1916-2s	9.25	0.69	7.23	.....	41.21	0.15	33.19	14.48	1.03	365
1919	10.23	1.63	6.54	.....	37.28	0.15	36.84	10.28	3.59	370
1901-2b	13.40	0.50	3.31	20.70	.....	....	64.80[2]		0.60	347
1912-20	.....	....	2.48	15.50	.....	....	.....	.....	.....	...
1906-2f	10.30	0.70	6.62	.....	37.70	0.30	46.20[1]	3.80	1.00	360
1911-2k	8.30	1.10	5.86	.....	33.40	0.20	42.00	12.60	2.40	374
1914-2q	8.21	0.65	6.48	.....	36.93	0.33	41.82	10.83	1.23	369
1899-2a	2.10	4.00	4.59	28.70	.....	2.30	6.20	10.30	46.40	598
1913-2p	2.20	4.40	4.51	28.20	.....	1.70	4.00	11.20	48.30	608
1919	1.82	3.07	5.00	31.25	.....	1.77	5.29	8.53	48.27	615
1913-2p	2.00	3.50	4.70	29.40	.....	1.90	4.50	12.10	46.60	593
1919	1.99	3.32	4.86	30.38	.....	1.81	5.04	7.55	49.91	621
1913-2p	2.90	4.00	4.75	29.70	.....	1.20	4.60	9.70	47.90	607
1913-2p	1.80	3.80	4.72	29.50	.....	1.50	4.30	10.60	48.50	614
1913-2p	1.80	4.40	4.66	29.10	.....	1.80	4.80	15.30	42.80	582

[1] Includes water-soluble carbohydrates. [2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	PEANUT BUTTER—(*continued*).
	H. J. Heinz Co., Pittsburgh, Pa.
1913-2p	Peanut Butter
	The Kellogg Food Co., Battle Creek, Mich.
1913-2p	Peanut Butter
1913-2p	Peanut Butter
	Francis H. Leggett & Co., New York City.
1913-2p	Premier
	MacLaren Imperial Cheese Co., Detroit, Mich.
1913-2p	Eagle
	Nut Products Co., New Haven, Conn.
1913-2p	Penolia
	Penolia Food Co., New Haven, Conn.
1899-2a	Penolia
	S. S. Pierce Co., Boston, Mass.
1913-2p	Acharis Brand
	ALMOND PASTE.
	Chapman, Chicago, Ill.
1902-1c	Almond Paste
	Henry Heide, New York City.
1902-1c	Almond Paste
	Spencer, New York City.
1902-1c	Almond Paste
	NUTS AND NUT PREPARATIONS.
	Dieto Food Co., New York City.
1914-2q	Pine Nuts
	Chas. Lawrence Co., Boston, Mass. (sold by).
1913-2p	California Paper Shell Almonds, edible portion
	Christian National Food Co., Kenilworth, N. J.
1916-2s	Christian's Protoid Nuts
	Jireh Diabetic Food Co., New York City.
1913-2p	Diabetic Pine Nuts (Pignolias)
	The Kellogg Food Co., Battle Creek, Mich.
1906-2e	Almond Butter (Sanitas)
1908-10c	Almond Butter (Sanitas)
1901-10b	Malted Nuts
1913-2p	Nut Bromose (Meltose and Nuts)
1906-2e	Nut Butter (Sanitas)

OF DIABETIC FOODS—(*Continued*).

Reference.	Water.	Ash.	Nitrogen.	Protein.		Fiber.	Nitrogen-free extract.		Fat.	Calories.
				N. x 6.25.	N. x 5.70.		Starch.	Other nitrogen-free extract, by difference.		
1913-2p	3.00	3.90	4.62	28.90	.....	1.70	4.00	11.20	47.30	592
1913-2p	3.10	3.00	4.50	28.10	.....	1.40	3.40	11.30	49.70	619
1913-2p	3.60	3.30	4.90	30.60	.....	1.50	3.20	9.00	48.80	610
1913-2p	2.10	4.00	4.75	29.70	.....	1.70	6.50	12.30	43.70	587
1913-2p	1.50	3.80	5.14	32.10	.....	1.70	4.30	11.70	44.90	597
1913-2p	2.40	3.90	4.46	27.90	.....	1.50	3.90	9.10	51.30	625
1899-2a	2.00	6.00	4.78	29.90	.....	2.10	5.60	7.70	46.70	593
1913-2p	1.70	3.70	4.59	28.70	.....	3.00	5.10	9.50	48.30	608
1902-1c	23.70	1.40	2.10	13.10	.....	....	11.30	25.00[2]	25.50	427
1902-1c	22.00	1.60	2.03	12.70	.....	....	small	43.70[2]	20.00	406
1902-1c	27.00	1.70	2.16	13.50	.....	....	trace	31.60[2]	26.20	416
1914-2q	2.23	4.55	6.35	39.69	.....	0.75	none	2.76	50.02	620
1913-2p	3.50	3.50	2.94	18.40	.....	3.00	none	16.30	55.30	637
1916-2s	4.23	4.27	6.02	37.63	.....	....	trace	5.65[2]	48.22	607
1913-2p	2.00	4.60	6.35	39.70	.....	0.90	none	3.40	49.40	617
1906-2e	0.90	2.90	3.62	22.60	.....	3.90	3.70[1]	4.50	61.50	677
1908-10c	2.30	3.00	3.47	21.70	.....	....	11.50[2]		61.50	686
1901-10b	2.60	2.20	3.79	23.70	.....	....	43.90[2]		27.60	519
1913-2p	14.00	1.50	2.73	17.10	.....	1.20	3.20	36.20	26.80	467
1906-2e	0.20	2.90	4.61	28.80	.....	3.70	9.10[1]	4.80	50.50	625

[1] Includes water-soluble carbohydrates. [2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	NUTS AND NUT PREPARATIONS—(*continued*).
	The Kellogg Food Co., Battle Creek, Mich.—(*continued*).
1906-2e	Nut Meal
1906-2e	Nuttolene
1913-2p	Pine Nuts
1906-2e	Protose
	Nashville Sanitarium-Food Co., Nashville, Tenn.
1913-2p	Malted Nut Food
1913-2p	Nut Butter
1913-2p	Nutcysa
1913-2p	Nutfoda
	CHOCOLATE AND CHOCOLATE PREPARATIONS.
	Brusson, Jeune, Villemur, France.
1913-2p	Chocolate with Added Gluten à la Vanille
	Callard, Stewart & Watt, London.
1913-2p	Casoid Chocolate Almonds
	Fromm & Co., Dresden.
1913-2p	Conglutin-Diabetiker-Schokolade
	Karl Goldscheider, Karlsbad.
1914-2q	Feinste Dessert-Schokolade für Diabetiker, "9.98% carbohydrates"
1914-2q	Feinste Mocca-Schokolade für Diabetiker, "10.26% carbohydrates"
1914-2q	Feinste Nuss-Schokolade für Diabetiker, "11.32% carbohydrates"
1914-2q	Feinste Orange-Schokolade für Diabetiker, "9.98% carbohydrates"
	Groetzsch, Frankfurt.
1910-9	Essschokolade (Orange)
1910-9	Kochschokolade
	Loeb's Diabetic Food Bakery, New York City.
1914-2q	Almond Chocolate Bars
1914-2q	Diabetic Chocolates
1919	Almond Chocolate Bars
1919	Diabetic Chocolate
	Plasmon Co., London.
1901-13a	Plasmon Chocolate
1903-2c	Plasmon Chocolate
	Rademann's Nährmittelfabrik, Frankfurt.
1910-5	Diabetiker-Chokolade
1913-2p	Diabetiker-Chokolade
	Troponwerke, Mülheim.
1898-7	Tropon-Chokolade
1899-8	Tropon-Chokolade

OF DIABETIC FOODS—(*Continued*).

Reference.	Water.	Ash.	Nitrogen.	Protein.		Fiber.	Nitrogen-free extract.		Fat.	Calories.
				N. x 6.25.	N. x 5.70.		Starch.	Other nitrogen-free extract, by difference.		
1906-2e	3.00	2.20	4.64	29.00	.....	2.00	8.90[1]	3.20	51.70	630
1906-2e	55.20	2.20	2.03	12.70	.....	1.80	6.30		21.80	272
1913-2p	2.60	4.50	6.08	38.00	.....	1.10	4.20		49.60	615
1906-2e	62.20	1.50	3.62	22.60	.....	0.90	3.60		9.20	188
1913-2p	3.40	1.70	3.95	24.70	.....	....	3.40	24.10[2]	42.70	593
1913-2p	1.90	2.90	4.48	28.00	.....	1.60	3.80	9.20	52.60	637
1913-2p	57.00	1.80	2.06	12.90	.....	1.00	trace	6.30	21.00	266
1913-2p	62.30	1.60	3.33	20.80	.....	0.50	trace	6.80	8.00	182
1913-2p	2.60	3.20	2.54	15.90	.....	2.20	9.20	17.20	49.70	617
1913-2p	3.50	3.10	3.57	22.30	.....	3.20	trace	16.10	51.80	620
1913-2p	4.00	5.40	2.82	17.60	.....	1.20	4.30	28.40	39.10	553
1914-2q	2.17	1.80	1.82	11.38	.....	1.68	4.98	20.44	57.55	665
1914-2q	2.20	2.25	1.63	10.19	.....	1.65	4.11	19.38	60.22	677
1914-2q	3.37	2.65	2.34	14.63	.....	1.70	6.86	16.44	54.35	641
1914-2q	2.38	2.20	1.83	11.44	.....	1.43	4.98	19.93	57.64	664
1910-9	4.60	2.30	1.73	10.80	.....	4.40	12.00	5.20	60.70	658
1910-9	10.90	6.70	4.05	25.30	.....	5.90	15.90	20.20	25.10	432
1914-2q	2.88	3.77	2.60	16.25	.....	4.32	5.74	26.04	41.00	561
1914-2q	1.98	3.85	2.38	14.88	.....	4.90	6.92	16.05	51.42	614
1919	4.76	3.43	2.38	14.88	.....	2.81	5.34	15.55	53.23	622
1919	4.72	3.45	2.35	14.69	.....	2.62	7.26	15.52	51.74	716
1901-13a	.....	....	3.38	21.10	.....	....	.....	.....	.....	...
1903-2c	3.50	2.50	3.23	20.20	.....	0.70	trace	48.00	25.10	499
1910-5	.....	....	2.58	16.10	.....	....	9.60		.....	...
1913-2p	2.50	3.20	2.80	17.50	.....	2.30	3.80	13.10	57.60	656
1898-7	1.70	1.60	2.91	18.20	.....	2.70	49.90		25.90	506
1899-8	1.80	....	2.94	18.40	.....	....	.....	.....	.....	...

[1] Includes water-soluble carbohydrates. [2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	COCOA.
	The Dieto Food Co., New York City.
1914-2q	Dieto Cocoa
	Jireh Diabetic Food Co., New York City.
1906-2e	Diabetic Cocoa
1906-2e	Diabetic Cocoa
	Gustav Müller, New York City (Agent).
1913-2p	Charrasse Gluto-Cacao
	Plasmon Co., London.
1903-2c	Plasmon Cocoa
	Rademann's Nährmittelfabrik, Frankfurt.
1913-2p	Diabetiker-Cacao
	MISCELLANEOUS PRODUCTS.
	Dieto Food Co., New York City.
1914-2q	Dieto Baking Powder
1914-2q	Dieto Barley Coffee
1917-2t	Longuets de Lausanne, **Manual Freres**
	Health Food Co., New York City.
1913-2p	Kaffeebrod
	Genevieve Jackson, Los Angeles, Calif.
1919	Dia-Biskit
	The Kellogg Food Co., Battle Creek, Mich.
1911-2l	Sanitas Meltose
	Mansfield Laboratories, Mansfield, Mass.
1914-2q	No Name (square)
1914-2q	No Name (hexagonal)
	Gustav Müller & Co., New York City.
1913-2p	Dr. Bouma Sugar-Free Fat-Milk
	S. S. Pierce Co., Boston, Mass. (prepared for)
1919	Svea Wafers
1900-14	Diabetes Milch, 5%, **Rose's**
1900-14	Diabetes Milch, 10%, **Rose's**
	D. Whiting & Sons, Boston, Mass.
1913-2p	Sugar-Free Milk (ave. 3 analyses)
1919	Sugar-Free Milk

OF DIABETIC FOODS—(*Concluded*).

Reference.	Water.	Ash.	Nitrogen.	Protein.		Fiber.	Nitrogen-free extract.		Fat.	Calories.
				N. x 6.25.	N. x 5.70.		Starch.	Other nitrogen-free extract, by difference.		
1914-2q	4.29	5.40	3.77	23.56	.....	4.87	12.38	26.57	22.93	456
1906-2e	3.10	4.30	3.30	20.60	.....	3.60	32.60[1]	18.00	17.80	445
1906-2e	7.30	3.90	3.06	19.10	.....	3.40	29.00[1]	18.90	18.40	434
1913-2p	6.40	6.70	3.44	21.50	.....	3.10	16.30	23.80	22.20	446
1903-2c	8.90	6.60	8.45	52.80	.....	....	5.10	15.80[2]	10.80	392
1913-2p	5.20	5.90	2.82	17.60	.....	3.00	10.70	34.00	23.60	462
1914-2q	.....	....	.....	.....	.....	....	12.94	.....	.....	...
1914-2q	3.42	3.08	2.11	13.19	.....	9.14	17.72	46.15	7.30	374
1917-2t	10.78	3.04	2.27	14.19	.....	0.44	49.16	16.86	5.53	370
1913-2p	4.50	2.20	2.06	12.90	.....	6.40	10.10	62.40	1.50	355
1919	6.08	6.13	2.82	17.63	.....	11.99	6.13[4]	47.21	4.83	328
1911-2l	26.80	0.50	0.10	0.60	.....	....	.....	72.10[2]	.....	291
1914-2q	9.34	5.53	4.72	29.50	.....	0.43	34.26	13.53	7.41	376
1914-2q	8.65	4.84	4.06	25.38	.....	0.47	31.16	14.33	15.17	420
1913-2p	91.80	0.50	0.38	2.40	.....	....	.....	.....	5.30	57
1919	10.58	2.85	1.04	6.50	.....	0.13	53.72	25.53	0.69	349
1900-14	92.50	0.20	0.18	1.10	.....	....	.....	1.20	5.00	54
1900-14	86.30	0.20	0.37	2.30	.....	....	.....	1.20	10.00	104
1913-2p	86.40	0.70	0.91	5.70[5]		....	.....	trace	7.20	88
1919	83.30	0.76	1.01	6.43[5]		....	.....	0.22[6]	9.34	111

[1] Includes water-soluble carbohydrates.
[2] Includes fiber.
[4] Includes some reducing material derived from agar-agar.
[5] Nitrogen x 6.38.
[6] Reducing sugar calculated as lactose.

GENERAL SUMMARY.

Analyses from Connecticut Report, 1913		387
Analyses from Connecticut Reports since 1913		107
New analyses made in this laboratory in 1919:		
Commercial diabetic products	85	
Commercial and experimental preparations	22	107
Recent analyses compiled from other sources		51
Total		652

Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

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BEING THE

Report on Commercial Feeding Stuffs

1919

By E. M. BAILEY

CONTENTS

Commercial Feeding Stuffs

By E. M. Bailey.*

PROVISIONS OF THE STATUTES RELATING TO FEEDING STUFFS.

Under the Connecticut statutes the term "concentrated commercial feeding stuffs" covers practically all feeds excepting hay and straw, whole seeds, unmixed meal made directly from any of the cereals or from buckwheat, and feed ground from whole grain and sold directly from manufacturer to consumer.

Section 4775 requires that every lot or parcel of concentrated commercial feeding stuff shall bear a statement giving the name and address of the manufacturer or importer, the number of net pounds in the package, the name of the article, and the percentages of protein and fat contained in it. The law forbids the use of any metal in affixing tags.

No registration of feeds or payment of analysis or license fees is required.

The penalty for violation of the statute is not more than $100 fine for the first offense and not more than $200 for each subsequent offense.

The law authorizes this Station to take samples from any manufacturer or dealer, in a prescribed manner, and requires the Station to analyze annually at least one sample of each brand which it has collected, and to publish these analyses "together with such additional information in relation to the character, composition and use thereof as may be of importance."

THE STATUS OF COTTONSEED MEAL UNDER THE NEW FERTILIZER LAW.

By act of the General Assembly of 1919 cottonseed meal is classed as a commercial fertilizer within the meaning of the law.

* With the assistance of Messrs. C. E. Shepard and H. D. Edmond. The inspection and collection of samples were carried out by Mr. V. L. Churchill.

It is required that every brand shall be registered at this Station before it is offered for sale in the state, and an analysis fee of ten dollars paid thereon. On July first and January first thereafter a tonnage fee of six cents per ton shall be paid. It is provided that cottonseed meal sold and used as feeding stuff shall be exempt from the tonnage fee.

As regards the adjustment of the tonnage fee, the law provides for a sworn statement from dealers as to their sales. This Station will provide forms for this purpose, the same to be duly filled in, certified and returned to the Station semi-annually. Said statement shall show the total tonnage sold and the proportion thereof sold for use as a fertilizer; and such statement will be used as a basis to determine the deduction in tonnage to be made for goods sold for feeding purposes.

CLASSIFICATION OF SAMPLES ANALYZED DURING THE YEAR.

In the official inspection two hundred and four samples were collected, which may be classified as follows:

Cottonseed Meal	15	Maize Products	19
Cottonseed Feed	2	Brewers' and Distillers' Grains	3
Linseed Meal	7	Dried Beet Pulp	6
Wheat Bran	15	Cocoanut Meal	2
Wheat Mixed Feed	15	Peanut Meal	2
Wheat Middlings	12	Proprietary Stock Feeds	78
Rye Products	3	Poultry Feeds	14
Barley Products	1		
		Total	204

Sixty-two samples of miscellaneous feeding stuffs have been examined for the Dairy Commissioner and for individuals.

Four hundred and sixty-seven partial or complete analyses have been made of fodder and other materials in connection with field experiments. Of this number three hundred and ninety-one were received from Storrs and the remainder were from the Station Farm at Mt. Carmel.

Partial analyses of thirty-one samples of shelled corn were made for the Department of Plant Breeding.

The total for the year is seven hundred and sixty-four.

This report is concerned only with the results of the official inspection and samples submitted by the Dairy Commissioner and by individuals.

DETERMINING FACTORS IN COMPOUNDING RATIONS.

Gross and Digestible Nutrients.

The significance of the conventional analysis of a feeding stuff and the rôle of each of the nutrient groups contained therein have been discussed in previous bulletins.[1] Such proximate analyses show the gross amounts of nutrient materials in various concentrates or roughages but do not furnish any information as to the nature and quality of the several types of nutrients found. The gross supply of nutrient material eaten is not entirely utilized in the animal body; some is lost in the excretions. The amount not excreted is considered to be utilized or digested; thus if 100 parts of protein are fed in a given ration, e. g., cottonseed meal, and 16 parts are recovered in the excreta, then 84 parts are assumed to have been digested and 84 is the coefficient of digestibility for the protein of cottonseed meal. These figures are obtained by actual feeding experiments. Such trials also show that protein, fat and carbohydrate have different degrees of digestibility, and that the same type of nutrient from different sources may vary in this respect. Thus the protein of dried beet pulp is only 52 per cent. digestible. Henry and Morrison[2] have prepared a useful table which gives data of this kind upon a very wide range of fodder materials.

Energy Values.

To illustrate the various transformations of food in digestion, the animal body is often compared with an engine and the food with fuel. Feeding experiments all prove the fitness of this comparison. As the engine transforms the energy of its fuel supply into other forms, such as heat and mechanical work, so the animal body transforms the energy of its food; and in both cases the general law of conservation of energy holds true since the total amount of energy in the fuel or food is eventually accounted for in some form.

The gross energy value of any food is equal to the heat evolved upon burning that food completely. This is determined by means of an apparatus called a calorimeter, in which a definite amount of food material is burned with pure oxygen under pressure, the

[1] Conn. Agr. Exp. Sta., Bull. 206, Feb., 1918; Bull. 212, March, 1919.
[2] Feeds and Feeding, p. 647, et seq.

heat liberated being absorbed by a weighed amount of water and measured with a thermometer. If the amount of food material when completely burned liberates heat enough to raise the temperature of 1000 grams of water 1 degree Centigrade (or 1 pound of water 4 degrees Fahrenheit), the energy equivalent of that amount of material is one *Calorie*. Another unit of measure is the Therm, which has a value 1000 times that of the Calorie, i. e., it is the amount of heat required to raise the temperature of 1000 pounds of water 4 degrees F. By burning unit quantities of the various types of nutrient materials their energy values are established.

Since the gross supply of energy in food material cannot be completely utilized by the animal body it is evident that the fuel value of a given food is judged by that proportion of the gross supply which the animal can convert to its use. Deduction must be made therefor for the energy lost to the body in the solid, liquid and gaseous excreta. The remainder is the *available* or *metabolizable* energy and represents that part of the gross energy which the animal can transform; or its value to the animal for heat production purposes. But further energy is required in digesting the food and preparing it for absorption and assimilation. By making this further deduction the *net energy value* of the food is obtained, and it represents that part of the original gross supply finally counted on to maintain the activities of heart. lungs and other internal organs and, if the supply is in excess of these requirements, to contribute to the gain of flesh or the production of milk or the performance of mechanical work.

Differences between various feeding stuffs with respect to metabolizable energy are chiefly due to the varying energy losses in the excreta. Metabolizable energy per unit of digestible organic matter therefore shows considerable uniformity and may be estimated on that basis. For this purpose Armsby[1] gives the following factors which may be used for cattle and probably for other ruminants.

Roughage	1.588 Therms per lb.
Grains and similar feeds:	
less than 5% digestible fat	1.769 Therms per lb.
more than 5% digestible fat	1.814 Therms per lb.
Oil meals, etc.	1.996–2.177 Therms per lb.

[1] Penn. Agr. Exp. Sta., Bull. 142, 1916.

To obtain net energy values, however, a further deduction for the energy expended in the consumption of feed is required. This energy expenditure has been determined by Armsby and Fries[1] for a number of roughages and concentrates and they have prepared the following table which includes their own results and others obtained by Kellner and Köhler.

TABLE I. AVERAGE ENERGY EXPENDITURE BY CATTLE PER HUNDRED POUNDS OF DRY MATTER EATEN.

Roughages.	Energy Expenditure, Therms.
Timothy hay	35.47
Red clover hay	44.13
Red clover hay	42.27
Mixed hay	44.45
Alfalfa hay	53.03
"Grass hay"	47.40
Meadow hay	56.88
Rowen	43.46
Corn stover	48.31
Wheat straw	51.62
Barley straw	39.78
Oat straw	46.00
Straw pulp	52.62
Concentrates.	
Corn meal	58.33
Hominy chop	61.92
Wheat bran	53.39
Grain mixture No. 1	60.19
Grain mixture No. 2	51.76
Cottonseed meal	44.36
Linseed meal	54.79
Palmnut meal	45.68
Peanut meal	52.57
Beet molasses	44.82
Starch	56.61
Peanut oil	78.34
Wheat gluten	95.08

The application of these data in the case of cottonseed meal, for example, having 91.8 per cent. dry matter and 66.3 per cent. digestible nutrients is as follows:

[1] Penn. Agr. Exp Stat, Bull 142, 1916.

One hundred pounds of cottonseed meal contain:

Dry matter	91.8 lbs.
Digestible	
Protein	30.2 lbs.
Fat	6.1 lbs.
Carbohydrates (includes digestible fiber)	30.0 lbs.
Total	66.3 lbs.

From the table on page 248 it appears that the metabolizable energy in one hundred pounds of cottonseed meal may be taken approximately as 2.1 Therms; and from Table I that the energy expenditure in consumption of one hundred pounds dry matter is 44.36 Therms. Thus

Metabolizable energy =	2.1 x 66.3 = 139.2 Therms
Expenditure of consumption =	.4426 x 91.8 = 40.7 Therms
Net energy value	= 98.5 Therms

On the basis of Henry and Morrison's compilation of American analyses of feeding stuffs and digestible nutrients therein, Armsby and Putney[1] have computed net energy values for a great variety of feeds; and the net energy values in the following table are taken from this source (Table II).

Energy values of feeding stuffs may be expressed in other ways. Kellner[2] has adopted the *starch value* as a standard of measurement. He found by experiment that one pound of digestible starch fed to an ox in excess of his maintenance requirements produced about one quarter (0.248) of a pound of body fat. One hundred pounds of a feed which produced twenty pounds of fat would have a starch value of about 80. Fraps[3] uses *productive value* as a basis of comparison, this being the amount of fat a given feed will produce upon a fattening animal when fed in addition to a basal ration already adequate for the bodily needs of the animal. He expresses productive value in terms of fat and takes into account the variations in the productive values of the several groups of digestible nutrients. Productive value is calculated by means of production coefficients established for each class of nutrients.

[1] Penn. Agr. Exp. Stat., Bull. 142, 1916.
[2] Henry and Morrison, 15th ed., pp. 118-119.
[3] Texas Agr. Exp. Sta., Bull. 185.

TABLE II. COEFFICIENTS OF DIGESTIBILITY AND NET ENERGY VALUES OF FEEDING STUFFS.[1]

Feed	Average dry matter, lbs. per hundred.	Coefficient of digestibility.				Net energy value, Therms per hundred lbs.
		Protein.	Fiber.	Carbohydrates.	Fat.	
Cottonseed Meal	92 2	84	37	75	95	90.0
Cottonseed Feed	....	58	45	61	90	....
Linseed Meal (old process)	90.0	89	57	78	89	88.9
Linseed Meal (new process)	90.4	86	73	87	95	85.1
Wheat Bran	89.9	76	43	74	62	53.0
Wheat Feed	....	77	36	76	87	....
Wheat Middlings	89.6	77	30	78	88	59.1
Red Dog Flour	....	88	36	88	86	....
Rye Flour	....	80	..	88	90	....
Barley, ground	90.7	88	70	93	86	89.9
Barley Bran	....	85	20	86	87	....
Corn Gluten Meal	90.9	85	55	90	93	84.2
Corn Gluten Feed	91.3	85	76	88	85	80.7
Hominy Feed	89.9	66	76	90	91	81.3
Brewers' Grains	92.5	81	49	57	89	53.4
Malt Sprouts	92.4	77	87	80	85	72.7
Distiller's Grains, Corn	93.4	73	95	81	95	85.1
Distiller's Grains, Rye	92.8	59	..	67	84	56.0
Beet Pulp, dried	91.8	52	83	83	..	75.9
Peanut Cake, without shells	89.3	90	9	84	90	93.6
Soybean Meal, fat extracted	88.2	92	99	100	68	99 7
Cocoanut Cake	90.4	90	23	87	100	83.5

[1] Henry and Morrison; Armsby and Putney.

OTHER IMPORTANT CONSIDERATIONS.[1]

Feeding problems cannot, however, be entirely solved by knowledge of energy values, digestibility coefficients or nutritive ratios, useful as these may be for the purposes they are intended to serve. Many of the difficulties encountered in feeding have arisen from ignorance of the nature and quality of the ingredients of the feed. The striking differences in the feeding values of different proteins as shown by investigations at this Station and elsewhere illustrate this point and emphasize the fact that a knowledge of the chemical constitution of nutrient materials is quite as important as a knowledge of energy values.

[1] We quote largely from an unpublished paper by Dr. T. B. Osborne read at a conference of County Agents and others at this Station.

In feeding animals the quantity, kind and proportion of nutrients should be kept in mind.

As to quantity, energy values indicate how much should be fed per unit of live weight of the animal or unit of its production. Whether the animal will eat that amount of food or not depends upon the food or upon the animal. If the animal is healthy but does not eat as it should and does not grow, the food is inadequate in some way; if the food is corrected so that it produces growth, the animal will then eat as much as it should.

As to kinds of food, protein is of course necessary for its tissue-building qualities and fats and carbohydrates are necessary sources of energy. Mineral salts are also essential. There are conspicuous differences among proteins as regards nutritive values. For example, if zein is the sole source of protein in an animal's diet it dies within a short time. If zein is supplemented by tryptophane, or a protein containing it, the animal continues to live but does not grow. Finally if lysine is added to the ration the animal not only maintains itself but grows normally. Our present knowledge of carbohydrates and fats does not indicate such radical differences in nutritive values. Their functions in metabolism are different from that of protein. Probably the carbohydrates are chiefly valuable insofar as they may be converted into dextrose in digestion. Mineral nutrients are more important than has been generally supposed and it is important that the ration contain a sufficient amount of these materials. A corn and skimmed milk ration can be improved by adding calcium and chlorine to compensate the deficiency of these elements in corn.

Nutritive ratios indicate the proportion in which the different types of nutrients should be fed for particular purposes. Thus narrow ratios are fed for growth and production while wide ratios suffice for maintenance. But it has been shown that a young animal obtaining all its protein from gluten feed grows very poorly even though the nutritive ratio of the ration is narrow; and that by supplementing a part of the protein supply by the protein of milk, marked improvement in the rate of growth results even though the nutritive ratio remains the same. Nutritive ratios then can be most efficiently applied only with a knowledge of the nature and quality of the nitrogenous part of the ration.

An important feature of animal feeding is the proper and rational use of roughage. This problem is complicated by the fact that very little is known about the chemical constitution of the nitrogenous constituents of green leaves. These constituents are conventionally classed as proteins but this practice may be very far from the truth. Osborne and Wakeman have lately shown that about 50 per cent. of the nitrogen of spinach leaves is in protein form, 20 per cent. is non-protein and the nature of the remaining 30 per cent. has yet to be determined. This represents practically the sum of our present knowledge of the proteins in green foods.

Some of the practical conclusions to be drawn from these newer ideas regarding nutrition may be briefly summarized. It is a waste of good protein to mix it with feeds which are already adequate for normal growth or production. The more economical use of such protein is in supplementing those proteins which are deficient in kind or quantity of requisite amino acids. Again, although good results may sometimes be obtained by feeding enough poor protein, it is cheaper to feed less amounts of good protein because the market price will generally be about the same for each kind. Food intake is determined by the energy requirements of the animal; a maximum production cannot be expected without a maximum consumption of food. The animal is a machine which must be made to produce at a maximum capacity if it is to be run at a profit. If a healthy animal does not eat as much as it should there is generally something wrong with the food; if its consumption is normal but its production is low, something is wrong with the animal. The maximum capacity for growth or production is an inherited quality; it cannot be increased by feeding but it may be decreased by feeding improperly.

Recent work done at this Station and elsewhere proves that to the four or five nutrients hitherto considered as making a perfect food, must be added others, known as food accessories or vitamines. These are needed in only small amounts but are absolutely essential to maintenance and growth. While their nature and functions are not fully understood the work already done shows the special value of alfalfa, clover and green feed for growing stock, due to these valuable constituents.

DEFINITIONS OF FEEDING STUFFS.

Definition of feeding stuffs adopted by the Association of Feed Control Officials of the United States and revised to January, 1919, are as follows:

General Definitions.

Meal is the clean, sound, ground product of the entire grain, cereal or seed which it purports to represent.

Chop is a ground or chopped feed composed of one or more different cereals or by-products thereof. If it bears a name descriptive of the kind of cereals, it must be made exclusively of the entire grains of those cereals.

Screenings are the smaller, imperfect grains, weed seeds and other foreign material having feeding value, separated in cleaning the grain.

Alfalfa meal is the entire alfalfa hay ground, and does not contain an admixture of ground alfalfa straw or other foreign materials.

Animal Products.

Blood meal is ground dried blood.

Cracklings are the residue after partially extracting the fats and oils from the animal tissue. If they bear a name descriptive of their kind, composition or origin, they must correspond thereto.

Digester Tankage is the residue from animal tissue, exclusive of hoof and horn, specially prepared for feeding purposes by tanking under live steam, drying under high heat, and suitable grinding. If it contains more than 10 per cent. of phosphoric acid ($P_2 O_5$) it must be designated *Digester Meat and Bone Tankage.*

Meat Scrap and *Meat Meal* are the ground residues from animal tissues exclusive of hoof and horn. If they contain more than 10 per cent. of phosphoric acid ($P_2 O_5$) they must be designated *Meat and Bone Scrap and Meat and Bone Meal.* If they bear a name descriptive of their kind, composition or origin, they must correspond thereto.

Brewers' and Distillers' Products.

Brewers' Dried Grains are the properly dried residue from cereals obtained in the manufacture of beer.

Distillers' Dried Grains are the dried residue from cereals obtained in the manufacture of alcohol and distilled liquors. The product shall bear the designation indicating the cereal predominating.

Malt Sprouts are the sprouts of the barley grain. If the sprouts are derived from any other malted cereal, the source must be designated.

Buckwheat Products.

Buckwheat Shorts or *Buckwheat Middlings* are that portion of the buckwheat grain immediately inside of the hull after separation from the flour.

Corn Products.

Corn Bran is the outer coating of the corn kernel.

Corn Feed Meal is the by-product obtained in the manufacture of cracked corn, with or without aspiration products added to the siftings, and is also the by-product obtained in the manufacture of table meal from the whole grain by the non-degerminating process.

Corn Germ Meal is a product in the manufacture of starch, glucose and other corn products, and is the germ layer from which a part of the corn oil has been extracted.

Grits are the hard, flinty portions of Indian corn, without hulls and germs.

Corn Gluten Meal is that part of commercial shelled corn that remains after the separation of the larger part of the starch, the germ and the bran, by the processes employed in the manufacture of cornstarch and glucose. It may or may not contain corn solubles.

Corn Gluten Feed is that portion of commercial shelled corn that remains after the separation of the larger part of the starch and the germ by the processes employed in the manufacture of cornstarch and glucose. It may or may not contain corn solubles.

Hominy Feed, Hominy Meal or *Hominy Chop* is the kiln-dried mixture of the mill run bran coating, the mill run germ, with or without a partial extraction of the oil and a part of the starchy portion of the white corn kernel obtained in the manufacture of hominy, hominy grits and corn meal by the degerminating process.

Yellow Hominy Feed, Yellow Hominy Meal or *Yellow Hominy Chop* is a kiln-dried mixture of the mill run bran coating, the mill run germ, with or without a partial extraction of the oil and a part of the starchy portion of the yellow corn kernel obtained in the manufacture of yellow hominy grits and yellow corn meal by the degerminating process.

Oil Cake.

Oil Cake is the residual cake obtained after extraction of part of the oil by crushing, cooking and hydraulic pressure from seeds screened and cleaned of weed seeds and other foreign materials by the most improved commercial processes. When used alone the term "oil cake" shall be understood to designate the product obtained from partially extracted, screened and cleaned flaxseed. When used to cover any other product, the name of the seed from which it is obtained shall be prefixed to "oil cake."

Ground Oil Cake is the product obtained by grinding oil cake. When used alone, the term "ground oil cake" shall be understood to designate the product obtained from partially extracted, screened and cleaned flaxseed. When used to cover any other product the name of the seed from which it is obtained shall be prefixed to "ground oil cake."

Cottonseed Products.

Cottonseed Meal is a product of the cottonseed only, composed principally of the kernel with such portion of the hull as is necessary in the

manufacture of oil; provided that nothing shall be recognized as cottonseed meal that does not conform to the foregoing definition and that does not contain at least 36 per cent. of protein.

Choice Cottonseed Meal must be finely ground, not necessarily bolted, perfectly sound and sweet in odor, yellow, free from excess of lint, and must contain at least 41 per cent. of protein.

Prime Cottonseed Meal must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color, yellow, not brown or reddish, free from excess of lint, and must contain at least 38.6 per cent. of protein.

Good Cottonseed Meal must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color, and must contain at least 36 per cent. of protein.

Cottonseed Feed is a mixture of cottonseed meal and cottonseed hulls, containing less than 36 per cent. of protein.

Cold Pressed Cottonseed is the product resulting from subjecting the whole undecorticated cottonseed to the cold pressure process for the extraction of oil, and includes the entire cottonseed less the oil extracted.

Ground Cold Pressed Cottonseed is the ground product resulting from subjecting the whole undecorticated cottonseed to the cold pressure process for the extraction of oil, and includes the entire ground cottonseed less the oil extracted.

Linseed and Flax Products.

Linseed Meal is the ground product obtained after extraction of part of the oil from ground flaxseed screened and cleaned of weed seeds and other foreign materials by the most improved commercial processes, provided that the final product shall not contain over six per cent. of weed seeds and other foreign materials and provided further that no portion of the stated six per cent. of weed seeds and other foreign materials shall be deliberately added.

Oil Meal is the ground product obtained after the extraction of part of the oil by crushing, cooking and hydraulic pressure, or by crushing, heating and the use of solvents from seeds which have been screened and cleaned of weed seeds and other foreign materials by the most improved commercial processes. When used alone the term "Oil Meal" shall be understood to designate linseed meal as defined. When used to cover any other product the name of the seed from which it is obtained shall be prefixed to the words "oil meal."

Old Process Oil Meal is the ground product obtained after extraction of part of the oil by crushing, cooking and hydraulic pressure from seeds screened and cleaned of weed seeds and other foreign materials by the most improved commercial processes. When used alone the term "Old Process Oil Meal" shall be understood to designate linseed meal as defined, made by the old process. When used to cover any other product the name of the seed from which it is obtained shall be prefixed to "old process oil meal."

New Process Oil Meal is the ground product obtained after extraction of part of the oil by crushing, heating and the use of solvents from seeds

screened and cleaned of weed seeds and other foreign materials by the most improved commercial processes. When used alone the term "New Process Oil Meal" shall be understood to designate linseed meal as defined, made by the new process. When used to cover any other product the name of the seed from which it is obtained shall be prefixed to "new process oil meal."

Flax Plant By-Product is that portion of the flax plant remaining after the separation of the seed, the bast fiber and a portion of the shives, and consists of flax shives, flax pods, broken and immature flax seeds, and the cortical tissue of the stem.

Ground Flaxseed or *Flaxseed Meal* is the product obtained by grinding flaxseed which has been screened and cleaned of weed seeds and other foreign materials by the most improved commercial processes, provided that the final product shall not contain over four per cent. of weed seeds and other foreign materials, and provided further that no portion of the stated four per cent. of weed seeds and other foreign materials shall be deliberately added.

Unscreened Flaxseed Oil Feed is the ground product obtained after extraction of part of the oil from unscreened flaxseed by crushing, cooking and hydraulic pressure, or by crushing, heating and the use of solvents. When sold without grinding the unground product shall be designated as "unscreened flaxseed oil feed cake."

Ingredients of Unscreened Flaxseed Oil Feed—Ground cake from partially extracted flaxseed and foreign seeds (wheat, wild buckwheat, pigeon grass, wild mustard, etc.).

Screenings Oil Feed is the ground product obtained after extraction of part of the oil by crushing, cooking and hydraulic pressure, or by crushing, heating and the use of solvents from the smaller imperfect grains, weed seeds and other foreign materials having feeding value separated in cleaning the grain. The name of the grain from which the screenings are separated shall be prefixed to "screenings oil feed."

Oat Products.

Oat Groats are the kernels of the oat berry.

Oat Hulls are the outer chaffy coverings of the oat grain.

Oat Middlings are the floury portions of the oat groat obtained in the milling of rolled oats.

Oat Shorts are the covering of the oat grain lying immediately inside the hull, being a fuzzy material carrying with it considerable portions of the fine floury part of the groat obtained in the milling of rolled oats.

Clipped Oat By-Product is the resultant by-product obtained in the manufacture of clipped oats. It may contain light chaffy material broken from the ends of the hulls, empty hulls, light, immature oats and dust. It must not contain an excessive amount of oat hulls.

Peanut Products.

Peanut Oil Cake is the residue after the extraction of part of the oil by pressure or solvents from peanut kernels.

Peanut Oil Meal is the ground residue after the extraction of part of the oil from peanut kernels.

Unhulled Peanut Oil Feed is the ground residue obtained after extraction of part of the oil from whole peanuts, and the ingredients shall be designated as *Peanut Meal and Hulls.*

Rice Products.

Rice Bran is the cuticle beneath the hull.

Rice Hulls are the outer chaffy coverings of the rice grain.

Rice Polish is the finely powdered material obtained in polishing the kernel.

Wheat Products.

Wheat Bran is the coarse outer coatings of the wheat berry obtained in the usual commercial milling process from wheat that has been cleaned and scoured.

Shorts or *Standard Middlings* are the fine particles of the outer and inner bran separated from bran and white middlings.

Wheat White Middlings or *White Middlings* are that part of the offal of wheat intermediate between shorts or standard middlings and red dog.

Shipstuff or *Wheat Mixed Feed* is a mixture of the products other than the flour obtained from the milling of the wheat berry.

Red Dog is a low grade wheat flour containing the finer particles of bran.

Wheat Bran with Mill Run Screenings is pure wheat bran plus the screenings which were separated from the wheat used in preparing said bran.

Wheat Bran with Screenings not Exceeding Mill Run is either wheat bran with the whole mill run of screenings or wheat bran with a portion of the mill run of screenings, provided that such portion is not an inferior portion thereof.

Miscellaneous Products.

Yeast or *Vinegar Dried Grains* are the properly dried residue from the mixture of cereals, malt and malt sprouts (sometimes cottonseed meal) obtained in the manufacture of yeast or vinegar, and consists of corn or corn and rye from which most of the starch has been extracted, together with malt added during the manufacturing process to change the starch to sugars, and malt sprouts (sometimes cottonseed meal) added during the manufacturing process to aid in filtering the residue from the wort and serve as a source of food supply for the yeast.

Palm Kernel Oil Meal is the ground residue from the extraction of part of the oil by pressure or solvents from the kernel of the fruit of *Elaeis guineensis* or *Elaeis malanococca.*

Ivory Nut Meal is ground ivory nuts.

Tentative Definitions.

Barley Feed is the entire by-product resulting from the manufacture of pearl barley made from clean barley.

Barley Mixed Feed is the entire offal from the milling of barley flour from clean barley and is composed of barley hulls and barley middlings.

Dried Beet Pulp is the material obtained by drying the residue from sugar beets which have been extracted in the process of manufacturing sugar and shall not contain excessive amounts of crowns, tails or sand.

Cocoanut Oil Meal is the ground residue from the extraction of part of the oil from the meat of the cocoanut.

Wheat Bran consists of the coarse outer coatings of the kernel obtained in the usual commercial process of milling from wheat that has been cleaned and scoured.

Shorts or *Standard Middlings* consists mostly of the fine particles of bran and germ and contains very little of fibrous offal obtained from the "tail of the mill."

Gray (or total) *Shorts* consists of the fine particles of the outer bran, the inner or "Bee-wing" bran, the germ and the offal or fibrous material, obtained in the last reductions in milling.

White Shorts or *White Middlings* consists of a smaller portion of the fine bran particles and the germ and a much greater portion of the fibrous offal from the "tail of the mill."

Red Dog consists of a mixture of low-grade flour, fine particles of bran and the fibrous offal from the "tail of the mill."

Wheat Mixed Feed consists of pure wheat bran and the gray or total shorts or middlings combined in the proportions obtained in the usual process of commercial milling.

Wheat Bran and Standard Middlings consists of the two commodities as defined above mixed in the proportions obtained in the usual process of commercial milling.

(Note—If to any of the foregoing brands of feed there should be added screenings, or scourings, as hereinafter defined, either ground or unground, bolted or unbolted, such brand shall be so registered, labeled and sold as clearly to indicate this fact. The word "Screenings" or "Scourings" as the case may be, shall appear as a part of the name or brand and shall be printed in the same size and face of type as the remainder of the brand name.)

Screenings consists of the smaller imperfect grains, weed seeds and other foreign materials having feeding value separated in cleaning the grain.

Scourings consists of such portions of the cuticle, brush, white caps, dust smut, and other materials as are separated from the grain in the usual commercial process of scouring.

INSPECTION OF 1919.

Remarks on Analyses.

(*Analyses on pages 370-393.*)

Cottonseed Meal. Of the fifteen samples examined only two exceeded 40 per cent. protein. The average protein content is 37.10 per cent. as compared with 36.01 per cent. the preceding

year. Collectively the samples have exceeded their guaranties by about 0.6 per cent. protein and 1.4 per cent. fat. The average price of $82.67 is an increase of about 25 per cent. over the price a year ago. Deficient samples are noted in Table III.

Cottonseed Feed. Only two samples were examined, one of which was deficient in protein and contained excess fiber. These two brands sold at cottonseed meal prices.

Linseed Meal. The quality this year, as judged by the protein content, is lower than the average last year by about 3 per cent. The price has ranged from $82.00 to $93.00 per ton. As compared with cottonseed meal it has averaged nearly $3.00 per ton higher in price and carried 4.3 per cent. less protein.

Wheat Products. The quality of these products has been generally satisfactory and guaranties have been met in nearly every instance. Middlings have sharply advanced in price, the average, $68.62, being about $17.00 per ton more than the average in 1918. The price of wheat feed has averaged somewhat less than last year.

Rye, Barley and Maize Products have maintained average quality but prices have considerably advanced in most cases.

Miscellaneous Feeds. Peanut oil meal has sold for $75.00 to $81.00 per ton as compared with $58.00 last year. No samples of velvet bean feed have been found in this inspection. Apparently stock becomes accustomed to this feed rather slowly even in mixture although no trouble of this sort is experienced in the South. Copra cake meal is used to an increasing extent as an ingredient of mixed feeds. Its proteins are of a desirable kind and both fat soluble and water soluble vitamines are present.

Proprietary Mixed Feeds. When compounded with materials of good quality these feeds possess undoubted merit. The variety of sources from which they derive their nutrients makes possible a supplementing of nutritive qualities which modern ideas of efficient feeding endorse as a rational practice. The criticism of them is that on account of their variety, they furnish an outlet for low-grade materials of little worth. Some of these show plainly on the tags the ingredients of which they are composed. While the law in this State does not require such information it is a valuable guide to the feeder, and is given in case of the following brands:

Algrane Milk Feed. Cottonseed meal, linseed oil meal, corn gluten feed, ground corn, wheat middlings (with screenings), ground barley, molasses, one-half of one per cent. salt, oat hulls, shorts, clippings not over 600 pounds per ton.

Bufceco Chop Feed. Ground corn, oats and barley, hominy feed, oat shorts and oat hulls.

Bufceco Dairy Feed. Ground corn, wheat bran and middlings, hominy feed, corn gluten feed, oat shorts, oat middlings, oat hulls, one-half of one per cent. salt.

Bufceco Horse Feed. Ground corn, oats and barley, hominy feed, oat shorts, oat hulls, linseed meal, corn gluten feed, wheat middlings containing mill run ground screenings, one-half of one per cent. salt.

Crosby's 1918 Dairy Ration. Distillery dried grains, cottonseed meal, peanut meal, brewers' dried grains, hominy feed and oat feed (oat hulls, oat shorts and oat middlings).

Crosby's Stock Food. Ground barley, ground hominy feed, ground oats, oat feed (oat hulls, oat shorts, oat middlings).

Emerald Horse Feed. Cracked corn, oats, barley, alfalfa meal and molasses.

H. & S. Horse, Mule and Dairy Feed. Crushed flaxseed meal, old process oil meal, alfalfa meal, dried brewers' and distillers' grains, pure cane syrup, one-half of one per cent. salt.

Mystic Feed. Ground oats and barley, wheat middlings, corn meal, white hominy feed, oat middlings, oat hulls, old process oil meal, not over one per cent. salt.

Pennant Brand Stock Feed. Fine white hominy and oat by-products (oat middlings, hulls and shorts).

Purina Cow Chow Feed. Old process linseed oil meal, gluten feed from corn, hominy feed, cottonseed meal, ground alfalfa, molasses and one per cent. salt.

Purina Pig Chow. Hominy feed, cane molasses, ground barley, gluten feed from corn, cracked corn, digester tankage, old process linseed oil meal, alfalfa, charcoal, one per cent. salt.

Big Q Dairy Ration. Cottonseed meal, corn distillers' grains, corn gluten feed, old process linseed oil meal, wheat middlings, wheat bran (with screenings not exceeding mill run), oat meal mill by-products (oat middlings, hulls and shorts), hominy feed, yellow hominy feed, one per cent. salt.

Read the Tag Dairy Feed. Cottonseed meal, corn gluten feed, linseed oil meal, corn meal, hominy feed, ground barley, wheat middlings (with mill run screenings), molasses, three-fourths of one per cent. salt, oat hulls and oat shorts not over 225 pounds per ton.

Biles Ready Dairy Ration. Corn distillers' grains, choice cottonseed meal, old process linseed meal, white wheat middlings, winter wheat bran, hominy meal, cocoanut oil meal, corn gluten feed, brewers' dried grains, barley malt sprouts, one-half per cent. fine table salt.

Yellow Tag Stock Feed. Ground barley, ground hominy meal, ground

corn, oat meal mill by-product (oat middlings, shorts and hulls), one-half of one per cent. salt. Part of the ingredients have been cooked or steamed.

Bufceco Poultry Mash. Ground corn, wheat bran and middlings, hominy feed, corn gluten feed, oat middlings, rolled oats, one-half of one per cent. salt.

H.-O. Laying Mash. Linseed oil meal, corn gluten feed, bone meal, ground corn, oat middlings, wheat middlings, wheat bran (with mill run screenings), hominy feed, rolled oats, ground peas.

Tioga Growing Mash. Wheat middlings, hominy feed, old process linseed oil meal, wheat bran, corn feed meal, kaffir corn meal, corn gluten meal, corn gluten feed, phosphate of lime.

Bicorn Hog Feed. Digester tankage, corn germ meal, wheat middlings, hominy feed, corn feed meal, barley, oats, linseed meal, bone meal, corn gluten feed and salt.

Summary of deficiencies. Variations from guaranty greater than one per cent. in protein and fiber and one-quarter of one per cent. in fat together with other points of criticism revealed by the inspection this year are summarized in Table III.

TABLE III.—FEEDS NOT CONFORMING TO GUARANTIES OR OTHERWISE ILLEGAL.

Station No.	Brand and Manufacturer.	Protein deficiency.	Fat deficiency.	Fiber excess.	Remarks.
		%	%	%	
	Cottonseed Meal.				
13794	Buckeye. Buckeye Cotton Oil Co., Cincinnati, Ohio	....	....	....	Wire tags, illegal.
13904	Clover Leaf. Manufacturer unknown	1.75	....	....	
13873	Hall. W. D. Hall Co., Atlanta, Ga.	....	....	....	Wire tags, illegal.
13864	Quaker Oats Co., Richford, Vt.	5.75	....	4.31	
13931	A-1. Winner Feed Co., Chattanooga, Tenn.	1.44	....	....	
	Cottonseed Feed.				
13788	Beauty. S. P. Davis, Little Rock, Ark.	1.00	....	1.84	
	Linseed Meal.				
13834	Archer Daniels Linseed Co., Buffalo, N. Y.	....	....	....	Wire tags, illegal.
13892	Economic Feed Co., New York	....	1.10	....	Wire tags, illegal.
13783	Kelloggs & Miller, Amsterdam, N. Y.	....	....	....	Wire tags, illegal.
13763	Spencer Kellogg & Sons, Buffalo, N. Y.	2.06	....	....	Wire tags, illegal.
	Wheat Products.				
13823	Bell Cow Bran. Quaker Oats Co., Chicago, Ill.	....	0.37	....	
13791	Tekoe Middlings. Russell Miller Mills Co., Minneapolis, Minn.	....	....	....	No guaranty.
13859	Roberts Roller Mill. Co., Batavia, N. Y.	....	....	....	No guaranty.
	Corn Gluten Feed.				
13804	Cream of Corn. American Maize Products Co., Roby, Ind.	....	....	....	Wire tags, illegal.

TABLE III.—FEEDS NOT CONFORMING TO GUARANTIES OR OTHERWISE ILLEGAL—*Continued.*

Station No.	Brand and Manufacturer.	Protein deficiency.	Fat deficiency.	Fibre. excess.	Remarks.
		%	%	%	
	Hominy Feed.				
13910	Bufceco. Buffalo Cereal Co., Buffalo, N. Y.	....	0.40	....	
13779	Yellow. Buffalo Cereal Co., Buffalo, N. Y.	....	1.56	....	
13875	Cereal Mills Co., Wausau, Wis.	....	1.20	....	
13835	Paragon. Chas. M. Cox Co., Boston, Mass.	....	0.56	....	
13874	National Feed Co., St. Louis, Mo.	....	0.76	....	Wire tags, illegal.
13790	Burts. Postum Cereal Co., Battle Creek, Mich.	....	0.51	....	
	Brewery Products.				
13846	Dried Brewers' Grains. James Hanley Brewing Co., Providence, R. I.	....	....	....	Wire tags, illegal.
	Miscellaneous.				
13778	Peanut Meal. Richland Cotton Oil Co., Richland, Ga.	....	....	1.03	
	Proprietary Mixed Feeds.				
13787	Red Horn Calf Meal. Hales & Edwards Co., Chicago, Ill.	....	0.58	....	
13933	Purina Calf Chow. Purina Mills, St. Louis, Mo.	....	1.19	....	
13913	H. & S. Dwight E. Hamlin, Pittsburgh, Pa.	2.56	1.96	....	
13848	Harvest. Hales & Edwards Co., Chicago, Ill.	....	0.31	....	
13831	Monogram. Metropolitan Mills, New York	3.31	1.12	....	
13919	Mystic. Mystic Milling & Feed Co., Rochester, N. Y.	...	....	1.41	Wire tags, illegal.
13747	Emerald. Prairie State Milling Co., Chicago, Ill.	....	0.60	3.23	
13854	Purina Pig Chow. Purina Mills, St. Louis, Mo.	....	....	1.77	
13923	Niagara. Boston Feed Store, Willimantic	....	....	....	No guaranty.
13906	Yellow Tag Stock Feed. F. L. Cressey, Boston, Mass.	....	....	1.17	
13867	Iowa. Purity Oats Co., Davenport, Iowa	....	0.26	....	
13751	Schumacker. Quaker Oats Co., Chicago, Ill.	....	0.26	....	
13842	Winner. David Stott, Detroit, Mich.	....	0.60	....	
13768	Provender. D. L. Talcott, Torrington	....	....	....	No guaranty.
13927	Niagara. Boston Feed Store, Willimantic	....	....	....	No guaranty.
13749	H. O. Milk Feed. H. O. Co.'s Mills, Buffalo, N. Y.	....	0.49	....	
13813	Read the Tag. H. O. Co.'s Mills, Buffalo, N. Y.	....	0.51	....	
13757	Gold Flake. Hales & Edwards Co., Chicago, Ill.	1.50	0.50	....	
13830	Barfords. Meech & Stoddard, Inc., Middletown	....	0.71	....	
13868	Purina Cow Chow. Purina Mills, St. Louis, Mo.	....	0.49	....	
13780	Syragold. Syracuse Milling Co., Syracuse, N. Y.	....	0.41	....	
	Poultry Feeds.				
13881	Buffalo Laying Mash. Globe Elevator Co., Buffalo, N. Y.	....	3.58	....	
13786	Red Comb Mash Feed. Hales & Edwards Co., Chicago, Ill.	....	0.42	....	

Feeds Containing Molasses. As in previous years feeds containing molasses have been examined for fat both by the official method and by extraction after removing sugar by washing with water.

Results by the two methods are as follows:

TABLE IV. FAT IN MOLASSES FEEDS.

No.	Brand.	Official Method.	Modified Method.	Guaranty.
		%	%	%
13743	Peters King Corn Horse and Mule Feed ..	0.77	1.47	1.50
13747	Emerald Horse Feed	0.61	1.40	2.00
13762	Purina Molene Feed	4.60	3.64	3.20
13765	Eshelman's 40 Horse Feed	2.06	2.16	2.00
13811	Greenfield Brand	0.45	0.94	0.50
13826	Allstock Molasses Grains	2.34	3.18	2.00
13831	Monogram Feed	1.22	1.88	3.00
13833	Bufceco Horse Feed	4.69	3.52	4.00
13848	Harvest Horse Feed	1.39	1.69	2.00
13871	Lancaster Horse Feed	2.63	2.70	2.50
13895	Harvest Horse Feed	1.29	2.03	2.00
13912	Sucrene Dairy Feed	3.91	4.39	3.50
13913	H. & S. Horse, Mule and Dairy Feed	0.90	1.54	3.50
13919	Mystic Feed, Horse, Cattle & Swine	3.99	2.77	3.00

In eleven cases the results after removing sugar were higher than those by the regular official method; in three cases they were lower.

MISCELLANEOUS SAMPLES.

VELVET BEANS.

Analyses have been made of three of the principal varieties of velvet beans, samples of which were obtained through the courtesy of the Bureau of Plant Industry at Washington.

Variety	Osceola.	Alabama.	Georgia.
	%	%	%
Moisture	9.79	7.42	7.73
Ash	3.22	3.22	3.02
Protein (N. x 6.25)	25.25	24.81	23.85
Fiber	5.65	5.35	6.72
Starch	32.50	32.88	32.02
Other nitrogen-free extract	19.29	20.03	20.61
Ether extract	4.30	6.29	6.05

SAMPLES SUBMITTED BY THE DAIRY COMMISSIONER.

Two samples were examined; **12523**, Morgan B Stock Feed, and **15954**, Brewers' Grains, contained 15.63 per cent. and 17.31 per cent. of protein, respectively. These numbers are of the Commissioner's series.

SAMPLES SUBMITTED BY INDIVIDUALS.

Barley Feed. **13382**, sent by E. Manchester and Sons, Winsted, contained 12.25 per cent. protein, 10.25 per cent, fiber and 3.86 per cent. fat and conformed to its guaranty.

Corn Products. **13404**, Fancy Cracked Corn (degerminated), manufactured by the Krause Milling Co. and sent by Chas. M. Cox Co., Boston.

13399, Corn Meal, sent by A. B. Congdon, Middletown.

14243, Gluten Feed, sent by Frank C. Beach, New Milford.

12368, Hominy Feed, sent by The P. Schwartz Co., Inc., New London.

14390, Corn and Cob Meal, sent by A. Bender, Port Chester, N. Y.

Analyses of these materials are as follows:

	13404	13399	14243	12368	14390
Moisture	12.93	....	5.78	....	....
Ash	0.39	....	3.43	....	....
Protein	8.88	13.25	27.38	11.19	8.63
Fiber	0.26	....	5.64	....	....
Nitrogen-free extract	77.24	....	54.48	....	....
Fat	0.30	....	3.29	....	....

Cottonseed Meal. **12381**, **12946**, American Cotton Oil Co.; **12436**, **12739**, Park and Pollard Co.; **12603**, Deutsch & Sickert Co.; **12738**, E. Crosby & Co., all sent by The Coles Company, Middletown.

12467, sent by E. J. Wells, Jr., East Windsor Hill.

13160, Pioneer, sent by Wood Ford Farm, Avon.

13512, Danish, sent by Wm. E. Wheelock, Quinebaug; **14180**, sent by Humphreys-Goodwin Co., the same being a portion of a sample taken by Mr. Wheelock from the same lot as sample **13512** and sent by him to them at their request.

14303, sent by H. H. McKnight, Ellington.

Analyses of these samples are as follows:

Station No.	Protein found. %	Protein guaranteed. %
12381	35.81	36.00
12946	36.63	36.00
12436	40.94	36.00
12739	35.00	36.00
12603	36.81	36.00
12738	31.75	36.00
12467	43.44	Unit basis
13160	40.44	41.00
13512	34.31	36.00
14180	36.31	....
14303	35.31	....

A recheck on our sample **13512**, made in this laboratory, substantiated our original result.

Oat Products. **12605**, Ground Oats, sent by B. W. Ellis, County Agent, Putnam, and **13629**, sent by Almon N. Perkins, Litchfield, contained 11.63 per cent. and 14.00 per cent. protein respectively.

Wheat Products. **13383**, Big Diamond Standard Middlings, sent by Henry Peacock, Wilton, contained 15.75 per cent. protein, 8.05 per cent. fiber and 5.20 per cent. fat. The sample conformed to its guaranty.

12920, Middlings, sent by M. Hurwitz & Co., Stepney, to be examined for foreign material. Examination showed no material other than wheat products.

Proprietary Mixed Feeds. **14244**, Dairy Feed, sent by Frank C. Beach, New Milford.

14392, Eshelman's 24 Dairy Feed, sent by Fairlea Farm, Orange.

12282, Federal Stock Food, sent by Frank S. Platt Co., New Haven.

12462, Stock Feed, sent by C. A. Cowles, Plantsville.

12497, Sweet Stock Feed, made by Metropolitan Mills, N. Y., composed of unground oat feed, cocoanut oil meal, dried brewers' grains and molasses.

12546, W. & C. Dairy Feed, mixed and sent by Boston Grain Store, Willimantic.

12702, Davis Stock Feed, mixed and sent by R. G. Davis and Sons, New Haven.

13395, Ideal Cow Ration, sent by Washington Supply Co., Inc., Washington Depot.

12887, Barford's Balanced Dairy Ration, sent by Meech and Stoddard, Inc., Middletown, composed of ground oats, barley, wheat bran, standard middlings, gluten feed, peanut, cocoanut and linseed meals.

14027, Barford's Balanced Dairy Ration, sent by Connecticut State Hospital, Middletown.

14236, Barford's Balanced Dairy Ration, sent by Meech and Stoddard, Inc., Middletown.

12474, Morgan's Balanced Ration, sent by The Hubbell Coal and Storage Co., Saugatuck.

14340, Morgan's Balanced Ration, sent by The A. E. Plant Sons Co., Branford.

14245, Dairy Ration, sent by Mrs. I. E. Bauch, Woodbury.

12185, Dairy Feed, sent by R. M. Fenn, Middlebury.

14388, Holsum Horse Feed, and **14389**, King Corn, sent by Lewis Sperry, Hartford.

12883, Special Mixture. Analysis requested by J. P. Stillson, New Preston.

12746, sent by G. W. Thorpe, West Cheshire.

12307, sent by Daniel H. Morgan, Southport.

Analyses of these feeds are as follows:

TABLE V. ANALYSES OF MISCELLANEOUS PROPRIETARY FEEDS.

Station No.	Moisture. %	Ash. %	Protein. %	Fiber. %	Nitrogen-free Extract. %	Fat. %
14244	6.31	5.18	21.94	9.66	51.45	5.46
14392	6.91	6.30	24.06	11.14	45.87	5.72
12282	12.98	....	7.06	....	....	5.25
12462	9.12	3.83	7.81	13.52	62.69	3.03
12497	5.53	7.61	7.13	13.70	64.06	1.97
12546	6.99	....	17.88	....	....	4.01
12702	8.32	....	10.94	....	....	4.09
13395	11.92	4.02	21.13	8.13	49.79	5.01
12887	10.80	4.94	20.00	7.50	50.25	6.51
14027	6.84	4.86	20.50	8.64	52.14	7.02
14236	9.60	5.18	21.25	10.91	47.78	5.28
12474	5.52	7.04	15.75	14.04	46.73	10.92
14340	....	....	22.31	....	....	....
14245	8.83	5.07	20.75	16.97	43.83	4.55
12185	7.39	7.06	22.25	11.33	47.38	4.59
14388	5.20	7.80	10.13	14.97	60.19	1.71
14389	5.04	7.88	11.88	15.25	58.00	1.95
12883	10.39	4.66	22.50	9.14	48.23	5.08
12746	7.06	....	18.94	....	....	9.00
12307	....	....	18.06	....	....	....

Poultry Feeds, etc. **13412,** Meat Meal, and **13413,** Meat Scrap, sent by Z. N. Beach, Wallingford, contained 83.75 per cent. and 50.00 per cent. protein respectively.

13033, 13034, 13035, Beef Scraps, and **13036,** Meat and Bone Scraps, sent by L. C. Orcutt, Rockville, contained 44.63 per cent., 43.38 per cent., 57.00 per cent., and 41.00 per cent. protein in the order named.

12472, Dry Mash, sent by S. M. Crowell, Middletown, contained 23.19 per cent. protein.

Unclassified. **13351,** Extravim Feed Molasses, sent by E. D. Curtis, Bantam. Examination and analysis of this material showed the following results:

Color, very dark; odor and taste normal; total solids 71.14 per cent.; total reducing sugar 50.85 per cent. (sucrose 30.63 per cent., invert sugar 20.22 per cent.); nitrogen 1.39 per cent.

The material is probably the so-called "third molasses" obtained in the manufacture of sugar and used in the preparation of molasses feeds.

14171, Cull beans, sent by Edw. P. Smith and Co., Baltimore. They contained 8.86 per cent. moisture, 5.33 per cent. ash, 25.13 per cent. protein, 3.99 per cent. fiber, 55.00 per cent. nitrogen-free extract and 1.69 per cent. fat.

Proprietary Remedies. **13648,** More Egg Tonic, 2-4-1, and **13649,** Little Champions, a White Diarrhoea Remedy, both samples sent by the Associated Advertising Clubs of the World, New York.

More Egg Tonic is claimed to increase or double egg production; and Little Champions are claimed to be a preventative and cure for white diarrhoea in chicks.

Examination and analysis of these remedies showed the following composition:

13648. Tablets averaged 0.4780 gram each. Total nitrogen 1.36 per cent.; nitrogen in nitrates 1.03 per cent.; total ash 18.95 per cent. (contains chiefly sulphates, potassium, iron and calcium); fenugreek present; ginger present; possibly gentian.

The tablets consist essentially of ferrous sulphate, salt peter and ground roots or herbs or both, ingredients which are widely used in poultry remedies and conditioners.

13649. Tablets averaged 0.1689 gram each. Ash 0.14 per cent.; organic and volatile 99.86 per cent.; mercuric chloride 60.65 per cent.; filler undetermined; organic matter present.

These tablets contain bichloride of mercury as the chief medicament with unidentified organic material probably used as a vehicle.

A great deal of study has been given to the subject of white diarrhoea at the Storrs Station where the bacterium causing the disease was discovered. There is no recognized cure for it and the claims made for this remedy are unjustified.

Feeds suspected of containing poisonous materials, etc. Complaints are occasionally received that certain feeds have apparently produced sickness or death, or that animals refuse to eat them. Conclusive evidence that sickness or death has resulted from a particular feed is difficult to establish, although the circumstances may strongly indicate such conclusions in some cases. Unless toxic chemical substances can be detected a satisfactory explanation as to the probable cause of the trouble can seldom be given. Feeding experiments, particularly in Canada, have shown quite conclusively that certain weed seeds, such as the mustards, produce ill or fatal results in animals, especially hogs. A refusal to eat a certain ration may indicate the presence of some unpalatable ingredient. Velvet beans, for example, are not relished by animals unaccustomed to such fodder.

Eight samples of suspicious feeds have been examined during the past year. In six of these unpalatability due to some ingredient to which the animals were not accustomed seemed to be the only explanation that could be made. **12775,** Starch Feed, containing "lumps," was sent for identification of the foreign material. The "lumps" were rock phosphate. **12856,** Middlings, suspected of containing foreign material, appeared to be a genuine wheat product.

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	OIL SEED PRODUCTS.	
	Cottonseed Meal.	
13898	Paramount. Ashcraft Wilkins Co., Atlanta, Ga.	Middletown: Meech & Stoddard, Inc.
		Guaranty
13879	Dove. F. W. Brode & Co., Memphis, Tenn.	Brookfield: C. R. Dubia
		Guaranty
13872	Jay. F. W. Brode & Co., Memphis, Tenn.	Stamford: C. E. Slauson Co.
		Guaranty
13934	Jay. F. W. Brode & Co., Memphis, Tenn.	Rockville: Rockville Milling Co.
		Guaranty
13794†	Buckeye. Buckeye Cotton Oil Co., Cincinnati, Ohio	Granby: E. H. Rollins
		Guaranty
13889	Good Luck. S. P. Davis, Little Rock, Ark.	New Milford: Geo. E. Ackley Co.
		Guaranty
13873†	Hall. W. D. Hall Co., Atlanta, Ga.	Stamford: W. L. Crabb
		Guaranty
13744	Danish. Humphreys, Godwin Co., Memphis, Tenn.	Shelton: Ansonia Flour & Grain Co.
		Guaranty
13904	Clover Leaf. Manufacturer unknown	Middletown: Meech & Stoddard, Inc.
		Guaranty
13756	Upland. Park & Pollard Co., Boston, Mass.	Watertown: M. D. Leonard Co.
		Guaranty
13864	Quaker Oats Co., Richford, Vt.	Saugatuck: Hubbell Coal & Storage Co.
		Guaranty
13817	Puritan. J. E. Soper Co., Boston, Mass.	Plantsville: C. A. Cowles
		Guaranty
13803	Good. Taylor Commission Co., Atlanta, Ga.	Hazardville: A. D. Bridges Sons
		Guaranty
13852	Surety. Union Seed & Fertz. Co., Macon, Ga.	Meriden: Meriden Grain & Feed Co.
		Guaranty
13931	A-1. Winer Feed Co., Chattanooga, Tenn.	New Haven: R. G. Davis & Sons
		Guaranty
		Average guaranty
		Average of analyses
		Average digestible
	Cottonseed Feed.	
13870	Goodlow. M. F. Baringer, Philadelphia, Pa.	South Norwalk: S. Roodner
		Guaranty

† Wire tags.

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Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N. x 6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Crude Fat)	
13898	6.74	6.18	39.13	12.11	29.18	6.66	$84.00
....	....	....	36.00	14.00	27.00	5.50	....
13879	7.30	6.55	40.19	11.59	27.66	6.71	87.00
....	....	....	38.63	12.00	22.00	6.00	....
13872	5.78	6.55	37.94	10.86	31.22	7.65	84.00
....	....	....	36.00	14.00	30.00	5.00	....
13934	7.59	6.35	36.06	12.41	31.44	6.15	83.00
....	....	....	36.00	14.00	30.00	5.00	....
13794	7.01	5.65	36.19	12.46	31.56	7.12	82.00
....	....	....	36.00	14.00	30.00	5.00	....
13889	8.00	6.90	43.63	9.65	23.62	8.20	88.00
....	....	....	41.00	9.00	....	6.00	....
13873	7.95	6.05	37.88	12.95	29.29	5.88	70.00
....	....	....	36.00	14.00	27.00	5.50	....
13744	7.40	6.53	36.38	11.22	31.18	7.29	86.00
....	....	....	36.00	15.00	25.00	5.00	....
13904	7.55	6.17	34.25	12.92	31.78	7.33	84.00
....	....	....	36.00	....	....	5.00	....
13756	6.89	5.83	34.69	15.81	31.42	5.36	82.00
....	....	....	36.00	....	....	5.00	....
13864	8.70	5.31	30.25	18.31	32.20	5.23	85.00
....	....	....	36.00	14.00	27.00	5.00	....
13817	7.29	6.13	39.69	10.96	28.63	7.30	82.00
....	....	....	36.00	15.00	30.00	5.00	....
13803	7.28	6.00	37.94	11.96	29.88	6.94	80.00
....	....	....	36.00	....	....	7.00	....
13852	7.95	5.63	37.75	11.98	30.10	6.59	80.00
....	....	....	36.00	14.00	27.00	5.50	....
13931	6.99	5.78	34.56	13 94	31.72	7.01	83.00
....	....	....	36.00	14.00	27.00	5.50	....
....	....	....	36.51	....	....	5.37	....
....	7.36	6.11	37.10	12.61	30.06	6.76	82.67
....	....	....	31.2	4.7	22.5	6.4	....
13870	7.42	5.89	36.38	12.47	31.22	6.62	84.00
....	....	....	36.00	16.00	....	5.00	....

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	OIL SEED PRODUCTS—*Concluded.*	
	Cottonseed Feed—Concluded.	
13788	Beauty. S. P. Davis, Little Rock, Ark.	Simsbury: Woods-Chandler Co. .....
		Guaranty .....
		Average guaranty .....
		Average of analyses .....
		Average digestible .....
	Linseed Meal, Old Process.	
13816	Oil Meal. American Linseed Co., New York .	Plantsville: C. A. Cowles ...
		Guaranty .....
13822	Amco. American Milling Co., Peoria, Ill.	West Cheshire: G. W. Thorpe
		Guaranty .....
13834†	Ground Oil Cake. Archer Daniels Linseed Co., Buffalo, N. Y.	Thompsonville: George S. Phelps Co. .....
		Guaranty .....
13892†	Economic Feed Co., New York	Hamden: I. W. Beers .....
		Guaranty .....
13783†	Oil Meal. Kelloggs & Miller, Amsterdam, N. Y.	Canaan: Ives & Pierce .....
		Guaranty .....
13763†	Oil Meal. Spencer Kellogg & Sons, Buffalo, N. Y.	Torrington: D. L. Talcott ..
		Guaranty .....
13893	Oil Meal. The Mann Bros. Co., Buffalo, N. Y.	Branford: S. V. Osborne ...
		Guaranty .....
		Average guaranty .....
		Average of analyses .....
		Average digestible .....
	WHEAT PRODUCTS.	
	Wheat Bran.	
13849*	Commander. Commander Mill. Co., Minneapolis, Minn.	New Britain: C. W. Lines Co.
		Guaranty .....
13795*	Fancy. C. C. Davison, Geneva, N. Y.	West Suffield: S. J. Orr ....
		Guaranty .....
13829	Gwinn's. Gwinn Milling Co., Columbus, Ohio..	Hartford: Meech Grain Co.
		Guaranty .....
13746*	Wm. Hamilton & Son, Honeoye Falls, N. Y...	Derby: Peterson-Hendee Co.
		Guaranty .....
13844*	The Hogan Milling Co., Junction City, Kans...	Manchester: Little & McKinney .....
		Guaranty .....
13857*	Hunter Milling Co., Wellington, Kans.	Wallingford: E. E. Hall ....
		Guaranty .....
13886	Majestic Milling Co., Aurora, Mo.	New Milford: Geo. T. Soule
		Guaranty .....
13771	Ogilvie Flour Mill. Co., Winnipeg, Canada	Torrington: F. L. Wadhams & Son .....
		Guaranty .....

* With screenings. † Wire tags.

INSPECTION OF 1919—*Continued.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N. x 6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Crude Fat)	
13788	7.66	5.90	35.00	15.84	29.58	6.02	$80.00
....	....	....	36.00	14.00	....	6.00	....
....	....	....	36.00	15.00	....	5.50	....
....	7.54	5.90	35.69	14.16	30.39	6.32	82.00
....	....	....	20.8	6.4	18.5	5.7	....
13816	8.13	5.76	34.50	7.38	38.00	6.23	82.00
....	....	....	34.00	....	....	5.00	....
13822	8.59	6.46	30.50	8.71	37.99	7.75	86.00
....	....	....	30.00	....	....	6.00	....
13834	9.09	5.76	33.75	7.29	37.60	6.57	82.00
....	....	....	33.00	10.00	....	6.00	....
13892	9.50	5.73	33.44	8.27	36.16	6.90	89.00
....	....	....	33.00	10.00	....	8.00	....
13783	8.15	6.15	31.44	7.55	40.98	5.73	84.00
....	....	....	31.00	9.00	....	4.00	....
13763	9.60	6.21	30.94	7.77	39.43	6.05	82.00
....	....	....	33.00	....	....	5.00	....
13893	9.93	5.82	35.19	7.77	34.22	7.07	93.00
....	....	....	33.00	10.00	....	6.00	....
....	....	....	32.83[1]	....	....	6.16[1]	....
....	8.99	5.98	32.82	7.82	37.78	6.61	85.42
....	....	....	29.2	4.5	29.5	5.9	....
13849	9.94	6.83	14.75	11.06	52.82	4.60	50.00
....	....	....	12.00	....	....	4.00	....
13795	9.18	7.15	15.69	10.17	53.58	4.33	72.00
....	....	....	15.00	....	....	4.00	....
13829	9.05	6.10	16.13	8.49	56.16	4.07	51.00
....	....	....	13.00	....	....	4.00	....
13746	10.06	6.73	14.69	9.76	54.70	4.06	52.00
....	....	....	13.15	10.97	....	3.00	....
13844	9.86	6.33	15.69	9.95	53.62	4.55	52.00
....	....	....	14.50	11.00	....	3.50	....
13857	10.14	6.94	15.75	10.76	52.05	4.36	48.00
....	....	....	14.50	....	....	3.50	....
13886	9.69	5.73	16.31	8.92	55.25	4.10	50.00
....	....	....	14.00	14.00	50.00	3.75	....
13771	8.95	6.10	17.50	10.08	51.64	5.73	52.00
....	....	....	13.00	....	....	4.00	....

[1] Average of six guaranties.

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	WHEAT PRODUCTS—*Continued.*	
	Wheat Bran—Concluded.	
13929	Phoenix Milling Co., Davenport, Iowa	Rockville: Rockville Milling Co.
		Guaranty
13894	Winter. Quaker City Flour Mills Co., Philadelphia, Pa.	Guilford: Morse & Landon
		Guaranty
13823*	Bell Cow. Quaker Oats Co., Chicago, Ill.	West Cheshire: G. W. Thorpe
		Guaranty
13839*	T. & C. Thornton and Chester Milling Co., Buffalo, N. Y.	Thompsonville: George S. Phelps & Co.
		Guaranty
13907*	Sun Beam. Schultz, Baujan & Co., Beardstown, Ill.	New London: P. Schwartz Co.
		Guaranty
13807*	Geo. Urban Milling Co., Buffalo, N. Y.	Unionville: F. D. Lawton
		Guaranty
13858*	Valier's. Valier & Spies Milling Co., St. Louis, Mo.	North Haven: Coöperative Feed Co.
		Guaranty
13750*	Washburn-Crosby Co., Minneapolis, Minn.	Ansonia: Ansonia Flour & Grain Co.
		Guaranty
		Average guaranty
		Average of analyses
		Average digestible
	Wheat Feed (Mixed Feed).	
13775	Boston. Duluth Superior Milling Co., Duluth, Minn.	Winsted: E. Manchester & Sons
		Guaranty
13824	Frazee's. James Frazee Mill. Co., Baldwinsville, N. Y.	West Cheshire: G. W. Thorpe
		Guaranty
13748	Snow Flake. Lawrenceburg Flour Mills Co., Lawrenceburg, Ind.	Ansonia: Ansonia Flour & Grain Co.
		Guaranty
13761	Planet. Northwestern Consolidated Co., Minneapolis, Minn.	Litchfield: The Wadhams Co.
		Guaranty
13888*	Fancy. Pillsbury Flour Mills Co., Miinneapolis, Minn.	New Milford: Geo. E. Ackley Co.
		Guaranty
13820*	Fancy. Pillsbury Flour Mills Co., Minneapolis, Minn.	Plantsville: C. A. Cowles
		Guaranty
13843*	Buckeye. Quaker Oats Co., Chicago, Ill.	Manchester: Little & McKinney
		Guaranty
13793	Occident. Russell Miller Mills Co., Minneapolis, Minn.	Granby: E. H. Rollins
		Guaranty

* With screenings.

INSPECTION OF 1919—*Continued.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N. x 6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Crude Fat)	
13929	10.28	6.55	16.44	9.26	53.38	4.09	$56.00
....	....	....	14.31	....	....	3.73	....
13894	10.03	6.50	16.06	9.54	53.62	4.25	52.00
....	....	....	13.00	....	....	3.00	....
13823	8.38	5.75	16.13	9.71	54.90	5.13	48.00
....	....	....	15.30	7.60	56.00	5.50	....
13839	8.20	6.60	15.19	9.95	55.63	4.43	50.00
....	....	....	14.00	....	....	4.00	....
13907	9.54	7.90	15.19	11.34	51.33	4.70	50.00
....	....	....	15.00	10.00	56.00	3.50	....
13807	9.24	6.83	15.19	10.43	53.22	5.09	48.00
....	....	....	14.00	12.50	....	3.50	....
13858	9.72	6.55	17.81	9 77	51.30	4.85	48.00
....	....	....	14.50	10.00	50.00	3.50	....
13750	9.46	6.88	15.38	9.81	53.65	4.82	49.00
....	....	....	13.00	....	....	4.00	....
....	....	....	13.89	....	....	3.78	....
....	9.42	6.59	15 87	9.94	53.61	4.57	51.75
....	....	....	12.0	4.3	40.3	2.8	....
13775	10.02	4.63	17.06	8.72	53.94	5.63	61.00
....	....	....	15.00	....	....	4.00	....
13824	9.54	5.23	16.19	7.18	57.08	4.78	61.00
....	....	....	14.00	12.00	....	3.50	....
13748	9.65	6.09	17.94	7.89	53.90	4.53	59.00
....	....	....	14.00	....	....	3.00	....
13761	10.24	5.00	17.88	5.88	55.69	5.31	60.00
....	....	....	15.00	....	....	4.00	....
13888	9.97	4.91	17.06	7.08	56.59	4.39	62.00
....	....	....	14.00	....	....	4.00	....
13820	9.78	4.91	17.00	8.07	55.48	4.76	58.00
....	....	....	14.00	....	....	4.00	....
13843	9.05	5.85	16.75	8.64	54.69	5.02	59.00
....	....	....	15.50	....	....	4.50	....
13793	9.34	5.50	16.69	8.41	54.30	5.76	58.00
....	....	....	15.00	....	....	4.50	....

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	WHEAT PRODUCTS—*Continued.*	
	Wheat Feed (Mixed Feed)—Concluded.	
13752	Gold Mine. Sheffield King Milling Co., Minneapolis, Minn.	Waterbury: Spencer Grain Co.
		Guaranty
13769	Stott's Honest. David Stott's Flour Mills, Detroit, Mich.	Torrington: F. L. Wadhams & Son
		Guaranty
13850*	Angelus. Thompson Milling Co., Lockport, N. Y.	New Britain: C. W. Lines Co.
		Guaranty
13837*	T. & C. Thornton & Chester Milling Co., Buffalo, N. Y.	Thompsonville: George S. Phelps & Co.
		Guaranty
13914*	Victor. Victor Milling Co., Victor, N. Y.	Norwich: Chas. Slosberg & Son
		Guaranty
13812*	Washburn-Crosby Co., Minneapolis, Minn.	Plainville: Eaton Bros.
		Guaranty
13777	Kent. Williams Bros. Co., Kent, Ohio	Winsted: E. Manchester & Son
		Guaranty
		Average guaranty
		Average of analyses
		Average digestible
	Wheat Middlings.	
13877	Bay State. Bay State Milling Co., Winona, Minn.	Danbury: F. C. Benjamin
		Guaranty
13796	Fancy. C. C. Davison, Geneva, N. Y.	West Suffield: S. J. Ora
		Guaranty
13745	Wm. Hamilton & Son, Honeoye Falls, N. Y.	Derby: Peterson-Hendee Co.
		Guaranty
13791	Tekoe Flour Middlings. Russell Miller Mills Co., Minneapolis, Minn.	Granby: E. H. Rollins
		Guaranty
13838	Choice. Niagara Milling Co., Niagara Falls, N. Y.	Thompsonville: George S. Phelps Co.
		Guaranty
13930	Shorts. Phoenix Milling Co., Davenport, Iowa	Rockville: Rockville Milling Co.
		Guaranty
13827	B. Pillsbury Flour Mills Co., Minneapolis, Minn.	Hartford: Meech Grain Co.
		Guaranty
13841	XX Daisy. Pillsbury Flour Mills Co., Minneapolis, Minn.	So. Manchester: G. W. Strant
		Guaranty
13782	Quaker City. Quaker City Flour Mills Co., Philadelphia, Pa.	Canaan: Ives & Pierce
		Guaranty
13859	Roberts Roller Mill Co., Batavia, N. Y.	North Haven: Coöperative Feed Co.
		Guaranty

* With screenings.

INSPECTION OF 1919—*Continued.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N. x 6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Crude Fat)	
13752	9.45	5.50	15.63	8.12	56.68	4.62	$75.00
....	....	....	15.00	....	....	4.50	....
13769	9.96	5.28	16.75	7.70	55.59	4.72	61.00
....	....	....	15.00	....	....	4.00	....
13850	9.27	5.90	16.81	8.66	54.73	4.63	63.00
....	....	....	11.00	....	....	3.00	....
13837	8.95	5.93	16.69	9.66	53.49	5.28	58.00
....	....	....	14.00	....	....	4.50	....
13914	10.92	5.03	17.00	7.54	54.56	4.95	55.00
....	....	....	15.00	....	....	4.50	....
13812	9.03	6.10	15.88	8.43	56.25	4.31	65.00
....	....	....	14.00	....	....	4.00	....
13777	9.55	5.55	16.19	7.19	56.68	4.82	62.00
....	....	....	14.00	....	....	3.00	....
....	....	....	14.30	....	....	3.93	....
....	9.65	5.43	16.77	7.94	55.31	4.90	61.13
....	....	....	12.9	2.9	42.0	4.3	....
13877	11.05	4.18	17.25	6.60	56.06	4.86	68.00
....	....	....	15.00	....	....	4.00	....
13796	8.92	5.25	18.06	5.77	56.99	5.01	78.00
....	....	....	15.00	....	....	4.50	....
13745	10.07	4.40	18.38	4.46	56.88	5.81	68.00
....	....	....	14.80	....	....	5.30	....
13791	10.37	1.60	17.31	1.03	66.43	3.26	80.00
....	....	....	....	....	....	....	....
13838	9.83	4.60	17.81	7.13	55.21	5.42	64.00
....	....	....	14.00	....	....	4.00	....
13930	10.95	4.63	17.56	5.49	56.49	4.88	61.00
....	....	....	16.50	....	....	4.30	....
13827	8.69	6.68	16.38	10.13	53.87	5.25	66.00
....	....	....	14.00	....	....	4.00	....
13841	11.10	2.90	17.38	3.07	61.53	4.02	78.00
....	....	....	15.00	....	....	4.00	....
13782	9.05	4.40	18.56	5.62	57.11	5.26	69.50
....	....	....	14.00	....	....	4.00	....
13859	9.86	4.45	21.81	6.03	53.39	4.46	66.00
....	....	....	....	....	....	....	....

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	WHEAT PRODUCTS—*Concluded.*	
	Wheat Middlings—Concluded.	
13809*	Washburn Mills, Minneapolis, Minn.	Plainville: Eaton Bros.
		Guaranty
13924	Shorts. Weber Flour Mills Corp., Salina, Kans.	Willimantic: Boston Feed Store
		Guaranty
		Average guaranty
		Average of analyses
		Average digestible
	RYE PRODUCTS.	
13825	Feed. Boutwell Mill & Grain Co., Troy, N. Y.	West Cheshire: G. W. Thorpe
		Guaranty
13776	Middlings. Northland Rye Mills Co., Minneapolis, Minn.	Winsted: E. Manchester & Sons
		Guaranty
13819	True Value Middlings. Stratton Ladish Mill. Co., Milwaukee, Wis.	Plantsville: C. A. Cowles
		Guaranty
	BARLEY PRODUCTS.	
13773	Ground Barley. Albert Dickinson Co., Minneapolis, Minn.	Winsted: E. Manchester & Sons
		Guaranty
	MAIZE PRODUCTS.	
	Corn Gluten Feed.	
13804†	Cream of Corn. American Maize Products Co., Roby, Ind.	Hazardville: A. D. Bridges Sons
		Guaranty
13770	Buffalo. Corn Products Refining Co., New York	Torrington: F. L. Wadhams & Son
		Guaranty
13742	Globe. Corn Products Refining Co., New York	Shelton: Ansonia Flour & Grain Co.
		Guaranty
13915	Staley's. A. F. Staley Mfg. Co., Decatur, Ill.	Yantic: Yantic Grain & Products Co.
		Guaranty
		Average guaranty
		Average of analyses
		Average digestible
	Hominy Feed.	
13840	Armour Grain Co., Chicago, Ill.	Hartford: Garber Bros.
		Guaranty
13855	Spring Garden. Baltimore Pearl Hominy Co., Baltimore, Md.	Wallingford: E. E. Hall
		Guaranty
13910	Bufceco. Buffalo Cereal Co., Buffalo, N. Y.	Mystic: Mystic Grain Co.
		Guaranty

* With screenings. † Wire tags.

INSPECTION OF 1919—*Continued.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N. x 6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Crude Fat)	
13809	9.00	4.50	17.75	5.09	58.99	4.67	$65.00
....	....	....	15.00	....	....	4.00	....
13924	10.88	4.84	18.00	6.85	55.01	4.42	60 00
....	....	....	16.00	....	....	3.50	....
....	....	....	14.93[1]	....	....	4.16[1]	....
....	9.98	4.29	18.02	5.69	57.34	4.78	68.62
....	....	....	13.9	1.7	44.7	4.2	....
13825	9.09	3.90	16.13	3.88	63.78	3.22	59.00
....	....	....	13.50	....	....	3.00	....
13776	9.58	4.58	16.25	7.39	57.90	4.30	54.00
....	....	....	14.00	....	....	3.00	....
13819	8.61	4.55	17.00	6.06	60.00	3.78	58.00
....	....	....	13.50	....	....	3.00	....
13773	9.67	3.60	12.75	9.05	61.40	3.53	67.00
....	....	....	10.00	8.00	....	2.00	....
13804	7.99	2.03	24.06	6.17	55.94	3.81	78.00
....	....	....	23.00	8.50	....	1.50	....
13770	7.58	4.20	27.63	6.67	49.67	4.25	76.00
....	....	....	23.00	....	....	1.00	....
13742	8.59	3.05	23.31	6.04	57.52	1.49	76.00
....	....	....	23.00	....	....	1.00	....
13915	7.94	4.23	29.30	6.34	49.55	2.64	....
....	....	....	23.00	....	....	2.50	....
....	....	....	23.00	....	....	1.50	....
....	8.02	3.38	26.07	6.31	51.17	3.05	76.66[2]
....	....	....	22.1	4.8	46.8	2.6	....
13840	7.54	2.55	11.50	5.13	65.87	7.41	70.00
....	....	....	10.00	....	....	5.00	....
13855	8.30	3.33	12.00	8.55	61.93	5.89	63.00
....	....	....	10.00	6.00	....	5.00	....
13910	9.71	2.52	12.13	3.87	66.17	5.60	63.00
....	....	....	10.00	4.00	....	6.00	....

[1] Average of ten guaranties. [2] Average of three prices.

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	MAIZE PRODUCTS—*Concluded.*	
	Hominy Feed—Concluded.	
13779	Yellow. Buffalo Cereal Co., Buffalo, N. Y. ...	Winsted: E. Manchester & Sons .....
		Guaranty .....
13875	Cereal Mills Co., Wausau, Wis.	Ridgefield: S. D. Keeler ....
		Guaranty .....
13835	Paragon. Chas. M. Cox Co., Boston, Mass. ...	Thompsonville: George S. Phelps & Co. .....
		Guaranty .....
13891	Emco. Evans Milling Co., Indianapolis, Ind. ..	Hamden: I. W. Beers .....
		Guaranty .....
13774	Miller Cereal Mills, Omaha, Neb.	Winsted: E. Manchester & Sons .....
		Guaranty .....
13828	Choice Steam Cooked. Miner-Hillard Milling Co., Wilkesbarre, Pa.	Hartford: Meech Grain Co..
		Guaranty .....
13874†	National Feed Co., St. Louis, Mo.	Stamford: W. L. Crabb ....
		Guaranty .....
13790	Burts. Postum Cereal Co., Battle Creek, Mich.	Granby: E. H. Rollins .....
		Guaranty .....
13805	Yellow. Quaker Oats Co., Chicago, Ill.	Unionville: F. D. Lawton ...
		Guaranty .....
13883	True Value. Stratton Ladish Milling Co., Milwaukee, Wis.	New Milford: Geo. T. Soule
		Guaranty .....
13815	Wathen Milling Co., Louisville, Ky.	Bristol: Goodsell Bros. .....
		Guaranty .....
		Average guaranty .....
		Average of analyses .....
		Average digestible .....
	Dried Corn Flake Feed.	
13865	Kellogg Toasted Corn Flake Co., Battle Creek, Mich.	Saugatuck: Hubbell Coal & Storage Co. .....
		Guaranty .....
	BREWERY PRODUCTS.	
13846†	Dried Brewers' Grain. James Hanley Brewing Co., Providence, R. I.	Rockville: Rockville Grain & Coal Co. .....
		Guaranty .....
13758	Dried Brewers' Grain. Providence Brewing Co., Providence, R. I.	Thomaston: Thomaston Grain & Coal Co. .....
		Guaranty .....
		Average guaranty .....
		Average of analyses .....
		Average digestible .....
	MISCELLANEOUS FEEDS.	
13916‡	Dried Beet Pulp. Continental Sugar Co., Blissfield, Mich.	Yantic: Yantic Grain & Products Co. .....
		Guaranty .....

† Wire tags. ‡ Sold, guaranteed and licensed by the Larrowe Milling Co., Detroit, Mich.

INSPECTION OF 1919—*Continued.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N. x 6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Crude Fat)	
13779	10.39	1.65	10.50	2.43	70.59	4.44	$72.00
....	....	....	10.00	4.00	65.00	6.00	....
13875	10.24	2.60	12.63	3.32	65.41	5.80	75.00
....	8.25	....	10.00	4.00	....	7.00	....
13835	8.98	2.85	11.06	3.61	66.56	6.94	68.00
....	....	....	9.50	7.00	60.00	7.50	....
13891	9.04	2.80	12.19	5.13	62.28	8.56	71.00
....	....	....	10.00	7.00	....	7.50	....
13774	9.69	2.90	11.88	4.58	62.64	8.31	72.00
....	11.00	2.00	10.00	4.00	65.00	8.00	....
13828	8.87	2.60	11.25	3.71	67.67	5.90	73.00
....	....	....	10.00	....	....	4.00	....
13874	8.74	3.03	13.25	4.63	66.11	4.24	72.00
....	....	....	10.00	10.00	....	5.00	....
13790	9.18	2.22	11.00	3.22	68.89	5.49	68.00
....	....	....	10.00	5.00	....	6.00	....
13805	9.14	2.95	12.38	4.79	63.94	6.80	68.00
....	....	....	9.00	4.50	....	4.00	....
13883	9.10	2.60	11.63	4.56	64.18	7.93	68.00
....	....	....	10.50	5.00	....	5.00	....
13815	9.16	2.08	10.38	4.85	67.32	6.21	79.00
....	....	....	10.00	7.00	....	6.00	....
....	....	....	9.21	....	....	5.80	....
....	9.14	2.62	11.70	4.45	65.70	6.39	70.14
....	....	....	7.7	3.6	58.9	5.8	....
13865	6.56	3.25	8.06	1.12	79.41	1.60	78.00
....	....	....	6.91	0.42	78.62	2.15	....
13846	7.18	4.23	20.50	16.62	44.37	7.10	68.00
....	....	....	20.00	....	....	6.00	....
13758	6.82	3.48	27.06	13.57	43.77	5.30	66.00
....	....	....	25.00	....	....	5.00	....
....	....	....	22.50	....	....	5.50	....
....	7.00	3.86	23.78	15.09	40.07	6.20	67.00
....	....	....	19.3	7.4	22.8	5.5	....
13916	9.26	4.73	10.00	15.80	59.25	0.96	64.00
....	....	....	8.00	20.00	58.00	0.50	....

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	MISCELLANEOUS FEEDS—*Concluded.*	
13832	Dried Beet Pulp. Larrowe Milling Co., Detroit, Mich.	Hartford: C. H. Northam Grain Co.
		Guaranty
13856	Dried Beet Pulp. Larrowe Milling Co., Detroit, Mich.	Wallingford: E. E. Hall
		Guaranty
13905‡	Beet Pulp with Molasses. Mich. Sugar Co., Alma, Mich.	New London: Conn. Grain Corp.
		Guaranty
13885‡	Dried Beet Pulp and Molasses. Mich. Sugar Co., Caro, Mich.	New Milford: Geo. T. Soule
		Guaranty
13908	Dried Beet Pulp. West Bay City Sugar Co., Bay City, Mich.	New London: P. Schwartz Co.
		Guaranty
		Average guaranty
		Average of analyses
		Average digestible
13754	Cocoanut Meal. Quaker Oats Co., Chicago, Ill.	Waterbury: H. S. Coe & Co.
		Guaranty
13902	Cocoa Brand Cocoanut Meal. Oil Seed Co., Bayonne, N. J.	Middletown: Meech & Stoddard, Inc.
		Guaranty
13772	Beta Brand Peanut Oil Meal, Oil Seed Co., Bayonne, N. J.	Winsted: E. Manchester & Sons
		Guaranty
13778	Pride of Richland Meal (Peanut). Richland Cotton Oil Co., Richland, Ga.	Winsted: E. Manchester & Sons
		Guaranty
	PROPRIETARY MIXED FEEDS. *Horse, Dairy and Stock Feeds.*	
13806	Blatchford's Calf Meal. Blatchford Calf Meal Co., Wauregan, Ill.	Unionville: F. D. Lawton
		Guaranty
13787	Red Horn Calf Meal. Hales & Edwards Co., Chicago, Ill.	New Hartford: Case & Schwab
		Guaranty
13933	Purina Calf Chow. Purina Mills, St. Louis, Mo.	New Haven: Crittenden-Benham Co.
		Guaranty
13845	Schumacher's Calf Meal. Quaker Oats Co., Chicago, Ill.	Manchester: Little & McKinney
		Guaranty
13833	Bufceco Horse Feed. Buffalo Cereal Co., Buffalo, N. Y.	Hartford: C. H. Northam Grain Co.
		Guaranty
13765	Eshelman's 40 Horse Feed. John W. Eshelman & Sons, Lancaster, Pa.	Torrington: D. L. Talcott
		Guaranty
13913	H. & S. Horse, Mule and Dairy Feed. Dwight E. Hamlin, Pittsburgh, Pa.	Norwich: Chas. Slosberg & Son
		Guaranty

‡ Sold, guaranteed and licensed by the Larrowe Milling Co., Detroit, Mich.

INSPECTION OF 1919—*Continued.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N. x 6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Crude Fat)	
13832	4.82	3.10	9.25	19.81	62.54	0.48	$68.00
....	....	....	8.00	20.00	58.00	0.50	....
13856	5.35	3.55	8.69	20.37	61.56	0.48	62.00
....	....	....	8.00	....	....	0.50	....
13905	8.79	4.71	11.19	15.53	58.79	0.99	68.00
....	....	....	9.00	18.00	58.00	0.50	....
13885	9.37	3.18	9.31	18.67	58.09	1.38	60.00
....	....	....	9.00	18.00	58.00	0.50	....
13908	4.32	3.43	9.94	19.03	62.80	0.48	64.00
....	....	....	8.00	20.00	58.00	0.50	....
....	....	....	8.33	....	....	0.50	....
....	6.98	3.78	9.73	18.20	60.51	0.80	64.33
....	....	....	5.1	13.1	50.2	....	....
13754	9.13	6.05	21.06	8.90	47.20	7.66	58.00
....	....	....	20.00	....	....	7.00	....
13902	8.25	6.85	26.94	9.77	35.59	12.60	77.00
....	....	....	20.00	10.00	....	7.00	....
13772	7.73	5.10	29.63	8.94	36.85	11.75	75.00
....	....	....	30.00	8.00	....	7.00	....
13778	7.45	4.74	36.56	23.03	22.16	6.06	81.00
....	....	....	36.00	22.00	23.00	6.00	....
13806	8.79	6.26	25.31	7.40	45.33	6.89	105.00
....	....	....	24.00	....	....	5.00	....
13787	9.76	4.95	18.06	1.91	60.90	4.42	108.00
....	....	....	18.00	....	....	5.00	....
13933	10.02	4.03	28.75	3.23	50.66	3.31	113.00
....	....	....	27.00	....	....	4.50	....
13845	7.77	5.36	18.31	2.63	57.99	7.94	110.00
....	....	....	18.00	....	....	4.00	....
13833	9.70	3.85	12.50	8.43	60.83	4.69	73.00
....	....	....	10.00	9.00	....	4.00	....
13765	8.25	6.66	10.63	17.50	54.80	2.16	64.00
....	....	....	9.00	....	....	2.00	....
13913	10.33	10.20	11.44	14.93	51.56	1.54	58.00
....	....	....	14.00	16.00	58.00	3.50	....

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	PROPRIETARY MIXED FEEDS—*Continued.*	
	Horse, Dairy and Stock Feeds—Continued.	
13848	Harvest Horse Feed. Hales & Edwards Co., Chicago, Ill.	New Britain: Stanley Svea Grain Co.
		Guaranty
13895	Harvest Horse Feed. Hales & Edwards Co., Chicago, Ill.	Guilford: Morse & Landon..
		Guaranty
13871	Lancaster Horse Feed. Lancaster Milling Co., Lancaster, Pa.	South Norwalk: S. Roodner
		Guaranty
13831	Monogram Feed. Metropolitan Mills, New York	Hartford: Meech Grain Co..
		Guaranty
13919†	Mystic Feed. Horse, Cattle and Swine. Mystic Milling & Feed Co., Rochester, N. Y.	Jewett City: Havens & Son..
		Guaranty
13743	Peters' King Corn Horse and Mule Feed. M. C. Peters Mill. Co., Omaha, Neb.	Shelton: Ansonia Flour & Grain Co.
		Guaranty
13747	Emerald Horse Feed. Prairie State Milling Co., Chicago, Ill.	Derby: Peterson-Hendee Co.
		Guaranty
13811	Greenfield Brand. Prairie State Milling Co., Chicago, Ill.	Plantsville: Eaton Bros.
		Guaranty
13762	Purina Molene Feed. Purina Mills, St. Louis, Mo.	Litchfield: The Wadhams Co.
		Guaranty
13802	Bicorn Hog Feed. Chapin & Co., Hammond, Ind.	Somers: W. C. Everett
		Guaranty
13785	Pioneer Hog Feed. Hales & Edwards, Chicago, Ill.	New Hartford: Case & Schwab
		Guaranty
13903	Barford's Ready Ration for Growing Pigs. Meech & Stoddard, Inc., Middletown	Middletown: Meech & Stoddard, Inc.
		Guaranty
13755	Go-Tu-It Hog Ration. Park & Pollard Co., Boston, Mass.	Waterbury: H. S. Coe & Co.
		Guaranty
13854	Purina Pig Chow. Purina Mills, St. Louis, Mo.	Meriden: August Grulich Est.
		Guaranty
13911	Portage Stock Feed. Akron Feed & Milling Co., Akron, Ohio	Norwich: Chas. Slosberg & Son
		Guaranty
13861	Armour's Stock Feed. Armour Grain Co., Chicago, Ill.	Southport: C. Buckingham..
		Guaranty
13909	Pennant Brand Stock Feed. E. W. Bailey, Swanton, Vt.	Mystic: Mystic Grain Co.
		Guaranty
13923	Niagara Stock Feed. Boston Feed Store, Willimantic	Willimantic: Boston Feed Store
		Guaranty
13876	Bufceco Chop Feed. Buffalo Cereal Co., Buffalo, N. Y.	Danbury: F. C. Benjamin
		Guaranty
13797	Wirthmore Stock Feed. C. M. Cox Co., Boston, Mass.	Suffield: Spencer Bros.
		Guaranty

† Wire tags.

INSPECTION OF 1919—*Continued.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N. x 6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Crude Fat)	
13848	7.52	6.85	10.69	20.99	52.26	1.69	$62.00
....	....	....	10.00	....	....	2.00	....
13895	10.25	7.00	10.81	13.75	56.16	2.03	63.00
....	....	....	10.00	....	....	2.00	....
13871	9.73	5.78	11.31	13.02	57.46	2.70	68.00
....	....	....	10.00	....	....	2.50	....
13831	8.43	5.93	10.69	13.10	59.97	1.88	58.00
....	....	....	14.00	....	....	3.00	....
13919	8.85	3.90	12.50	10.41	60.35	3.99	58.00
....	....	....	9.00	9.00	....	3.50	....
13743	8.99	8.30	12.60	16.81	52.63	1.47	64.00
....	....	....	10.00	....	....	1.50	....
13747	8 56	7.63	10.94	15.23	56.24	1.40	58.00
....	....	....	9.00	12.00	....	2.00	....
13811	9.99	8.43	10.56	15.81	54.27	0.94	56.00
....	....	....	8.00	....	....	0.50	....
13762	8.52	5.33	10.81	9.64	61.10	4.60	72.00
....	....	....	9.70	....	....	3.20	....
13802	9.51	4.96	18.81	5.82	56.30	4.60	80.00
....	....	....	17.50	6.00	....	4.50	....
13785	9.25	7.58	25.13	6.13	47.04	4.87	78.00
....	....	....	15.00	....	....	4.00	....
13903	9.78	4.33	19.75	7.39	52.96	6.79	78.00
....	....	....	18.00	....	....	5.00	....
13755	8.12	11.43	18.81	10.76	44.60	6.28	75.00
....	....	....	15.00	....	....	6.00	....
13854	11.03	7.50	17.25	10.77	50.56	2.89	81.00
....	....	6.00	15.00	9.00	59.00	2.50	....
13911	8.13	3.80	11.75	9.78	61.77	4.77	64.00
....	....	....	8.50	....	....	4.00	....
13861	7.30	4.98	13.75	8.86	58.66	6.45	64.00
....	....	....	12.00	....	....	4.00	....
13909	7.39	3.75	10.06	9.33	63.74	5.73	67.00
....	....	....	9.00	10.00	....	5.00	....
13923	8.16	4.95	13.63	15.28	52.81	5.17	60.00
....	....	....	....	....	....	....	....
13876	9.11	4.45	10 06	11.33	61.07	3.98	64.00
....	....	....	8.00	12.00	....	4.00	....
13797	8.29	3.68	10.75	7.72	64.50	5.06	68.00
....	....	....	9.00	....	....	4.00	....

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	PROPRIETARY MIXED FEEDS—*Continued.*	
	Horse, Dairy and Stock Feeds—Continued.	
13906	Yellow Tag Stock Feed. F. L. Cressey, Boston, Mass.	New London: Conn. Grain Corp.
		Guaranty
13926	Crosby's Stock Feed. E. Crosby & Co., Brattleboro, Vt.	Willimantic: Boston Feed Store
		Guaranty
13764	Stock Feed. John W. Eshelman & Sons, Lancaster, Pa.	Torrington: D. L. Talcott
		Guaranty
13882	No. 1. Chop Feed. Globe Elevator Co., Buffalo, N. Y.	New Milford; G. T. Soule
		Guaranty
13880	Buffalo Chop Feed. Globe Elevator Co., Buffalo, N. Y.	Brookfield: C. R. Dubia
		Guaranty
13878	Grandin's Stock Feed. D. H. Grandin Mill. Co., Jamestown, N. Y.	Danbury: H. E. Meecker, Inc.
		Guaranty
13759	College Stock Feed. Hales & Edwards Co., Chicago, Ill.	Thomaston: Thomaston Grain & Coal Co.
		Guaranty
13918	Haven's Stock Feed. Havens & Son, Jewett City	Jewett City: Havens & Son
		Guaranty
13836	Badger Monopoly Feed. Chas. A. Krause Mill. Co., Milwaukee, Wis.	Thompsonville: George S. Phelps & Co.
		Guaranty
13896	M. & S. Stock Feed. Meech & Stoddard, Inc., Middletown	Middletown: Meech & Stoddard, Inc.
		Guaranty
13826	Allstock Molasses Grains. Metropolitan Mills, New York	Hartford: Meech Grain Co.
		Guaranty
13867	Iowa Stock Feed. Purity Oats Co., Davenport, Iowa	Norwalk: C. E. Slauson Co.
		Guaranty
13751	Schumacker's Stock Feed. Quaker Oats Co., Chicago, Ill.	Waterbury: Spencer Grain Co.
		Guaranty
13860	Victor Feed. Quaker Oats Co., Chicago, Ill.	Milford: E. L. Oviatt
		Guaranty
13920	Vitality Stock Feed. Rosenbaum Bros., Chicago, Ill.	Jewett City: Havens & Son
		Guaranty
13842	Winner Chop Feed. David Stott's Flour Mills, Detroit, Mich.	Manchester: Little & McKinney
		Guaranty
13890	National Stock Feed. Stratton Ladish Mill. Co., Milwaukee, Wis.	Newtown: Newtown Coal & Grain Co.
		Guaranty
13768	Provender. D. L. Talcott, Torrington	Torrington: D. L. Talcott
		Guaranty
13912	Sucrene Dairy Feed. American Milling Co., Peoria, Ill.	Norwich: Chas. Slosberg & Son
		Guaranty

INSPECTION OF 1919—*Continued.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N. x 6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Crude Fat)	
13906	9.48	5.03	10.88	10.67	59.35	4.59	$65.00
....	....	....	9.00	9.50	....	4.00	....
13926	9.60	3.75	11.25	10.76	60.20	4.44	66.00
....	....	....	9.00	10.00	60 00	4.00	....
13764	9.93	4.93	11.81	12.60	56.48	4.25	64.00
....	....	....	10.00	....	....	3.00	....
13882	8.92	4.00	10.19	11.62	60.21	5.06	65.00
....	....	....	9.00	....	....	3.00	....
13880	10.16	4.25	11.19	11.23	59.60	3.57	66.00
....	....	....	10.00	....	....	3.00	....
13878	8.76	4.38	11.31	12.96	58.39	4.20	70.00
....	....	....	10.00	....	....	4.00	....
13759	8.92	4.98	13.25	13.77	55.29	3.79	70.00
....	....	....	12.00	....	....	3.00	....
13918	8 47	3.93	10.69	12.06	60.36	4.49	65.00
....	....	....	7.00	....	....	3.00	....
13836	9.43	3.10	11.88	9.35	61.96	4.28	66.00
....	....	....	10.00	....	....	3.00	....
13896	9.00	3.50	12.56	8.55	61.16	5.23	63.00
....	....	....	9.00	....	....	4.00	....
13826	8.05	5.05	12.94	9.91	60.87	3.18	58.00
....	....	....	13.00	....	....	2.00	....
13867	8.72	4.98	11.88	10.88	59.80	3.74	65.00
....	....	....	10.00	....	....	4.00	....
13751	7.84	5.90	11.38	10.15	61.74	2.99	64.00
....	....	....	10.00	....	....	3.25	....
13860	8.43	4.18	9.38	12.82	60.04	5.15	63.00
....	....	....	8.00	....	....	3.00	....
13920	8.14	4.18	10.25	12.93	61.02	3.48	66.00
....	....	....	9.00	....	....	3.00	....
13842	10.68	3.20	9.81	8.14	63.77	4.40	66.00
....	....	....	8.00	10.00	70.00	5.00	....
13890	8.60	5.05	14.00	12.05	56.12	4.18	63 00
....	....	....	10.00	....	....	3.00	....
13768	11.38	2.40	11.00	5.87	64.92	4.43	66.00
....	....	....	....	....	....	....	....
13912	8.13	8.25	20.88	11.21	47.14	4.39	58.00
....	....	....	16.50	....	....	3.50	....

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	PROPRIETARY MIXED FEEDS—*Continued.*	
	Horse, Dairy and Stock Feeds—Continued.	
13927	Niagara Dairy Feed. Boston Feed Store, Willimantic	Willimantic: Boston Feed Store
		Guaranty
13741	Bufceco Dairy Feed. Buffalo Cereal Co., Buffalo, N. Y.	Shelton: Ansonia Flour & Grain Co.
		Guaranty
13800	Lactola Dairy Feed. Chapin & Co., Hammond, Ind.	Somers: W. C. Everett
		Guaranty
13799	Triangle Dairy Feed. Chapin & Co., Hammond, Ind	Somers: W. C. Everett
		Guaranty
13801	Unicorn Dairy Ration. Chapin & Co., Hammond, Ind.	Somers: W. C. Everett
		Guaranty
13925	Crosby's 1918 Dairy Ration. E. Crosby Co., Brattleboro, Vt.	Willimantic: Boston Feed Store
		Guaranty
13767	Eshelman's 20 Dairy Feed. John W. Eshelman & Sons, Lancaster, Pa.	Torrington: D. L. Talcott
		Guaranty
13887	Globe Creamery Feed. Globe Elevator Co., Buffalo, N. Y.	New Milford: Geo. E. Ackley Co.
		Guaranty
13792	Twin Six Dairy Feed. D. H. Grandin Mill. Co., Jamestown, N. Y.	Granby: E. H. Rollins
		Guaranty
13917	Twin Six Dairy Feed. D. H. Grandin Mill. Co., Jamestown, N. Y.	Norwich: Norwich Grain Co.
		Guaranty
13749	H. O. Algrane Milk Feed. H. O. Co.'s Mills, Buffalo, N. Y.	Ansonia: Ansonia Flour & Grain Co.
		Guaranty
13813	Read the Tag Dairy Feed. H. O. Co.'s Mills, Buffalo, N. Y.	Bristol: Goodsell Bros.
		Guaranty
13757	Gold Flake Dairy Feed. Hales & Edwards Co., Chicago, Ill.	Thomaston: Thomaston Coal & Grain Co.
		Guaranty
13922	Haven's Special Dairy Feed. Havens & Son, Jewett City	Jewett City: Havens & Son
		Guaranty
13862	Morgan's Balanced Ration. Hubbell Coal & Storage Co., Saugatuck	Saugatuck: Hubbell Coal & Storage Co.
		Guaranty
13863	Morgan's Balanced Ration. Hubbell Coal & Storage Co., Saugatuck	Saugatuck: Hubbell Coal & Storage Co.
		Guaranty
13798	Larro-Feed. Larrowe Milling Co., Detroit, Mich.	Suffield: Spencer Bros.
		Guaranty
13830	Barford's Balanced Dairy Ration, Meech & Stoddard, Inc., Middletown	Hartford: Meech Grain Co.
		Guaranty
13899	Barford's Balanced Dairy Ration. Meech & Stoddard, Inc., Middletown	Middletown: Meech & Stoddard, Inc.
		Guaranty

INSPECTION OF 1919—*Continued.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N. x 6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Crude Fat)	
13927	7.89	5.15	17.50	15.90	49.46	4.10	$70.00
....	....	....	....	....	....	....	....
13741	8.08	4.50	13.06	11.01	58.93	4.42	68.00
....	....	....	12.00	12.00	....	3.00	....
13800	8.18	5.19	17.88	11.37	52.76	4.62	64.00
....	....	....	16.50	....	....	3.00	....
13799	8.17	6.33	21.00	9.20	60.35	4.95	78.00
....	....	....	21.00	....	....	4.00	....
13801	7.38	5.98	26.19	11.02	43.55	5.88	82.00
....	....	....	26.00	....	....	4.00	....
13925	7.10	4.63	25.44	14.43	40.61	7.79	75.00
....	....	....	25.00	15.00	59.00	6.00	....
13767	9.21	7.86	21.25	13.27	42.87	5.60	66.00
....	....	....	20.00	....	....	4.00	....
13887	8.77	4.90	27.13	11.08	42.77	5.35	74.00
....	....	....	23.00	....	....	5.00	....
13792	8.06	5.75	24.13	11.33	46.40	5.33	76.00
....	....	....	22.00	....	....	5.00	....
13917	8.05	5.90	24.81	11.09	44.69	5.46	76.00
....	....	....	22.00	....	....	5.00	....
13749	8.27	5.38	14.63	10.48	57.73	3.51	64.00
....	....	....	14.00	15.00	....	4.00	....
13813	8.16	5.50	22.38	8.93	50.54	4.49	68.00
....	....	....	20.00	9.50	....	5.00	....
13757	9.20	6.84	14.50	17.20	49.26	3.00	60.00
....	....	....	16.00	....	....	3.50	....
13922	9.93	4.75	22.75	9.36	48.46	4.75	65.00
....	....	....	18.00	....	....	4.00	....
13862	7.88	5.18	19.56	11.30	46.38	9.70	62.00
....	....	....	18.00	....	....	8.00	....
13863	7.73	5.90	22.44	11.45	44.40	8.08	68.00
....	....	....	22.00	....	....	8.00	....
13798	8.61	5.58	21.56	11.09	48.82	4.34	78.00
....	....	....	20.00	....	....	3.00	....
13830	8.61	5.10	21.31	10.31	49.88	4.79	80.00
....	....	....	19.00	....	....	5.50	....
13899	9.60	5.18	21.25	10.91	47.78	5.28	77.00
....	....	....	19.00	....	....	5.50	....

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	PROPRIETARY MIXED FEEDS—*Concluded.*	
	Horse, Dairy and Stock Feeds—Concluded.	
13900	Barford's Balanced Dairy Ration. Meech & Stoddard, Inc., Middletown	Middletown: Meech & Stoddard, Inc.
		Guaranty
13897	M. & S. Dairy Feed. Meech & Stoddard, Inc., Middletown	Middletown: Meech & Stoddard, Inc.
		Guaranty
13753	Stevens' 44 Dairy Ration. Park & Pollard, Boston, Mass.	Waterbury: Spencer Grain Co.
		Guaranty
13868	Purina Cow Chow Feed. Purina Mills, St. Louis, Mo.	Norwalk: C. E. Slauson Co.
		Guaranty
13869	Protena Dairy Feed. Purina Mills, St. Louis, Mo.	Norwalk: C. E. Slauson Co.
		Guaranty
13760	Big Q. Dairy Ration. Quaker Oats Co., Chicago, Ill.	Litchfield: The Wadhams Co.
		Guaranty
13808	Vitality Dairy Feed. Rosenbaum Bros., Chicago, Ill.	Plainville: Eaton Bros.
		Guaranty
13921	Will-Pay Dairy Feed. Rosenbaum Bros., Chicago, Ill.	Jewett City: Havens & Son
		Guaranty
13884	True Value Dairy Feed. Stratton Ladish Milling Co., Milwaukee, Wis.	New Milford: Geo. T. Soule
		Guaranty
13780	Syragold Dairy Feed. Syracuse Milling Co., Syracuse, N. Y.	Norfolk: August Curtiss
		Guaranty
13789	Syragold Milk Ration. Syracuse Milling Co., Syracuse, N. Y.	Simsbury: Woods-Chandler Co.
		Guaranty
13821	Ti-O-Ga Red Brand Dairy Feed. Tioga Mill. & Elev. Co., Waverly, N. Y.	West Cheshire: G. W. Thorpe
		Guaranty
13781	Biles Ready Dairy Ration. Ubiko Milling Co., Cincinnati, Ohio	Canaan: Ives & Pierce
		Guaranty
	POULTRY FEEDS.	
13851	Bufceco Poultry Mash. Buffalo Cereal Co., Buffalo, N. Y.	Meriden: Meriden Grain & Feed Co.
		Guaranty
13766	Laying Mash. John W. Eshelman & Sons, Lancaster, Pa.	Torrington: D. L. Talcott
		Guaranty
13881	Buffalo Laying Mash. Globe Elevator Co., Buffalo, N. Y.	Brookfield: C. R. Dubia
		Guaranty
13786	Red Comb Mash Feed (with dried buttermilk). Hales & Edwards Co., Chicago, Ill.	New Hartford: Case & Schwab
		Guaranty
13814	H. O. Co.'s Laying Mash. H. O. Co.'s Mills, Buffalo, N. Y.	Bristol: Goodsell Bros.
		Guaranty

INSPECTION OF 1919—*Continued.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N. x 6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Crude Fat)	
13900	8.67	5.20	22.00	11.93	46.81	5.39	$77.00
....	....	....	19.00	....	....	5.50	....
13897	9.68	3.90	20.81	9.05	51.07	5.49	76.00
....	....	....	18.00	....	....	4.00	....
13753	7.75	5.94	24.50	11.87	43.39	6.55	78.00
....	....	....	24.00	....	....	5.00	....
13868	9.55	6.25	24.25	12.42	43.22	4.31	85.00
....	....	....	24.00	12.00	....	4.80	....
13869	8.35	7.10	18.00	13.59	49.43	3.53	70 00
....	....	....	16.50	....	....	3.50	....
13760	9.00	5.93	21.13	10.33	48.83	4.78	78.00
....	....	....	21.00	11.00	50.00	5.00	....
13808	8.78	4.16	22.13	9.60	49.28	5.05	80.00
....	....	....	20.00	....	....	4.00	....
13921	10.34	7.19	18.50	9.87	50.61	3.49	64.00
....	....	....	16.00	....	....	3.50	....
13884	8.55	6.59	24.63	9.64	44.50	6.09	80.00
....	....	....	24.00	....	....	5.00	....
13780	9.77	3.95	18.81	7.34	55.54	4.59	78.00
....	....	....	18.00	....	....	5.00	....
13789	8.35	5.60	23.13	15.66	42.63	4.63	70.00
....	....	....	20.00	....	....	4.50	....
13821	8.69	6.50	26.63	9.35	42.84	5.99	76.00
....	....	....	23.50	....	....	3.50	....
13781	8.95	5.68	23.50	9.57	47.31	4.99	81.00
....	....	....	24.00	10.00	50.00	5.00	....
13851	8.97	3.83	16.69	4.88	60.65	4.98	81.00
....	....	....	15.00	5.00	....	4.00	....
13766	9.71	7.78	22.06	5.38	49.10	5.97	78.00
....	....	....	20.00	....	....	5.00	....
13881	10.11	8.25	22.13	8.88	46.21	4.42	78.00
....	....	....	20.00	....	....	8.00	....
13786	9.95	12.45	16.50	6.86	50.66	3.58	80.00
....	....	....	15.00	....	....	4.00	....
13814	8.01	9.83	20.44	5.32	51.14	5.26	78.00
....	....	....	17.00	6.00	....	4.50	....

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	POULTRY FEEDS—*Concluded.*	
13901	M. & S. Dry Mash. Meech & Stoddard, Inc., Middletown	Middletown: Meech & Stoddard, Inc.
		Guaranty
13818	Lay or Bust Poultry Mash. Park & Pollard Co., Boston, Mass.	Plantsville: C. A. Cowles
		Guaranty
13784	Park & Pollard Growing Feed. Park & Pollard Co., Boston, Mass.	Canaan: Ives & Pierce
		Guaranty
13922	Purina Chicken Chowder. Purina Mills, St. Louis, Mo.	New Haven: Crittenden-Benham Co.
		Guaranty
13847	Ful-O-Pep Dry Mash. Quaker Oats Co., Chicago, Ill.	Rockville: Rockville Milling Co.
		Guaranty
13810	Vitality Egg Mash (with milk albumen). Rosenbaum Bros., Chicago, Ill.	Plainville: Eaton Bros.
		Guaranty
13928	Chic Chuck. Russia Cement Co., Gloucester, Mass.	Rockville: Rockville Milling Co.
		Guaranty
13853	Wirthmore Mash Feed. C. M. Cox Co., Boston, Mass.	Meriden: Meriden Grain & Feed Co.
		Guaranty
13866	Ti-O-Ga Growing Mash. Tioga Mill. & Elev. Co., Waverly, N. Y.	Norwalk: C. E. Slauson Co.
		Guaranty

INSPECTION OF 1919—*Concluded.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N. x 6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Crude Fat)	
13901	9.32	7.88	21.75	6.26	49.42	5.37	$76.00
....	....	....	12.00	....	....	3.00	....
13818	8.13	11.98	21.56	8.16	46.79	3.38	82.00
....	....	....	18.00	....	....	1.50	....
13784	9.84	7.92	16.31	4.70	55.59	4.64	84.00
....	....	....	10.00	....	....	1.50	....
13932	9.38	7.68	20.38	8.76	49.24	4.56	90.00
....	....	....	19.00	....	....	4.00	....
13847	8.47	9.73	22.25	8.40	45.07	6.08	84.00
....	....	....	20.00	....	....	4.00	....
13810	8.06	13.48	18.69	8.35	46.99	4.43	80.00
....	....	....	18.00	....	....	4.00	....
13928	6.04	35.78	55.50	....	0.43	2.25	95.00
....	....	....	50.00	....	....	2.00	....
13853	8.96	9.00	22.31	6.58	48.11	5.04	81.00
....	....	....	20.00	....	....	4.00	....
13866	8.60	1.61	15.69	5.10	65.04	3.96	85.00
....	....	....	12.00	6.00	....	2.00	....

Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

Bulletin 222 August, 1920

NEW OR UNUSUAL PLANT INJURIES AND DISEASES Found in Connecticut, 1916-1919

By

GEORGE P. CLINTON, Sc.D., Botanist

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REPORT OF THE BOTANIST,

G. P. Clinton,

for 1919.

NEW OR UNUSUAL PLANT INJURIES AND DISEASES, FOUND IN CONNECTICUT, 1916-1919.

Introduction.

In our first Report, for 1903, we gave brief mention of all of the Connecticut plant troubles, not including insect injuries, that had been reported by others or observed by ourselves up to that time. Since then in most of our Reports, additional troubles have been recorded in the same manner. However since 1915, no account, in this general way, has been rendered of the troubles that have come to hand during these four years. It is the aim of the present Report to cover this period, reporting such of these as have been definitely determined.

As in previous Reports we discuss both diseases and injuries, including abnormal or monstrous growths, of all our economic plants. Most of these troubles are caused by fungi and they are indicated here by the common name in small caps with the scientific name, where definitely known, in italics. The other troubles follow these and are indicated by a common name printed in italics. As practically all of these latter are mechanical, environmental or so-called physiological diseases or injuries, they have no scientific name. As in the past these troubles are most conveniently reported in alphabetical order under their hosts, also arranged alphabetically according to their common names with scientific names following.

We shall not attempt here to give in any detail, as previously, the weather conditions of each year and their bearing on the suppression or development of these troubles. It might be well to note in passing that the winter of 1917-1918 was one of the most severe winters since we began our disease survey of Connecticut, and that there resulted great injury to perennial plants, especially to cultivated fruit trees. The injury to the wood and flower buds of peach trees from this and the preceding and

following winters has been such as to put this prominent fruit industry largely out of business. The spring and early summer of 1918 were so wet and the midsummer so dry that very unusual troubles of potatoes, largely physiological, developed. Furthermore the spring and summer of 1919 had so much rainy or muggy weather that an unusually large number of fungous diseases developed, including very serious injury by the late potato blight. The lack of potash in most fertilizers, due to the war during these years, also played some part in the development of unusual troubles, especially of potato and tobacco.

Before proceeding to a specific account of these various troubles, we wish to briefly discuss here two that do not come strictly under the designation of "plant diseases," since while of a fungous nature their injurious activities were directed to the destruction of household timbers in one case, and household butter in the other.

DRY ROT.

Dry Rot Fungus, *Merulius lacrymans* (Wulf.) Schum. We first called attention to this fungus in our Report of 1906, pp. 336-41, where we noted, with illustrations, its action on the wainscoting of a church basement at Stony Creek. Again, in 1916 (Rep. 1915: 424-5.) we reported a vigorous development of the fungus on flooring, boxes, tools and heads of sewing machines at the Singer Mfg. Company's Plant in Bridgeport.

An even more destructive and luxuriant growth of the fungus, than at either of these places, was called to our attention in July, 1918, by Mrs. Robert H. Comstock, who wrote in part as follows: "Five years ago we built a small house on high farm land along the sandy beach of the Sound at Westbrook, Conn. We laid a cement foundation but did not dig a cellar and when the land was graded the cement was almost entirely covered, as we particularly wanted the cottage to set low. For several years we have noticed a fungous growth on the partitions and under some built-in drawers in the middle of the house. This spring we found the floor was rotted out, even the top floor was more than half gone." Plate XXXIII, a.

At Mrs. Comstock's request we inspected this unoccupied shore cottage, a view of which is given here, making a detailed examination as to the cause and the amount of injury. It was readily seen that the trouble was due to the dry-rot fungus, *Merulius lacrymans,* as it was found in good fruiting condition. In fact the spores from the fruiting bodies had developed so abundantly that they had settled as a very evident reddish-brown dust all over the floors and tables except where these were protected by covers so that when the latter were raised a distinct boundary showed between the covered and uncovered surfaces. The cement foundation had practically no openings allowing for ventilation, thus there was a closed air space of about a foot between the wood beams supporting the double floor and the ground. This prevented the drying-out of the air and gave ideal conditions for the development of the fungus when once it got started on the wood. There were no eave troughs to carry away the water from the roof and likewise the water from the ice-box went into the ground under the house, thus increasing the dampness.

Some idea of the destruction of the woodwork can be gained from the two pictures shown here, one with the flooring partially removed. Some of the wood was so rotten as to crumble easily as punk between the fingers. The entire floor of the living room, Plate XXXIII, b, together with the floor joist, had to be removed. Considerable injury in the kitchen, Plate XXXIII, c, under a built-in set of drawers and in an adjacent closet also was evident, and here the fungus had gone up between the walls of the board partitions a short distance. There was no evidence that the fungus had reached the second story. The fungous growth was very luxuriant on the under surface of the floor boards both in its thick, whitish, felt-like mycelium and, in places, in the reddish-brown, laxly-poroid, fruiting surfaces.

The remedial measures suggested were as follows:—The removal and burning of all infected wood and rubbish; the creosoting, if possible, of the new wood used; the building of several sunken areaways, protected only by wire netting, to allow free access of air under the house; the placing of eaves and leaders and a drain to carry away the water from the roof and the ice chest. A year later we examined the cottage and found that

most of these suggestions had been carried out. There was a very good air drainage under the house by five sunken openings, two on one side and three on the other, and part of the earth had been removed making a larger air space. We saw no indications of further development of the fungus. Somewhat similar suggestions were made for the Stony Creek and Bridgeport outbreaks. We have had no complaints of further trouble at either of these places, and so judge that the fungus has been kept largely if not entirely in check. We are convinced from our experience that this fungus depends in great measure for its development upon a fairly small and tightly closed air space next the wood, and a sufficient amount of water to keep the air therein constantly saturated or at least above the normal amount.

MOLDY UNSALTED BUTTER.

The second trouble, see Plate XXXIV, a, that of moldy unsalted butter, was really first called to our attention in 1913. With Mr. Stoddard we made a preliminary investigation of the trouble then and during 1914 and 1915, intending to make a more complete study of it later, but as no complaints have come in since we have not done so. We make this short report here as a matter of record as little has been published by botanists in this country about the trouble.

The first sample sent us was received in the late fall of 1913 from A. L. Kuran of the New Hartford Creamery. In January, 1914, Prof. H. F. Judkins of Storrs sent us a pound package from the Suffield Creamery and another sample from a different source in November. In these and most other samples seen of wrapped butter, there developed on the surface more or less numerous small spots of a blackish and others of a decided reddish color. These were easily determined as due to fungous growths. In all the samples seen these molds did not penetrate very deeply into the butter. One of the specimens which we have kept ever since 1915 in a closed glass jar, now, however, shows the whole surface overgrown with mixed olive-black and reddish growths and the interior entirely changed into a somewhat dried red substance penetrated by mycelium. Concerning the Suffield sample Prof. Judkins, under date of Jan. 7th, wrote in part as follows:—

"I am sending in a separate package a pound of butter which I obtained from the Suffield creamery. You will note that this butter is unsalted and it is a rather long story to tell all the troubles Mr. Totman, the buttermaker, has had with his butter since last spring, so I will not recite them to you now.

"I am very much interested to find out what kind of growth or growths there is on this butter, particularly the red growth. He has never noticed any of this growth on salted butter. He has never noticed any of the growth as long as it stayed in his refrigerator.

"The print which I am sending you was one of a lot, made on November 25th, sent to New Haven and returned to the creamery on December 6th, in practically the same condition that it is in now, showing that the cold evidently checked the growth of the mold.

"In making a careful examination of the prints and molds used by the buttermaker, I ran across four or five cakes of cottage cheese on one of the shelves in the refrigerator, one of which I am sending you along with the butter. This was made over a year ago and has gone so bad that the mold even penetrated the parchment paper in which it was wrapped. I have, of course, ordered that cleaned up and the place thoroughly disinfected.

"I am wondering whether there is any connection between this and the growth in the butter. On the other hand, if we can trace back the growth in the butter to perhaps one or two of the creamery patrons, I may be able to find the cause of the butter going rancid so rapidly. I am anxious to see the trouble straightened out, if possible, because the creamery will not long exist if the trouble continues to break out at frequent intervals."

In February, 1915, we sent a form letter to all of the creameries of the state asking for information concerning this trouble. The replies received showed that many were unacquainted with it, partly because they did not make unsalted butter, but four or five reported more or less trouble of this kind. Later in the year Mr. Stoddard made an examination of two or three creameries to determine, if possible, conditions favoring its development. Separation cultures were made by Mr. Stoddard from several of the samples received at different times, and the following fungi were obtained:

(1) *Mucor,* sp. undet. (2) *Alternaria,* sp. undet. (3) *Penicillium roqueforti,* according to Thom. (4) *Oidium lactis,* a common fungus of milk and its products. (5) *Epicoccum,* probably *E. purpurascens.* The *Epicoccum* at first was mixed with the *Oidium* in our cultures and did not form spores. We thought it might be an *Oidium* or *Oospora.* Later Mr. Stoddard got it in pure cultures producing the characteristic spores of several cells united into a globular, semi-sessile ball. This last fungus is the one that was responsible for the red colonies in the butter. The *Penicillium* was responsible for blue-green and the *Alternaria* and *Mucor* for blackish growths.

Some inoculations on good unsalted butter were tried but were not very successful, in most cases developing best when the fungus worked down between the tubes and the butter where there was little air space and more moisture. There seemed to be some indication, too, that certain species followed in the wake of the others. However our tests were not extensive enough to be very trustworthy. If the inoculations had been made on butter covered with paper better results might have been obtained.

Concerning the development of the trouble in the creameries, etc., the following information was obtained. The molds were confined to unsalted butter, the salt evidently acting as a preservative. Some claimed that where the butter was wrapped in paper dipped in hot brine they were not so likely to develop. Others claimed that when the milk was pasteurized there was no trouble. Undoubtedly in some cases the trouble was due to unsanitary conditions in the dairy itself, as in the case cited by Prof. Judkins. Care in handling the butter after it was made, especially as regards moisture, cold storage and length of time the butter was kept, also entered into the problem.

Another quite important factor was the condition of the milk when it arrived at the creamery. Most of the fungi isolated were common saprophytic species that easily develop in cattle barns on moist hay, bedding, silage, etc. Petrie dish exposures by Mr. Stoddard in two barns developed very similar species to those recorded here. The *Epicoccum* was thus obtained both in barns and in one of the creameries where this trouble developed. The cleanliness of the barn, the care used in milking and keeping the air free from dust at that time and the protection given the milk before delivery, all are factors determining the number of spores that will fall into the milk and cause trouble later.

While unsalted butter is still used to a considerable extent by Jewish families and some of the larger hotels and restaurants, the reason no complaints have been made in recent years is probably because most of the creameries of the state have gone out of business. Their decline was due to their inability to compete with milk sold for direct family use and to the destructive competition of the large milk corporations that now dominate the market.

There are comparatively few references, so far as we have found in botanical literature, concerning molds that cause trouble in butter. We are indebted to F. C. Stewart for calling our attention to several of the following:

European investigators have done the most work along this line. Lafar and his co-editors (Handb. Techn. Myk. 1907 ed.) give resumés of most of this work together with references to the literature. In vol. 2, p. 214, *Cladosporium butyri,* a fat-splitting fungus, is mentioned, especially in connection with *Oidium lactis,* as a cause of rancid butter; while, pp. 220-1, bacteria are mentioned as causing red and blue specks in butter, nothing is said about fungi causing similar color troubles. In vol. 4, p. 525, *Mucor Mucedo* and *M. racemosus* are also mentioned as fat-splitting fungi found in butter.

Gripenberg (Milch. Zeitung **28**: 626-8, 644-6, 662-3. 1899.) published quite an extensive article dealing with experiments under which infection of butter takes place. He found infection comes from the wood of the tubs, the paper wrappings and the air. The chief fungi responsible are *Mucor, Penicillium,* and *Trichosporium.* Hard wood tubs, thick paper, absolute cleanliness, soaking tubs and paper in concentrated salt solutions (over 25%) or steaming paper and tubs are preventive measures recommended.

According to Stewart, Happich (Zeitschr. Fleisch- Milchhygiene 11: 297.) found *Botrytis, Oidium lactis, Penicillium* and *Mucor* in moldy butter. Hanus and Stocky (Zeitschr. Unters. Nahr. Genussm. 3: 606. 1900.) report *Mucor Mucedo* to be a fat-splitting agent in butter.

We found no definite references in European literature to red spots in butter caused by a fungus, though according to Saccardo, (Syll. Fung. 4: 20. 1886.), Trabut reports *Oospora ruberrima,* originally described by Saccardo on damp wax of wasps, as occurring on butter in Algiers. The spore masses of this fungus are red.

In America, while considerable work has been published on the bacteria of milk and its products, but little along the same line has made its appearance concerning fungi, except that on cheese by Thom and others. However we have found a few references to moldy butter, chiefly relating to control methods.

Apparently not so much trouble is experienced now as formerly because of this advanced knowledge of control methods.

Duggar (N. Y. Prod. Rev. Amer. Creamery. Oct. 27, 1897.) in a popular article was one of the first, at least among botanists, to suggest preventive measures for controlling molds of tub and paper-wrapped butter. He found tubs made of sap wood most objectionable, spreading from this through the paper into the butter. He advised steaming the tubs and keeping them dry; also treatment of paper and tubs with copper sulphate.

Rogers (Exp. Sta. Rec. 14: 534. 1903.) is reported as isolating a fat-splitting torula yeast from several samples of canned butter. Its action was weaker than that of fat-splitting molds. The same author (U. S. Dep. Agr. Bur. Anim. Ind. Bull. 89: 7-13. 1906. *Ibid.* Circ. 130: 1908.) described methods of "Preventing Molds in Butter Tubs" and "Paraffining Butter Tubs" in the publications here cited and especially recommended the paraffining of tubs giving directions and details.

About the only article dealing with the fungi causing these troubles is that by Thom and Shaw (Journ. Agr. Res. 3: 301-10. 1915.) on "Moldiness in Butter." They classify the fungi found under the following headings: (1) Smudged or *Alternaria* type, including here besides the *Alternaria, Cladosporium butyri, Stemphylium butyri* Patt., *Cladosporium* sp., and our red fungus, an undetermined specimen of which was sent them. (2) Green-mold type, including *Penicillium roqueforti, P. expansum, P. chrysogenum,* etc. (3) Oidium type, producing various shades of orange-yellow by *O. lactis.* Besides these fungi they noted under certain conditions the presence of *Mucor* sps.

INJURIES AND DISEASES OF PLANTS ARRANGED ACCORDING TO HOSTS.

Apple, *Pyrus Malus.*

Bacterial Fruit Spot, Bacteria undet. Plate XXXIV, b. Early in October, 1919, several diseased apples were received for examination from Mr. E. M. Ives of Meriden. Two of these presented an appearance, in certain areas, a little different from anything that we had seen before; in fact, on superficial examination, these areas looked as if they might be due to spray or sun scorch of an unusual type. An examination of the injured tissue, however, revealed the presence of such numbers of

bacteria as to lead us to the conclusion that these were, if not the primary, at least the secondary cause of the trouble. The skin over these extended irregular areas was slightly sunken and reddish-brown in color, in strong contrast with the normal reddish skin. The parenchyma cells immediately beneath the diseased areas were also reddish-brown, as compared to the normal white tissue, and were somewhat collapsed with contents dead. The bacteria were especially abundant in the intercellular spaces. While the apple showed injury by the railroad worms, these had no apparent relation to the bacteria since their channels were not connected with this injury. The photograph reproduced here gives a somewhat unsatisfactory view of the trouble because of the high lights shown, but the principal diseased area is in the center from which a strip of the skin has been removed.

Cultures were attempted by taking tissue from the interior diseased parenchyma and placing it in test tubes of agar. Practically all of these produced bacteria but they were not pure, showing in some cases yellowish and in others whitish growths in the different tubes. The latter seemed the most likely to contain the injurious species but cultures made directly from these colonies, without attempts to isolate a single form, also showed that they were impure. Further work at this time being neglected, the cultures were left until too late to properly isolate and identify the organism. While these bacteria might have been an accidental invasion following some previous injury, it is also possible they were the pear blight organism on an unusual part of the host, since this organism occurred in these orchards especially on pears, and the owner kept bees. However, we have seen no references in literature where this blight occurred on mature fruit after the manner described here.

Bark Canker, *Myxosporium corticolum* Edg. This fungus while not reported before is evidently not a new or uncommon one in this state. It does not seem to be a very vigorous parasite as it is often associated with winter injury of the bark or wood. When so associated it looks much like the black rot canker, *Sphaeropsis malorum,* with which it is often confused, especially as the two are sometimes found in the same collection or even together on the same branch. The bark canker seems to penetrate less deeply, being confined to the bark which may

slough off and a new growth free of the fungus develop beneath. The fruiting pustules of the two are also similar, but, if the spores are oozing out, the white tendrils of the bark canker usually distinguish it from the black rot canker whose spores are deeply colored. However, when young the black rot spores are also hyaline and about the same size (perhaps average wider) and shape, so they may be mistaken for each other. In fact on the winter injured specimens mentioned in our Report for 1906, p. 310, both these fungi are present according to our recent examinations, although originally we reported only the black rot. The bark canker was called especially to our attention in the spring of 1919 by specimens from Danbury, which contained both this and to a less extent the black rot fungus; it was also found a short time later prominent on a small winter injured tree at East Haven.

Paddock (N. Y. Agr. Exp. Sta. Bull. 163: 203. 1899. *Ibid.* 185: 211. 1900.) and Stewart *et al.* (*Ibid.* 191: 298. 1900.) were the first to make early mention of this fungus which they called *Macrophoma malorum.* More recently Edgerton (Ann. Mycol. 6: 48. 1908.) has shown that this name is a synonym of the black rot fungus and he has described the bark canker as a new species and given it the scientific name used here. Paddock's inoculation experiments with the fungus failed to show its parasitic nature; so it is not likely to prove a serious pest at best.

Downy Mildew Rot, *Phytophthora cactorum* (Cohn & Leb.) Schroet. In late August, 1918, the writer received a dozen dried apples from J. S. Adam of Canaan, Conn., which had been stored in paper bags since the previous fall. These apparently had not rotted but dried down into the preserved specimens much like raisins. They were so full of sugar that Mr. Adam wanted to know if this was an unusual occurrence. Upon examining the reddish preserved tissues microscopically, we were much surprised to find an abundance of a non-septate guttulate mycelium, of variable diameter, much like that of *Phytophthora.* Cultures attempted from this tissue failed, however, to produce any growth so the mycelium was evidently dead at this time. The next year stored pears sent from Bridgeport showed the same type of non-fruiting mycelium present; in this case we were able

to isolate the fungus, produce its fruiting stage in cultures, and so accurately establish its identity as above named. A more complete statement concerning the fungus is given in this paper under Pear, *q. v.*

Heart Rots, *Polyporus admirabilis* Pk. and *P.* (*Spongipellis*) *galactinus* Berk. Dodge (Myc. 8: 5-14. Ja. 1916.) in his article entitled "Fungi Producing Heart-Rot of Apple Trees" describes these two species as partly responsible for this trouble. The former occurs singly, or more frequently in calla-lily-like clusters, on the trunks showing as large milk-white, centrally depressed, fragile, fleshy fungi that on drying become hard and leathery and have a peculiar "glacé kid glove" feel to the upper surface. His observations on the species were made chiefly in Litchfield Co., Conn. He collected specimens at the Columbia Camp and vicinity near Litchfield, but he reports other specimens from Redding. In May, 1918, the writer also collected an old specimen of this species on a dead apple tree at Union, Conn.

The second species, *P. galactinus,* is smaller but in its bracketed group becomes even more conspicuous and is of about the same color. Dodge reports this from the same two localities as the other species. Recently Murrill (Myc. 11: 310. 1919.) also noticed it on apple trees in Eastern Connecticut, and the writer collected it on a living apple tree at Norfolk in 1916. Others have also reported it from Connecticut. Both of these fungi, while causing a rot of the heart wood, do not seem to especially attack the living tissue and so cause much less damage than if that were the case.

White Heart Rot, *Fomes igniarius* (L.) Gill. We have seen this fungus several times in this state upon living apple trees. The oldest specimen we have in the herbarium is from Norfolk, collected in September, 1911, and it was found there again in 1916. It was also collected twice from an apple tree at Milford, the latter year. It is treated more fully under Oak, *q. v.*

Hail Injury. In one of our spray bulletins, which see (Conn. Agr. Exp. Sta. Rep. 1911: 382. 1912.), we briefly mentioned and showed a half tone of hail injury to the apples at our Mt. Carmel farm. Hail storms coming on the young fruit produce in time some misshapening of the mature fruit but

especially show their effect as conspicuous russeted or corky spots on the skin. In 1918 we heard of more or less injury at Wallingford to the fruit but had particularly called to our attention hail injury to the twigs in the Bellinger orchard at Litchfield. Mr. Stoddard, who examined the orchard to obtain data, found that it appeared on the 1 to 3 year old twigs on a certain side of the trees and the owner recalled a severe hail storm of the previous year that came from that direction. The beating of the hail had so bruised the bark that a callous growth was formed beneath, causing the bark to split open and reveal the slight swelling.

Malformed Twigs and AERIAL CROWN GALL, *Pseudomonas tumefaciens* (Sm. & Town.) Stev. Plates XXXV, a-b. Besides the hail injury mentioned above, we have received at various times for identification peculiar malformations of apple twigs, as to the cause of which we were not always sure. Two of these are shown in the illustrations given here. The one that is shown in Fig. a, we have usually called aerial crown gall. The ordinary nursery type of galls at the base of stems and the hairy root, we have mentioned in our Report for 1903, but the specimens considered here have been studied without a chance to examine the trees in the orchard and thereby determine the condition of their roots. These aerial galls occur on both young and old trees. Hedgecock (U. S. Bur. Pl. Ind. Bull. 186: 15. 1910.) pictures (Plate V, Fig. 1) and describes this form and associates it with the hairy root type of crown gall. Garman (Ky. Agr. Exp. Sta. Bull. 93: 106. 1901.) previously pictured and described a similar trouble as a "Knot Disease," and while he thought it contagious he did not associate it with the crown gall which he described in the same bulletin.

This trouble is usually found by the apple growers in late winter when pruning the trees and the specimens sent us show as a distinct lateral growth on the branch or as a swelling at the base of a side branch. Occasionally it takes the form of a distinct spherical knob like the typical basal crown gall. More frequently it forms flattened growths, at first perhaps smooth or with smaller knobs on it but usually with an abundance of small closely packed protuberances something like adventitious buds. These affected tissues die prematurely so that we have never seen these "buds" develop further. Some of these areas on larger branches reach a lateral diameter of two inches, or where abundant, individuals may partly coalesce into even larger areas, but they rarely grow out half an inch beyond the surface of the bark. While we have never heard of these growths killing the whole tree, where extending completely around the branches as they sometimes do, they killed these in time.

The specimens preserved in the Station's herbarium and letters show data as follows: (1) W. T. Coe & Son, Durham, Apr., 1907, branches ½ to 1½ inches diameter, in center of tree, with numerous irregular swellings with abundance of "buds" on these. (2) J. O. Landon, Norwich, Mar., 1911, rounded smooth typical gall on ¾ inch branch showing winter injury of heart wood. Reported several galls on a single 12-15 year old tree. (3) E. S. Lovell, Newton, Apr., 1913, several irregular and roughened swellings, largest about 1 inch diameter, around twigs about half their size. Three Sour Bough trees infected. (4) F. P. Tolles, Terryville, Apr., 1915, branches 2 inches diameter with large flattened areas with abundance of "buds." (5) C. E. Shepard, Mt. Carmel, Apr., 1917, branches on young tree, shown in photograph. (6) H. J. Tillson, County Agent, found in orchard near Norwich, Mar., 1917, same type as Lovell specimens; one tree badly infected.

The other type of abnormal growth has been sent less frequently for identification, and we are even less certain of its origin. The specimens, illustrated in Fig. f, were received in March, 1913, from J. T. Cullen, Derby. These show young twigs with an evident swelling below a terminal bud or branch that has been killed and a new branch developed from a lateral bud. The swelling is largely due to an abnormal development of spongy parenchyma which at least in some cases dies prematurely. One could easily imagine such a growth due to winter injury of the terminal branch or bud, to insect stings or mechanical injury in some way. Quite frequently one sees in orchards, especially on certain varieties, as Ben Davis, very similar natural swellings apparently due to abundance of food material stored in the tip of the year's growth that retains the swelling somewhat the next year at the base of that year's growth. No injury to the tissues follows in these cases. There are

cases where such malformations as described here are claimed to be the result of the crown gall bacteria. Hedgecock (*loc. cit.*, Plate IV, figs. 1-2) shows by his illustrations and his statement that they are the "early stage of the aerial form of the 'Hairy Root'" and finally develop into the type of trouble first mentioned in this article.

A very similar trouble to this on pear twigs we have described elsewhere in this Report as due to winter injury. Because of our uncertainty that the crown gall germ is always responsible for these two injuries they are described here both as physiological and bacterial troubles.

Mice Girdle. Each year, during the winter season, mice cause more or less injury to trees by eating off the bark at their base. Some years, however, the injury is much more serious than in others, and when there is an abundance of snow on the ground the injury seems to be worse. Apple trees suffer more than any others though complaints have been made of injury to peach, maple, Scotch and white pine. The winter of 1919-20, with its abundant snowfall, apparently was the worst of any yet noticed. Even poison ivy was girdled along fence rows. In a nursery we saw considerable injury to Japanese maples and other ornamental plants. Reports were received of serious injury in many apple orchards, and to a less extent in peach orchards, to both young and old trees so that many thousands of fruit trees in the state were thus girdled. Most of this injury occurred below the snow line. We will not discuss the trouble further here, but refer the reader to the special article on this subject by Mr. Stoddard recently issued by the Station (Bull. of Inf. 10: 1-7. *Figs. 1-8.* Mr. 1920.).

Smoke Injury. In July, 1919, a letter was received by the Station from C. A. Burley of Stamford in which he wrote: "I have an orchard which (I think) is being killed by smoke from a factory alongside of it. In fact several of the trees are already dead and the others very weak. I would like very much if you could send someone to look over the situation." Soon afterward the writer and the state forester, Mr. Filley, went to Stamford, and with Mr. F. A. Bartlett and one of the parties interested examined the orchard and the vicinity for the cause of the trouble.

A suspicious thing, in the mind of the writer at least, was the presence, about in a direct line a quarter of a mile away but lower down near a stream, of a chlorine factory that was used during the war by the government for making chlorine gas but now abandoned. An examination of the vegetation, especially the trees immediately around this factory, showed no injury except to a few trees on the edge of the stream into which had been emptied considerable chemical refuse from the factory. In other words as there seemed to be no indication here of injury to the trees or herbaceous vegetation from possible escaping fumes, there was no likelihood of the trouble in the orchard being due to such a cause.

The orchard, however, bordered directly on one side of the buildings of a bronze factory, through the open windows of which were blown the minute particles from the burnished bronze. More or less of this dust settled upon the surrounding vegetation and could be distinctly seen as minute golden particles on the apple leaves even some distance away. The man who showed us around thought that the bronze dust was responsible for the injury to the trees. At first sight this also seems plausible, as the apple leaves where the dust was most abundant had numerous small reddish specks often immediately under the bronze particles. An examination of the vegetation immediately under the factory windows where the dust was thickest, showed no evident injury on such tender leaves as pokeweed, burdock, *Bidens,* etc. It seemed probable, therefore, that this dust caused no harm, unless possibly on long standing some unknown chemical change took place that produced these specks and even then this would not account for the death of the trees and the severe scorching of the foliage elsewhere. The smoke from the factory was carried off by a high stack, with the wind mostly taking it away from the trees, thus eliminating this as a factor. In the rear of the factory, was a temporary incinerator with a low stack for burning rubbish including the waste that was used in burnishing the bronze. The smoke from this was strong and could be easily carried, with the wind in the right direction, over the apple trees. In fact it was in an extension of the orchard nearest this that most of the dead trees occurred. From what we have seen of smoke injury elsewhere, this seemed to us to be

the most logical source of the injury. Just what chemical matter was included in this waste that could cause the injury we did not determine, but if sulphur was present it could have been responsible.

Winter Injury Cankers. The severe winter of 1917-1918 did great harm to various trees in this state, especially to cultivated ones and particularly to peaches and apples. We have in previous Station Reports discussed various forms of winter injury to the apple, and in the Rept. of the Conn. Pom. Soc., vol. 21, p. 102, 1919, have given a brief resumé of these including the trouble mentioned here. We wish in this note merely to mention this unusual form of winter cankers not noted before in our Station Reports. One of the worst injured orchards that we saw was that of W. B. Johnston, of South Meriden, who had us examine it in June as he thought he had some unusual disease.

The orchard, chiefly Baldwins, was on an exposed hill that got a full sweep of the winter winds and had shown no such injury the previous season. Trees that bore heavily the previous fall were those that suffered the most winter injury. Besides the dead and badly injured trees, there were some that showed irregular dead areas on the trunk or elongated dead areas on the limbs that looked like disease cankers as they were sharply marked off by cracks in the bark from the living tissues. Often these showed fruiting pustules, thus increasing the impression of their fungous origin to one not acquainted with the facts of the case. A peculiarity of the cankers in many cases was their situation *on the lower side of branches* with the upper side healthy or only slightly injured! Just what caused this difference in susceptibility to injury we do not know. Possibly the tissues of the upper side were more matured or contained less water. Such cankers on the under side of branches were not infrequent in other orchards following this severe winter.

Ash, White, *Fraxinus americana.*

ANTHRACNOSE, *Gloeosporium aridum* Ell. & Holw. We have reported anthracnoses before on maple, oak and some other trees, but in the summer of 1919 we received for the first time specimens on white ash. They were sent, early in June, both by Miss Jessie H. Brown from Lyme and H. O. Taylor from

Cobalt, who complained of the trouble as a serious one causing more or less defoliation of their shade trees. In the first case at least, the leaves were also attacked by the rust mentioned below. The disease appeared on the leaves as they were reaching maturity causing a scorch-like burn usually involving considerable area from the margin inward; occasionally there were smaller isolated spots within. The diseased area was somewhat translucent, of a light or yellowish-brown color, sharply marked off from the healthy tissues and easily broken when dry. The very inconspicuous fruiting pustules were seen with a hand lens more or less abundantly imbedded in the lower surface. The wet spring weather was very favorable for this as well as other true anthracnoses.

Four different species of anthracnose have been reported on this host and at least one or two on other species of ash. So far as we can determine from the printed description, our specimens agree best with the species given above which was published by Ellis and Everhart in the Journ. Myc., p. 21, 1887. The specimens upon which this species was based were received from J. J. Davis of Racine, Wis. Davis (Trans. Wisc. Acad. Sci. Arts 9: 169.) in 1892 erroneously gave the authority for the name as E. & E. He writes, "Abundant. When developing vigorously on exposed trees it attacks one edge of the leaf, causing it to curl toward the affected side. When less vigorous on leaves of shaded trees it occurs on roundish spots about 5 mm. in diameter."

The spores as we find them are hyaline, oblong or broadly oblong, slightly pointed at the ends, straight or very slightly curved, 6-10μ by 2.5 - 3.5μ but chiefly 7-9μ by 3μ. *Gloeosporium irregulare* Peck, described shortly after this species, does not seem to differ materially from it except in the greater width of the spores (4-5μ) as given by Peck. Recently we have received typical specimens of *G. aridum* from Davis, and of *G. irregulare* from House, and both express the opinion that they are the same species. Our examination of these specimens also confirmed our suspicions that this was the case. Dr. House writes, "I think there is no question as to the identity of *irregulare* with *aridum*, apparent differences in the measurements given in the description are not borne out in the specimens. I enclose a bit of the type."

RUST, *Aecidium Fraxini* Schw. Plate XXXV, c. We have illustrated and briefly described this rust in previous Reports (Conn. Agr. Exp. Sta. Rep. 1903: 304. *Ibid.* 1911-12: 343.) as occurring not uncommonly on the blades and petioles of the white ash in this state. During the early summer of 1919 it was more abundant than we have ever seen it before. It was sent in several times as causing more or less injury to the lawn trees and was said to cause severe defoliation in one case. In our collection this year we found the rust not only on the blades and petioles but also on the young stems of this year's growth, the maturing winged seeds and the staminate blossoms which had been curiously transformed through the action of the phytoptus mite occurring on this host. The mycelium causes more or less distortion of the infected parts and this is especially so on the branches, where it produces gall-like growths, covered with the aecial stage, and often involving the young axial parts, as shown in the illustration. When young the aecia are elongated but wear away in time to short cups. Farlow (Proc. Soc. Prom. Agr. Sci. 9: 26. 1888.) reported a serious and extended outbreak of this fungus in 1885. Arthur (Bot. Gaz. 29: 275.) reports cultures made in 1899, and several times since, with the III stage of a *Puccinia* from *Spartina* sps.; he produced the I stage on *Fraxinus lanceolata*. He calls the fungus, therefore, *Puccinia fraxinata* (Schw.) Arth. So far as we have found, no one has infected other species of *Fraxinus* with the *Spartina* rust. Arthur however failed in several attempts with other genera in the same family as *Fraxinus*. While this rust is common along the Sound where *Spartina* also occurs, we have often seen ash trees badly affected quite removed from any specimens of it. Our efforts, however, to obtain any further clues of relationship met with failure. We tried several times to inoculate species of *Agropyron repens, Poa pratensis, Spartina* (large and small) sps., and even leaves of *Fraxinus americana*, with the I spores from the last host without result.

Asparagus, *Asparagus officinalis*.

ANTHRACNOSE, *Colletotrichum* sp. On Burr's Mammoth Asparagus at the Station farm, the latter part of September, 1919, we noticed a conspicuous disease on the green stems that

we had not seen before. This was causing more or less injury to the infected plants. Irregular, often elongated, grey areas, of greater or less extent, appeared in the normal green skin; in these were numerous very small but conspicuous, black fruiting pustules. The center of these often showed a white spot evidently where the spores were discharged. The spores are hyaline, narrowly to broadly oblong, often somewhat pointed at one end and 12-17μ long by 4-6μ wide. The fungus is evidently that briefly described and pictured by Halstead (N. J. Agr. Exp. Sta. Rep. 1896: 410.) in 1897 but of which he gives no description of the spores, etc. There are no setae on the fruiting pustules of our specimens so that the fungus looks as much like a *Phoma* as a *Colletotrichum*. Several species of each of these genera have been described on asparagus, but all appear to be on the dead stems and none quite like ours. We have found no further reference to Halstead's *Colletotrichum* sp., and Cook writes that there are no specimens of it in the herbarium at New Brunswick. On our specimens, often in the same spots, there is also a *Fusarium*, previously mentioned by us (Rep. 1903: 305.). This probably has no connection with the *Colletotrichum* and seems to form more definite elliptical or elongated spots with a distinct purplish border, but it is difficult to tell, in some cases, which fungus caused the spots. It may be that both are languishing parasites on the older stems or that one follows the other as a lesser parasite.

Fasciation. Harshberger in his book (Mycol. Plant Path.: 329.) describes fasciation as follows: "Fasciation in its simplest form consists of a flat, ribbon-like expansion of stem, branch, flower clusters, flowers and fruits which may be cylindric below, but flattened above." Sorauer (Handb. Pflanzenkr. 1: 332.) says concerning these fasciations: "We may likewise consider as due to local over-nutrition, the condition arising when a cylindrical branch becomes broad and flattened. It then looks as if a number of branches had grown together; nevertheless, this is only rarely the case, for almost always only a single branch is involved, which, by broadening its vegetative point, no longer has a vegetation cone at its apex but a comb-like vegetative surface." The last writer also states: "We have seen already in roots held fast between split rocks that pressure from two

opposite sides may give the axis a band-like form. Under certain circumstances such a changed direction or growth may continue if the cause of arrestment itself has disappeared." Cowles (Text Book Bot. 2:786.) writes: "The phenomenon is not well understood, but often it is believed to be associated with 'over nutrition'; sometimes it is produced by mechanical causes, or by insect or fungal activities (as in *Œnothera*). Fasciation sometimes appears to be inheritable, but this remains to be established, at least as a general proposition."

Mr. Frank Hanchett of Falls Village, Conn., brought to the Experiment Station during the winter of 1918 a specimen of asparagus (partly shown in Plate XXXVI, a, here) taken from his garden the summer previous, that showed evident fasciation. The stem was flattened so that when green it was two and a half inches wide across the base as against half an inch in thickness. The stem as brought to us was about two feet long and was flattened the entire length. The apex was narrowed and twisted into an irregular spiral coil of two and a half turns. About half way down, the specimen branched but the second branch was broken off a short distance above its origin so the nature of its apex was not disclosed. Sections made through the stem showed abundance of the mycelium of some fungus scattered somewhat irregularly through its length. These threads were much more abundant in spots, evidently developing best in the vicinity of the fibro-vascular bundles, especially in the pith cells surrounding them and in the vascular ducts. Concerning the identity of the fungus we could not be sure because no definite spores were seen, but it appeared to be a *Fusarium*. There may have been some connection between the presence of the fungus and the fasciation, but we cannot be sure.

Keeping this malformation in mind we unearthed several examples of fasciation of asparagus during the spring of 1918. These came from Milford, North Haven and Middlebury, so this trouble cannot be considered very rare. We did not find in these subsequent specimens the mycelium of any fungus though all were not carefully examined. The largest of the two or three specimens from the Whittemore estate at Middlebury was about 3 feet long and showed short bifurcated and slightly coiled tips. The specimen from the Clark Wilcox place at Milford

was by far the most striking, being at least five feet long and the flattened side of the stem three inches wide, with numerous branches scattered along its sides in the axils of the scale-like leaves, as was the case with the other specimens. The stem was coiled in one complete turn near the center but the nature of the tip was obscured though probably slightly bifurcated.

In 1919 market agent Stack brought us a specimen purchased in the New Haven market, and in 1920 other specimens were found in the Station's asparagus bed. Efforts in 1920 to produce this flattening by various artificial methods involving pressure on the growing tips were apparently not successful; but further work along this line will be done.

Besides these fasciations of asparagus, we briefly describe in this Report somewhat similar troubles on Larkspur, Pea Shrub, Rose and Sumac, and previously (Rep. 1913:6. 1914.) we have described and figured the same thing on a young apple twig. Besides the flattening of the stem, common characters with most of these fasciations are the bifurcation and coiling of the tips.

Bean, *Phaseolus vulgaris.*

Bacterial Wilt, *Bacteria* sp. Plate XXXVI, c. Several times in the early summer of 1918, we had complaints of young beans in war gardens dying from a scorch-like wilt. We did not have opportunity to thoroughly investigate all of these complaints, but such plants as we did examine led us to conclude that the trouble was not primarily a sun-scorch but resulted from invasion of the vascular system by bacteria. These eventually more or less completely cut off the water supply, with resulting wilting and scorching of the leaves under exposure to bright sunlight. The spring and early summer had been unusually wet and so favored bacterial invasion of the stem through injuries of the roots. Some of the specimens examined showed as yet little wilting of the foliage but evident invasion of the vascular ducts both in the stems and the leaves. Often the invaded tissues were apparently little injured; occasionally bacteria were found in the pith of the stem as well as in the ducts. A peculiar case shown us by F. J. Reveley, supervisor of war gardens at East Haven, was in a garden of eight rows of beans, four of which had the trouble badly, while the other four were

apparently free. Some bacteria, however, were found in the plants of the unaffected rows. The only difference, so far as we could determine, between the affected and unaffected was that the latter had a little more shade!

While there is a bacterial disease causing a spotting of the leaves of beans, the trouble mentioned seems to be another thing altogether. It is more like the bacterial wilt of cucurbits, but whether, as in that case, caused by a definite organism we do not know. We have seen no references describing such a trouble of beans.

Beech, *Fagus* sps.

Gas Injury. Through the kindness of Mr. G. F. Herthal, tree expert, the writer, with the State Forester, was shown in August, 1919, a couple of beech trees on the Nathaniel Wheeler Estate at Bridgeport, that developed the unusual injuries mentioned here. The first tree was near a driveway under which passed the gas supply to the house. The tree for at least the past two years had developed a serious injury of the leaves soon after they matured. This showed as a scorch, chiefly at the margins, and caused more or less defoliation. Otherwise the tree looked healthy and there was no apparent fungous or insect cause for the trouble. As the scorch had a similar appearance to gas injury that we have seen on maple trees on the streets, we finally concluded that there was a slight leak from the gas pipe in the road that caused injury to the roots and thereby affected the leaves.

Lightning Injury. In this same yard there was a very old and noble copper beech which a number of years before had been struck by lightning. The most evident effect was the killing of the bark at the base of the tree so that at this time it was entirely girdled, except for a slight connection on one side with a large root. While the tree had been trimmed of a large dead branch in the past and had one nearly dead main branch on one side, it still maintained evident vigor of the main very large branches despite this almost complete girdling at the base.

Bitter Sweet, *Celastrus scandens.*

Chlorosis. This was merely a case of yellowish-white spotting of the leaves, most frequently near the margin. Some leaves had yellowish areas instead of the small definite spots. This

trouble may have resulted from some insect sucking the juices from the leaves when they were quite young, but it was more likely due to the late frosts that came early in May, as we have seen somewhat similar injury caused on other plants. See Frost Injury under Tobacco. The specimens were found in June, 1919, on a wild plant at East Haven, but may be looked for on cultivated ones, as some of the cultivated species have variegated foliage.

Blackberry, *Rubus* sps.

Orange Rust, *Caeoma nitens* Schw. Germination tests so far made show that this rust on cultivated *Rubus villosus* (Gray's 6th ed.) in this state belongs to the short cycled form. This rust was found doing serious damage to a certain variety in a plantation in Westville in 1919. On the wild blackberries, likewise, all germination tests of the collections show the rust to be this form, except one which was long cycled, and later collections disclosed the III stage of *Gymnoconia interstitialis* on this same plant. See "Raspberry" for further details.

Box, *Buxus sempervirens* var. *suffruticosa.*

Winter Injury. From time to time during the past years, there have been sent to the Station branches of box in which the leaves were dead, having a yellowish-white color, and complaint was made that the whole plant or part of it was in this condition. Search has sometimes revealed immature stages of some fungus developing in these dead leaves or branches, but no definite indication has ever been found that such a trouble was due to the attack of a particular parasite. Sometimes we have seen individual plants in the nursery showing this trouble, and we have wondered if it might not be the result of sun scorch.

After the severe winter of 1917-18, we saw so much trouble of this nature on box hedges that we could not but conclude that most, if not all, of these troubles trace back to severe winter injury of the leaves, stems or roots. We saw one hedge at the Whittemore estate at Middlebury in the spring of 1918, where the upper branches and leaves were all killed while those below were uninjured. In this case the hedge had been protected during the winter by an artificial covering but this did not reach the tops of the plants, with the result that the parts exposed were thus injured. Box is not entirely hardy so far north as this and

in severe winters some mulch protection, either artificial or snow, is usually needed to prevent winter injury. The winter of 1917-18 was so severe that many unprotected hedges were ruined. Why in some hedges certain plants are badly injured and others escape, we cannot surely say, but this may be due in part to the immaturity or the weaker condition of those affected.

Butternut, *Juglans cinerea.*

STAGHEAD, *Melanconium oblongum* Berk. We have not made personal observations on this fungus but have had it called to our attention by Dr. A. H. Graves who has made a study of it in this and adjacent states. He holds the view that it is largely responsible for the dead limbs so frequently seen on butternuts, and finally for the stag-headed appearance of the trees due to the death of the tops. A discussion of it by Dr. Graves appeared in Mycologia 11: 111-13, in May, 1919.

Cabbage, *Brassica oleracea.*

BLACK LEG, *Phoma lingam* (Tode) Desm. (*P. oleracea* Sacc.) Plate XXXVI, b. We have found this disease only twice in this state and then under conditions that were very unfavorable to the cabbage plants. It was first called to our attention about the middle of November, 1918, at the D. L. Clarke & Sons' farm at Milford. Cabbage plants had been set out very late in their field during dry weather. The plants used had been kept too long in the seed bed, and so were over-sized being long and spindling. They were dropped in a furrow, watered and then set in by tramping the earth around them with hoe and foot. The plants as a whole did very poorly, many died and others failed to make much of a growth, so that about 90% were failures. When seen by us the stem underground and partly above was badly withered, or decayed in many cases, as shown in the illustration. The fruiting pustules of the *Phoma* could be seen on most of the stems, but on others the fungus was not evident. The same fall at the Experiment Station farm at Mt. Carmel, we found a few freak plants in the club-root experiments that showed the same trouble.

The disease was first called prominently to the attention of cabbage growers in this country by Manns (Ohio Agr. Exp. Sta. Bull. 228: 276-90.) of Ohio in 1911. It seems to be a trouble that starts in the seed bed but becomes most serious and conspicuous after transplanting in the field. The disease starts on the stem as a white sunken area, usually near the junction of a leaf petiole, eventually forms serious cankers or girdled areas, invaded by bacteria, etc., and becomes black in color, hence the common name of "black leg." The fruiting pustules are easily made out in the infected areas as small black dots. The spores are hyaline, oval to oblong and chiefly 3.5-5μ by 1.5μ-2μ. More recent investigations (Wisc. Agr. Exp. Sta. Res. Bull. 38: 6. 1915.) show that *Phoma oleracea* Sacc., as it is called by Manns, is a synonym of *Phoma lingam* (Tode) Desm.

Cabbage, Chinese, *Brassica pekinensis.*

LEAF MOLD, *Alternaria Brassicae* var. *macrospora* Sacc. This fungus forms small, rounded, blackish, zoned spots on the leaves. We noted it, in 1916, from the Station's farm at Mt. Carmel, as "quite bad on some varieties." Apparently no specimens were saved so nothing further can be said of it.

LEAF SPOT, *Cercosporella albo-maculans* (Ell. & Ev.) Sacc. This forms conspicuous greyish spots, with a more or less distinct border, that are from a quarter to half an inch in diameter. In dried specimens some of these spots retain a more greenish color than the rest of the leaf. Our specimens were collected on Aug. 30, 1917, at the Station's Mt. Carmel farm. So far as we have learned, the fungus has not been reported before on this host, at least under this name. We have had considerable trouble in identifying it because from the dried specimens it is quite difficult to determine how the spores are borne.

Alternately we have considered it under the genera *Cercospora, Cylindrosporium* and *Cercosporella,* since species on *Brassica* are described under each of these that fit our specimens fairly well, especially as regards the spots and appearance of the spores. *Cercospora brassicicola* P. Henn, described in 1905 from Japan on *Brassica sinensis,* however, seems not to be the same since the hyphae bearing the hyaline spores (40-80μ long) are said to be *dark colored* and 20-25μ long. We could find no such definite hyphae associated with the spores. If the author has mistaken other hyphae of saprophytic species that rarely occur on old spots,

we may have what he has described but we have no specimens for comparison.

Cylindrosporium Brassicae Faut. & Roum. (Rev. Myc. 13: 81. 1891.) seems to fit our specimens even better as the spores are said to be 80-120μ long (forma *Napi,* however, in Roum. Fungi sel. no. 6727, only 40-80μ) but they are enclosed *in the parenchyma.* Our study of these dried specimens (Roum. Fungi. sel. nos. 5679, 6727, 7318) leads us to believe that the writers were misled in their conclusions as to the origin of the spores and that they are really borne on the outside on short hyphae as in *Cercosporella.* Perhaps further study of fresh specimens from France is needed to definitely prove this point. This name antedates any of the others.

Cercosporella albo-maculans (E. & Ev.) Sacc., originally described as a *Cercospora* (*Cercosporella*) on *Brassica campestris* from California (Proc. Phil. Acad.: 378. 1894.) was placed definitely under *Cercosporella* by Saccardo (Syll. Fung. 11: 606.) because the hyphae (8-12μ by 2μ) bearing the spores were decribed as hyaline. The spores are given as 40-68μ by 2-2.5μ. Except for this somewhat smaller size of the spores the description agrees very well with our specimens. These latter we find to vary from 50-105μ (chiefly 65-90μ) by 2.5-3μ. They are hyaline, straight or somewhat curved and septate. The septa are more or less evident, usually three being found, but with staining even four to six can sometimes be made out. After much examination we definitely determined that the spores are borne externally on very short, inconspicuous, hyaline hyphae no wider than the spores. These may be somewhat grouped or isolated, and come from the stoma or directly through the epidermis. As the spores are easily broken the size given for them may vary according as one measures them whole or broken. We have seen a fragment of the type of *C. albo-maculans,* sent us from the N. Y. Bot. Garden, and found the spores to vary from 45-85μ by 2.5-3μ and as these measurements agree fairly well with those from our specimens we have adopted this name though we have small doubt as to their identity with the French specimens described under *Cylindrosporium.*

Soft Rot, *Bacillus carotovorus* Jones. Plate XXXVII, a. In the summer of 1918 a serious disease took off at least ten per cent

of the Chinese cabbage grown at the Station's Mt. Carmel farm. The outer leaves would wilt, drop over, turn yellowish and finally the whole plant would go down. An examination showed that the trouble was of bacterial origin and the dropping of the leaves was due to the rotting of the tissue at the base of the petiole and in the stem. When cut lengthwise through the stem, there was revealed a rotting mass that in time became hollowed out as shown in the photo. Sometimes the rot finally extended up the mid rib and even into the leaf blade. The wet season may have favored this trouble since the cabbage was grown on soil not in this crop before and very little manure was used; however, the rot was not very prevalent either the year before or after 1918, although 1919 was even more moist than 1918. The variety called Wong Bok seems to have been most subject to the rot.

While we made no special bacteriological study of the rot, it was so similar to the ordinary soft rot of cabbage and other vegetables previously recorded from this state, that we have little doubt that the usual soft rot organism was responsible for the trouble. Recently Brown and Harvey (Phytop. 10: 81-90. Fe. 1920.) have described a similar bacterial rot of Chinese cabbage and have noted besides the rot a spotting of the leaves due to the same cause. They think, however, that, while the soft rot is due to different bacteria, the trouble really starts through invasion of the bundles by *Pseudomonas campestris,* the black rot organism of cabbage, etc.

Carrot, *Daucus Carota.*

Drop Rot, *Sclerotinia Libertiana* Fckl. Carrots bought from a grocery store by the writer in the winter of 1919-20 developed, on their outside, while stored in the paper bag, a rot with the conspicuous white mycelium and large black sclerotia of the above fungus. We have found the same fungus causing drop of lettuce and parsley in the greenhouse and dampening-off of seedling beets in hot beds (Rep. 1908: 860, 863, 868.) A similar fungus of doubtful identity has been reported by us as causing a rot of stored cabbage (Rep. 1915: 428.).

Celery, *Apium graveolens.*

Root Rot, *Pythium deBaryanum* Hesse. Mr. E. B. Hall of Middletown in September, 1915, sent us specimens of celery hav-

ing stunted roots more or less rotted off. An examination of these revealed the oospores of a *Pythium*-like fungus in the tissues. We did not determine the fungus more definitely at the time, but our recent study of a variety of similar troubles led us to re-examine the celery specimens and decide that the fungus was *Pythium deBaryanum*. In size and general appearance the oogonia and oospores are the same as those found in the Spinach trouble, *q. v.*, discussed elsewhere. In these old dry roots of celery, however, the oogonia have become thicker and wrinkled somewhat as shown in Plate LVI, 5. Very similar wrinkling however, is developed in the older artificial cultures of this *Pythium* when dried out, as shown in Plate LVI, 8.

Complaint was made of serious injury to the celery but whether or not this fungus was the chief cause could not be determined from the specimens received, as there was also a bacterial rot of the stems present, in some plants. In Aug., 1918, we had called to our attention a root rot of Golden Self-Blanching celery on the farm of W. G. Griswold at Wethersfield. This was so far advanced that the primary cause was not determined though *Fusarium* and bacteria were at least subsequent agents. A careful search for *Pythium,* however, was not made. It seems quite probable, however, that *Pythium deBaryanum* may often be the starting point of such root and stem rots.

Crinkle. Plate XXXVII, b. The illustration shows the contrast between a normal leaf and one with the crinkle. This trouble was called to the writer's attention, the last of August, 1918, by Mr. H. D. Peters of Highwood. He said the trouble appeared rather suddenly in his celery field and that the same seed had not shown it the year before. At the time of our examination the plants seemed to be outgrowing the trouble, as the newest leaves did not show it to any extent. Crinkle develops on the leaves as numerous small puckers or larger folds as if the lower surface had grown faster than the upper. Sometimes the segments of the crinkled leaves are much narrower than those of the normal leaves. Occasionally the color of the leaf is a lighter green but the general appearance is not like that of mosaic.

Evidently the trouble is developed in the young growing leaf and not after it is matured. No signs of lice were present and the folding was toward the upper surface rather than the lower,

the way lice normally injure the leaves. When the plants were set out early in July the weather was rather dry, they had not been watered, and their first leaves showed no crinkling. It seems probable since the central leaves showed the trouble most conspicuously that it was caused by a rather sudden change from the dry to the wet weather that followed with abnormally fast growth compared with that previously made, resulting in faster cell development on the lower side and the crinkling. In time the plants become acclimated to the change with a gradual return to the normal type of growth. Sanford White (see Plate XXXVII) was the variety that showed the trouble by far the most conspicuously though it was seen somewhat on Salzer's Early Bleaching.

Corn, *Zea Mays.*

ANTHRACNOSE, *Colletotrichum graminicolum* (Cesati) Wilson. The disease shows on the leaves of this host, at first, as small oval or elliptical spots containing more or less evident fruiting pustules. If numerous spots occur, the intervening tissues are soon killed so that elongated irregular, brownish areas run lengthwise of the leaf obscuring the smaller spots, and the tissue may become more generally invaded. The setae are prominent on the fruiting pustules and are blackish straight spines about 6 to 8μ wide at the base and 60 to 120μ long. The spores are hyaline, occasionally straight but chiefly decidedly curved and broadest near the center tapering to a decided point at the free end. They vary from 24-30μ by 5-6μ. We have found this fungus in this state twice, collecting it once in July, 1919, on leaves of Golden Bantam sweet corn at the Frank Beach farm in Woodmont. Here the fungus occurred as a parasite but did not seem to be causing any very conspicuous damage, being confined largely to the lower smaller leaves that sooner or later die anyway. The other collection, made on Aug. 24, 1918, was on the stalks of sweet corn from the same general neighborhood. The stalks had been collected for the Fusarium root rot mentioned later, and were kept for some time in paper bags where the *Colletotrichum* probably developed as a saprophyte.

This fungus was first presented in detail from this country by Selby and Manns (Ohio Agr. Exp. Sta. Bull. 203: 187-211. 1909.). Manns described it as a new species, *C. cereale,* and

found it was causing more or less injury to various cereals and grasses, being especially bad on wheat and rye, since it attacked the heads and caused withering of the grain. He found it on the leaves, heads, stems and roots of its different hosts, but he did not include corn among these. Later Wilson (Phytop. 4: 106-112. Ap. 1914.) made a special study of the nomenclature of the fungus and decided it was an old species that had received about a dozen specific names in the past and he adopted the one given here as the authentic name. He gives *Zea Mays* as a host, in fact the earliest collection in 1852 from Italy being in part on it. He also lists it on this host from Connecticut, New Jersey, S. Carolina and W. Virginia in the United States. The citation on *Zea Mays* from Conn., collected by Rorer, apparently is intended for *Sorghum vulgare,* since we have it in the Station's herbarium on this, and Wilson credits it to *Sorghum* only from this state in the main part of his paper.

We have not seen any reference in literature where the fungus was claimed to be an active parasite of corn, most of the collections apparently having been made on the dead stalks. While the size of the spores as found by us on corn are larger than those given by Manns, they are not larger than found by Wilson on some of the hosts and are similar in appearance and size to those found in the Rorer specimen on *Sorghum* (Conn. Rep. 1903: 358.). On this latter host, however, the spotting is much more conspicuous being very decided reddish-brown on the green leaves. It is commonly known as *Colletotrichum lineola* Cda. on this host.

Purple Fungus, *Monascus purpureus* Went. This fungus was isolated in Dec., 1916, from New Milford corn silage sent by L. W. Marsh who thought that the silage was causing the cattle fed on it to scour. Later he came to the conclusion that that was not the cause of the trouble. An examination of the silage showed many of the corn fragments of a decided reddish-purple color and on these by close examination a moldy growth of this fungus in fruiting condition was found.

The only reference we have found where this fungus was suspected of having caused injury is in Pammel's Manual of Poisonous Plants, p. 247, where he says: "The family *Monascaceae* contains one fungus which has been found in mouldy corn and silage in Iowa, the *Monascus purpureus* Went. * * * The

coloring matter from *M. purpureus,* known as 'ang-quac,' is used in Eastern Asia as a pigment, being produced by the growth of the fungus on rice. * * * Dr. Buchanan found this species in spoiled corn silage, which was responsible for the death of several horses in Iowa. This species possibly has been the cause of the disease, this fungus occurring only where air had access to the silage."

Concerning the coloring matter produced by the fungus Lafar (Tech. Myc. 2: 10. Salter trans.) says: "To impart a red colour to rice wine, to various spirituous liquors, bread, cakes, and to the fish held in such high esteem (under the name of Macassar or red fish) in the Malay archipelago, the Chinese employ a colouring matter extracted from a red Hyphomyces, which they cultivate on boiled rice. The fungus grows with vigor on this medium, and imparts thereto a red coloration; and the dried cultures, to which a preservative addition of arsenic and mustard oil is made at the time of preparation, form an article of commerce under the name Ang-Khak. C. Went. has named this fungus *Monascus purpureus.*"

This commercial use would indicate that the fungus was at least not a very poisonous species and it is probably entirely harmless. Even when silage does produce illness in cattle the real cause of the trouble is quite an open question, indigestibility, bacteria and various fungi all coming in for consideration. Apparently as yet no organism has been isolated and fed directly, producing similar trouble, to prove its connection.

Root and Stalk Rot, *Gibberella Saubinetii* (Mont.) Sacc. In August, 1918, in company with Dr. Hoffer of the Indiana Station, we examined fields of sweet corn, grown for seed, in the towns of Orange and Milford, to determine if the *Fusarium* root and stalk rot, so serious in the sweet corn fields in Indiana, was present here. Connecticut supplies much of the seed of sweet corn grown for the canneries in the west. We found this trouble in small amounts in various fields of such varieties as Crosby, Evergreen, Howling Mob, Country Gentleman and Golden Bantam. It was only in a single field of the last variety, however, that the trouble was conspicuous enough to attract serious attention, as about 5% of the stalks here were injured. As shown to us by Dr. Hoffer, the trouble may start from the seed as a primary

infection, or it may possibly get into the young plant later through injuries of the roots. In time the roots are more or less rotted and the lower portion of the stalk invaded. By cutting stalks lengthwise from the base up, the infection is shown by the discolored and diseased tissues at the nodes for a shorter or longer distance according to the progress of the fungus upward. The lower leaves die prematurely and the stalk is often barren, especially in the west, and is easily blown or broken over. The trouble was seen again in 1919 on sweet corn, but as yet we have not looked for it on field corn where it probably also occurs.

While we have made no particular study of the cause of the disease we do not doubt that it is sometimes carried in the seeds, apparently through secondary infections according to Hoffer. However, we should judge, since it is not a very serious trouble here, that the infected soils of the west were more a source of infection there than Connecticut seed. We shall speak more of this matter, however, under "Poor Seed."

Hoffer, Johnson and Atanasoff (Journ. Agr. Res. 14: 611-12. 23S. 1918.) have recently proved the identity of the *Fusarium* of corn root rot in the west to the *Fusarium* causing scab of wheat, etc., which is so prominent in that region, and have connected these with a mature stage belonging to the genus *Gibberella*. This stage has also been found on old corn stalks recently in Connecticut fields. The ascospores of this are hyaline, four-celled, straight or slightly curved and chiefly 24-30μ long by 5-6μ wide. Ellis issued (N. A. F. no. 81, under the name of *Nectria* (*Gibbera*) *pulicaris* Fr.) what appears from our specimens to be a different thing on old corn stalks.

On one of our specimens we also found *Diplodia macrospora* Earle, fruiting abundantly. What connection, if any, this fungus may have with the root rot we do not know. *Diplodia Zeae* (Schw.) Lev. is reported as a serious disease of corn in Illinois (Ill. Agr. Sta. Bull. 133.) and Farlow and Seymour (Host Index: 156.) give it as a synonym of *Gibberella Saubinetii* Sacc.

Yearly rotation of corn, care being used not to follow wheat or rye, and the use only of healthy vigorous seed, are methods for limiting this trouble to minimum injury.

Root Rot, *Phytophthora cactorum* (Cohn & Leb.) Schroet.

There were various complaints in 1919 of corn not doing well, and the cause was not always evident from the information and specimens received. Some of the trouble may have been due to the *Fusarium* already mentioned, or to the leaf blight, *Helminthosporium turcicum,* which killed the leaves as if by a frost, especially in late planted sweet corn. In other cases apparently neither of these fungi was the responsible agent. An unusual case was called to our attention late in the fall by County Agent Southwick of Hartford who sent us corn stubble for examination and wrote as follows:—

"I got them from John Cannon who lives in North Granby. This particular field raised a good crop of corn last year but had no other fertilization this year than a thousand pounds, I believe, of a 3-10-0 fertilizer. The corn was backward early in the season, and on two adjacent fields as well as part of this field cottonseed meal was applied during the summer. Wherever the cottonseed meal was used the corn seemed to recover and made very satisfactory growth. This particular field, however, never made very much growth and was about the size of pop corn although it should have been good-sized yellow flint. Mr. Cannon says that when cultivating the corn it was easy to pull the whole plant out, as the roots seemed to be decayed, particularly in the center.

"I noticed in pulling up this stubble that some of the first roots had apparently disappeared and that secondary roots, although small in size, had developed. The application of cottonseed meal could be determined right up to the last row of corn, because in this field it was impossible to pull out the stubble where cottonseed meal was used, but the next row to it was like the specimens I send. I thought at first perhaps the fertilizer might have contained some borax, but nothing on the enclosed tag seems to warrant such an idea. Whatever the trouble was the cottonseed meal seemed to give the corn a new start so that a reasonable crop was secured."

It was of course too late for us to tell from the specimens sent the actual cause of the trouble, but we ran across a fungus that possibly may have had some bearing on it, and as we had never seen it before on corn, we have thought it worth while mentioning even if it should finally prove to be merely a saprophyte. In the pith of the stubble when cut across we found in the vicinity of the nodes the oospores of a fungus, see Plate LVI, 1, more or less abundant. As there were no other stages with these oospores, and as no cultures were obtained, we were not sure at first whether they belonged to a species of *Pythium* or *Phytophthora*. *Pythium deBaryanum* has been reported as dampening-off corn seedlings (Fischer, Die Pilze 1^4: 405.) but the oospores we found are too large for that species, and are enveloped too closely by the oogonium; besides there was a good stand of corn in the field. The oogonia varied from 21-33μ but

chiefly from 24-30μ and the oospores from 18-29μ but chiefly from 22-27μ. The walls of the oogonia and oospores were hyaline, and those of the latter were quite thick (2.5-4.5μ.) As a rule the oogonia enveloped the oospores rather closely and likewise the spores agree fairly well with those of *Phytophthora cactorum* in other respects, though the cell wall appears to be thicker than usual on spores in artificial cultures.

Infection experiments with the culture of *Phytophthora cactorum,* obtained from Pear, were not very successful on corn seedlings either in Petrie dishes or in soil in crocks. We did, however, in the latter get one or two seeds that showed oospores developed in them and a slight invasion of the main stem of the seedling. We have observed a number of root rots of different plants, especially in 1919, that were caused by *Phytophthora* or *Pythium,* and these we have discussed further under Pea, *q. v.*

Albinism, or *Striped Chlorosis.* Cases are not rare in both field and sweet corn where the young plants instead of being normally green have a whitish or yellowish-white color, or have similar elongated bands running lengthwise of the leaves separated by the normal green tissues. The more complete albinos never grow to large plants, and even the others are often somewhat stunted and may not mature seed. In 1919 several cases of the striped chlorosis were observed in Golden Bantam Sweet corn in the writer's garden and on a similar specimen of field corn sent to the station by G. D. Stone from Windham County.

Dr. Jones of this Station has grown experimentally several types of such corn and finds that when seed is matured the trouble is perpetuated more or less definitely as is the case with a number of our variegated plants cultivated for ornamental purposes. Just what prevents the development of chlorophyll in certain portions of the leaf and not elsewhere, thereby giving rise to this peculiar striping, is not known. Davis (Ia. Acad. Sci. 24: 459-60.) in 1917 conducted some experiments with chlorotic corn in Iowa that seem to show that this trouble is not communicated by handling or inoculation as is the mosaic of tobacco.

Pellucid Spots. Plate XXXVIII, a. The trouble shown in the photograph reproduced here was called to our attention during the summer of 1919. In June at Milford, Dr. Britton's men collected the first specimens from which the photograph was made; and in July even more striking specimens were received from A. B. Case of West Granby. Dr. Britton was not able to identify the trouble as one caused by sucking insects, though it has somewhat that appearance. Neither did the writer in the fresh specimens find any fungus or bacterial agent as a probable cause. We place it here for the present as an indefinite physiological trouble. Later, in the dried herbarium material, sections showed some mycelium in the tissues but whether of a saprophytic or parasitic character could not be determined.

The pellucid, semi-watery, more or less zoned spots have somewhat the appearance of a bacterial trouble. In some specimens these spots are half an inch long and very numerous so that the intervening tissue is killed or the spots run together indefinitely. When first formed in the otherwise healthy leaf, they are quite striking in appearance. Usually there is a minute spot at the center which is apparently the point of entrance or starting point of the trouble. Mr. Case wrote: "The dead stalks like sample are scattered over the field, occasionally a whole hill infected, with good corn all around it, but usually only one stalk affected in the hill. There is one spot in the piece, however, covering two square rods, where nearly all the corn is affected. The corn was all fertilized alike."

Poor Seed. In 1917 corn, field and sweet, over much of the United States was of such poor quality that it was difficult to obtain seed of sufficiently high germination for the 1918 crop. While this was partly true of the Connecticut seed corn, apparently the corn here was not so severely hurt as in most other states. So that there was an unusual demand, from this state, for good field corn for seed purposes. Germination tests showed great variations in the corn, due in part to injury from the early frosts in the fall before the corn was thoroughly ripened, and in part to the poor care given in drying and storing afterwards. The severe winter of 1919-20 also produced somewhat similar injury but to a less degree. There is no question that, where corn is grown for seed purposes, as is considerable of the sweet corn in this state, more attention should be given to having it properly matured, dried and stored to avoid the injury that comes with cold weather. Much corn is stored in open corn cribs and great variation in germination of this

corn, after severe winters, is sometimes shown. Thoroughly dried corn or corn stored in warmer buildings does not seem to suffer so much.

Frost-injured corn usually develops wrinkles in the skin, that are quite visible to the naked eye. On germinating in the seed testers, this poor corn is also apt to become more or less moldy with a variety of saprophytic molds, much as does the *Fusarium* infested seed as shown by Hoffer. There is no doubt that such seed even if it does germinate will not give as complete or vigorous a final stand in the field as perfect seed. On the other hand it does not appear that the *Fusarium* is primarily responsible for the poor seed of 1919 so that we are not dealing with a serious field parasite that might be harder to control than poor seed due to improper conditions of harvesting and storing.

Cotoneaster, *Cotoneaster horizontalis.*

Red Canker, *Tubercularia vulgaris* Tode. This fungus was abundant on some dead stems sent us in Sept., 1916, by the Elm City Nursery Co., from Westville. Presumably the fungus followed winter injury, as it seems to be more of a saprophyte than a parasite. We have seen it a number of times on trees winter-injured, especially on nursery trees not strictly hardy in this climate.

Cucumber, *Cucumis sativus.*

Angular Leaf Spot, *Bacterium lachrymans* Sm. & Bryan. This disease shows as evident angular spots on the leaves as if water soaked. These at first are semi-transparent, but later are more opaque, reddish-brown, dead areas from which the tissues easily drop out. The bacteria also are said to cause a soft rot of the leaf petioles and young vines, and from small watery spots on the surface of the fruit Burger believes there develops a soft rot in the interior. This disease was sent us once or twice from Indiana some years ago, but we have only one collection on cucumber from Connecticut in the herbarium. This was found on the leaves at Milford in June, 1918. Our impression is that we have seen it at other times, but did not definitely identify it or collect specimens. However, we did collect specimens on musk-melons many years before this.

There is some question as to who first mentioned this trouble. So far as we have determined, it seems to have been first described in a popular way in 1894 by Halsted (N. J. Agr. Exp. Sta. Rep. 1893: 354-5.). He found it on musk-melons and reproduced a photograph of an infected leaf, but gave no scientific name to the bacterium producing the trouble. The writer found the disease first in Connecticut on the same host in 1902, and briefly mentioned it in his Reports (1903: 331. 1904: 346.) under the Bacterial Wilt disease with which we thought it might possibly be connected. It was collected at Southington, New Haven, Montowese, and seemed to be not uncommon in 1902 and 1903, but we have not collected it since. Burger (Phytopath. 3: 169-70.) in 1913 was apparently the first to make cultures and give a scientific description of the organism, which he placed under the genus *Pseudomonas,* but he gave no specific name. More recently, Dec., 1915, Smith and Bryan (Journ. Agr. Res. 5: 465-76.) gave a comprehensive account of the organism, which they call *Bacterium lachrymans.* These authors believe they studied the same leaf disease but concluded that Burger had a different organism in the soft rot of the fruit. It is quite possible that this organism opens the way for decay of the fruit by the ordinary soft rot bacteria. Some authorities would consider *Bacterium lachrymans* as a *Pseudomonas,* as it has polar flagella.

Currant, Black, *Ribes nigrum.*

Leaf Spot, *Septoria Ribis* Desm. This shows on the leaves as small, angular, brownish spots with a purplish border. The very minute, fruiting conceptacles are embedded as black dots in these. The linear spores are curved, hyaline, and chiefly 45μ by 1μ in size. The same fungus has been previously reported by us on red currants and gooseberries. The specimens on the black currant reported here were collected by the writer at the Nathan Hale homestead at Coventry, in June, 1917.

Rust, *Aecidium Grossulariae* (P.) Schum. This was collected on escaped black currants in North Stonington, June 20, 1919, by Mr. Stoddard of this department. It occurred on both the fruit and leaves. This was not the first collection in the state, however, as we have specimens in the herbarium on the same host

made by Thaxter at Green's Farms in 1889, and by Filley, near Bridgeport, in 1917. It has been reported before on cultivated gooseberries, but not on cultivated red currants, though it is quite common on various wild species of *Ribes* in the state.

Currant, Flowering, *Ribes odoratum.*

ANTHRACNOSE, *Glomerella cingulata* (Ston.) Sp. & v. Schr. The *Gloeosporium* stage of this fungus was found on the fruit of the flowering currant in a farm yard between Meriden and Middlefield, June 21, 1917, by the writer. The fruiting stage showed as numerous pinkish pustules on the half ripened berries. The spores were chiefly 12-15μ by 4-5μ. Apparently this fungus has not been reported, at least frequently, on this host. Saccardo described a species, *Gloeosporium tubercularioides,* as occurring on the leaves, but this, because of its wider spores, seems to be different from our species which we have also previously reported on the fruit of the red currant.

BLISTER RUST, *Cronartium ribicola* Fisch. Both the lemon-yellow dusty pustules of the II or summer stage and the hair-like spore columns of the III or mature stage of this fungus have been found on the cultivated yellow-flowering or Missouri currant in this state. This host is especially subject to the disease, being almost as much so as the black currant. The collections were made in each of the years 1916 to 1919. They were chiefly from the northern and eastern part of the state, in quite a number of different localities, at least twelve being recorded in 1916.

Currant, Red, *Ribes vulgare.*

BLISTER RUST, *Cronartium ribicola* Fisch. We have not reported the white pine blister rust on this host except incidentally in our 1915 Report, p. 423, where we noted that Spaulding found specimens near Meriden. There were only a few sori on abandoned bushes in the Middletown Water Company's Plantation at the Digby reservoir. Since then many other collections have been made in the state, the rust being common on abandoned or escaped currants in the woods in the vicinity of Norfolk and especially near the woodlands where the *Peridermium* stage on white pines is found. In 1916 thirty-eight collections were reported in twenty-six different towns or localities, and in 1917 an

even larger number of collections were made but mostly in the same localities. Since then the collections have been made each year but not to such an extent as the search has not been so thorough. While these localities reported are fairly well scattered over the state they represent chiefly the northern and eastern sections.

Mottled Chlorosis. We have occasionally seen isolated branches on currants where the leaves showed a conspicuous yellow mottling over the whole or part of the leaves. This may show as numerous small bands following the veins and enclosing equal angular areas of normal green tissue. The cause of this chlorosis we do not now know. Similar leaves have been seen on isolated branches of apple trees. Injury to the leaves in their very young state by sucking insects or by frost has been suggested as a possible cause.

Dewberry, *Rubus* sps.

ORANGE RUST, *Caeoma nitens* Schw. Germination tests seem to indicate that all specimens of this rust on wild species of *Rubus canadensis* in Connecticut belong to the short cycled form. We have not yet found this rust on cultivated dewberries. See Raspberry, in this Report, for further details.

Fir, Douglas, *Pseudotsuga mucronata.*

GREY MOLD, *Botrytis cinerea* Pers. We are indebted to Mr. F. A. Bartlett for calling to our attention in August, 1919, this disease on Douglas Fir at the Rockefeller Estate, Greenwich. The fungus kills the young shoots of the season's growth, and develops a more or less conspicuous growth of the characteristic conidial stage on the dead tissues. The fungus occurs on a variety of herbaceous plants as a parasite under moist conditions.

This fungus has been also reported as causing injury to Douglas Fir in Germany by Tubeuf (Diseases of Plants: 269. Eng. ed.) who named it *Botrytis Douglasii* but Smith (Bot. Gaz. 29: 403. 1900.) considered it the species mentioned here, of which *B. vulgaris* is also given by him as a synonym. Some authors (See Duggar's Fungous Dis. Plants: 196.) consider *B. cinerea* as merely the conidial stage of *Sclerotinia Fuckeliana* DeBy.

Gooseberry, *Ribes* sps.

BLISTER RUST, *Cronartium ribicola* Fisch. The blister rust, both in its II and III stages, has been collected several times on cultivated gooseberries in the state during the last few years. However it does not occur so commonly or abundantly on this host as on the red currant, and much less so than on the yellow or black currants. Even when these other plants alongside of it are abundantly infected, it may escape infection entirely. This is probably only a specific characteristic of the gooseberries cultivated here, as certain species of native gooseberries, and others used in our infection experiments indoors, are easily and abundantly infected. Of the five collections made on cultivated gooseberries in 1916 and 1917, all were on plants in the northern or eastern part of the state.

Grape, *Vitis* sps.

ROT, *Pythium hydnosporum* (Mont.) Schroet. In August, 1919, E. V. Parr of Clinton sent us grapes that were badly diseased. This was chiefly due to the black rot fungus which was very prominent that year, though some injury was also caused by the grape berry moth. Other fungi present apparently followed as saprophytes, of which the *Pythium* named above was the most conspicuous. It is a fungus that is not reported, at least prominently, in American literature. We have seen it occasionally developed in rotten potato tubers, the original host, following injury by *Phytophthora infestans,* and have also found it on pea roots (kept in water) injured by the *Phytophthora cactorum* mentioned in this Report. On these rotting grapes, however, we found it developed more prominently than ever before.

The oospores in certain grapes were very abundant, in some being produced within the pycnia of the black rot as if belonging there naturally. They were also found in the grape tissues and even in the bodies of the larvae infesting them! The oogonia (see Plate LVI, 9) are very striking because of their fairly numerous conspicuous spines. These reach out to 2-5μ beyond the oogonial wall and are often quite sharply pointed but with age they may become blunter and less conspicuous. The smooth spherical oospore is often so closely enveloped by the oogonium

that this resembles one of its coats. With age the oogonia are tinted and, including the spines, measure from 20-27μ in diameter, while the oospores vary from 15-20μ with their thick wall from 2.5-3.5μ. No other stages were seen by us and according to Winter, who calls it *Pythium artotrogus,* none have been found. It is now placed under the sub-genus *Artotrogus* (under which it was originally described by Montaigne) because of the spiny oogonia.

Lightning Injury. In July, 1918, we had called to our attention at Marlborough, lightning injury of grapes. According to the owner, Mr. d'Esopo of Hartford, a year or two previous lightning had struck the two wire trellis along which the Clinton variety of grapes was trained. Within a day or two all the branches that were attached to the wires were dead. However, the main stem was not killed and new runners were quickly developed from this, so that at the time we saw them they were as vigorous as ever. Prof. Hollister, who was with us at the time, stated that he had seen similar injury to grapes at Bolton Notch.

Smoke Injury. We were called in September 1919 to examine serious smoke injury to a variety of plants in the suburbs of New Haven. There was a difference of opinion as to the cause of the injury, some claiming that it came from an aluminium factory and others from a brick kiln. After our examination of the vegetation in the vicinity of each, we had no hesitancy in deciding that the brick kiln was the responsible agent. The kiln was situated along the railroad, and the smoke had been carried in a west southwestern direction until it struck against the hillside of East Rock Park. From the slopes of this going toward the kiln, one could trace all the way in a direct line, damage to a variety of trees, vines and herbs.

In the park gray birch, beech and hornbeam were the trees most injured. Hemlock, hickory and maples here showed the least injury. However, in 1910 (Rep. 1909-10:722.) we saw serious injury to conifers, especially young spruce, in this same park from another brick kiln. Maple and elm trees, midway of the park and the kiln, showed the trouble more or less prominently according to their situation. Part of the injury to the maples, however, may have been due to sun scorch as we are

unable to tell these troubles apart from the appearance of the leaves. Corn, tomatoes and some trees and weeds near the kiln were also injured. Grapes in a number of the yards midway showed the trouble as conspicuously as any of the plants. Their leaves were badly scorched and some of the young twigs suffered injury at their base. The ripening fruit was insipid and was dropping considerably. The few peach trees seen did not seem to be injured, which agrees with Stone's statement, *loc. cit.*, that this tree, with black locust and *Ailanthus,* is more immune than most trees.

As we have heard of injury to vegetation from at least three brick kilns in this state, it might be well to give here the conditions under which, as we understand them, this damage occurs.

In the first place the injury is chiefly due to the sulphur dioxide in the smoke that comes from coal in the fires and particularly from the coal dust mixed with the bricks to help burn them. As these become red hot it is necessary at a certain time in the firing to lift the board covers of the sheds to avoid fire and let out the heat and smoke. If this takes place on a wet or muggy day and the smoke is driven toward the ground and comes in contact with the damp foliage, a burn results, probably due to the formation of sulphurous or sulphuric acid. If the day is fair and the smoke ascends no damage results. So only occasionally, when all conditions are right, does injury to vegetation follow. Smoke injury is not always due to sulphur dioxide, but other gases and sedimentary deposits sometimes cause injury in specific cases.

In our Report for 1908 we mention briefly smoke injury to asparagus from a brick kiln and in the present one describe injury to apple (*q. v.*) by smoke from a bronze factory. Smelters, particularly in the western United States, cause such great injury that much special investigation has been made in recent years by botanists and others. Hedgecock (Torr. 12: 25-30. 1912. Journ. Wash. Acad. Sci. 4: 70-1. 1914.) has briefly described such injury in Montana and Tennessee. Bakke (Ia. Agr. Exp. Sta. Bull. 145: 383-409. 1913.) gives a more detailed account, with references to literature, upon "The Effect of City Smoke on Vegetation," while Stone (Mass. Agr. Exp. Sta. Bull. 170: 228-32. 1916.) treats of the effect of atmospheric gases on shade trees, in a popular manner.

Winter Injury. The d'Esopo vineyard, previously mentioned under Lightning Injury, is situated on a high ridge in Marlborough and is the largest vineyard in the state, consisting of about one hundred acres. For some years the Italians have been gradually going into growing grapes and this fruit is therefore becoming more prominent while the peach is becoming less so. As comparatively few grapes have been grown here commercially, except in a small way, the troubles of the vine require more notice than has been given them in the past.

We wish to call attention here to a very serious trouble that developed in this vineyard, chiefly on Concords, which with Professor Hollister of Storrs, we were asked to investigate. It was first noticed in the early summer of 1917 when the vines in some cases produced a scanty or sickly foliage and in a few cases died outright. Mr. d'Esopo thought some unknown disease was at work, especially as in 1918 the trouble became more conspicuous. Our examination, made July 18, soon convinced us that the trouble was entirely winter injury, due in part to a lack of snow mulch in 1916-17, but more particularly to the very severe winter of 1917-18. The vines most injured were on a ridge. Some of these were dead, others dying, or with more or less scanty foliage, and some apparently in fair shape. We found the wood of the sickly vines to be sound, but an examination of the roots showed these were injured and in some cases, especially those nearest the surface of the ground, partly or entirely dead. The condition of the foliage above ground corresponded so closely to the condition of the roots beneath that one could not doubt that it resulted from this diseased condition of the roots. There was nothing on the roots to indicate a parasite as the cause of their death, one peculiar saprophytic hyphomycete on certain dead roots being the only fungus seen.

There was no question that winter injury was the cause since complaints of winter injury to fruit trees from these two winters, especially the last, had been greater than for many years. Many peach trees on this farm had been killed. Then, too, the exposed high elevation of the grapes had been favorable for such injury and we had another complaint from the neighborhood of Colchester of similar injury under such conditions although the grapes in both localities had received good attention.

Most persons are likely to overlook winter as the cause of much injury to grapes since it often does not become manifest until early summer, after the foliage has been put forth, when the leaves die quickly under the hot sun or dry weather conditions. The winter is much harder on the roots than on the vines above ground. Often the roots are dead or badly injured when the vines and buds are uninjured, but while the buds may develop they cannot live, or only a portion can live if the roots are not too severely injured. In the latter case good cultivation and fertilization early in the season to stimulate new root growth is desirable. Snow or other mulch of course is helpful in preventing the trouble. Wet spots and shallow soil are to be avoided as being more likely to favor winter injury. Selection of hardy varieties, where possible, is also to be taken into consideration although the Concord, more or less subject to injury, is the most common variety grown.

Hickory, *Carya* sps.

CONNATE FOMES, *Fomes connatus* (Weinm.) Gillet. Plate XXXVIII, b. This fungus is called *Fomes populinus* by Murrill. The specimen shown here was collected Nov. 25, 1918, on a living hickory tree in the woods between New Haven and Milford. The bracketed pilei in this cluster were much larger than we have seen them on the maple, the ordinary host in this state, being 4 by 4 by 8 inches. The upper surface of the pileus is whitish, with age becoming blackish or greenish with algal growth behind. The under or fruiting surface has more of a flesh color, the rather small and thin pores often having a satiny lustre. The pilei are irregular, with small shelves often growing into the larger. The stratified pores, characteristic of the genus, are evident but often irregularly placed.

This species differs from most of the *Fomes* found in this state by the less woody and more corky pileus especially its context. Murrill (Northern Polypores: 47.) says: "Rather common throughout on living trunks of maple and certain other deciduous trees, causing decay."

Witches' Broom. Plate XXXVIII, c. This trouble of *Carya ovata* was first called to our attention in 1917 by Mr. E. B. Harger of Oxford, Conn., and we have seen specimens from his trees each

year since. Swollen places show on the branches and from these several secondary branches are formed giving the witches' broom effect. The leaves drop off prematurely, often leaving the petioles still attached to the limbs. The morbid growth eventually dies, killing the parts beyond. Mr. Harger has observed about a dozen hickory trees so affected on his place and thinks the trouble is spreading slowly although not many of the branches on a tree are yet involved.

We were unable to find any indications that this was an insect injury and very little evidence that it was caused by a fungus. No fruiting stages have yet been seen on any of the branches. Mr. Stoddard, in examining the wood microscopically, found a little evidence of mycelium in one specimen but was unable to obtain cultures of a fungus from the tissues of the morbid growths. Of course it is possible this trouble is merely a stag-head growth developed through winter injury of the terminal bud or tip of the twigs.

Honeysuckle, Hall's, *Lonicera japonica* var. *Halliana.*

CROWN GALL, *Pseudomonas tumefaciens* (Sm. & Towns.) Stev. This bacterial disease was sent us on the above host, new to the state, from the Elm City Nursery in June, 1918. It was not causing any great damage, showing as small galls on plants in storage.

Horsechestnut, *Aesculus Hippocastanum.*

ANTHRACNOSE, *Glomerella cingulata* (Ston.) Sp. & v.S. Plate XXXIX, a. Specimens of this disease of horsechestnut were sent us about the middle of August, 1917, by Mr. C. F. Crosson and a short time later we examined the tree from which they came. The tree was in the yard of Mr. George Wilcox at Meriden. Many of the leaves showed a bad scorch-like injury and were dropping prematurely. Often only part of the leaflets or a portion of the blade of a single one showed the reddish-brown injury, the rest remaining the usual green color, as shown in the photograph reproduced here. An examination of the tissues of the blades, the midribs and the petioles revealed the presence of both the *Gloeosporium* and asco stage of the above fungus.

So far as we know this is a new, or at least an unusual, host

for this fungus as it is not reported in Saccardo's or Farlow & Seymour's Host Index or by Shear and Wood in their bulletin on Glomerella. The tree was in a sickly condition, other than from the action of this fungus on the leaves, apparently due to winter injury. Whether or not this weakened condition of the tree influenced the appearance of the anthracnose on the leaves we do not know, but there was no doubt that it was occurring there as an active parasite.

Red Canker, *Tubercularia vulgaris* Tode. Plate XXXIX, b. This was collected on the branches of the winter injured tree mentioned above. The fruiting stage breaks through the bark as numerous, small, firm, pinkish pustules. It seems to be at most a weak parasite and is the conidial stage of *Nectria cinnabarina* (Tode) Fr., with which it is often associated but was not in these specimens.

Winter Injury. Besides the above horsechestnut tree, which showed dead branches and some winter cankers due to the unusual exposure on a terrace to the western sun, we had specimens sent us from Wallingford, by Mr. C. H. Brown, of a rather unusual winter injury. The leaves on certain branches from this tree developed later and were much smaller than those of the rest of the tree. On cutting those twigs lengthwise, the pith in the previous year's growth was found to be, especially at the nodes, turning a reddish-brown color. This winter injury no doubt had been sufficient to interfere somewhat with the transference of the starch, as it was present here but not in the normally white pith, with the result that while the leaves were put forth they did not reach their full size through lack of sufficient food for normal growth.

Hydrangea, *Hydrangea paniculata* var. *grandiflora.*

Chlorosis. We know of no variety of this cultivated plant that is variegated. In a yard near the Station is a plant certain of the leaves of which showed a whitish mottling, in the fall of 1916. Usually these small spots ran more or less together and were situated in the vicinity of the larger ribs or at the margin of the leaves. The mottling was quite varied in pattern, in one case forming a nearly complete, narrow, banded circle at the apex of a leaf. In some respects the trouble appeared like

insect injury to the leaves when very young which prevented chlorophyll formation at these spots.

Kohlrabi, *Brassica oleracea* var. *caulo-rapa.*

Club Root, *Plasmodiophora Brassicae* Wor. Plate XXXIX, c. This slime mold disease of cruciferous plants, showing on the roots as irregular knobs or gall-like growths that eventually rot off, has previously been reported by us on Brussels sprouts, cabbage and turnips (both yellow and white) and is recorded here on radish, *q. v.* It was found on the roots of kohlrabi sent the Station in June, 1918. Club root was unusually common that year being most frequently found on cabbage, the only host on which we have found it causing very much damage in the state so far. Badly infected cabbage plants fail to grow, in many cases turning yellow and dying prematurely, or at best making small heads. While the germs become established in the soil and infect plants each year, certain seasons seem to favor their development more than others. The season of 1918 was much more favorable than that of 1920.

Larkspur, *Delphinium* sp.

Fasciation. A specimen showing fasciation of a single fruiting stem of a cultivated larkspur from the garden of Mrs. E. D. Driesbach, Whitneyville, was collected by Mr. Stoddard in July, 1919. The flattened two-foot stem in this case was about half an inch wide, or twice its normal diameter for the entire length. The upper half of the stem was occupied by the seed pods and had a half curl part way up. The top was forked for a short distance but the tips were not coiled. See Asparagus.

Lettuce, *Lactuca sativa.*

Bladdery Peziza, *Peziza vesiculosa* Bull. Specimens of this fungus were sent us in May, 1918, by Mr. Gordon J. Gale, Garden Supervisor of Bridgeport, who found them in a cold frame of lettuce. They did no harm, except from crowding the plants, as the fungus is a saprophyte developing only on the humus in the soil. This is one of the cup fungi, occurring in thick clusters of semi-globose cups (often flattened by pressure) which are closed at first but later open by an incurved broad mouth. The sessile cups are an inch or two in diameter.

Concerning the fruiting receptacles Hard (Mushrooms, Edible and Otherwise: 508. 1908.) says: "They are found on dung hills, hot-beds or wherever the ground has been strongly fertilized and contains the necessary moisture. This is an interesting plant and often found in large numbers."

Maple, *Acer* sps.

CONNATE FOMES, *Fomes connatus* (Weinm.) Gillet. We have seen this species several times on maples, especially on living red maples at both Woodbridge and Union. It is more or less of a parasite, chiefly causing decay of the heart wood. Under Hickory it is described more in detail.

Mountain Ash, *Pyrus americana.*

RUST, *Roestelia cornuta* (Pers.) Fr. So far we have found this rust only at Norfolk, Conn. We remember seeing specimens several years ago on American mountain ash trees in the golf grounds there and in June, 1919, collected specimens of the spermagonial stage on the same host at the edge of woods in the same general vicinity. Very near these small trees, whose leaves were rather abundantly infected, we found the III or mature stage on *Juniperus communis.* On the mountain ash the fungus makes conspicuous yellow spots, showing on both sides of the leaves, with the spermagonia quite evident on the upper and the aecia in time appearing on the lower. This fungus is a northern species, apparently, specimens having been sent us from both Massachusetts and Maine where it seems to be more common than in Connecticut.

Farlow (Host Index: 199.) also gives *Aecidium globosum* on this species of mountain ash and Kern (Bull. N. Y. Bot. Gard. 7: 434. 1911.), while he lists six species on Sorbus, gives only these two on *Pyrus* (*Sorbus*) *americana.* Concerning the III stage, *Gymnosporangium cornutum* (Pers.) Arth., Arthur (Myc. 1: 240. 1909.) says: "Telia on branches of *Juniperus Sibirica* Burgsd. were collected May 19, 1908, by Mr. F. D. Kern and Mr. E. Bethel, at Palmer Lake, Colo., and sown May 23, on *Sorbus americana,* giving an abundance of pycnia June 1, followed by numerous aecia. * * * Although the horn-like aecia of this species are common and often collected, this is the first time that the telia have been found in America." Thaxter

(Farlow Bibl. Index: 36. 1905.) however, seems to think the proper name of the mature stage is *Gymnosporangium conicum,* as he says: "Since what is believed to be the true *Gymnosporangium conicum* D. C. occurs in New England and northward on *Juniperus communis,* the citations of *Aecidium cornutum* on *Pirus americana* in those regions probably refer to the true *Aecidium cornutum* of Europe."

Musk Melon, *Cucumis Melo.*

ANGULAR LEAF SPOT, *Bacterium lachrymans* Sm. & Bryan. Although this bacterium was described originally on cucumbers (*q. v.*) there seems to be no reason for doubting that it causes the similar disease on musk melons mentioned by us in our 1903 and 1904 Reports.

Oak, *Quercus* sps.

PINK ROT, *Cephalothecium roseum* Cda. This fungus was brought us in July, 1916, by the entomological inspectors, on specimens of *Quercus rubra* recently imported by a nursery from Holland. They had just been transplanted and the stems were dying, a growth of the above fungus developing on them. We have little doubt that the trees were injured by long continued or poor storage on ship-board, perhaps developing scald from improper watering and heating, and that this fungus came as a result and not as the cause of injury. During the war, shipping conditions were very bad and many shiploads of plants were lost or greatly injured because of slow delivery.

SULPHURY POLYPORE, *Polyporus sulphureus* (Bull.) Fr. Plate XXXIX, d. Large fruiting clusters of this fungus were found on a living oak shade tree at the Barnes Nursery, Yalesville, in September, 1917. The fungus was doing considerable injury to the tree, possibly having got a start through winter injury of the bark. It is one of the larger and more attractive polypores. When young the fruiting brackets are quite compact, as shown in the illustration, and are fleshy and moist, but with age they develop into more flattened, shelf-like, overlapping pilei that in drying become corky and brittle but are not so durable as the real woody kinds. The upper surface has a reddish or orange color, and the lower, poroid, fruiting surface a decided sulphur yellow. The flesh is white. It is not uncommon as a saprophyte.

Cooke (Fungoid Pests Cult. Plants: 208: 1906.) says of it: "This large and attractive looking polypore is a wound parasite on several trees such as oak, alder, willow, poplar, and even pear and apple, as well as larch." Von Schrenk and Spaulding (Bur. Pl. Ind. Bull. 149: 37. 1909.) write, "It is widely distributed throughout the United States and Canada and in most of the forest regions of Europe, where it is regarded as a destructive parasite, both on deciduous trees and conifers."

WHITE HEART ROTS, *Fomes igniarius* (L.) Gill. and *F. Everhartii* (E. & G.) v. Schr. & Spauld. By European authors the first of these large, perennial, woody fungi has been given the common names of False-tinder fungus or Rusty-hoof Polyporus. It is not uncommon in this section of the country on various hard woods, but so far in this state we have seen it only upon oak and apple, *q. v.* As we have observed this fungus, it first develops as rounded, smooth, ferruginous knobs on the trunks. In time these growths show a differentiation into upper and lower surfaces, the upper becoming greyish in color and the lower ferruginous surface developing the small fruiting pores; the shape now has become somewhat ungulate or even more flattened. With age the upper surface turns black and is somewhat zonate and cracked but still with a ferruginous, smooth, obtuse margin separating it from the poroid surface. The spores are said to be hyaline but we have failed to find them on the specimens we have examined. The stuffed whitish tubes also are somewhat characteristic.

Von Schrenk and Spaulding (U. S. Bur. Pl. Ind. Bull. 149: 25-37. 1909.) give a comprehensive description of the fungus and its injuries in their bulletin on "Diseases of Deciduous Forest Trees." It is considered quite a serious wood rotting fungus, causing the heart wood especially to become broken up into a whitish punk, hence the common name of the disease. It also injures the living wood and bark slowly. The fungus not only renders the wood unfit for timber but weakens the trees so that they are more easily blown over. It is said to gain entrance through wounds and often fruits near its point of entrance. We noticed it for several years on a street tree of *Quercus velutina* in New Haven. Each year the fruiting bodies were cut off but reappeared, in time, with the disease slowly extending in the bark until finally the tree was cut down because of the injury.

The second species was originally described by Ellis and Galloway (Journ. Mys. 5: 141. 1889.) as *Mucronoporus Everhartii* and has since been placed by Murrill under both *Pyropolyporus* and *Fulvifomes,* but in the opinion of the writer belongs better under the more comprehensive genus *Fomes,* characterized by layers of fruiting tubes formed in superimposed strata each year. This species is much like the former in appearance and is sometimes mistaken for it but the upper surface becomes more cracked and rougher with age and the strata of tubes are more reddish without much evidence of the white stuffed appearance and easily yield an abundance of ferruginous spores. Von Schrenk and Spaulding, *loc. cit.* p. 48, state that the action on its host is much the same as that of the other species. We have found it only once in this state, on a living oak near Lake Congamond in June, 1916.

Onion, *Allium Cepa.*

During the last five or six years some attention has been given by us to the onions which are grown for seed in this state. This seed-growing has been quite an industry in the past but the great uncertainty of a crop, due largely to the so-called "blast," has discouraged most farmers from growing onions in recent years. In our study of the blast we have noted various troubles and abnormalities, mostly of a non-parasitic nature, which we briefly describe here. For Blast see Plate XLII, a.

RUST, *Puccinia Porri* (Sow.) Wint. We reported (Conn. Agr. Exp. Sta. Rep. 1915: 438. 1916.) the II stage of this fungus, found on Ægyptian perennial onions at Storrs, in 1914. We have since collected it on the same plants several times but the collection on Nov. 17, 1917, was the only one where we found the III stage, thus completely establishing the identity of the rust. Apparently this mature stage develops rather late.

YELLOW LEG, *Fusarium* and *bacterial* rots of bulbs, etc. This trouble usually shows when the onions are fully grown, but not matured, by occasional stalks turning yellow below and finally dying before fully maturing their seed. Such stalks are easily pulled from the ground, as the roots have been largely rotted off.

Generally *Fusarium* or bacteria are the cause of this rot and these may come from the old bulbs, possibly developing there largely as saprophytes. Damp weather and poor bulbs favor the trouble.

Bastard Blossom. Plate XL, a. This is a common name applied by growers to occasional abnormal heads that appear in the field, the appearance of which is well shown in the illustration where two such heads are contrasted with the central normal one. These heads have the individual pedicels more elongated, so the flowers spread out in a larger laxer bunch. Growers complain that little or no seed is developed, so they pull them up when seen, but whether the seed that is produced tends to form similar plants we do not know. The reason little seed is produced is because the pistils are often changed into foliacious structures. Sometimes the heads fail to form blossoms at all, but in their place form numerous slender stem-like growths from little bulbils.

Bulblet Head. Plate XL, b. Occasionally the plants, instead of producing a blossom cluster at the end of the stalk, form a bunch of bulblets in the same place, as is often seen in wild species and some cultivated varieties. Rarely we have found specimens like that shown in the illustration, where after these bulblets were started the stem continued on above and also formed a smaller flower cluster. The specimen figured here also shows another trouble which we call "Goose Neck."

Double Flower Head. Plate XL, c. Occasionally instead of a single flower cluster on the end of the stem there may be two, a lateral one below the other. Usually these are about the same size and but a short distance apart, though we have also found specimens where the lower one was much farther down the stem and quite small.

Elongated Spathe. Plate XLI, b. Normally the flower head is enclosed when young by a small spathe that later becomes ruptured and withers up at the side as a sort of bract. Occasionally, however, it is more permanent and pretentious, continuing as a pointed extension of the stem, which the blossom finally forces to one side, as shown in the illustration.

Goose Neck. Plate XLI, a. This is a term we have coined for those not infrequent crooks in the stems that develop all

the way from a slight bend to a completely coiled turn or even a turn and a half, as shown in one specimen in the plate. We cannot be sure of the cause of these but suspect that during rapid growth the stem is sometime bent to one side, from one cause or another, and this produces turgor that results in more rapid growth on the opposite side and the resulting curvature. Possibly in pushing through the bulbs the stem is sometimes caught at the tip and before this is released the stalk has made a bending exit. The natural tendency, after the bending has become prominent, is for the tip to again grow upwards, hence many half turns, bends, etc.

Hail Injury. Plate XLI, c. We saw rather severe injury to a field of Southport White Globe seed onions in Milford, caused by a hail storm on July 27, 1917. As usual there soon showed on the side of the stalks from which the storm came the characteristic white spots or marks that we have found with hail injury to tobacco, *q. v.* Corn in an adjacent field also showed a little of a similar injury. Plate XLI, c, shows three hail-injured onion stalks, two showing the injured sides exposed to the hail and the other with the uninjured side protected from it.

White Ring. Plate XLII, b. This trouble shows as narrow white rings or cracks extending more or less completely around the stem. They apparently start as a small break in the epidermis which extends crosswise around the stem but whether gradually or suddenly we do not know. These rings may be single or several parallel to each other and are always found somewhat above the bulge on the lower part of the stem. If they extend deeply into the tissues the stem often breaks off at one of them.

At first we thought that they were the result of insect injury but finally decided that they are growth cracks. The epidermis of the stem is very thick and the stem makes a rapid growth of three or four feet in a few weeks at most. This stretches the epidermis greatly, especially longitudinally, with the result, in our opinion, that cracks develop at the place of greatest strain which appears to be above the bulge on the stems.

Under the designation of "Crack Neck" Chapman has recently described (Phytopath. 9: 532-4. 1919.) and illustrated a trouble of chrysanthemums very similar to this. The causes he states as follows: "(1) Very little transpiration takes place as a re-

sult of the low air temperature and the high humidity, and (2) the soil temperature remaining practically stationary, the soil having been previously well supplied with moisture; and the roots functioning normally in so far as the absorption of water and solutes was concerned. These and similar conditions always bring about abnormal cell relations and in consequence an excessive turgor is brought about in some of the cells with no normal means of regulation, such as occurs when the plants are transpiring freely, and as a result some of the tissues must give way to permit of a return to the normal condition."

Pea, *Pisum sativum.*

Root Rot, *Phytophthora cactorum* (Cohn & Leb.) Schroet. Early in July, 1919, Mr. A. N. Farnham, a large market gardener of Westville, sent to our office samples of pea vines that were being killed by some unknown agent. The vines at this time were in their prime, the first picking not yet having been made. The vines eventually turned yellow and wilted down, so that, except for the one or two small early pickings, there was practically no crop in a field of several acres. A visit to the field showed that the trouble started as a root rot, but in time the stem also rotted somewhat below and both became invaded by bacteria, nematodes, etc. Other fields in the vicinity showed the same trouble, which had little or nothing to do with the manner of fertilization or rotation. Afterward complaints came in from growers in Milford, Waterbury, Bloomfield and Winsted. The trouble was also seen in the writer's and in the Station's garden. Very similar troubles have been caused in previous years by both a *Fusarium* and a *Rhizoctonia* fungus. While these may have been the cause of the trouble on some vines this year, we could not find them generally present, and so were inclined to look elsewhere for the chief cause.

With many of the specimens it was difficult to find, on ordinary examination, any fungus apparently guilty of the trouble. Continued search, coupled with sections of the tissues, however, usually revealed the presence of oospores of a phycomycetous fungus more or less prominent in certain of the tissues. This was especially true of the Farnham field where we had the best opportunity for studying the trouble. We finally came to the conclusion that this fungus was at least the original agent in

starting the trouble and that its development might be rather local in the underground parts. It was too late to study the disease in its beginning, but it did not seem to act like the ordinary dampening off caused by *Pythium de Baryanum,* especially since no complaints of a poor stand were received. We found the oospores, occasionally with attached antheridia, chiefly in the outermost tissues which also contained the prominent intercellular mycelium that gave rise to them. No signs of any other stage was found, and apparently the mycelium in later stages of the rot did not develop so prominently, being crowded out by other rot agents.

The oogonia were chiefly hyaline but with age in the old specimens became somewhat tinted yellowish-red and the wall (1-2μ thick) wrinkled. They varied from 24-36μ but were chiefly 27-33μ in diameter. The thick walled (2-4μ) smooth oospores varied from 20-30μ but were chiefly 22-27μ in diameter, and from oval to chiefly subspherical in shape. The oval shape was apparently due to pressure when formed within the plant cells. When we first tried to identify this fungus from the oospores found in the tissues, we were uncertain whether it was a *Pythium* or a *Phytophthora.* Naturally *Pythium deBaryanum* suggested itself, but the fungus failed to form any external mycelium when specimens were placed in water. The oogonia and oospores of *P. deBaryanum* as seen by us on Spinach (*q. v.*), also in a culture received from Washington and as given by Fischer (Die Pilze 1^4: 404. oogonia, 21-24μ; oospores 15-18μ), were considerably smaller than those found in the pea roots. Furthermore Fischer states that Hesse failed to infect *Pisum* with *Pythium deBaryanum* in his infection experiments. Atkinson (Corn. Agr. Exp. Sta. Bull. 94: 245. 1895.) gives an extended description of *Pythium deBaryanum* that agrees with these others but not well with our pea fungus. On the other hand Jones (Phytoph. 10: 67. Ja. 1920.) has recently published a note on pea blight in Wisconsin, etc., occurring in 1919, that he attributes in part to *"Pythium* (probably *deBaryanum*)." Various references exist in literature (Tubeuf and Smith Dis. Plants, p. 117; Zeitschr. Pflanzenkr. 2: 253.) to a *Pythium Sadebeckianum,* described by Wittmack from Germany in 1892, as causing serious root rot of peas and lupins. We have not seen the original reference and have not been able to find any

description of the fungus giving measurements of the oogonia and oospores. It is possible that this is the fungus we have found and that it is quite distinct from *P. deBaryanum.*

On the other hand the fact that Hesse failed to infect peas with *P. de Baryanum,* and the absence of any definite sporangia, so far as we could determine, and the agreement in size of the oospores and oogonia with *Phytophthora cactorum,* has led us to conclude that this latter is the fungus that we have been dealing with. Our preliminary infection experiments of peas in Petrie dishes and crocks with *P. cactorum* from Pear also indicated that under certain conditions infection of the seeds and roots may take place, though apparently not so abundantly or seriously as similar infections with *Pythium deBaryanum.* Apparently moisture conditions and the stage of the cultures are important factors in the results.

Phytophthora cactorum seems to be a soil fungus and is accused of causing root and stem rots in a great variety of plants in Europe. It was present to an unusual degree in Connecticut in 1919, as shown by rotting pears and apples on the ground. The year was very moist and favored this unusual development. The injury to corn (*q. v.*) already mentioned, and the fact that in 1907 we found similar oospores in the roots of rotting sweet peas, also help us to the conclusion that in very wet situations or moist years this fungus may be responsible for more or less obscure root rots on a wider range of hosts in this country than have yet been reported. It is very desirable that cultures from various plants be obtained for definite comparisons and inoculation experiments. It is not easy, however, to obtain cultures under conditions of rot as produced on the pea vines.

In comparing the oogonia and oospores of these fungi in cultures with those found in the rotting tissues in nature, it is well to remember that under the latter conditions, especially in old dried specimens, one is liable to find the walls more deeply tinted and thicker, and the oogonial walls often wrinkled or folded. These variations might lead one to suppose they are specific differences, when they are merely due to the different conditions under which the spores are produced. In Plate LVI, Dr. McCormick has made drawings of different species of *Pythium* and *Phytophthora cactorum,* as produced in artificial cultures and as found on various hosts in nature, in which we

have tried to bring out specific differences and the environmental variations in the same species.

For further discussion of *Phytophthora* and *Pythium* rots in this Report, look under the following: Apple, Celery, Corn, Grape, Pear, Sweet Pea and Spinach.

Root Rot, *Fusarium* sp. Specimens of garden peas showing this root and stem rot were first received from C. A. Weatherby of East Hartford in July, 1917, and in June, 1918, others were sent by J. H. Taylor of Middletown. The general symptons are very similar to those mentioned in the preceding trouble. The plants usually attain fair size and may even start to blossom when they turn yellow and wither away. An investigation shows that the base of the stem and roots have been rotted away so that the vines are easily pulled from the ground. Microscopical examination of the tissues reveals the mycelium of a *Fusarium* rather abundant and extending up into the healthy tissues. Some microconidia may be found, but if the specimens are placed in a moist chamber usually an abundance of a white or pinkish mycelium appears over the tissues with both macro- and microconidia. Besides the *Phytophthora* and *Fusarium* mentioned here, *Rhizoctonia* also causes a similar trouble. Wet weather plays a very prominent part in the development of all these fungi. Care in the use of manure, rotation and frequent cultivation to keep the top soil dry, help to control these troubles.

Pea Shrub, *Lespedeza Sieboldi.*

Fasciation. This abnormality was called to our attention by Dr. Britton who, while inspecting the Steven Hoyt & Sons' Nursery at New Canaan, in the latter part of August, 1917, found a couple of stems of a plant of this Japanese shrub-like herb that were very abnormally flattened. These or similar stems were seen at the same place in May by Mr. Zappe. They were at least 18 inches in length and where broken off were still flattened so that they may have formed quite an extended flattened stem as the plant, which grows in bunches from the ground, sometimes reaches a length of six feet. Like other fasciation we have seen, the leaves were scattered apparently irregularly over the stem and the top was recurved or coiled for a couple of turns. One specimen had the usual bifurcated coiled tips of approximately the same size, while the other had a much smaller

side branch. In each case the two branches coiled to the same side. Under Asparagus in this Report, pp. 415-17, we call attention to the similar fasciation on that and other plants.

Peach, *Prunus Persica.*

Die Back, *Valsa leucostoma* (Pers.) Fr. Plate XLIII, a. This trouble was first called to our attention in 1917 by Mr. N. S. Platt who complained that it was causing serious injury to his orchard at West Haven. We have examined the orchard several times and have seen cankers of all sizes from small dead spots on the twigs to large cankers, on the main branches, several inches in diameter and the bark entirely gone. Often these develop at the base of a dead twig or branch and are much like winter injury cankers with which we believe the trouble to be closely connected. Mr. Platt, with more or less success, has tried to control the trouble by carefully cutting away these cankers each winter.

At first we thought the trouble might have some connection with the brown rot as the cankers much resemble those described by Jehle (Phytopath. 3: 105-10. 1913.). We failed, however, to isolate this fungus from the injured or dead tissue. After some failures we finally in 1918 succeeded rather uniformly in obtaining cultures of the *Cytospora* stage of the *Valsa* here named and later were able to find this conidial stage more or less abundantly on the infected branches. Rolfs (Mo. St. Fruit Exp. Sta. Bull 17: 1-101. 1910.) made an elaborate study of this trouble and its cause and came to the conclusion, partly through inoculation experiments, that this fungus was largely responsible for similar injury to peaches in Missouri.

Winter Injury. Plate XLIII, b, shows a neglected and winter injured peach orchard at East Wallingford. During the severe winter of 1917-18 many trees were killed or badly injured. Our experimental orchard at Yalesville, although most of the trees were severely hurt and some killed, was saved by vigorous pruning and liberal fertilization with sodium nitrate and has since made a splendid growth.

Pear, *Pyrus communis.*

Downy Mildew Rot, *Phytophthora cactorum* (Cohn & Leb.) Schroet. Plate XLIV, a. We first found this fungus on pears

sent us the last of September, 1919, by A. B. Beers of Bridgeport. These pears had been picked and stored but when ripening started rotting apparently from the inside. This was a soft rot, the slightly discolored and diseased tissues easily separating from the healthy and forming darker or reddish-brown areas on the skin, with no signs of any spore stage, as shown in the illustration. The microscope revealed a non-septate, prominent, laxly branched mycelium, rich in oil-like drops, running between the cells. Sometimes there was a sidewise branch and occasionally two or three with one taking the place of the main branch and these varied in width from 3-9μ. There was no indication whatever of any spore stage. The mycelium was evidently of the same type as that found in the peculiar rotting of stored apples that were sent in for examination in 1918, brief mention of which has already been made under Apple in this Report.

Petrie dish cultures were easily obtained on oat agar and these produced a great abundance of oospores imbedded in the medium, but no aerial growth bearing conidia of any kind. We were not sure from this whether the fungus was a *Phytophthora* or a *Pythium*. However when the fungus was transferred with a bit of the medium to water in van Tieghem cells the typical conidia of *Phytophthora* were produced. A study of the cultures in both stages led us to the conclusion that the fungus was *Phytophthora cactorum* as described by Rosenbaum (Corn. Agr. Exp. Sta. Bull. 363: 65-106. 1915.). Later cultures made at the same time and on the same medium, oat agar, from this pear fungus and from *Phytophthora cactorum* obtained from Wheztel in Nov., 1909 (host not given us but possibly ginseng,) grew exactly alike. The pear culture this time developed a little more prominent aerial growth, in which the conidial stage appeared. In cultures we found the oogonia varying from 24-36μ and the oospores from 21-32μ, but the average measurements were for the former 27-32μ and for the latter 24-28μ. The appearance of the oogonia and oospores is shown in Plate LVI, 4.

After determining the identity of the fungus we searched for it on the fallen fruit at the Station grounds. We were surprised to find on picking up the partially rotted pears showing no external fruiting stage that most of these contained mycelium of this fungus. An examination of the most suspicious apples on the ground in our orchard at Mt. Carmel also gave similar re-

sults. However, because of the advanced stage of the rots and their exposure to various animal and fungous invasions, we were not able to separate the *Phytophthora* in pure cultures from either the pears or apples. This experience leads us to believe that the fungus as a fruit rot is more common in this country than reports would indicate; by this we do not mean as a serious rot of fruit on the trees, but as an important rot of the fruit after it falls to the ground. It may be, however, that the unusual moist conditions of last summer were responsible for its development here. In no case on any of the fruit have we found any signs of a fruiting stage, so the identity of the fungus is easily overlooked.

We should not be surprised from our experience of 1919 with a variety of root rots, etc., if the fungus is responsible in wet years for more injuries than we now know. Besides the hosts we mention in this Report (apple, corn, peas, pear, sweet-pea, *q. v.*) Rosenbaum, in the reference already cited, gives the hosts for this fungus, reported chiefly from Europe, as follows: *Panax quinquefolium, Cereus giganteus, Melocactus nigrotomentosus, Phyllocactus, Sempervirum, Fagus, Acer, Pinus, Larix, Picea.*

An examination of the literature showed that this fungus already had been reported from this country on apples. Whetzel and Rosenbaum (Phytopath. 6:89. Fe. 1916.) reported it from New York state as found in July, 1915. These apples were on a tree in a garden, but were on branches near the ground. They also stated that it was isolated in the laboratory from apples purchased in the market and give references to its occurrence on both apples and pears in Europe. They report, too, that Osterwalder found both conidia and oospores on rotted fruit in Switzerland, which is different from our experience. Hesler (Bu. Pl. Ind. Pl. Dis. Sur. 2:172. 15S. 1918.) has since reported this trouble on other varieties of apples from New York. Very recently Güssow (Phytopath. 10:50. Ja. 1920.) reported the fungus on pears in Nova Scotia. So far as we have learned, our report is the first on this fruit in the United States. Under the title of "A Phytophthora Rot of Pears and Apples" Wormald (Ann. Appl. Biol. 6:89-100. D. 1919.) has very recently reported this same disease from England and given a detailed account of it including inoculation experiments and references to literature.

We have tried no inoculation experiments yet with the cultures obtained from the pear on either apples or pears. However from this same culture we had tried to infect 20 kinds of seedlings of herbaceous plants to prove its connection with the root rots that have been reported on certain of these. The results are partially given elsewhere under a few of these hosts.

Winter Injury Swellings. A trouble, similar to that shown on apple-twigs in Plate XXXV, b, was found on pears by the Stamford Quality Seed Store in March and by Miss Daisy Ineson from Ansonia in April, 1920. The swellings on the small twigs were usually at the end of the preceding year's growth and often at the base of a dead twig or where one had been. They were about twice the normal diameter of the twig and usually less than an inch long. Cross sections showed the swelling due to increase of pith cells and to a less extent of bark cells, with more or less irregular arrangement of tissues which were somewhat blackened.

The similarity of these enlargements to those described by Hedgecock on apples, *loc. cit.*, due to the crown gall organism, led us to believe at first that these had similar origin. Specimens were sent to Dr. Smith who said that they were not so caused and suggested winter injury. Inoculations made by Dr. McCormick on geranium stems with fragments of the injured tissues failed to produce any suspicious growth although similar inoculations made at the same time with cultures of the crown gall, *Pseudomonas,* were quite successful. This leads us to conclude that winter injury, killing the young growth of the year and slightly injuring that of the preceding year, caused the latter to make a morbid growth resulting in these enlargements.

Pine, *Pinus* sps.

Black Rot, *Sphaeropsis Malorum* Berk. This is a common fungus that causes more or less injury on apple twigs and leaves. We found it on the leaves of *Pinus austriaca,* collected at Black Point, Niantic, and mentioned later under winter injury of buds. It seemed there to be a saprophyte, or at best only a weak parasite, the trouble being originally due to winter injury. Hesler (Corn. Agr. Exp. Sta. Bull. 379:98. 1916.) gives white

pine as one of the hosts of this stage of the fungus whose mature form he finds to be *Physalospora Cydoniae* Arn.

Lightning Injury. Plate XLIV, b. In September, 1917, the writer with State Forester Filley inspected a white pine tree at Cornwall that had been struck by lightning about a month previously. It was a beautiful tall specimen standing by itself on a hillside. The bolt had made an evident crack in the bark from about two thirds the way up, where the branches began, to the ground forty feet below. Except for this splitting and a slight shattering of the bark, as shown in the photograph taken by Mr. Filley, and a few broken branches, there was no evident injury to the tree. Even the foliage on the broken-off branches was still green. The injury was therefore mechanical and not fatal to the cambium, etc., as in the cases of lightning injury to grape and tobacco mentioned elsewhere in this report.

Mice Girdle. We saw serious injury to a young plantation of white pine on a low spot in the American Optical Co.'s land at Union in 1918, and had previously received specimens from Watertown and elsewhere. During the winter of 1919-20, mice were also said to have seriously girdled Scotch pine in some plantations. See Mice Girdle under Apple.

Snow Bend. Plate XLIV, c. In the younger white pine plantations in the vicinity of Norfolk, after winters of heavy snow fall, the tops of the pines have been so long bent over from the weight of snow that the injury causes more or less permanent bends, as shown in the illustration.

Winter (Bark) Injury. Occasionally on the sunny side of white pine trees, there are seen more or less extended reddish brown areas, in strong contrast with the greenish color of the healthy bark. Cutting these with a knife shows that the tissues are dead, at least part way to the wood. As fruiting bodies are not seen in these areas and as cultures from their tissues have yielded no fungous growth, they appear to be merely local winter cankers. Often on older stems, where the tissues are changing from the smooth to the rough bark type, numerous small spots of similar color are seen but these do not usually reach in deep enough to cause particular injury.

Winter (Bud) Injury. Plate XLV, c. The writer, with Mr. Filley, during the summer of 1918 and twice since, made examinations of injured Austrian pines near the shore in two places. The first called to our attention was on Black Point, near Niantic at the summer residence of Mr. A. H. Mosle; the second was at the residence of Dr. Winfield Ayres at Shippan Point, near Stamford. In both cases the trees were close to the shore and exposed to the severe winter storms. The trouble showed prominently the following summer when many of the tips of the branches failed to grow or their buds opened and developed only weakly, often dying later, as shown in the illustration. In late summer these injured and dead tips are in strong contrast with the healthy ones and are scattered more or less over the trees. The leaves at the tip of the Austrian pine branches form in winter a cup in which frozen spray could be easily held, thereby offering excellent opportunity for winter injury of the buds and adjacent tissues.

A search revealed no suspicious insects as possible cause, and the only fungus found, and that sparingly on the oldest injured buds, was the black rot, *Sphaeropsis Malorum,* previously mentioned. The Austrian pine does not seem quite hardy for such exposed places so that each winter some buds are injured but that of 1917-18, being exceptionally severe, caused an unusual amount of injury. One of the owners was inclined to think the trouble a contagious disease, but we have seen somewhat similar injury to unhardy pines in the state plantations at Rainbow. We have never found this trouble inland on Austrian pines, but specimens were sent us from Watch Hill, R. I., also on the Sound, in 1919, so we have no doubt as to its winter injury nature.

Witches' Brooms. We have seen two types of witches' brooms, illustrated here, on pines. On the white pine the broom took a bushy shape due to numerous small branches developing equal growth, with the leaves compactly massed together. (Plate XLVI, a.) The other, XLV, b, was on a branch of Scotch pine in a plantation at Union, where the abnormal growth was more elongated. As this had numerous, stunted, small branches along the sides, it possibly in time would have developed similarly to the other, which was evidently older. No cause was found for either trouble, though winter injury might offer a plausible explanation in the absence of any other.

Yellow Stem-Spot. Plate XLV, a. On the young branches of

white pine one or two seasons old, there frequently develop, especially in the vicinity of Norfolk, evident golden or yellow spots on the green bark. These spots are usually about a quarter to a third of an inch in diameter and very frequently center from the base of a leaf bundle whose leaves may also be yellowed at their base and shorter than normal. As these spots resemble so nearly, in color, the blister-rust infection spots on the leaves and occur most conspicuously in a region where blister-rust had escaped into the woods, we thought that they might be the first signs of stem infection by this fungus. Continued search of microscopic sections made through such spots, however, has uniformly failed to show any evidence of mycelium. The next suspicious agent was the spittle bug, as this insect was quite abundant on these young twigs in that vicinity, but as yet no definite connection between the two has been shown. Injury by bending is said to cause similar spots.

Pine, Umbrella, *Sciadopitys verticillata.*

Black Scurf, *Rhizoctonia Solani* Kühn. The mycelium of this fungus was found by entomological inspector Zappe creeping abundantly over the stems of young Japanese umbrella pines just imported from Holland. It had not caused much injury however. Packing the plants closely in a closed case no doubt favored its development.

Pleroma, *Pleroma splendens.*

Intumescence. Plate XLVI, b. This unusual trouble on the leaves of a Pleroma plant was sent to the Station in Oct., 1916, by Dr. F. H. Williams of Bristol. Although he had owned the plant for twenty years, this malady had only shown during the last three or four. During the winters the plant was kept in a window on an enclosed stoop, steam heated, and in the summers was planted outdoors, usually in shade. As the white fly had troubled it the last winter, it was cut back to the roots when taken out doors and planted in the sun. It made a fair new growth outdoors, with no trouble showing, and when transferred indoors continued to grow rapidly with the intumescences appearing in the leaves. Later formed leaves, however, did not show the trouble.

The very small pimply outbreaks, faintly shown in the illustration because of the hairy covering, were confined chiefly to

the upper surface of the leaves and were usually thickly placed over the whole surface. They resembled somewhat extraneous deposits since when wet they had a gelatinous-like appearance. Sections through the leaves showed that they were formed by a morbid growth of unusually elongated cells. We think the trouble was due to unusual turgor brought about in the developing leaves from excessive water supplied by the roots. Cutting back the plants severely, planting them in the sun outdoors, and then transferring them to the partially shaded stoop, with the presence of numerous hairs on the leaves to lessen transpiration, all were factors in upsetting the proper balance between water supplied by the roots and its transpiration from the leaves.

Several American papers have appeared, most of them recently, on intumescence of leaves. Von Schrenk (Mo. Bot. Gard. Rep. 16: 125-48. 1905.) describes and figures intumescences on cauliflower leaves due to various copper sprays. Smith (Journ. Agr. Res. 8: 165-86. 1917.) similarly treats of intumescence on this same host produced by various chemical vapors. Harvey (*Ibid.* 15: 83-111. 1918.) relates where they were caused on cabbage by frost. Wolf (*Ibid.* 13: 253-9. 1918.) gives injury from wind-blown sand as an ultimate cause of such trouble on cabbage.

Poplar, *Populus* sps.

European Canker, *Dothichiza populea* Sacc. & Briard. Plate XLVII, a. This disease has been well described by Hedgecock and Hunt (Mycol. 8: 300-8. 1916.). It was first called definitely to our attention in Connecticut by F. A. Bartlett (Tree Talk 4: 76. 1917.) from Stamford in 1917. We are not sure, however, that the canker trouble mentioned in our 1903 Report, p. 347, was not due to this fungus. In recent years specimens have been received from Stonington, Hartford, New Canaan and New Haven. It is found in nurseries as well as on private grounds, and in our experience seems to be more or less associated with winter injury. The Lombardy poplar is the most common host here. On smooth bark of smaller branches it forms a brownish dead area with the fruiting stage evident as small erumpent pustules. On older branches or the main trunks quite evident cankers, as shown in the illustration here, may develop. When these girdle the stem the parts beyond die.

Potato, *Solanum tuberosum.*

While not as a rule so serious as the fungous diseases, non-parasitic troubles of the potato are at least more numerous in this state. They are due to a variety of causes but chiefly to unfavorable or unusual weather conditions. A few are caused by other environmental factors; some are constitutional, being inherited from the preceding crop; one or two are somewhat infectious. Regarding the weather conditions, mention should be made of the year 1918, when an unusually large number of these troubles appeared, due in part to the effect of the severe winter of 1917-18 on the stored tubers and in part to the wet-spring, dry-summer weather that followed. In the previous Reports we have discussed briefly a few of these troubles, such as tip-burn, internal brown spot, spray injury, etc., and in the following pages fifteen more are added to this list.

Aerial Tubers. Plate XLVII, b. Occasionally there has been sent to the Station for examination and explanation potato vines producing abnormal swellings on the stems above ground. In such cases usually some injury has occurred on the stem beneath the ground, thereby cutting off the food material manufactured in the leaves from being transferred to the rootstocks where it is stored in the tubers. As a result of injury below, the material is stored in the stem above ground in these unusual aerial tubers. Injury to the stem by the *Rhizoctonia* fungus is one of the common causes of these monstrosities. In both 1916 and 1917 fine examples of aerial potatoes were reported; Plate XLVII, b, shows some of those found on plants in a Yalesville field where the injury was caused by *Rhizoctonia.* Orton (U. S. Dept. Agr. Bull. 64: 33. 1914.) has described a case of aerial tubers on leaf roll plants where there was no injury to the base of the plants. Phloem-necrosis, no doubt, had its influence in this case, as the elaborated sap is carried down the stem through the phloem.

Black Heart. This trouble, as indicated by its name, shows as a blackening of the tissues at the center of the tuber. Often this blackening is accompanied by large cavities. It has only been reported to us once or twice, in recent years, from this state.

Bartholomew (Phytopath. 3: 180-2. 1913.) found it developed on potatoes shipped in heated cars and he was able to produce it in the laboratory "when potatoes taken in April and May from

storage cellars were exposed to a temperature of about 38° to 45°C, in an ordinary drying oven for from eighteen to forty-eight hours."

Stewart and Mix (N. Y. Exp. Sta. Bull. 436: 321-62. 1917.), who also studied the trouble, succeeded in producing it by cutting down the supply of oxygen needed for the slow changes that take place in the dormant tubers. They therefore concluded that the trouble results from improper storage conditions, such as poor ventilation and piling the potatoes too deeply in bins and cars, as well as by too high a storage temperature.

Curly Dwarf. Plate XLVIII, a. As indicated by the name and by the accompanying illustration, this trouble applies to potato plants of a decided dwarfed development, with curling and wrinkling of the foliage. Orton (*loc. cit.*: 37-40. 1914.) writes: "The stem and its branches, the leaf petioles, and even the midribs and veins of the leaves all tend to be shortened in many cases to a very marked extent, and particularly in the upper nodes of the plant, so that the foliage is thickly clustered. Typical curly-dwarf is readily distinguished from leaf-roll by the wrinkled or downward curling of the leaves, the normal color of the foliage and the firmness of the leaves, which do not lack turgidity."

We have occasionally found curly-dwarf plants in potato fields in this state, but do not believe it is as common here as in some potato districts. It is an hereditary trouble transmitted through the tubers. Quanjer (Phytopath. 10: 35-47. 1920.) claims that curly-dwarf is only an extreme case of mosaic.

Frozen Tubers. During the winter of 1917-18, because of its severity, many potatoes in farm storage in this state were frozen. Badly frozen tubers soon rot, so they are of no value. Others only slightly hurt are often put on the market. Such tubers tend to darken, when cut. We believe that some of the unusual troubles, such as spindling sprout, that developed in the potato crops of 1918 were due to potatoes so injured.

Hollow Heart. Plate XLVIII, b. This is a name applied to potatoes that have a conspicuous cavity in their center. Large potatoes, especially those of certain varieties as Dibble's Russet, are more apt to develop such cavities than the smaller tubers. Usually the trouble appears in a season favorable for rapid

growth, especially if dry weather is followed by very wet. The cracking of the fruit in certain varieties of peaches and musk melons is a similar phenomenon in our opinion.

Leaf Roll. Plate XLIX, a. This trouble is distinguished by a decided upward roll of the margins of the leaves, and often is accompanied by more or less color changes. The plants often make a fairly normal growth otherwise. It is easily distinguished from the work of aphids by the upward, instead of the downward, roll of the leaf margins. Leaf roll has been much studied in Europe (See Orton, *loc. cit.*: 18-33.) and there are various opinions concerning it. There seem to be at least two types, one merely a seasonal trouble due to unfavorable weather conditions, as too much wet weather followed by dry, and another that is a constitutional and more serious trouble. Most of the roll we have seen in this state on both potatoes and tomatoes we believe to be of the former type. In 1918, however, in a yard in Westville, we saw what may have been the second type. It was quite evident on Gold Coin, but not on other varieties grown near by. True leaf roll, according to Quanjer, is a phloem-necrosis trouble and is both contagious and pseudo-hereditary.

Mosaic. This chlorosis trouble of potato foliage was first noticed by the writer in this state in the early summer of 1916. Both Green Mountain and Irish Cobblers, the two varieties most commonly grown here, showed the trouble. It was seen again in 1917 in several fields, but probably not so prominently on the whole, as in 1916. In 1918 it was more prominent but in 1919 it was less evident than in any of these years, due apparently to favorable weather conditions for foliage growth. The leaves show a yellow-green mottling and some crinkling of the foliage, something like the mosaic of tobacco but usually not so prominent. As the vines grow older this mottling usually becomes less rather than more prominent. Mosaic tubers from Maine, furnished the writer by the U. S. Dept. of Agr. and planted at Mt. Carmel in 1919, failed to show any more signs of mosaic on their leaves than did the so-called checks from the same source. The former, on the other hand, were a less thrifty strain, as shown by the size of the vines, etc.

We have not noticed that Connecticut potato fields were very materially affected as to vigor or yield of tubers, but in Maine

and some other states where this trouble is more prominent, it is said that mosaic plants give smaller yields. In Bermuda Wortley (Rep. Dir. Agr. 1914 and 1915.) reports this trouble very bad on Bliss Triumph. He found the yield from mosaic tubers to be half that from tubers of mosaic free plants. As a result of his investigations importation of seed stock into this island is regulated to guard against bringing in this trouble from badly infected fields.

Quanjer of Holland, *loc. cit.*, and Schultz *et al.* of the U. S. Dept. of Agr. (Journ. Agr. Res. 17: 247-73. 1919.) have done much work on this disease and their experiments show that it is not only a constitutional trouble carried by the tubers, but it is contagious in the field. The latter investigator found aphids as one of the carriers of the trouble from diseased to healthy plants.

Net Necrosis. Plate XLIX, b. We have previously described in one of our Reports an internal brown spot of potato tubers that is somewhat similar to this. In net necrosis, however, the brownish diseased areas are smaller and more net-like. Neither is caused by fungi and their nature is not well understood. It is thought by some that net necrosis is connected with some of the other troubles described here.

Potash Hunger. In 1917 and 1918 there was some indication that potatoes suffered from lack of potash, especially on certain soils and where manure was not used abundantly. Such plants are said to show more or less bronzing of the foliage and are apt to flop over easily or turn yellow and die prematurely and are subject to early invasion by saprophytic fungi. It is hard to tell, in our opinion, potash hunger from unbalanced fertilization or from the drought injury described here in detail under Wilt and Prematuring, *q. v.*

Premature Sprouts. Plate L, a. Another trouble of potatoes reported as not uncommon in both 1916 and 1917 was the premature sprouting of the tubers before being dug. Usually only occasional hills in the fields showed this trouble, so that the injury was not very great, and the sprouts found were not elongated, being something like those shown in the illustration. However we did see cases in 1917 where these sprouts not only became elongated but appeared above ground and formed foliage.

Sometimes the sprouts merely developed into small secondary tubers. Such are sometimes found on sprouting old tubers in storage.

We are not sure of the cause of this premature sprouting but believe it may be caused by plants receiving a serious set-back, as by drought, before they are fully matured, and then having a favorable period for growth start into activity again. Such conditions we know will cause "knobby" tubers. Knobby tubers are often found in fields where tip-burn or blight has badly injured the vines but still left them vigorous enough to respond to a later favorable growing period.

Rootstock Invaded-Tubers. Plates L, b, LI, a. An occasional injury is found in potato fields where the rootstocks of some other plant penetrate the tubers themselves. Nut grass, *Cyperus* sp., not infrequently causes injury of this kind. The most serious injury of this same nature we have seen was in a field of Mr. Arthur Clark at Orange in 1917 and was caused by quack grass, *Agropyrum repens.* Here the slender rootstocks of the grass, as shown in the illustration, not only bored into many of the tubers, but in some cases went clear through them, coming out at the opposite end and formed a leafy shoot above ground. It is a question whether these penetrating rootstocks receive any nourishment from the potato tubers. The tissues of the two plants evidently form no union, though in some cases, short side sucker-like branches were formed. No noticeable injury of tissues in their vicinity was observed; in fact the rootstocks seemed to force their way through the tubers with no special discoloration of the invaded tissues. Such invaded tubers have no market value.

Russeted Tubers. Plate LI, b. This name is applied to tubers with a thicker or rougher skin. Certain varieties have a more russeted skin than do others, but under certain conditions the skin in the same variety may be rougher than normal. The sample shown here is an unusual or areated russeted type. It came from Maine seed potatoes and probably, as in other cases, was due to some external irritant, like a fertilizer, acting on the skin when quite young, and stimulating it to form an unusual corky growth.

Spindling Sprout. Plate LI, c. The chief characteristic of this trouble is the slender needle-shaped sprouts that appear in

place of the normal lead-pencil thick sprouts. The trouble was not uncommon in 1918 but we saw little of it before or since. This leads to the belief that it is in some way connected with freezing or too cold storage of the tubers in the preceding winter. Spindling sprouts grow into very weak small plants that yield poorly if they survive. One grower in 1918 plowed up his entire field as worthless. Stewart and Sirrine (N. Y. Agr. Exp. Sta. Bull. 399: 133-43. 1915.) have studied this trouble rather carefully, and while they do not know the cause they found home-grown seed developed the trouble much more than northern grown, where the trouble rarely occurs. Excessive heat and drought are given by them as a possible cause.

Wilt and *Prematuring.* Plate LII, a. There appeared suddenly, in 1918, in southern Connecticut an unusual trouble popularly designated as a blight, which was first called to the writer's attention on July 6th in a field that had grown potatoes for three years. In this field a spot had yellowed up and was dying prematurely, and the owner said that he had first noticed the trouble two or three days previously. Later the writer saw many similar fields and received numerous complaints. The trouble seemed to be a complicated one with indications that more than one factor entered into it. However, our general conclusion was that primarily it was not due to fungi but rather to lack of sufficient moisture and food for continued normal plant growth.

The fields visited showed two or three types of the trouble, as follows: 1. A prematuring of the vines in which the stem and leaves gradually turn yellow, the plant often remaining erect, the leaves dropping off or dying, and finally the whole plant succumbing. 2. Plants wilting and flopping over as if the stem had not strength enough to support them. Parts normally green and no particular spotting of the stem. 3. A bronzing and spotting more or less of the stem; plants lopping over somewhat; frequently the stem was soft near the ground so that it was easily pinched together, as if some fungus or borer had been at work.

We carefully examined the stems above and below the ground in the field, and cut many sections of the stems in the laboratory, and while occasionally bacteria and fungous threads were seen which might aid in wilting, and a *Phoma* that possibly might cause rotting, we found no definite association of these particular agencies with the trouble.

The wilt first showed on Irish Cobblers or other early varieties. Irish Cobblers and Green Mountains are the varieties most frequently planted in this State, and are the ones on which the trouble appeared most prominently. Dibble's Russet was the least injured variety seen. We have since learned that it is a variety quite resistant to drought injury.

The time of planting or maturing of the potatoes seemed to have had considerable to do with the appearance of the disease. In other words, the trouble did not develop until the plants had bloomed and were in that stage where the foliage had made its growth and most of its energies were used in the formation of tubers. The trouble quite often was very prominent on Irish Cobblers when Green Mountains beside them did not show it, or on Irish Cobblers when near-by rows of the same variety planted a few days later did not show it. In time, however, both the Green Mountains and the later planted Cobblers did have the trouble when they reached the right stage of maturity. One farmer planted Irish Cobblers and Green Mountains on four different dates, covering a month, and the trouble appeared in the fields and varieties in the order of their planting and maturity, being quite severe on the earliest when just beginning to show up on the latest.

We saw many cases where the trouble showed over a field when the vines under shade trees, especially apples which are apt to be within the field, were still quite green and unaffected. In other cases where the field was quite irregular the vines were always green in the gullies on the lower portions where the earth was more moist and got the wash from the fertilization. Invariably in fields with gravelly knolls the trouble first appeared and showed more prominently in those spots, no matter what the fertilization. In fields insufficiently fertilized, the trouble was most pronounced, especially if only artificial fertilizers were used. Fields that had been heavily manured, or had a complete fertilizer containing potash, did not usually suffer like fields where only a 4-10 fertilizer was used. Fields of poor or leachy soil on which a 4-10 fertilizer was used were seen producing a fairly luxuriant growth under the favorable moist conditions of the spring and early summer, but going down when this fertilizer had been used up or leached out.

The lack of moisture had a very important bearing on this trouble and was also shown by injury to other plants, grass dying, and trees losing their foliage, from the dry hot weather of July 21st to 30th. The potato is more subject to drought injury than any of our cultivated crops, so naturally this was the first to show ill effects. Ordinarily this is shown as tip-burn but in 1918 the injury was not so much of this type as in the prematuring of the foliage.

All these facts led us to the conclusion that lack of moisture and in some cases insufficient plant food of which lack of potash was one of the chief factors, were primarily responsible for most of the troubles, rather than fungi, poor seed, or insects, especially lice, all of which were attributed as the cause.

Radish, *Raphanus sativus.*

CLUB ROOT, *Plasmodiophora Brassicae* Wor. This was sent us Sept. 20th, 1917, from Northford by Mr. Burnham and was the first collection on the radish from the state. See Kohlrabi in this Report.

Raspberry, *Rubus* sps.

ORANGE RUST, *Gymnoconia interstitialis* (Schl.) Lag. (*Puccinia Peckiana* Howe). Plate LII, b. In our 1903 Report under Blackberry, Dewberry and Raspberry we recorded the presence of the I stage (*Caeoma nitens*) of this fungus as occurring on these hosts in Connecticut. The recent work of Kunkel (Bull. Tor. Bot. Club. 43: 559. N. 1916.) however has shown that there are two forms in this country known under the general term *Caeoma nitens*. One of these germinates with a long non-septate germ tube, and the other with a short septate promycelium producing sporidia. Morphologically the spores of the two cannot be distinguished. The first form Kunkel calls the long cycled because it is the I stage (*Caeoma interstitialis* Schl.) of *Gymnoconia interstitialis*, also found in Europe, and the other he calls the short cycled since it apparently reproduces itself and has no connection with any other stage. This latter form he considers to be the true *Caeoma nitens* of Schweinitz. Arthur more recently (Bot. Gaz. LXIII: 501. Je. 1917.) has made this latter form the basis of a new genus and placed it under the species *Kunkelia nitens* (Schw.) Arth. He has made an

arbitrary attempt to determine the specimens of the I stage in his herbarium, placing them with one or the other of these genera (*Gymnoconia* and *Kunkelia*) chiefly according to the part of the country from which they came.

Later still an article by Atkinson (Am. Journ. Bot. 5:79-83. F. 1918.) has appeared, in which he advocates from his investigations and the distribution of the two forms, that the life cycle of *Gymnoconia Peckiana,* as he calls it, is not definitely fixed so that in the warm climate of the south it produces the short cycled form and in the cool climate of the north the long cycled form, and in between sometimes one and sometimes the other according to the temperature conditions of June and July. This interpretation is based largely on the results of infecting raspberries at low temperatures (under bell jar with ice) with spores of the short cycled form from wild dewberry, *Rubus canadensis* as called in our paper, and producing the telial stage of the long cycled form. He thinks that under these cool conditions the short cycled form instead of forming a promycelium with sporidia, really formed the germ tube characteristic of the long cycled form.

For some years we have believed that the orange rust of Connecticut, found most commonly on wild dewberry, was distinct from that we studied previously in Illinois (Ill. Agr. Sta. Bull. 29:273-300. 1893.) since here we never found the III or Gymnoconia stage associated with it. In fact, so far as we know, this stage had not been reported from Connecticut. The past three seasons (1917, '18, '19) in the light of Kunkel's investigations and with help of our assistant Dr. McCormick, we have tested the germination of the I stage obtained from numerous specimens on different hosts from various localities in the state. As a result of these germination tests we have found that both the long and the short cycled forms occur in this state. The classification of these collections according to their germination as given under the different hosts (Gray's 6th edition) is as follows:

Puccinia interstitialis (Schl.) Lag. Long cycled form. On *Rubus hispidus* (wild) 2 tests; *Rubus occidentalis* (cult.) 2 tests; *Rubus strigosus* (cult.) 2 tests; *Rubus villosus* (wild) 1 test; *Rubus* sp. (wild raspberry) 2 tests, (cult. raspberry) 1 test.

Caeoma nitens Schw. Short cycled form. On *Rubus canadensis* (wild) 19 tests; *Rubus hispidus* (wild) 1 test; *Rubus villosus* (cult.) 2 tests, (wild) 5 tests; *Rubus* sp. (wild raspberry), 1 test.

From the above it will be seen that out of thirty-eight tests only ten of them were of the long cycled form, and with seven of these we were able later in the season to go back to the same vicinity and collect the III stage on the same hosts and even on the same individuals where known! In three cases we were not able later to look for the III stage. At first we got the impression that the short cycled form only occurred here on blackberries and dewberries and the long cycled only on raspberries. While this seems to be generally true for this state, later results show that no host is infected by only one form, unless it is *Rubus canadensis,* the wild dewberry. From this host all of the 19 tests have yielded the short cycled form, and we have never collected the III stage of Gymnoconia on it. But even here some of the spores in the same cultures with the short cycled have given germ tubes that were of the long cycled type as far as determined without special staining. That *Rubus canadensis* is a possible long cycled host in this state we have further proved by an inoculation experiment as follows: Long cycled spores of the I stage from *Rubus hispidus* from Norfolk were placed June 11th in Petrie dishes on a leaf of *Rubus canadensis.* On July 14th there had developed on this leaf numerous mature sori of the III stage of *Gymnoconia interstitialis* (See Plate LII, b). On the same date I spores of the short cycled form on *Rubus canadensis* from Norfolk, collected at the same time, placed on a leaf of *R. canadensis* in a Petrie dish failed to produce any infection whatever! This we had tried before without results and also several times in the past have tried to infect plants in crocks of *Rubus canadensis* with spores from the same host and have never succeeded.

Our failures to secure infection of *Rubus* sps. with the short cycled form and the fact that it produces sporidia that might easily be blown some distance has led us to consider if it might not be a heteroecious rust having other stages (*Melampsora* for example) on entirely different hosts. So for some years past we have been trying to inoculate various hosts but without results. The hosts and years of inoculation are as follows: In

1914, on *Populus deltoides;* in 1916, on *Populus deltoides, P. grandidentata, P. tremuloides, P. alba?, Salix* sp.; in 1917, on *Salix* sps. (four); in 1918, on *Populus* sp.; in 1919, on *P. deltoides, P. grandidentata, P. tremuloides, Betula populifolia, B. lenta, Salix* sps. (two).

With Atkinson's theory that the same individual host in this locality may one year produce the short cycled form and another year the long cycled, according as the weather at the time is warm or cold, we cannot agree. We have in several cases tested the spores from the same definite locality during different years, and they have always given the same result. We have collected the III stage for three years on the same plants of *Rubus occidentalis* at Birdsey's, East Meriden, and the tests of the I stage there have always been long cycled. Furthermore we tried the germination of both long and short cycled spores several times at ordinary room temperature, and then tried their germination in iced water and got no different results. If temperature determines the type of germination why should collections made in the same vicinity on the same date but from different hosts give different types of germination? Also why in our higher room temperatures did we get both types of germination? We are inclined to interpret Atkinson's successful infection in 1917, where with so-called short cycled spores he produced the III stage on plants kept iced under bell jars as, due first, to the fact that he had favorable conditions for infection, and, second, to the probability that a few of the spores used normally produced germ tubes (long cycle) instead of sporidia (short cycled) as did the majority (just as we have occasionally found to be the case in our cultures from this host, as already mentioned) and it was the former only that produced the infection. In other words we believe that the short cycled form with its sporidia *does not infect the mature leaves but secures infection through the very young perennial* parts as is apparently the case with the sporidia of the III stage. This delays the appearance of the infection until the next year when the I stage is produced from the perennial mycelium. This would account for our failure to infect *Rubus* through the leaves with the short cycled form, and would explain the successful infections with this stage reported by both Atkinson and Kunkel the year after their inoculations were made.

From the observations of our own and those of the various other investigators we therefore come to the following conclusions.

(1) There are two forms (not species or genera) of the formerly so-called *Caeoma nitens* in this country. One of these produces only one spore stage, aecial spores, and can be termed *Caeoma nitens* Schw., and the other produces both aecial and telial spores and can be termed *Gymnoconia interstitialis* (Schl.) Lag.

(2) *Caeoma nitens* through the fusion of the two nuclei in the aecial spores, for some still unknown reason, has become a short cycled form and cuts out the telial stage entirely, but on germinating functions as such, as shown by development of a promycelium and sporidia. *Gymnoconia interstitialis* has aecial spores whose two nuclei do not fuse and so give rise to the ordinary germ tube and eventually to a mycelium with two nuclei to a cell.

(3) Infection from the aecial spores of *Gymnoconia interstitialis* takes place only through the stomates of the leaves and the telial stage results from this. Infection from both the aecial spores of *Caeoma nitens* and the telial spores of *Gymnoconia interstitialis* takes place only by the penetration of the germinating sporidia through very young tissue, usually that of the underground shoots, and this results in a perennial mycelium that the next season gives rise to the aecial stage in the leaves.

(4) *Caeoma nitens* is largely confined to a region south of Connecticut, and *Gymnoconia interstitialis* largely to the region north of this state, but in the intermediary region both forms may occur more or less commonly.

(5) In this intermediary region it is not impossible that the forms are not so definitely fixed but that occasionally on the same host both types of germination of the aecial spores appear; or possibly the same individual host occasionally becomes infected with both forms and both types of aecial spores are therefore produced on it.

(6) However, conclusion (5) does not mean that once the aecial spores on an individual plant, or any plant infected from these, show only the short or the long cycled type of germination that they can be changed to the other type by differences in weather conditions during that or any other season.

Romaine, *Lactuca sativa* var. *Romana.*

Chlorosis. In a private garden in the fall of 1916 at Middlebury, we saw an occasional plant of Romaine or Cos lettuce in which the leaves showed a yellow mottling and crinkling. This, while indicating an unhealthy condition of the plant, was no disadvantage so far as the edibility of the plant was concerned, as such plants were probably less bitter in taste due to less chlorophyll.

Rose, *Rosa* sps.

Powdery Mildew, *Sphaerotheca pannosa* (Wallr.) Lev. In July, 1919, specimens of Dorothy Perkins roses were brought to the Station from New Haven by their owner to learn what caused their failure to open properly. Many that did open made inferior blossoms that frequently died prematurely. An examination showed that the hips were covered, in part or entirely, with a thick whitish felt of the above fungus. This was made up of mycelial threads with few conidiophores, and doing little or no injury. On the inside, however, a less conspicuous mycelial growth, with plenty of conidia, was the cause of the injury to the petals, that prevented their proper maturity, etc. In the writer's garden the same trouble developed similarly but with the perithecia, deeply imbedded in the felty mat, finally appearing. The Dorothy Perkins was injured more than the Crimson Rambler. We have reported this fungus before but not on blossoms causing injury of this nature.

Fasciation. This specimen was found in April, 1918, by G. A. Stack in a yard in Westville. The stem as it started from the ground was about a third of an inch in diameter and only slightly flattened. It gradually flattened toward the top, which was broken off, until it was an inch and a half wide. The fasciation seemed to run off from one side since, for the entire length, one side was slightly marked by its thicker more rounded character until near the end where it was entirely separated as a distinct naturally rounded stem about a quarter of an inch in diameter. This extended for less than a foot but had been cut off here as had the flattened portion so the nature of the tips could not be determined. Stewart (N. Y. Agr. Exp. Sta. Bull. 328: 392. 1910.) describes and figures somewhat similar fasciations of rose which are said to be not uncommon. See Asparagus in this Report for other cases.

Rye, *Secale cereale.*

Scab, *Gibberella Saubinetii* (Mont.) Sacc. The conidial stage of this fungus, which until recently has been known as *Fusarium culmorum,* was found in this state for the first time in two rye fields at Yalesville, in 1918. It occurs in the heads causing all or a part of the spikelets to die prematurely, the fungus showing at the base of these as a pinkish growth. While the disease is bad in the middle west, it does not seem to be at all common or serious here in Connecticut. The same thing occurs on wheat, *q. v.*

Spinach, *Spinacia oleracea.*

Dampening Off, *Pythium deBaryanum* Hess. Mr. H. D. Johnson of Highwood called the writer's attention, late in September, 1919, to a young spinach field of his that had been seriously injured by the plants dampening off irregularly in the rows, making a very uneven stand. The plants had come through the ground during a rather wet period which proved to be especially favorable for the development of the disease since a field planted a short time later did not develop the trouble. The seedlings an inch or so high dropped over, the trouble first showing as a blackish or brownish softening of the tissue just below or above ground. After falling over they wither up in dry weather and soon disappear. Mr. Johnson had never been troubled before in this way and it was the first time we had seen dampening off in a spinach field, although we had seen the disease on other seedlings in seed beds and greenhouses.

An examination of the tissues revealed the presence of an abundant, guttulate, non-septate mycelium of the phycomycetous type, but no very evident spore stage, except possibly temporary sporangia. After the seedlings were left in water for a few days a rather luxuriant growth of mycelium developed around them and in this appeared the temporary sporangia, and finally definite oogonia and oospores. These agreed very well in size and appearance with those grown in artificial cultures recently received from the Department of Agriculture at Washington. Plate LVI.

The oogonia varied from 18-27μ, chiefly 20-25μ, and the oospores from 15-21μ, chiefly 16-18μ. The oogonia and oospore walls remain hyaline and the latter are not very thick, usually 2-2.5μ. It seems characteristic of this fungus to produce

oogonia much more readily in a liquid than in a dry medium, so that a portion of our agar cultures transferred to water in a Petrie dish developed them much more abundantly than before. On oat agar the fungus rapidly develops a very prominent, fluffy, aerial, white growth, with some oogonia and temporary sporangia. The temporary sporangia look much like unfertilized oogonia. On roots of peas and corn (*q. v.*) this same year we found different specimens with larger oospores that we have placed under *Phytophthora cactorum*.

Spruce, Norway, *Picea excelsa.*

Felt Fungus, *Coniophora byssoidea* (Pers.) Fr. Mr. Walden found this fungus on young plants of Norway spruce imported from France in 1918. In the packing cases it had developed a very conspicuous felty growth of the tawny mycelium over the individual stems running up onto them from the soil. Whether it caused any harm was uncertain but probably it was developing merely as a saprophyte under these favorable conditions. Dr. Burt confirmed our determination of the species.

Sumach, *Rhus glabra.*

Fasciation. Near the Station grounds a stem of the common sumach was found in 1919 that from the ground up gradually flattened out until the flattened part was twice the normal width of the stalk and much thinner. The end was bifurcated into short tips curved in opposite directions. Brannon (Bot. Gaz. 58: 518-26. 1914.) describes a fasciation of cottonwood and willows on young sprouts from stumps of trees cut down the year before, and discusses the causes of this and other cases of fasciation. See Asparagus in this Report.

Sweet Pea, *Lathyrus odoratus.*

Root Rot, *Phytophthora cactorum* (Cohn & Leb.) Schroet. In our Report for 1907, p. 359, under Sweet Pea we mentioned *Pythium* and *Rhizoctonia* as causes of dampening off. The specimens discussed there were brought to us in July, 1907, by Mr. Walden of this Station from his garden. A re-examination of them shows that the so-called *Pythium*, whose oogonia with oospores were present in the cortical tissues of the roots, is the same thing that in the present Report we have discussed under

peas and called *Phytophthora cactorum.* The oospores from the sweet pea are figured in Plate LVI, 3, and can be compared with those found on the other hosts reported here.

Root Rot, *Fusarium* sp. As well as the garden pea, the Sweet Pea has similar rots due to *Rhizoctonia, Phytophthora* and *Fusarium,* and the effect produced by all three is much the same, in that the half-grown plants turn yellow, wilt and dry up due to the rotting of the roots and base of the stem. The *Fusarium* specimens reported here were sent from the Stoeckel estate at Norfolk, in June, 1918. The fungus is probably the same species that causes more or less trouble in greenhouses on cuttings, etc.

Sycamore, *Platanus occidentalis.*

Electrical Injury. Trees near trolley lines are sometimes apparently killed by leaks in the feed wires. In the summer of 1918, a sycamore tree along the trolley line in Centerville showed such injury on a single branch which had come in contact with the feed wire where the insulation was worn off. A decided burn showed on the under side of the branch, and the leaves had all died. The insulation on the feed wire was evidently quite poor and for a distance of half a mile small twigs here and there on the street trees could be seen that had recently been killed, apparently when the wet leaves came in contact with the poorly protected wire.

Tobacco, *Nicotiana Tabacum.*

Besides the troubles described here we have run across several more, chiefly of the leaf spotting type, but because of their obscure nature we have omitted consideration of them for the present. All of the troubles discussed, except the first, are of a non-parasitic nature.

Bacterial Soft Rot, *Bacillus carotovorus* Jones. Plate LIII, b. The only place where we have seen this trouble was on W. J. Reeves' tobacco at Windsorville. We first saw it there with Johnson of the Wisconsin Station, in July, 1918, and found it there again in 1919. Only a few plants in the field showed the trouble but these were mostly in the same row or near each other. The disease starts at the lower end of the plant, rotting out the pith so that the stem can easily be crushed with slight pressure though the outside may seem nearly normal. The rot

eventually reaches and invades the veins and tissues of the leaves when they drop down and finally die. Johnson (Wisc. Agr. Exp. Sta. Bull. 237: 27. 1914.) has briefly mentioned this trouble under the designation "hollow stalk." He claims it can be produced by inoculation and we succeeded in so doing by cutting into healthy plants and inserting diseased tissue. Not having worked on the trouble from a bacterial standpoint, we merely assume that it is not different from the ordinary soft rot troubles found here on a variety of plants.

Fire Injury. Occasional tobacco plants under tents are more or less injured by the cloth of the tents catching fire and the burning fragments falling down on the leaves. Sparks from locomotives, cigarettes and incendiarism are causes of such fires. Some growers have supplied watchers to prevent them. See Lightning Injury.

Frost Mottling. Plate LIII, a. A curious case of frost injury to young tobacco plants was called to our attention the latter part of July, 1918, by Mr. Beinhart, the Government tobacco expert, at the tobacco farm of Mr. Eastwood in Somers. The owner noticed the trouble about the first of July, shortly after there had been an unusually late frost in that neighborhood. During the two weeks that had elapsed since first seen by Beinhart and then by both of us, the injury had become less conspicuous according to him. At the latter date the plants still showed considerable spotting and some irregularity of leaves, especially of the lower older ones. The spotting was due to the chlorophyll being killed in spots that were now whitish or white and so in strong contrast with the rest of the normally green tissues. Sometimes these white spots were large areas and sometimes small specks of a mottled arrangement, as shown by the two leaves photographed. Such injury follows light frosts, with possibly moisture on the leaves where their tissues are injured.

Hail Injury. Plate LIV. On August 4, 1917, we visited, with Beinhart and Johnson of the Dept. of Agriculture, the region in East Suffield where a storm on Aug. 2d had caused injury to the tobacco. This storm was rather local, doing great injury to some fields, while other fields near by suffered little. A good many large trees or their branches were blown down by the high wind. Tobacco in the open was more or less blown

over and had to be propped up again. The greatest injury, however, was from hail, which in a streak through the region inflicted great damage to the tobacco in the open, numerous fields of which were largely or entirely ruined; it also caused damage to the tobacco under tents in some cases. This latter damage occurred where the wind was strong enough to carry the cloth from the tents. We saw a tent of ten acres where the wind had whipped the cloth to pieces, bent and blew over much of the tobacco, as shown in the photograph taken by Johnson, while the hail entirely ruined what was not injured by the wind.

The hail injury was very marked on the stems, showing white irregular spots where the stones struck. See photo. These spots were entirely on the side of the stem from which the storm came. The leaves were largely shredded from the stem or beaten off on the ground and cut in irregular shapes. The damage caused to this one tent alone was probably five or six thousand dollars. We have seen tents where half a ton of hail stones tore down the cloth and were piled on the ground so that some of them remained there for twenty-four hours afterwards in warm weather.

Lightning Injury. Plate LV, a. Lightning may cause injury to tobacco in two ways. First, it may strike the field and produce injury in circular spots for a short distance around where it struck. This is apt to occur when the tobacco is young, the electricity following the moist earth comes in contact with the stems where it entirely kills the plant, or produces cankers up the stem and injury to the petioles. It also usually produces a permanent curling or a wilting of the leaves, as shown in the photograph. Some growers think that tobacco does not do well in after years on these spots. In one of our Reports we mentioned such injury, investigated by Stoddard, and in 1916 Beinhart showed us another field where similar injury had occurred. He also told of other cases which he had seen.

The second kind of injury which may be produced by lightning is where it strikes the tents running along the wires supporting the cloth, setting the latter on fire. The heat from the burning cloth, or more especially where the flaming particles fall on the tobacco beneath, may cause considerable injury. Some tent fields are protected by insurance against fire injury. When fire occurs

from lightning or other causes, the men, as soon as the fire is discovered, try to limit its spread by cutting through the cloth with corn knives. We saw a field at Scantic, near Bloomfield, which had been struck by lightning and injury caused to the plants under the small portion of the tent burned over. These plants were not entirely killed but showed brown dead spots on the leaves where the heat had been most intense, or the flaming material had touched them.

Potash Hunger. During 1919 we had called to our attention several fields where tobacco was doing poorly for no apparent cause. The leaves often were yellowed and finally spotted and the plants undersized. So far as we could determine the trouble seemed to be a fertilizer difficulty due to insufficiency of potash, of which the tobacco plant is a strong user. We know too little of the trouble, however, to speak positively.

Red Root-Rot. There were also fields or parts of fields, both under tent and in the open, that in 1919 did poorly, evidently because of a reddish rotting of the roots. This trouble did not seem to be caused by fungi. Whether or not the fertilizers used then or in the past had anything to do with the trouble is as yet undetermined, but it appeared to be more a trouble of that kind than of one caused by fungi.

Tulips, *Tulipa* sp.

White Spot. Plate LV, b. In May, 1919, there was called to our attention a curious trouble of tulips of the Darwin type at the Hammer estate at Branford. Each year the trouble was said to appear so that because of it the growing of tulips was being abandoned. Tulips that were picked early and taken into the house did not develop the injury. This showed as numerous small, elliptical, white spots standing out in strong contrast to the variously colored tissues of the petals. At first the spots were greyish or blackish but finally became white with the collapsing of the tissues. The trouble occurred to a much less extent on the leaves.

Jones and Miller (Phytopath. 9: 475-60. 1919.) have recently described a somewhat similar injury on the leaves of tulips, which they call frost necrosis. We were at a loss to account for the injury at Branford, but it is possibly a frost injury, since

there were late frosts that year that did considerable harm to other vegetation. This would scarcely explain, however, its presence each year. Before seeing the Jones article we had about concluded that this trouble was due to smoke injury from a nearby steel reducer. It was only rarely, but at this time of the year, that the smoke was carried over the tulip beds.

Turnip, *Brassica* sps.

Turnip Aphids killed by *Empusa Aphidis* Hoffm. In the summer of 1916, lice, *Aphis pseudobrassicae,* were very prevalent on both white and yellow turnips, causing a partial failure of the crop. After most of the harm was done to the turnips, this fungus got started and killed off millions of these lice. Collections were made in September in Mt. Carmel, New Haven and Westville where practically all of the lice on the leaves were killed. The fungus is similar to the species that kills house flies and the brown tail moth larvae.

Umbrella Tree, *Magnolia tripetala.*

Chlorosis. In May, 1916, we received from Southport partially developed leaves of the umbrella tree showing a very marked yellow-green mottling over the whole surface, resembling mosaic of tobacco. As the letter stated that the bark was dead in places and the tree had been ailing since the previous August, it seemed certain that it had been injured in some way, probably winter injury as it is a little out of its range so far north, and that the mottling of the leaves was the result of very poor nutrition on this account.

Wheat, *Triticum vulgare.*

Glume Blotch, *Septoria* sp. We collected this fungus once or twice in our disease survey work in 1918 as a very inconspicuous parasite on the glumes and leaves of wheat.

Powdery Mildew, *Erysiphe graminis* D. C. A little of this mildew was found in both 1918 and 1919 in wheat fields. It was too inconspicuous to cause any damage. On rye and barley, however, we have found it causing much more injury and making a more conspicuous growth.

Scab, *Gibberella Saubinetii* (Mont.) Sacc. Johnson and Haskell (U. S. Dep. Agr. Pl. Dis. Surv. Bull. No. 8, pp. 21-26.

1919.) now give this *Fusarium* fungus the above name and report it very serious in the upper Mississippi valley and eastward, in 1919. We found it first in Connecticut in 1917, and collected it again in 1918, but as on rye, *q. v.*, it seemed to cause little damage in this state.

STINKING SMUT, *Tilletia foetens* (B. & C.) Trel. We also found this smut very sparingly in the grain of wheat in 1918. While very serious in the west, it is a rare fungus here in Connecticut, this being our first collection though we had reported it before in cattle feeds.

Willow, *Salix* sp.

POWDERY MILDEW, *Uncinula salicis* (D. C.) Wint. This powdery mildew occurs more or less commonly on the upper surface of the leaves of certain basket willows at the Station's farm at Mt. Carmel.

a. General View of Invaded House.

b. Rotten Condition of Living Room Floor.

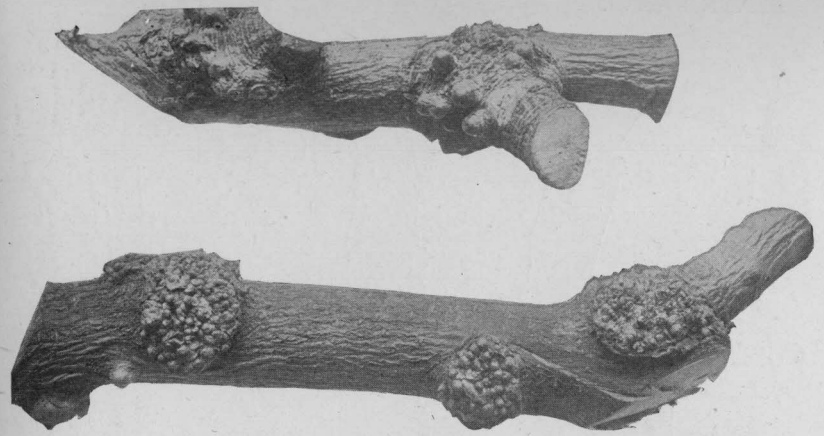
c. Luxuriant Growth of Fungus on Underside of Boards, etc.

DRY ROT FUNGUS, *Merulius lacrymans,* p. 398.

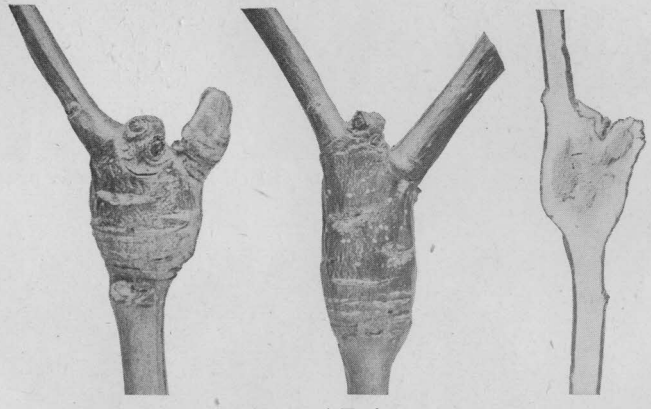
a. Mold of Unsalted Package Butter, p. 400.

b. Bacterial Fruit Spot, p. 404.

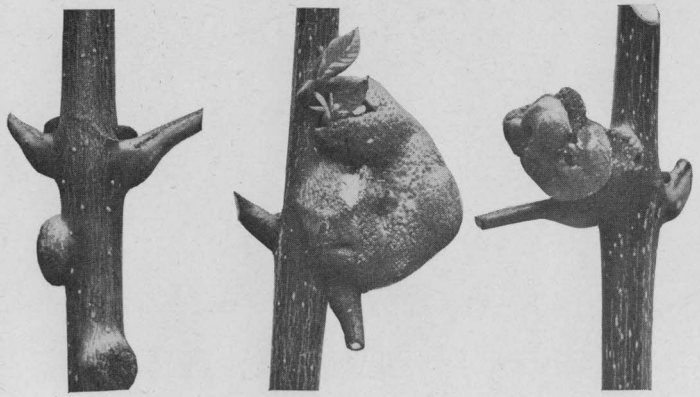
TROUBLES OF BUTTER AND APPLE.



a. Aerial Crown Gall, p. 408.

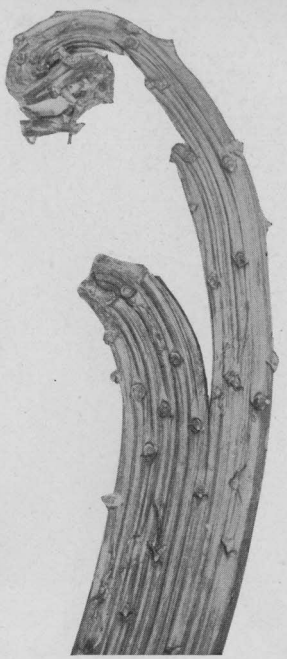


b. Malformed Twigs, p. 409.



c. Rust causing Swellings in Ash Twigs, p. 414.

TROUBLES OF APPLE AND ASH.



a. Fasciation, p. 415.

b. Black Leg of Cabbage, p. 420.

c. Bacterial Wilt of Beans, p. 417.

TROUBLES OF ASPARAGUS, BEANS, CABBAGE.

a. Soft Rot of Chinese Cabbage, p. 422.

b. Healthy and Crinkled Celery Leaves, p. 424.

TROUBLES OF CHINESE CABBAGE AND CELERY.

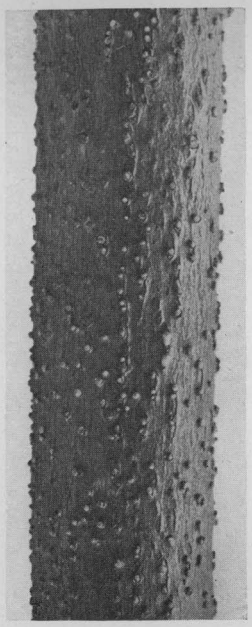
a. Pellucid Spot Disease of Corn, p. 430.

b. Connate Fomes of Hickory, p. 440.

c. Witches' Broom of Hickory, p. 440.

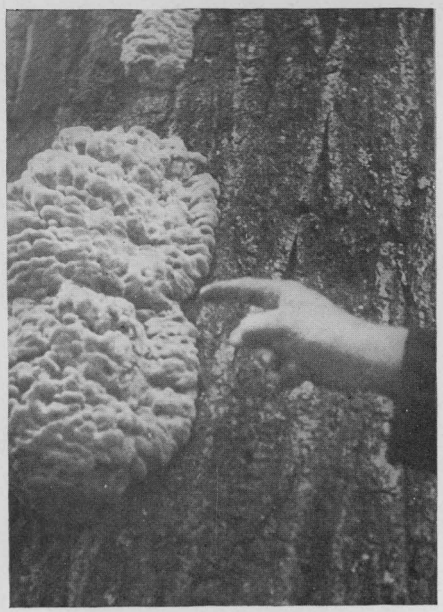
TROUBLES OF CORN AND HICKORY.

a. Anthracnose, p. 441.



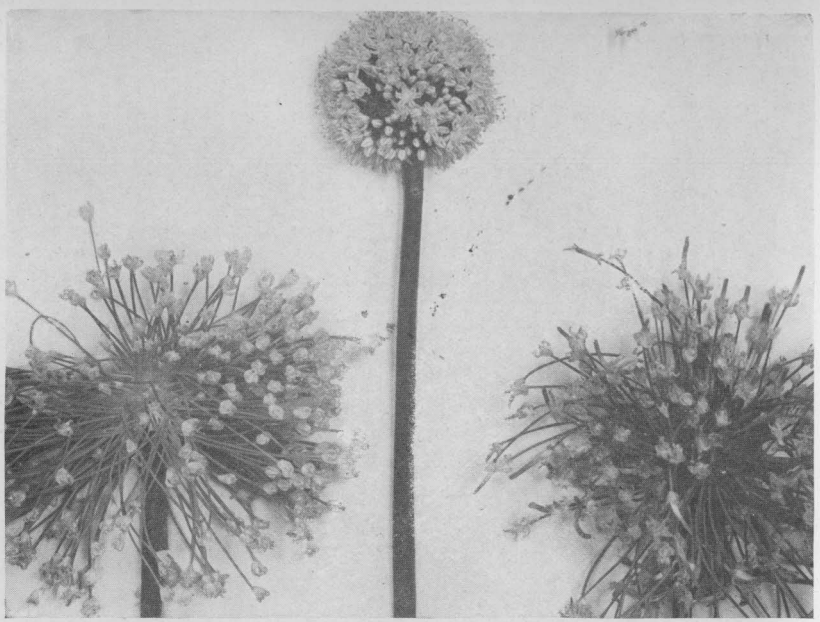
b. Red Canker, p. 442.

c. Club Root, p. 443.

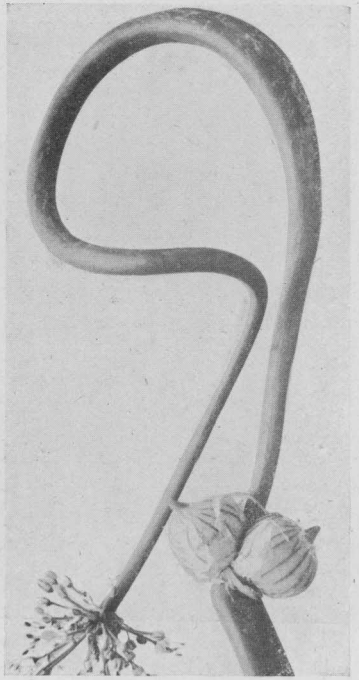


d. Sulphury Polypore, p. 445.

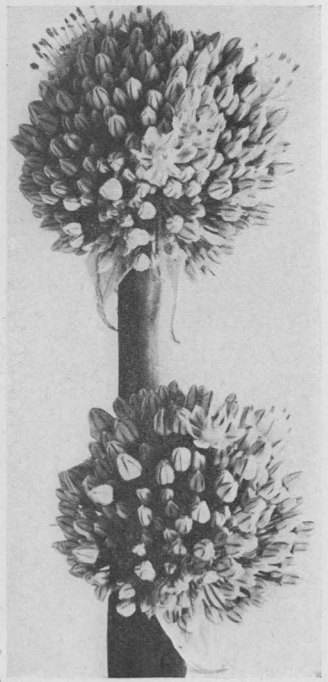
TROUBLES OF HORSECHESTNUT, KOHLRABI, OAK.



a. Bastard and Normal (central) Onion Blossoms.

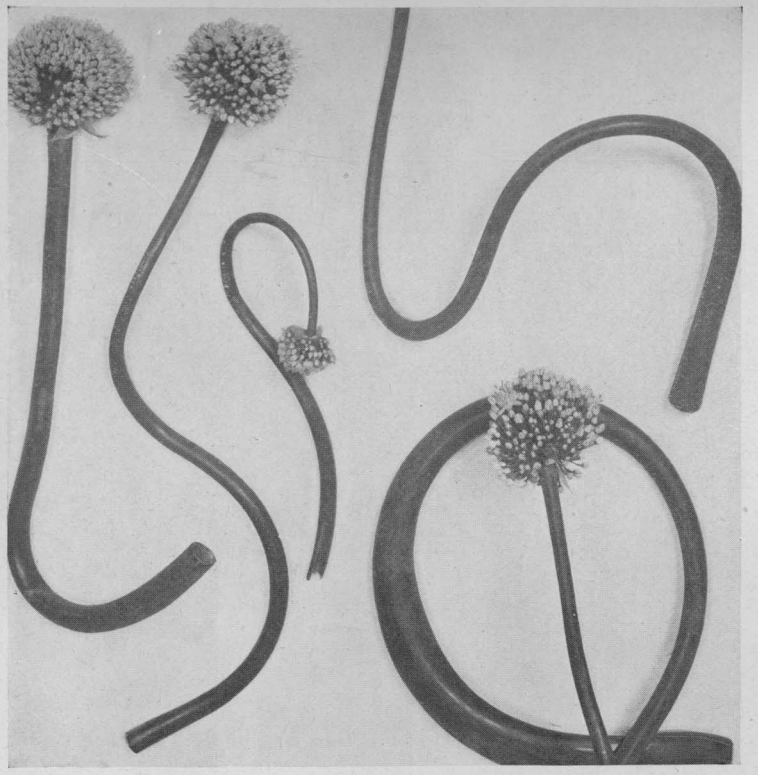


b. Bulblet Head.

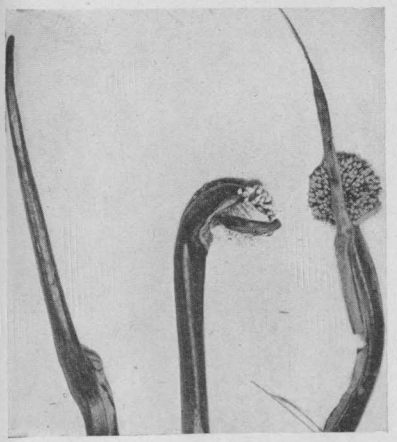


c. Double Head.

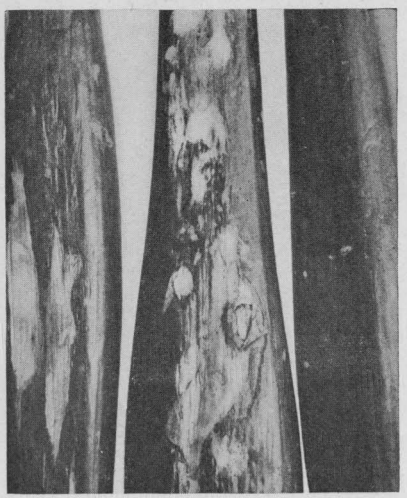
TROUBLES OF ONION, 448.



a. Goose Neck, p. 448.

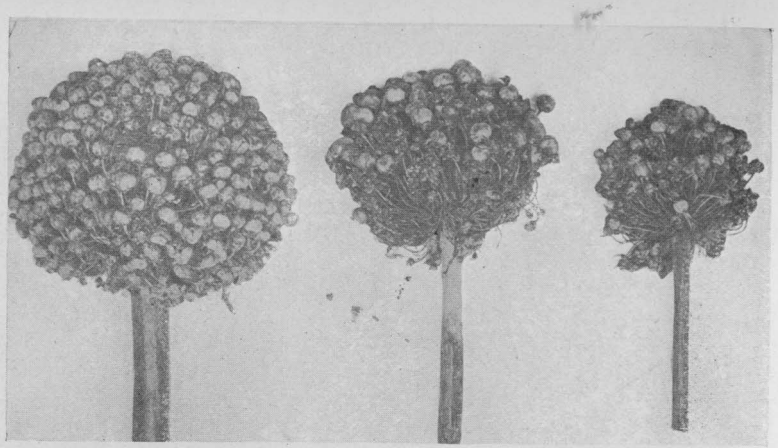


b. Elongated Spathe, p. 448.

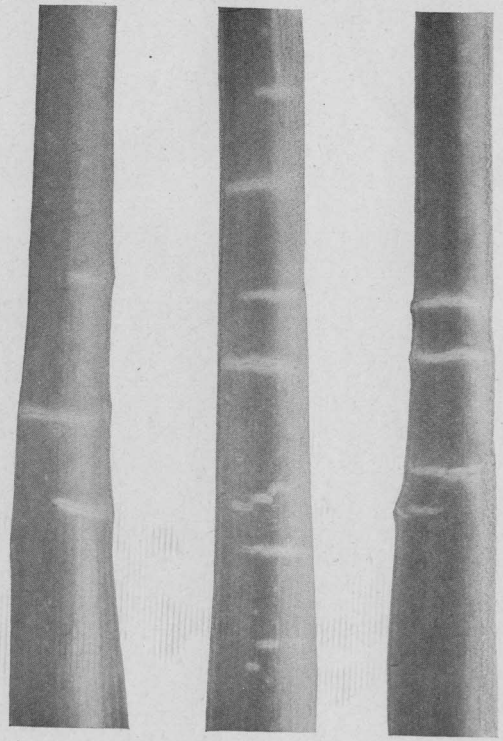


c. Hail Injury, p. 449.

TROUBLES OF ONION.

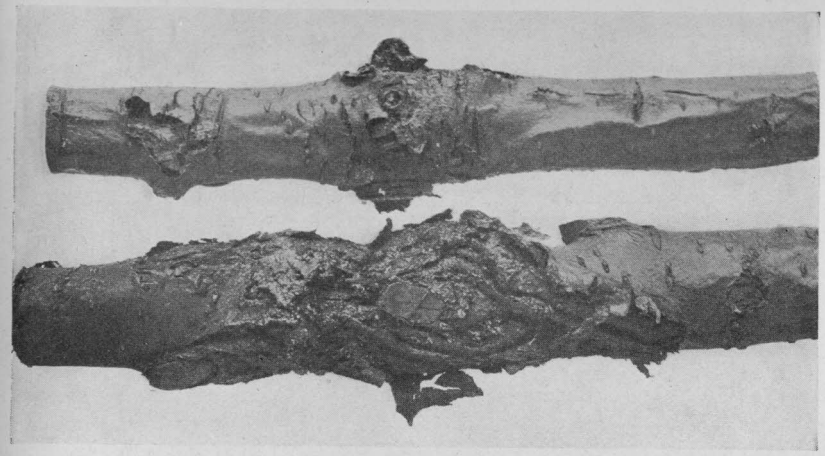


a. Normal and Blasted Heads, p. 447.



b. White Ring, p. 449.

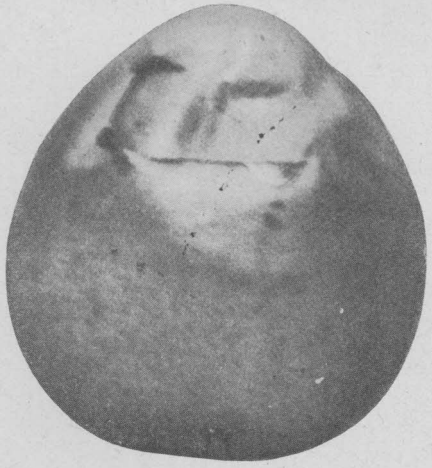
TROUBLES OF ONION.



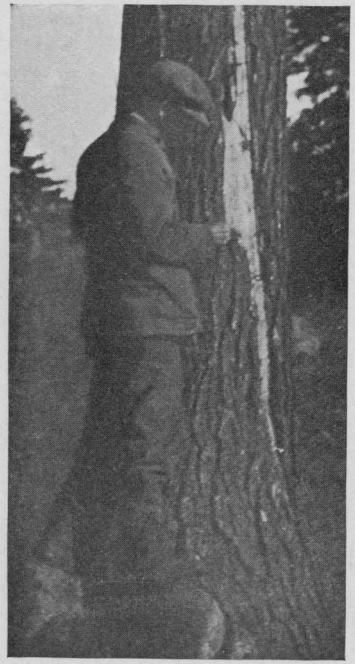
a. Die Back, p. 454.

b. Winter Injured Orchard, p. 454.

TROUBLES OF PEACH.



a. Downy Mildew Rot, p. 454.



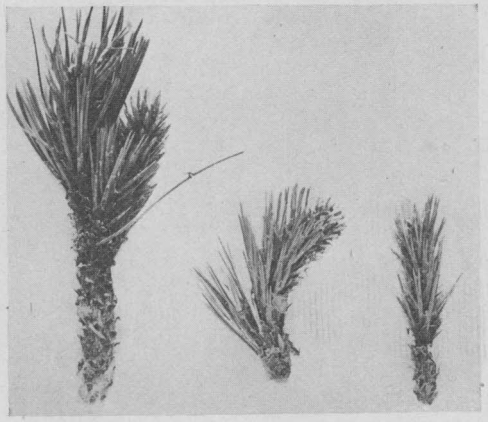
b. Lightning Injury, p. 458.

c. Snow Bend, p. 458.

TROUBLES OF PEAR AND WHITE PINE.

a. Yellow Spot, p. 459.

b. Witches' Broom, p. 459.



c. Winter Injury of Buds, p. 458.

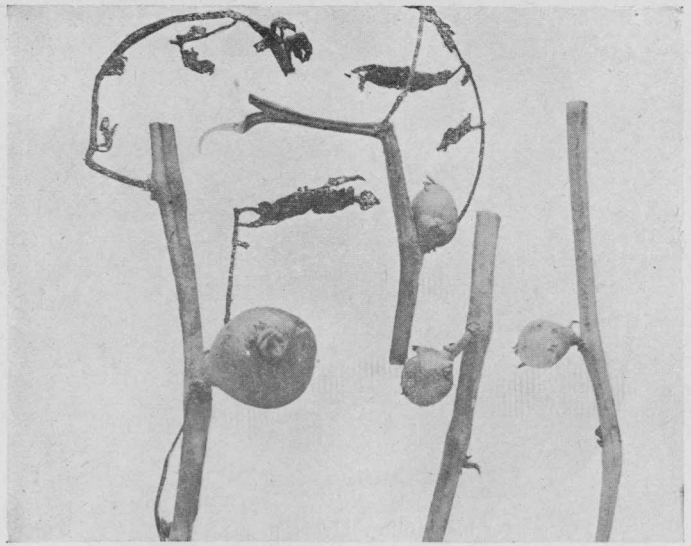
TROUBLES OF PINES (a. White, b. Scotch, c. Austrian).

a. Witches' Broom, p. 459.

b. Intumescence, p. 460.

TROUBLES OF WHITE PINE AND PLEUROMA.

a. European Canker, p. 461.



b. Aerial Tubers, p. 462.

TROUBLES OF POPLAR AND POTATO.

a. Normal and Curly Dwarf Vines, p. 463.

b. Hollow Heart, p. 463.

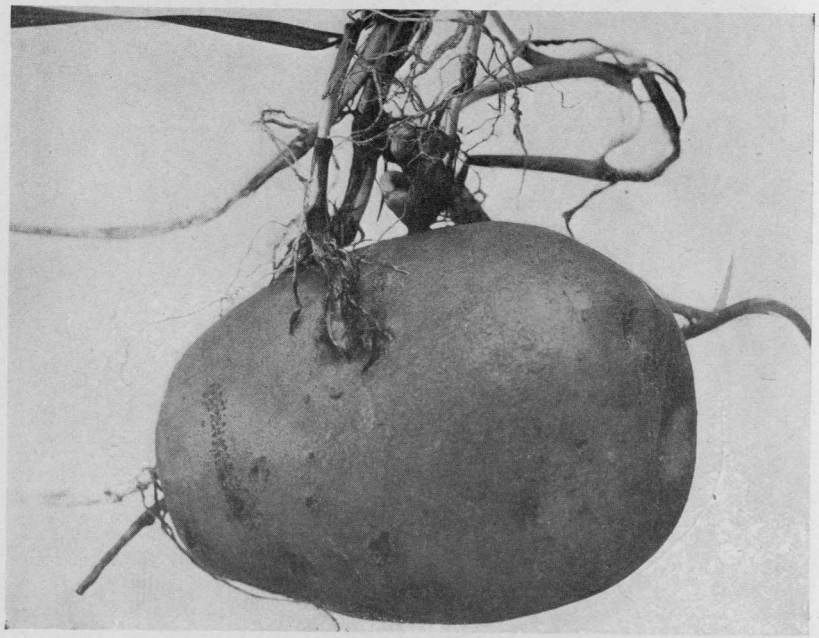
TROUBLES OF POTATO.

a. Leaf Roll, p. 464.

b. Net Necrosis, p. 465.

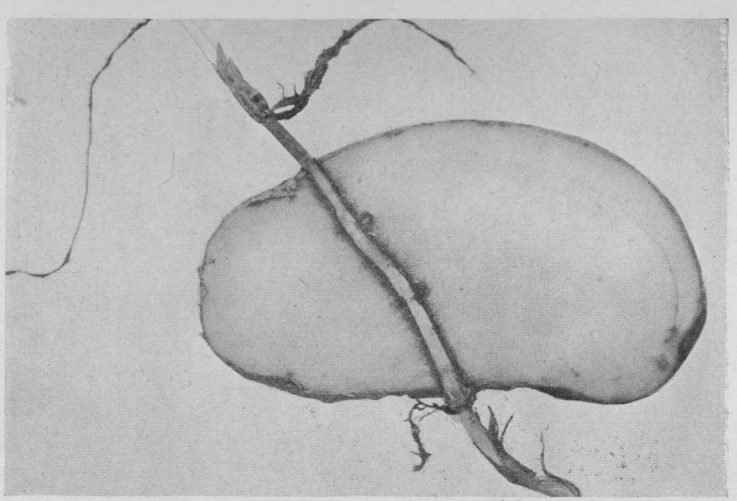
TROUBLES OF POTATO.

a. Premature Sprouts, p. 465.

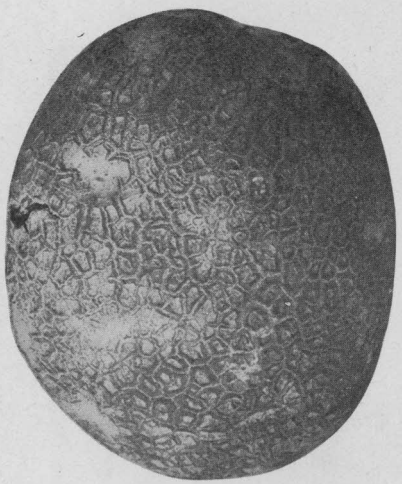


b. Rootstock Invaded-Tubers, p. 466.

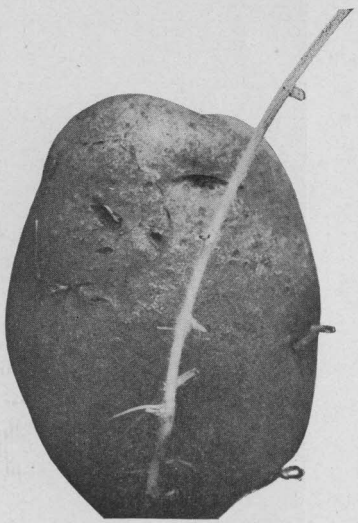
TROUBLES OF POTATO.



a. Section through Rootstock Invaded-Tuber.



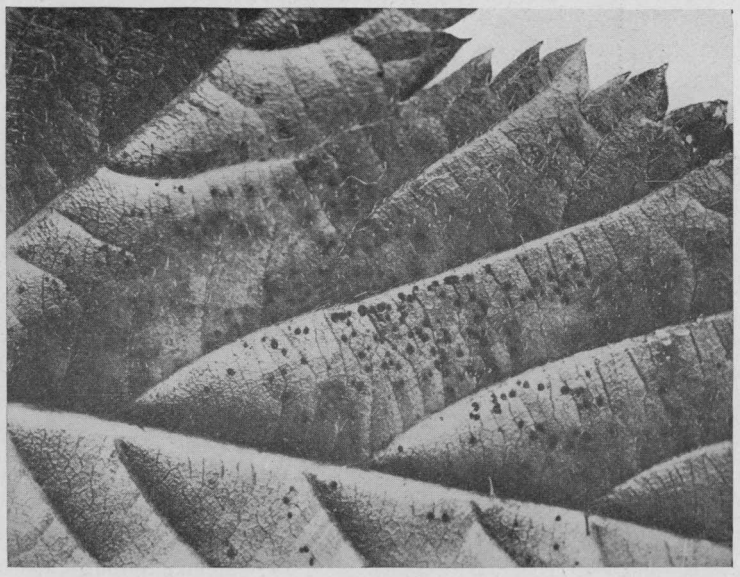
b. Russeted Tuber.



c. Spindle Sprout.

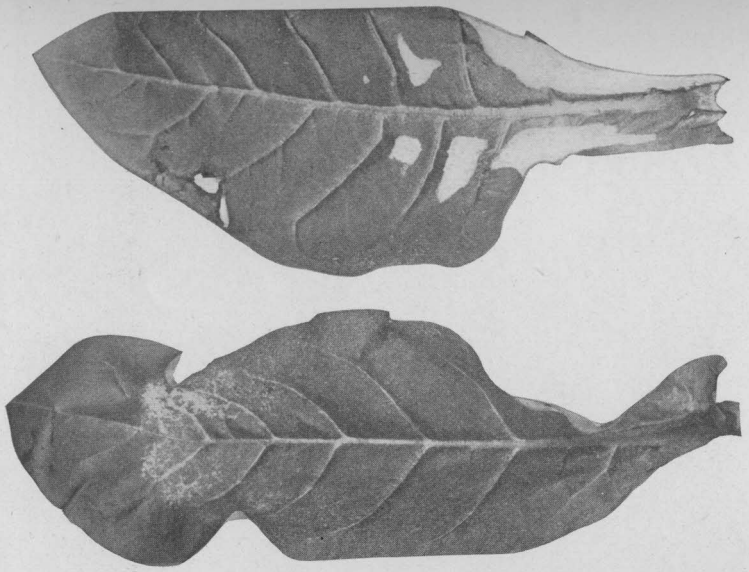
TROUBLES OF POTATOES, p. 466.

a. Wilt of Potato in Center Row, p. 467.



b. III Stage of Rust, p. 469.

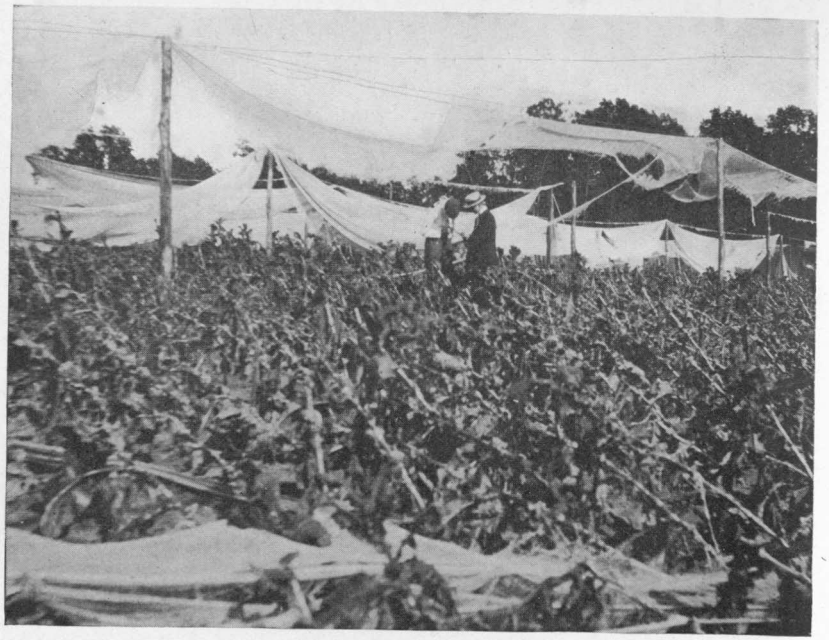
TROUBLES OF POTATO AND RUBUS.



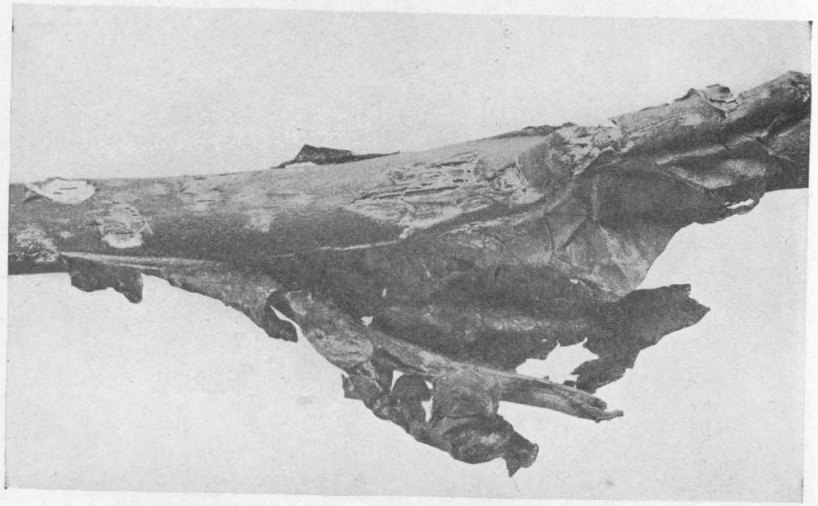
a. Frost Mottling, p. 478.

b. Bacterial Soft Rot, p. 477.

TROUBLES OF TOBACCO.



a. Tent and Tobacco Destroyed by Wind and Hail.



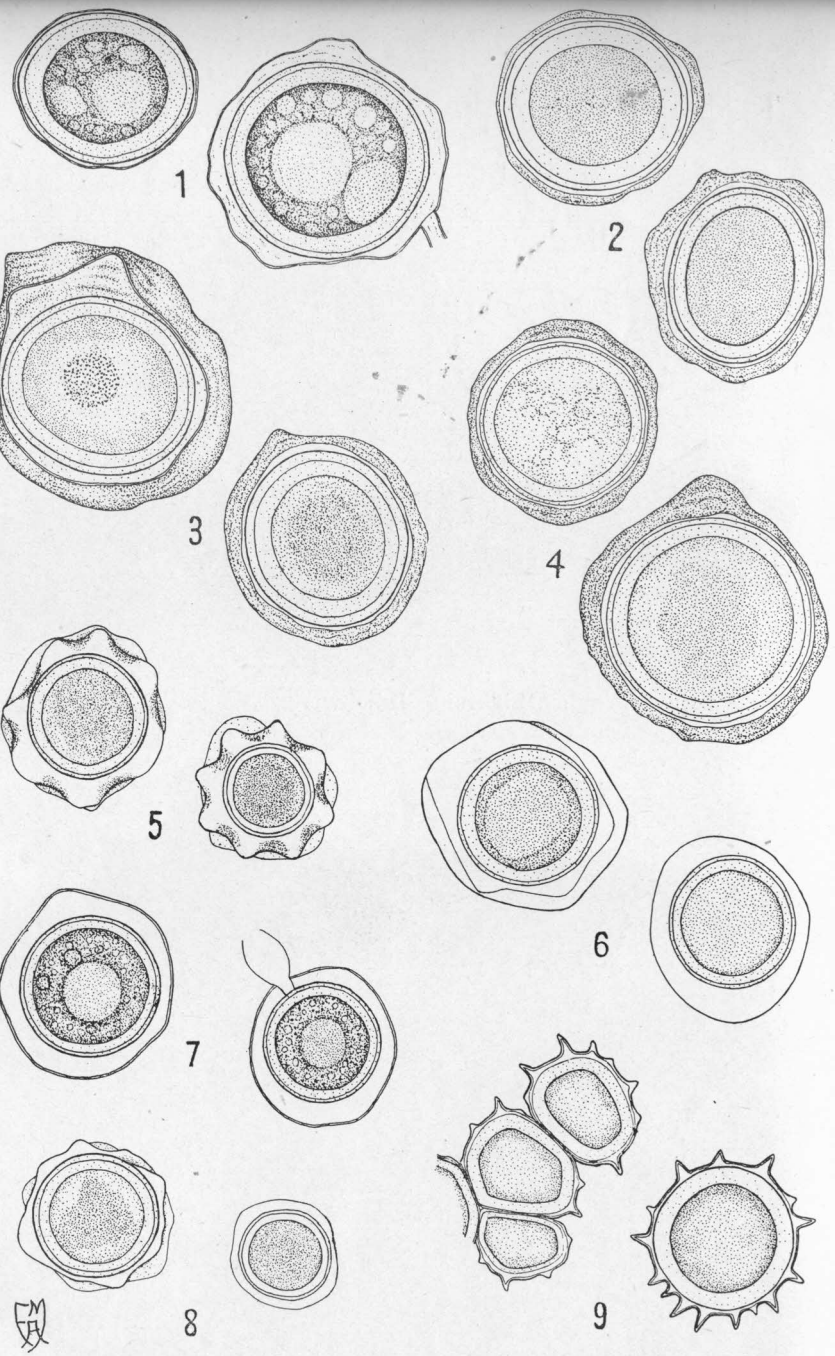
b. Showing Laceration and White Spots.

HAIL INJURY OF TOBACCO, p. 478.

a. Lightning Injury, p. 479.

b. White Spot, p. 480.

TROUBLES OF TOBACCO AND TULIP.



1-4, *Phytophthora cactorum:* 1, From Corn Roots, p. 428; 2, From Pea Roots, p. 452; 3, From Sweet Pea Roots, p. 476; 4, In Artificial Cultures from Pear, p. 454. 5-8, *Pythium deBaryanum:* 5, From Celery Roots, p. 423; 6, From Spinach Seedlings, p. 475; 7, In Artificial Test Tube Culture and, 8, in van Tieghem Cell Culture Drying Out, p. 452. 9, *Pythium hydnosporum,* From Grape Berries, p. 436.

OOSPORES AND OOGONIA OF PHYTOPHTHORA AND PYTHIUM.

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